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Being the Incorporation of
Electrochemical and Metallurgical Industry
and Iron and Steel Magazine

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CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

Volume 28 | New York, January 3, 1923 | Number 1

Chemical & Metallurgical Engineering
is the successor to *Metallurgical and Chemical Engineering*, which, in turn, was a consolidation of *Electrochemical and Metallurgical Industry* and *Iron and Steel Magazine* effected in July, 1906.

The magazine was originally founded as *Electrochemical Industry*, in September, 1902, and was published monthly under the editorial direction of Dr. E. F. ROEBER. It continued under that title until January, 1905, when it was changed to *Electrochemical and Metallurgical Industry*. In July, 1906, the consolidation was made with *Iron and Steel Magazine*, that had been founded 8 years previously by Dr. ALBERT SAUVEUR. In January, 1910, the title was changed to *Metallurgical and Chemical Engineering*, and semi-monthly publication was begun Sept. 1, 1915. On July 1, 1918, the title was changed to *Chemical and Metallurgical Engineering*, and weekly publication was begun Oct. 1, 1919.

Dr. E. F. ROEBER was editor of the paper from the time it was founded until his death on Oct. 17, 1917. After a brief interim he was succeeded by H. C. PARMELEE.

The staff of *Chemical and Metallurgical Engineering* comprises: H. C. PARMELEE, editor; ELLWOOD HENDRICK, consulting editor; ERNEST E. THUM, associate editor; J. S. NEGRU, managing editor; A. E. BUCHANAN, JR., CHARLES N. HULBURT, SIDNEY D. KIRKPATRICK, R. S. MCBRIDE (Washington, D. C.), GRAHAM L. MONTGOMERY, CHARLES WADSWORTH, 3RD, ALAN G. WIKOFF (Chicago), assistant editors.

The Hopeful Outlook

THE truth of the old adage that hope springs eternal in the human breast has been given fresh point and emphasis in the spirit of optimism with which the world has abandoned the old year and turned to the new. Nineteen-twenty-two has gone; and good riddance, say we all. The new year is at hand, fresh, promising, hopeful, and we welcome its opportunities as we do the next hole in golf after a particularly atrocious score. Another chance! A new opportunity! A clean sheet! Well, what shall be writ upon it? For 8 long years we have courageously faced a new beginning on January first, and December thirty-first has seen us dejected at failure and discouraged over the poor accomplishment. What reason is there now to believe that this year will yield us any better fruit and leave us with a greater degree of satisfaction?

First, there is increasing evidence that the United States is discovering Europe. Even irreconcilables who 3 years ago shouted their opposition to participation in the tangled affairs abroad and determined for us a policy of isolation that has all but wrecked international trade and finance now fervently declare that the economic distress of Europe is an American problem and that we must give aid in our own selfish interest. We name no names, being content to rejoice in an eleventh-hour conversion. Nothing, in our estimation, could so brighten the outlook for the whole world as a definite plan for the United States to participate actively in the study and solution of Europe's economic and financial problems. No partisan or personal motives should be allowed to hamper the President in his laudable plans; rather should he be strengthened in the knowledge that this country is now as ready to serve in restoring peace and prosperity as it was to enter the war in 1916. Time to create national sentiment was the essence of both situations; and it has been accomplished now as it was then.

Next, in the words of ELIHU ROOT, we are coming "to recognize not only our rights as citizens, but our duties," thus phrasing in a single sentence the quality of leadership that the world needs today. A quality, too, that is recognized far more clearly by engineers and business leaders than by those engaged in diplomacy and statecraft. Political parleys have failed miserably to bring men closer together, because they have been concerned more with rights than with duties. The problems of debts, disarmament and finance have been approached and regarded as though their amelioration was a matter of bookkeeping, of barter and trade, when as a matter of fact their real solution lies deeper in the moral and spiritual realms of international good will and desire for peace. Germany must cease her hating and France must cast out her fears.

Finally there has developed during the past year a respect for economic law that augurs well for the American business man. Much of his instruction may have been weak and immature, but economics has registered with him, and he is more disposed to base his actions on economic principles. In a few cases sound economics has even supplanted political expediency, thus giving an earnest of the heights that can be reached.

With Europe peaceful and under reconstruction; with a clear recognition of our duties as well as our rights as citizens; and with business at home on a sound economic basis, we can finish the year nineteen-twenty-three with a feeling of work well done. Let us hope it may be so! Man is essentially an optimistic animal. It would be inconceivable deliberately to look forward to failure.

A Stitch In Time

SOME WEEKS AGO we announced the appointment by the Assistant Secretary of War of a representative group of men in the chemical industry to co-operate with the War Department in its plans for preparedness against a national emergency. Back of this announcement is a well-organized and systematic campaign in the department to anticipate its varied needs for the national defence and at the same time to ascertain the industrial capacity of the country to meet those needs. The Surgeon-General's office recently announced a similar survey of industry. The thought behind this activity is a commendable desire to avoid the frantic haste and extravagance in the mobilization of industry that characterized the first year of our activity in the late war.

The Assistant Secretary of War is charged by law with the "supervision of procurement of all military supplies and all other business of the War Department pertaining thereto and the assurance of adequate provision for the mobilization of material and industrial organizations to war-time needs." Naturally this gives the Assistant Secretary a deep and abiding interest in the chemical industry, because, as he aptly stated in a recent issue of the U. S. Army *Recruiting News*, "Practically all modern warfare is chemical warfare." This, and much more to the same point, is a refreshing and practical appreciation of chemistry on the part of the War Department. Realizing its dependence upon peacetime industries for the national defence, the government understands that the more trained chemists there are in various branches of industry the more talent and ability will be available in emergency No one will accuse the War Department of desiring to make war. Its present activities are highly businesslike as long as we maintain a War Department and charge it with the national defence.

Recovery in Steel Production

IN RETROSPECT it may seem easy for steel production to have increased by more than 75 per cent from 1921 to 1922, but it is not difficult to recall that a year ago it required some courage to predict any very great increase in production until "fundamental conditions" should be greatly improved. Judgment a year ago, moreover, was warped by the fact that with a moderate improvement in steel demand in the autumn there had come a sharp decrease in December. It now appears that the tapering off in demand at the end of 1921 was due to buyers being fearful of inventory, for before the end of January steel production had fully recovered its loss.

Production of steel ingots in 1922 was about 34,000,000 tons, which is a large or small tonnage according to the viewpoint. It was large by comparison with production in the calendar year 1921, being more than 75 per cent above the 19,224,084 tons produced in that year, and it was also large from the viewpoint of operations in December, 1921, which represented ingot production at a rate of less than 20,000,000 tons a year. On the other hand, the 34,000,000 tons of 1922 looks somewhat small by comparison with the record output, 43,619,200 tons, made in 1917, or the 40,881,392 tons made in 1920.

Comparison of steel production with "capacity" must be made with reserve and with qualifications. Prior to November, 1916, the steel industry was practically always able to operate at its "capacity" when it had the requisite orders. Since then it has never so operated, although capacity as properly estimated is based upon the actual output in 1916 plus a conservative allowance for new construction. There have been strikes, railroad congestion and other factors every time the mills were filled with orders. The capacity may be estimated at between 50,000,000 and 55,000,000 tons a year, and on this basis the 1922 production represents a working rate of only about 65 per cent.

The steel industry prospered much less in 1922 than would be expected from the bare fact that it was called upon to produce nearly twice as much steel as in the previous year, or from the circumstance of market prices having risen fully $10 a ton on an average. Finished steel prices reached their lowest point as to some commodities late in 1921 and as to other commodities at the end of February, 1922. Some of the prices were below cost of production. Prices rose but moderately until they were forced up sharply by rising costs, partly due to the coal strike and its curious outcome and partly due to the general wage advance in the steel industry itself, effective Sept. 1, and which was indeed caused partly by the coal settlement. Mill operations had been restricted and many producers had to make, at higher cost, steel that had been sold at close to the minimum prices.

The steel industry leaves behind it, with the old year, practically all of its low-priced business, and with moderately full order books hopes to reduce its production costs somewhat in the new year by efficient and steady operation. The steel market is in good condition and speculation concerns itself chiefly with the question of how long the condition will last.

Engineers, "Engineers" And Ethics

IT HAS often occurred to us to wonder, particularly during the past 2 years when so many engineers were unemployed, what sort of a feeling must come over the graduate mechanical, civil or chemical engineer when his hopeful eye encounters, midway in the "male help wanted" column, the insert, "Engineer," and then- "for new apartment house; steam heat and lighting plant; must make own repairs." And the same thought springs to mind at the sight of the alluring prospect on the back cover of the magazine: "Be an automotive engineer. We teach you to repair any make of car by our 6-week correspondence course."

That picturesque hero of MONTAGUE GLASS' "Partners Again"—*Abe Potash*—voiced the thought when he remarked to *Mawrus*: "I suppose when we were in the cloak and suit business, I was a clothing engineer!"

With all due respect to the man who can wind an armature, or set a Corliss valve, or time an internal combustion engine, we begrudge him the title of engineer—not because he is one whit less essential in the economic scheme of things; not because we were fortunate enough to win a degree that he lacks and not because he is any less intelligent or skillful or clever than the M.E. or C.E., but simply because his craft is distinct from ours and therefore, in justice to each of us, should have a distinctive name.

The general public is directly responsible for this promiscuous application of the term "engineer." It is a practice which will be corrected—not by telling the public what the "engineer" is not, but by showing it what the engineer is. In other words, the engineer must and will come into closer contact with his fellow

men in his professional capacity. He must apply his trained mind to the problems of immediate interest to the community—political, economic and sociological as well as technical. He must inspire a wholesome respect for his ability to think straight, plan accurately and produce results efficiently. He must drive home a realization that his professional efforts are directed toward one goal—the common welfare. He must "sell" himself to the public.

That, as we see it, is the main significance of the recent action of a joint committee of the foremost American engineering societies, in formulating a code of ethics for engineers, reproduced on page 34 of this issue. The code is a good one, in that it is specific, complete and sets a high standard. But the engineer does not need a printed rule book to tell him what is right and in keeping with the ideals of his profession. If he is any kind of an engineer, he knows that good ethics is good business. Nevertheless, the formulation of such a code, embodying in black and white the ideas that had lurked in some odd corner of his mind as intangible sentiments, will serve to crystallize those ideals and awaken him to a lively appreciation of their importance. The mere existence of a standard code of ethics will probably change the practices and policies of very few engineers. But when every engineer becomes imbued with the ideals and dignity of his profession as embodied in this code, when his reputation for fidelity, fairness, loyalty, integrity and public spiritedness becomes second nature, then will the new conception of the engineer be generally accepted and then may we well rest in peace under the entirely adequate inscription—"Here lies John Doe—Engineer."

Slow Versus Rapid Carburizing Heats

IT IS NOT our intention to show that case-hardened parts have distinctive qualities which excellently fit them for certain exacting duties. Such would be trite. It is more timely to call attention to some of the means that have been adopted to cut the cost of the carburizing operation, or to substitute special alloy steels which retain considerable toughness after hardening.

It is our opinion, however, that if all the factors were properly appraised heat-treaters would not so readily substitute "rapid" carbonizers, highly energized with chemicals and unstable organic compounds, for the older charcoal and carbonate mixtures which have done yeoman service for so many decades. About the only argument advanced for energized compounds is the specious one that they reduce the time the work is to be held at high temperature, and consequently save a large amount of fuel. An operation which requires 24 hours or longer is thus shortened to 8 hours or less, and a night fireman may be discharged.

But not even all of that is profit. It takes far more fuel to heat a cold furnace and a cold charge every morning than it does to heat the same charge in a furnace already hot. Once the furnace and contents are at carburizing temperature, it requires surprisingly little fuel to maintain them so, balancing the radiation losses, if the furnace is properly designed or one of a bank. Furthermore, alternate cooling and heating break up the furnace brickwork with surprising rapidity, and introduce a high charge for maintenance.

Taking all these factors into consideration, if there is sufficient carburizing to be done to load a furnace daily, it will be found that it costs little if any more to keep a good furnace at heat constantly than for 8 hours daily. Then why not use it for the entire twenty-four? In other words, why discard the slow carbonizer for the rapid?

Such a slow cycle allows the work to come to heat more gradually and brings the work to temperature without high differences of temperature, edge to center, in the individual pots. On the other hand pieces packed near the corners of a pot in a rapid carbonizer and placed in a rapidly driven furnace reach carbonizing temperature a long time before the work buried deeper. Consequently the depth and kind of case in the work packed in the same box often show wide variations, depending upon placement. For the same reason, and due to the fact that rapid heats often produce hot spots in a furnace, the production from short carburizing cycles is frequently far from uniform, pot to pot. All this is due to causes other than the inherent instability and variability in action of complex organic carburizers, in turn producing wide variation in expected results.

Thus it seems that the illusive saving in fuel when using short heats is very likely to be far overbalanced by losses due to non-uniform work. There is no excuse for using a piece having a deeply carburized case except that it is of superior quality. If this fact alone were held in mind, practices would never be tolerated that militate against the production of work having the utmost uniformity in properties. In our estimation the case for slower carbonizers is clinched without considering the facts that they are cheaper in first cost and never change the alloy or steel pots used for containers.

Recording Failure As Well as Success

NEGATIVE results of research pay no dividends. This is an axiom that seems to be all to well recognized among industrial executives. But these same executives should not forget that negative results from a research will often save expenses of large magnitude.

Negative results from a research that was reasonably promising at the outset should be recorded as a guide for future action. It is for this reason that we feel more than usual satisfaction in the presentation of a series of articles on low-temperature carbonization by Dr. HARRY A. CURTIS, who has been directing the research and development work on the Carbocoal process for several years past. This process has come nearer to commercial success than any other low-temperature work thus far done in the United States. Thus it is entitled to special consideration. Furthermore, the record which is now spread for the information of all has been made most satisfying in completeness, because it includes a statement of failures as well as of successes, and it tells why failure was met.

Low-temperature carbonization is by no means a cure-all for our fuel troubles. But low-temperature carbonization does promise to be one of the important fuel developments of the next few decades. No one has yet succeeded in making low-temperature carbonization sufficiently cheap to be a thorough commercial success. But this does not mean that future efforts will not succeed. Each effort, though only partly successful, should bring us closer to ultimate complete success. And if in the future as in the present case investigators will give others the benefit of the experience in work that was not satisfactory, the energies in later study will be bent toward more promising lines and investigators will have the guideposts of past experience to direct their course most accurately.

Readers' Views and Comments

Copper and Brass Research

To the Editor of Chemical & Metallurgical Engineering

SIR:—Several recent utterances in the technical press have read almost like strictures on the activities of the Copper and Brass Research Association. Doubtless, therefore, you will not be averse to presenting the other side of the case. In the words of Mr. Agassiz, president of the association, "The underlying purpose of this whole effort is to develop to the maximum the domestic consumption of the metal"—surely a praiseworthy object, as you will agree. Continuing, the official statement issued at the recent meeting of the board of directors, says:

> Our plan is to provide through the instrumentality of the Copper and Brass Research Association a technical and advisory service which may be freely called upon by users of our metals—a service which no one copper or brass producer or manufacturer could reasonably be expected to undertake alone. Already, wide use is being made of these facilities. Information has been furnished on the use of copper and brass for almost every conceivable subject, from safety pins to locomotive boiler tubes.
>
> An important accomplishment has been the fact that many of the more than 2,000 manufacturers who produce articles made of brass or copper have taken advantage of the association's activity to individually advertise their products, thus extending the association's own educational work.

Lastly, you would be rash to cast reflections upon the undoubted eminence of the recently elected executive committee: R. L. Agassiz, president Calumet & Hecla Mining Co.; Walter Douglas, president Phelps Dodge Corporation; C. F. Kelley, president Anaconda Copper Mining Co.; Stephen Birch, president Kennecott Copper Corporation; Charles Hayden, vice-president Chino, Utah, Nevada Ray companies; F. S. Chase, president Chase Rolling Mills; Edward H. Binns, president C. G. Hassey & Co.; H. J. Rowland, sales manager Rome Brass & Copper Co. MARTIN SEYT.

The Problem of Marketing Ideas

To the Editor of Chemical & Metallurgical Engineering

SIR:—In a recent interview with a talented chemical engineer he dropped an expression that had in it a touch of pathos: "I don't want cheese any more; I want to get out of the trap." Able, keen, nobody's fool in business either, he was finally cornered and hobbled in his work and in his living because the threefold nature of his task was too much for him. First, there was research and the development of his ideas through the laboratory stage. Second came the protection of his inventions by patent claims. In these fields he was thoroughly at home. Third, there was the sale of his patents or the granting of licenses under royalties and the exploitation of his inventions. Given a free hand with nothing else to do, he could manage this business also; not as a great negotiator, but acceptably, nevertheless. One difficulty lay in the fact that the ways of men are different from the ways of matter. Under precisely the same conditions and in the same physical state, matter will conform to its ways. You can trust matter if you know enough about it.

The study of man is a different field. What will a given man do under given conditions? Will he be straight or will he be crooked? Will he use good judgment, or will he let his thoughts go wool-gathering and proceed to guess wrong and invite failure? Here are problems in psychology that some men seem able to solve by prescience, although to outward appearances it would seem as if they were only guesswork.

Now the truly gifted man of research is full of ideas, contributions to humanity pressing for expression. If he addresses himself to negotiation with business men, the chances are that the ideas will die. He cannot invent and negotiate too. Men engaged in productive research are sacred possessions of their generation. They need aid and encouragement. They need friendly and sympathetic business relations. Negotiation with them is not a game like draw poker, although that is how the game is played in many instances. How shall the man of scientific talent and ability market his ideas without being beaten out of his rights? The answer to the problem will bring fame to the successful aspirant and peace and contentment to many inventors who know the ways of matter but not the ways of men.

New York City E. H.

Artificial-Silk Progress in Germany

A recent canvass of artificial-silk manufacturers in Germany revealed the fact that few if any of these mills are today in a position to consider orders from abroad because of the large domestic demand. Many mills already have orders on hand sufficient to keep them busy for several months, and others have advised that they will not be in a position even to consider foreign business for some time, says *Commerce Reports* for Dec. 25, 1922.

One of Germany's best-known former ammunition manufacturers has evolved from guncotton a new product known as vistra, which was lately exhibited at the Munich Trade Exposition. It is understood that vistra may be mixed with silk, flax, cotton or wool, and a number of samples of imitation Smyrna rugs, silk sweaters and Gobelin tapestries employing it were shown at Munich.

Research on Edible Gelatine

The Edible Gelatin Manufacturers of America, Inc., announces the establishment of an industrial fellowship in the Mellon Institute of Industrial Research for the purpose of ascertaining the real food value of edible gelatine in its manifold applications in the American dietary.

In addition to experimental investigations, a correlation of all available facts regarding edible gelatine will be made, to be held at the disposal of all users and prospective users of the product. It is hoped that real service may be rendered by supplying scientific data and technical advice. The present incumbent of the industrial fellowship is Thomas B. Downey, who will be glad to furnish any available information to those interested in the uses of edible gelatine.

A Glimpse of the Liquid Carbon Dioxide Industry

BY ALAN G. WIKOFF

Efficient Utilization of Energy and Materials in Coke Process for Production of Carbon Dioxide—Associated Manufacturing Departments, Which Make It Possible to Render Complete Service to the Industry

LIKE sulphur dioxide, carbon dioxide is one of the great inorganic intermediates, although this fact is not generally realized, since the bulk of the production reaches the market in a combined form. Thus the amount of carbon dioxide required for the manufacture of sodium carbonate and bicarbonate by the ammonia-soda process is probably not far from 500,000 tons per year. Gases from limekilns in which the coke fuel is mixed directly with the limestone form the source of supply. Limekiln gases are also used for the carbonation of sugar solutions during the refining process. In each of these industries the carbon dioxide is used on the spot and the lime produced simultaneously is also required in the process

With the growth of the carbonated beverage industry it became necessary to perfect arrangements whereby carbon dioxide could be conveniently transported and distributed. The gas was liquefied by compressing into strong steel cylinders, and it is the development of this phase which is usually referred to as the carbon dioxide industry. Nearly 60,000,000 lb. of liquid CO_2, valued at more than $6,500,000, was produced in 1919.

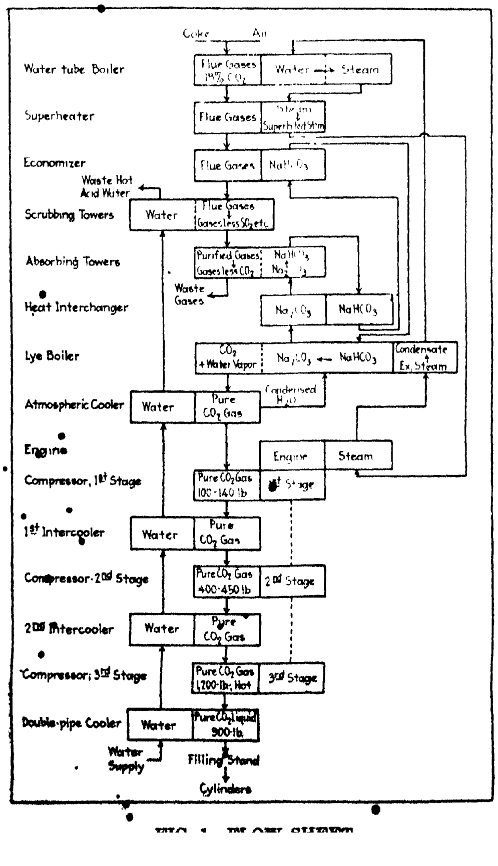


FIG. 1—FLOW SHEET

FIG. 2—FILLING CYLINDERS WITH CARBON DIOXIDE

Obviously, for beverage purposes purity is a primary consideration and it is also essential to exclude other gases. These points must be considered in selecting the method of production. Since power is required to compress the gas, the recovery of pure CO_2 from the flue gases of a coke-fired boiler has proved to be most economical. Recently some liquid CO_2 has been produced as a byproduct of industrial alcohol fermentation, but the greater part is made by the coke process. This is used by the Liquid Carbonic Co. in its thirteen plants, which have a total annual capacity of more than 30,000,000 lb. These are located at Chicago, Pittsburgh, St. Louis, Memphis, New York, Cincinnati, Kansas City, Minneapolis, Atlanta, Dallas, Boston, Philadelphia and Ashland. While of course the different installations vary somewhat in detail, the Chicago plant of this company may be taken as typical. The associated plants here are also of particular interest in showing the logical development of an organization for rendering complete service to an industry. Starting with the gas and carbonators, the company is now prepared to furnish every detail of the dispensers' and bottlers' requirements.

Briefly, the process of manufacture consists in burning coke under a boiler, absorbing the carbon dioxide in sodium carbonate solution and boiling the sodium bicarbonate solution to liberate pure CO_2, which is then compressed into cylinders. Steam furnished by the boiler supplies the energy required for compression and the heat in flue gases and exhaust steam is used to best advantage. As a result, the process forms an interesting example of efficient utilization of energy and materials. The various cycles and counter-current arrangements are indicated in the accompanying flow sheet, Fig. 1, and described in some detail in the following paragraphs.

Low sulphur content is a primary requirement for the

FIG. 3—MARBLE YARD

coke used. It should be low also in ash and the fusion point of the ash should be as high as possible. At present, coke containing less than 0.8 per cent sulphur is burned at Chicago. It may originate in either beehive or byproduct ovens.

This coke is burned under 200-hp. Kroeschell combination fire and water-tube boilers equipped with superheaters and economizers. Hand firing is employed, combustion being controlled through Ellison differential draft gages (connected right over the fire and also after the boiler) and a Uehling CO_2 recorder with an indicator on the boiler front. The flue gases regularly contain 18 to 19 per cent CO_2. Coke consumption is about 850 lb. per hour per boiler—approximately 1 lb. coke being required to produce 1 lb. of pure carbon dioxide. The boilers operate independently, as the plant consists of two complete units to obviate the possibility of a shut-down in case of accident to some part of a unit. As the two installations are exact duplicates, only one need be described.

After some of the heat has served to superheat the steam and to warm up bicarbonate solution in the economizer, impurities in the flue gases, particularly smoke, dust and sulphur dioxide, are removed by countercurrent scrubbing with water in two limestone-filled towers run in series. Because of the final temperature of the scrubbing water practically no carbon dioxide is lost. To insure complete removal of sulphur compounds it is essential that all the sulphur in the coke should have been burned to SO_2, with possibly traces of SO_3. Hydrogen sulphide is always avoided because of the tendency to pass right through the purification process and contaminate the product. The hot acid water discharged from the scrubbers is thrown away, as it is not possible to use it economically.

Absorption of carbon dioxide takes place in two coke-filled towers operated in series. Each tower is about 100 ft. high and contains about 110 tons of coke. A Roots blower draws the gases through the boiler and scrubbers and forces them through the two absorbers counter-current to the alkaline liquor, which enters the top of the first tower as sodium carbonate solution and leaves the bottom of the second absorber as sodium bicarbonate solution. Circulation is maintained by Goulds centrifugal pumps. Complete removal of the carbon dioxide is not feasible and the waste gases still contain about 10 per cent CO_2. This represents the economical limit, although in some cases the addition of a third tower may increase the recovery more than enough to offset the extra investment charges.

From the bicarbonate solution, carbon dioxide is recovered by simply boiling. The solution is preheated by passing through a heat interchanger, then through the economizer previously noted in connection with the coke-fired boiler. It then passes to the lye boiler, which is heated by exhaust steam. Here the carbon dioxide is boiled off under 8 to 9 lb. pressure, while the regenerated carbonate solution returns to the absorbers, passing first through the heat interchanger, where it serves to preheat the bicarbonate liquor about to enter the lye boiler.

Great care is taken to see that pipes leading from the absorbers to the boilers are at all times completely filled with liquor so that no air may enter the system. Furthermore, a pressure of 4 to 5 lb. is maintained on the CO_2 until it reaches the compressors so that it will not be possible for air to enter even should there be slight leaks in the piping. As the CO_2 is liberated from a boiling aqueous solution it is, of course, saturated with water vapor, but this is condensed in an atmospheric cooler, leaving the pure CO_2 ready for compression. The condensate is returned to the alkaline liquor cycle.

Still under slight pressure, the gas passes to a three-stage Worthington compressor driven by a 125-hp. Erie City Iron Works Lentz engine. The first stage is double acting and raises the pressure to 100-140 lb. After passing through an intercooler, this is increased to 400-450 lb. in the second stage, followed by another intercooler and the third stage, which delivers the gas under 1,100-1,200 lb. A double pipe cooler reduces the temperature below the critical temperature (31.35 deg. C.) and the carbon dioxide liquefies. It is distributed in the familiar 20-lb. or 50-lb. steel cylinders. These are placed on scales at the filling stand, the tare adjusted and the proper amount of liquid CO_2 run in. The cylinders are then inverted so that the valves dip in a trough of water, which indicates any leakage. The cap is put on and another test made with the stem open

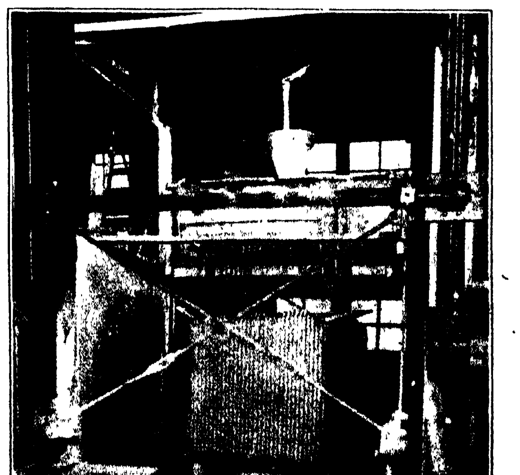


FIG. 4—GANG SAW CUTTING MARBLE SLABS

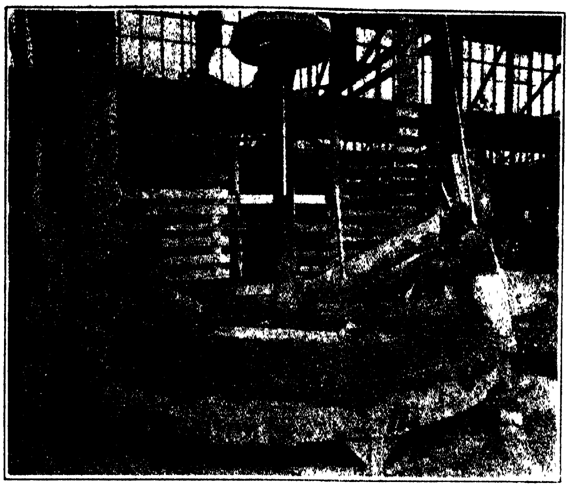


FIG. 5—RUBBING BED

to make sure that the cap is tight. The pressure in the cylinders is about 900 lb. at 70 deg. F. The operations of filling the cylinders and testing the valves for leakage are shown in Fig. 2.

At this point let us return for a moment to a consideration of the interrelation of the different steps in the process as indicated by the flow sheet. Coke and the air required for its combustion enter the system at the boiler and the products of combustion are separated into waste gases and pure carbon dioxide. Water from a deep well flows through the pure CO_2 coolers in a counter-current direction and is then fed to the scrubbing towers, emerging as waste hot acid water. Two closed cycles complete the process. The alkaline liquors circulate continuously through absorbing towers, heat interchangers, economizer and lye boiler. Superheated steam from the water-tube boiler operates the engine, the exhaust serves to boil the bicarbonate solution, while the condensate is returned to the boiler. Actual operation of the plant requires the services of only three men --engineer, fireman and a man at the filling stand. Men engaged in testing and handling cylinders raise the number of employees to five or six. An experienced chemical engineer is in charge of the plants.

Cylinders are purchased and as they have been tested under the supervision of the Bureau of Explosives by

FIG. 6—POLISHING MACHINES

the manufacturer before sale it is not necessary to test them for 5 years. As the empty cylinders are received for refilling, the dates stamped on them are examined and those which require testing are set aside. Others about which there is the slightest doubt are added to the group. In testing, a cylinder is filled with water and the pressure raised to 3,000 lb. per sq.in. by means of a hand-operated hydraulic pump. The cylinder is permitted to remain under pressure for 2 minutes, during which time any expansion is indicated by a drop in pressure. Should the pressure drop exceed a small permissible value, the cylinder is rejected. A Columbia recording gage gives a permanent record of all tests.

As an additional safeguard the valve is provided with a safety vent closed with a metal disk which will rupture should the pressure exceed 2,700 lb. In this way the bursting hazard becomes negligible, since the normal pressure in the cylinder is only about 900 lb. The valves are of the packing type and are made by the company.

Owing to the universal demand for carbonated beverages, it has been necessary to develop a distribution system which embraces practically every community, by means of distributing depots and jobbers, where

FIG. 7—GENERAL VIEW OF TIN SHOP

large stocks of full cylinders are kept. This ready availability is an important factor with the chemist or the engineer who is considering the use of carbon dioxide for its inertness or its chemical properties. It is the cheapest inert gas available.

While the greater part of the output is used for carbonation purposes, several other applications have been developed. For refrigeration, particularly household units, it possesses certain advantages over ammonia and sulphur dioxide. The manufacture of salicylic acid is typical of its use in the production of chemical products. Other applications include: Fire protection, food preservation, water purification, local anæthesia. New uses are constantly being developed through a fellowship which has been established for the purpose by the carbon dioxide manufacturers at the Mellon Institute for Industrial Research.

While the carbonated beverage industry could not exist without a convenient gas supply, it is equally true that without additional equipment a cylinder of carbon dioxide would be of no value to the dispenser. Means must be provided for preparing charged water and delivering it to the fountain. It is only natural that the

manufacture of machines for this purpose should supplement the production of carbon dioxide. Following this idea to its logical conclusion, it is not surprising to find that the greater part of the Chicago plant of the Liquid Carbonic Co. is devoted to the manufacture of products other than CO_2. A brief outline may serve to indicate the diversified character of these operations.

Having supplied the dispenser with gas and carbonator, it is but a step to the complete fountain with all accessories. Production of the fountains requires a marble shop, wood-working or cabinet shop, and sheet-metal department, together with facilities for assembling the various parts.

Marble from foreign and domestic quarries is received in the form of the huge blocks shown in Fig. 3. These are cut into slabs by gang saws, Fig. 4, the blades of which have no teeth. Cutting action is due to sharp sand carried by streams of water from an overhead trough. Continuous operation for about 2 weeks is required to cut through an 8-ft. block. After cutting to size, the slabs are polished. This operation starts on the large horizontally rotated cast-iron wheels or rubbing beds shown in Fig. 5, where fine sand forms the abrasive. High polish is obtained by the use of carborundum and other finer materials on machines of the type illustrated in Fig. 6. After finishing to size, the pieces are fitted together to make sure that there will be no difficulty in erecting. Meanwhile the rest of the fountain—the wooden or steel framework, the cork insulation, the pressed sheet-metal parts, the fixtures and fittings—has been assembled in the tin shop, Fig. 7. Certain sizes and arrangements have been adopted as standard, although much special work must be done to meet the whims of certain customers.

FIG. 8—FOUNDRY

Mention has already been made of the carbonators used by dispensers. A larger model is required by establishments which make bottled carbonated beverages. This is an important and growing branch of the industry, and a complete line of equipment has been developed to meet the needs of the bottler. In addition to the carbonator, there are the siruper, the filler, the crowner and the washer. The operation of the carbonator, siruper and filler has been discussed in an article on the ginger ale plant of the Beech-Nut Packing Co.[1]

FIG. 9—SPINNING BLOCK TIN CARBONATOR LINING

A good-sized plant is required to turn out this equipment, together with such miscellaneous parts as cylinder valves and pressure regulators. There is a large foundry designed for crucible melting of non-ferrous metals and alloys, Fig. 8. The non-ferrous castings, and also the variety of iron and steel parts, are worked up in a well-equipped machine shop connected with the plant, and finally assembled.

Solutions of carbon dioxide being weakly acid, it is necessary to exercise caution in choosing the materials with which they may come in contact, which explains the extensive use of non-ferrous metals. Only tin and silver are used in contact with carbonated water and sirups containing fruit acid. The carbonators are lined with block tin and one of the interesting operations in the machine shop is the spinning of this lining, Fig. 9. Many of the fixtures on the fountains—for example, the sirup pumps—are silver plated, so that the plant includes a silver-plating department which is one of the largest in the Chicago district for industrial purposes.

Fig. 10 shows the final assembly of the carbonators. These machines are very compact and are entirely automatic in operation. Carbon dioxide from a cylinder connected through a reducing valve is passed into water agitated in the mixing chamber, water pump and agitator being driven by an electric motor. Automatic

FIG. 10—ASSEMBLING CARBONATORS

[1]"Automatic Equipment and Chemical Control," G. L. Montgomery, *Chem. & Met.*, vol. 27, p. 160, July 26, 1922.

control of motor and gas supply is obtained through the counterbalanced external chamber which operates a rocking mercury switch. Although in direct communication with the mixing chamber, so that free flow of liquid is possible, the external chamber can move up and down within certain limits and the counterweight is so adjusted that fluctuations in the liquid level will operate the switch.

Another large department prepares crushed and preserved fruits, soda fountain flavors and bottlers' extracts. Fresh fruits, such as strawberries, cherries, peaches and pineapple, are cooked in closed glass-lined kettles, canned and placed in storage for shipment. Soda fountain flavors as a rule contain the necessary amount of sugar sirup, while bottlers prefer to add their own sirup and save transportation charges. Recent progress in this direction has led to the development of highly concentrated emulsions, which contain practically nothing but the flavoring materials.

This department has a large laboratory for control work, research and service to customers, under the direction of an experienced chemist. Such tests as the gas plants may require are also conducted here.

A small fountain is installed so that all flavors may be tested by tasting. There is also complete equipment for conducting a bottling test, as well as several ice cream machines for work on this product. Refrigeration is supplied by a Kroeschell CO_2 machine.

While it has not been possible to go into detail, it is hoped that this review may serve to show how a large manufacturing industry has been built up around the production and distribution of a single chemical product.

The writer is greatly indebted to the management for courtesies extended and in particular to Edwin D. Hale, Chemical Engineer, for assistance in the collection of data.

Value of Commercial Training in Technical Schools

That engineering college graduates are handicapped without a supplementary commercial training is the basis of research investigations just completed by Dr. W. F. Rittman and W. F. Reilly, of Carnegie Institute of Technology, Pittsburgh.

A study of the present occupations of Carnegie Tech graduates was made. Of the graduates from 1908 to 1921, the investigations showed that approximately 67 per cent of the total engineering graduates are now engaged in commercial or managerial work. This majority becomes significant in consideration of the fact that "engineering" graduates include a wide range of highly technical fields such as mechanical, electrical, civil, chemical, metallurgical, mining, sanitary, and science.

An interesting tabulation in the report shows the following percentages of engineering graduates in all departments who are now in commercial or managerial capacities: mechanical engineering, 65 per cent; electrical engineering, 60 per cent; civil engineering, 73 per cent; chemical engineering, 59 per cent; commercial engineering, 91 per cent; metallurgical and mining engineering, 67 per cent; sanitary engineering, 60 per cent; science, 77 per cent.

One of the two most important generalizations cited by the authors in their report is that "the great majority of graduates use their technical education as a means of getting into commercial or managerial work. It is believed that a similar study of the activities of the graduates of other technical institutions would show this same order of classification."

Glass Rings—A New Filling Material for Towers*

By F. C. Zeisberg
Chemical Engineer, the du Pont Company

In a recent article[1] entitled "The Efficiency and Capacity of Fractionating Columns," W. A. Peters, Jr., describes experiments on fractionating columns packed with various materials; among others, hollow cylinders. It was shown that hollow cylinders have so much greater capacity per square foot of gross cross-sectional area than solid filling material of approximately the same dimensions that it seemed worth while pursuing the matter to see whether such hollow cylinders in small sizes could not be produced commercially. The desirability of the smaller sizes lies in the fact that the separating efficiency in a packed fractionating column increases almost directly as the size decreases.

So-called Raschig rings of earthenware and metal have been used for some time, but of larger dimensions than Mr. Peters' experiments indicated to be desirable. Thus, the General Ceramics Co. makes unglazed earthenware rings, 1x1 in. with $\frac{1}{8}$-in. walls, of two different types. One of these is a plain, open-ended, hollow cylinder, the other a similar cylinder with four notches at each end. Maurice A. Knight makes both glazed and unglazed cylinders in four sizes: $\frac{3}{8}$ in. with $\frac{1}{8}$-in. walls, [illegible] in. with $\frac{3}{16}$-in. walls, 1 in. with $\frac{3}{16}$-in. walls and $1\frac{1}{4}$ in. with $\frac{1}{4}$-in. walls.

In Germany both porcelain and metal rings have been in use for some time, but so far as we have been able to learn the smallest size used up until now is 15x15 mm., with 2-mm. walls in the case of porcelain and 0.5-mm. walls in the case of metal.

In England, Lessing[2] has attempted to improve the metal ring by adding a single central partition. This increases the surface of a given ring about 32 per cent. The Hydronyl Syndicate of London is marketing Lessing's ring in several sizes and in a variety of metals, such as copper, iron, aluminum and nickel. The cost of these rings is rather high.

It is probably true that the commercial limit has been reached with respect to further decrease in size of earthenware rings. Not only does the effective free space rapidly decrease as the ring size decreases, owing to the necessity of keeping the walls comparatively thick, but the cost of handling the rings in the drying and burning operations rapidly increases also. Furthermore, for some purposes, as, for example, handling hot sulphuric or nitric acids, the earthenware rings are not entirely suitable, tending to disintegrate.

While metal rings can easily be made of any desired size, no matter how small, by the use of automatic machinery, here the increase in surface per cubic foot of rings as the size decreases can in some instances work harmfully rather than otherwise. For example, in the distillation of acetic acid through a copper column filled with copper rings, the action of the acid on the copper is comparatively slight, measured in inches penetration per month, but when the enormous area exposed by the smaller size rings (252 sq.ft. per cu.ft. for $\frac{1}{4}$-in. Lessing rings) is taken into consideration, the total amount of copper dissolved is no insignificant factor.

*Paper presented before American Institute of Chemical Engineers, Richmond, Va., Dec. 6-9, 1922.

[1] *J. Ind. Eng. Chem.*, vol. 14, pp. 476-9 (1922).

[2] *J. Soc. Chem. Ind.*, vol. 40, pp. 115-19T (1921).

TABLE I—PROPERTIES OF GLASS FILLING RINGS

Chemical Department, E. I. du Pont de Nemours & Co.

Size*	4	5	6	7	8	9	10	11	1
No. per cu.ft.	369,000	189,000	109,300	68,800	46,100	32,400	23,600	17,750	13.
Wt. per cu.ft., lb.	52.0	49.1	46.2	43.4	40.5	37.7	34.8	32.0	29.
Sq.ft. per cu.ft.	415	332	274	233	203	178	160	144	
Per cent free space	66	68	69	71	73	75	77	79	
Wall thickness, mm.	0.58	0.63	0.68	0.73	0.78	0.83	0.87	0.92	0
Resistance, inches H₂O	9.4	6.7	5.0	3.8	3.0	2.4	1.9	1.55	1
Price per cu.ft.	$115.00	$65.00	$42.00	$31.00	$24.00	$20.00	$17.00	$15.00	$13

* The size number of the rings is simply the outside diameter in millimeters

This holds, of course, wherever the metal composing the ring is attacked, however slightly, by the vapors or liquids coming in contact with it, and this condition obtains in a surprisingly large number of works-scale cases.

It seemed to us, therefore, that neither metal nor earthenware promised to be the ideal material of which to fabricate small rings. In looking about for such a material, glass naturally suggested itself. Glass is a fairly cheap material, is inert to a large variety of chemicals, possesses the necessary strength, is a poor conductor of heat (which is an important consideration in a column where reactions occur having a marked temperature gradient) and is readily cleaned.

Considerable effort has been spent on methods of manufacturing these glass rings, and this has been successful to the point that the chemical department of the du Pont company is now in a position to market small glass rings at prices which make them attractive for a number of operations, notably for the filling of small distilling columns. The rings can be made in a large range of sizes. For each operation, however, there is an optimum size, indications being that for all-around purposes ring No. 11 is about the best. Table I shows the properties of the various size rings.

It should be emphasized that the weight, wall thickness, free space and surface shown in the table are only approximate. The wall thickness for a given size can be varied considerably, and with it all the other properties vary as a matter of course. The properties given, however, are for what appears the best proportioned ring.

The resistance shown is the pressure necessary to force 1,000 lb. air per hour, at 20 deg. C. and 760 mm., through a bed of rings having a cross-sectional area of 1 sq.ft. and a depth of 1 ft. The figures were calculated by the formula given in F. C. Blake's paper, "Resistance of Packing to Fluid Flow," and are probably accurate to within less than 10 per cent.

The prices given are tentative. They are for quantities of 50 cu.ft. or more and are f.o.b. Wilmington, Del. Prices on small quantities of the smaller rings for laboratory use will of course be considerably higher.

The du Pont company has these rings in use in several distilling operations. For example a 9-in. column, filled with 13 ft. of No. 9 rings, is producing 2,000 lb. per day of 90 per cent (by weight) alcohol from a 60 per cent feed alcohol, with a heat flow up the column of 220,000 B.t.u. per sq.ft. of cross-sectional area per hour. The performance is equivalent to that of a thirty-five-plate column, and has been satisfactory from the first.

In a second operation a 4-in. column, packed with 11 ft. of No. 11 rings, is used in stripping a 28 per cent ammonia liquor. The feed rate is 90 lb. of liquor per hour, with a heat flow of 395,000 B.t.u. per sq.ft. of cross-sectional area per hour. A vapor at approximately room temperature is delivered from the top of the colum while the hot water running from the base is NH_3-fre In this case only 6 ft. of the packed space is real functioning, equivalent to about sixteen plates, the r maining 5 ft. being used as insurance.

To illustrate the readiness with which these gla rings can be cleaned, this NH_3 column stopped up se eral weeks after being put in operation, and when was opened the rings were found stuck together with dark brown deposit which was found to be iron sal The rings were simply removed, treated with comme cial hydrochloric acid, which readily dissolved th deposit, washed with water and replaced in the column.

In conclusion, it should be stated that the du Por company has made what is felt to be only a very limite application of these rings to works-scale operation: Those applications susceptible to patent protectior however, as well as the phases of ring manufactur which can be covered, have been taken care of.

Sagger Problems Being Investigated

Saggers are containers employed in manufactories o chinaware for holding plates, cups, saucers, etc., dur ing the firing in the kiln. These containers are mad of clay which must have considerable strength and b of good refractory quality. The Bureau of Standard is conducting a thorough investigation involving a geo graphical study of sagger clays to classify them ac cording to their properties, and finally to see what ma be done toward increasing the life of the sagger.

To obtain a list of the sagger clays used throughout the country, letters were sent to 100 different manufacturers using these clays. About ninety different clays or rather clays sold under approximately ninety different names, are used for saggers in the United States.

Samples of fifty-two different clays, representing as well as could be judged all the important types, are being obtained in 200 lb. lots from the users rather than from producers or dealers. Manufacturers are contributing these rather large samples from their stocks and prepaying the freight to Washington.

In order to classify the sagger clays according to their properties, they are being subjected to the following tests: Water of plasticity, shrinkage, porosity, transverse strength, and burning behavior at five different cones. It is considered necessary, in order that the results of these tests may be of value, to devise, where necessary, methods or modifications of methods which will insure greater accuracy than is usually attained in such measurements. This involves the elimination of sources of variation all along the line in order to obtain close checks in the final results. As this is a feature which justifies closer attention than it has received up to this time from ceramic industries, it is proposed to include in the report of this investigation not only averages but maximum departures from these mean values.

The Low-Temperature Carbonization of Coal

I—The Development of the Carbocoal Process at the Irvington Plant of the International Coal Products Corporation

BY HARRY A. CURTIS AND WALTER J. CHAPMAN

THE present paper is the first in a series of articles which will be published by the senior author and several of his co-workers dealing with the project of manufacturing a smokeless fuel through processes involving the low-temperature distillation of coal. In describing the development of the Carbocoal process in the present paper there will necessarily be included considerable data of general application in any low-temperature carbonization process, for many of the problems encountered in the development of this particular process are not specific to the process, but are inherent in the nature of the operations to be carried out, regardless of the methods used.

There have been about sixty different retorts invented for carbonizing coal at relatively low temperatures. Many of these retorts are worthless because they disregard some of the fundamental principles of the art. It has cost time and money to discover these principles, and it is well that they are recorded. Nor is the problem of producing smokeless fuel solved when a successful retort has been developed. The question of what to do with the carbon residue turned out by such a retort must be answered also, for this carbon residue is not in suitable shape for the market.

Looking back over the records of the large-scale experimental work carried on at the Irvington, N. J., plant, it is easy to see that the company rushed into the use of large-scale apparatus and consequent heavy expenditures before small-scale experiments had disclosed the essentials of the Carbocoal process. It is true that inevitably there would have come a time in the development of the process when only large-scale apparatus would give the final data for plant construction, but the large-scale work at Irvington was premature. All of the early work at Irvington suffered from lack of good engineering, and many of the experiments were performed unnecessarily. In spite of these facts, however, progress was slowly made toward a successful process and a great deal of experience in the art was accumulated.

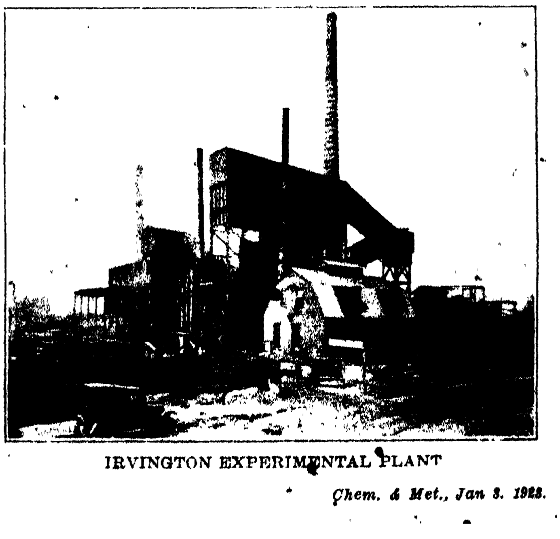
Experimental work was begun at the Irvington plant in May, 1915, and discontinued in June, 1921, after the Clinchfield, Va., plant had been in operation for a year. During this period several types of full-size low-temperature retorts were built and tested; methods of handling the carbon residue were devised; the art of briquetting the carbon residue was developed; and methods of carbonizing the briquets to make them smokeless were worked out. In the following pages a very brief summary of this work is presented.

RETORTS NO. 1 AND NO. 2

The original scheme of the Carbocoal process was to remove only such a part of the volatile of the coal as would leave the residue plastic and then to briquet the plastic.[1] This idea was later abandoned, for reasons which will appear, but Retorts No. 1 and No. 2 were built with this original scheme in view.

Retort No. 1 was fabricated by H. W. Caldwell & Sons and set up at Irvington during the summer of 1915. It consisted essentially of a horizontal, stationary, cast-iron cylinder, 36 in. in diameter and 17 ft. long, made in two sections, with a single paddle shaft through the center. The paddle shaft was an 8-in. wrought-iron pipe, with gudgeons for bearings in each end, and carried about forty paddles bolted in the shaft, the paddles being set at an angle so as both to stir the coal and to advance it through the retort. Crushed coal was fed from a bunker through a 6-in. helicoid screw, and dropped down a 7-in. pipe into the retort. The plastic carbon residue was discharged through a single 6-in. helicoid screw turning in a 7-in. pipe casing. The paddle shaft, feed and discharge were driven from a single motor through a worm gear. A simplified sketch of this retort is shown in Fig. 1.

When Retort No. 1 is regarded in the light of 7 years' accumulative experience which the company has now had in this line, it is amusing that such a retort should have been built and that most persistent efforts should have been made to operate it. And yet patents are being granted right along on retorts as impossible as this one. Tests were started with Retort No. 1 in September, 1915, and continued for more than a year in spite of the fact that practically every test ended in disaster within a few hours after it was begun. The final stage in every test which was not earlier terminated by plugged feed, plugged discharge or broken machinery was a retort plugged with carbon residue. The plastic mass of distilling coal would wind around the paddle shaft and paddles and gradually bake in place until it was impossible to get any more coal into the retort. Such is the inevitable result when a fusing coal is put into such a retort, and we may state as one of the fundamental facts of the art of low-temperature carbonization that any device for stirring a fusing coal during carbonization will inevitably become more and more heavily gummed up with carbon residue unless some positive mechanism be provided for removing this deposit. Likewise all simple revolving cylinder retorts will fail with fusing coal, and no amount



IRVINGTON EXPERIMENTAL PLANT

[1]See C. H. Smith patent, U. S., 1,224,424.

of argument on the part of their inventors will prevent the distilling coal from sticking on the sides of such a retort until it is plugged. Furthermore, all retorts involving the use of internal screws to agitate and convey the distilling coal will fail to handle a caking coal unless some means of keeping the screws clean be provided.

It must be recognized that caking coals, which fuse in the retort and pass through every stage from a fairly fluid mass to a brittle solid, act entirely differently from lignite or oil shale. Again and again retorts which have been used on lignite or shale are brought forward as suitable equipment for carbonizing all sorts of bituminous coals, and not one-half of 1 per cent of such retorts will operate at all on caking coals. Such was the lesson which Retort No. 1 taught, or tried to teach, almost daily for over a year at the Irvington plant. And it finally got the idea across, but not until dozens of tests had ended with a plugged retort and Retort No. 2 had been built along similar lines and had likewise failed.

Several other difficulties were made apparent during the course of the tests on Retort No. 1. The feed screw would frequently jam, due to a plug at the foot of the vertical section of the 7-in. feed pipe, this causing the pipe to fill up and very soon bind the screw with coal. When Retort No. 2 was built, early in 1916, the crushed coal was fed to the retort by a short plunger device at the floor level of the retort. This also gave much trouble. The problem of coal feed was eventually solved by using a 9-in. screw set horizontally and emptying directly into the retort through the end-plate, above the paddle shafts, as will be shown later in sketches of the Clinchfield type of retort. In this arrangement the retort paddles sweep past the discharge end of the feed screw and keep it free.

The single screw for discharging the carbon residue from Retort No. 1 was a failure. It would plug full of plastic carbon residue and cease discharging or break its driving mechanism. The single discharge screw was finally removed and two 6-in. screws were set in a brick discharge box at right angles to the axis of the retort. These also plugged. Nine-inch twin screws were then tried, and these worked a little better, but still the discharge would plug up frequently with plastic material. The 9-in. twin screws were next transferred to Retort No. 2, and Retort No. 1 rebuilt with a 24x36-in. cross bolted to the discharge end, with a 24-in. chute for discharging the carbon residue, the chute being closed with hand-operated slides. The slides became gummed up with heavy tar and could not be worked. A slide valve was then substituted for the hand-operated slides, but this also stuck and had to be abandoned. The problem of an entirely satisfactory discharge mechanism was never wholly solved at Irvington, although numerous schemes were tried out on the various retorts built and tested. The scheme finally adopted, known as the "Vesuvius discharge," is shown in the sketch of the Clinchfield retort, and subsequent experience with it has shown that it is a failure.

It must be borne in mind that during all of this first year of experimenting the idea was to operate the retort so as to yield plastic carbon residue and to briquet this residue without binder. It was not often that enough of the carbon residue could be made for use in briquetting tests. It was found impossible to control the operating conditions closely enough to get a continuous discharge of plastic material. An attempt to briquet the plastic material with a brick press failed, and the attempts to briquet it in roll presses were not very successful. Finally, in the summer of 1916, it was decided to abandon the plastic residue idea and to carry the carbonization to a non-plastic residue, later briquetting this residue with a suitable binder. Retort No. 1 was then provided with a hand-operated ram for breaking the carbon residue from between the paddles. This ram was a heavy I-beam which was run lengthwise through the retort at intervals, the paddles being stopped and the I-beam pushed between the rows of paddles. By frequent use of this ram and by carrying the carbonization past the plastic carbon residue stage, Retort No. 1 could occasionally be kept going for several hours before a breakdown, and in this way enough carbon residue was obtained for experimenting in briquetting, etc.

A Vertical Primary Retort

While Retort No. 1 was being tested, a vertical primary retort was set up and attempts made to operate it. Fig. 2 shows the essential features of this retort. Of the few utterly absurd pieces of apparatus built by the company, this vertical retort would easily take first rank. It is difficult to discover a single commendable feature in the whole apparatus, yet cur-

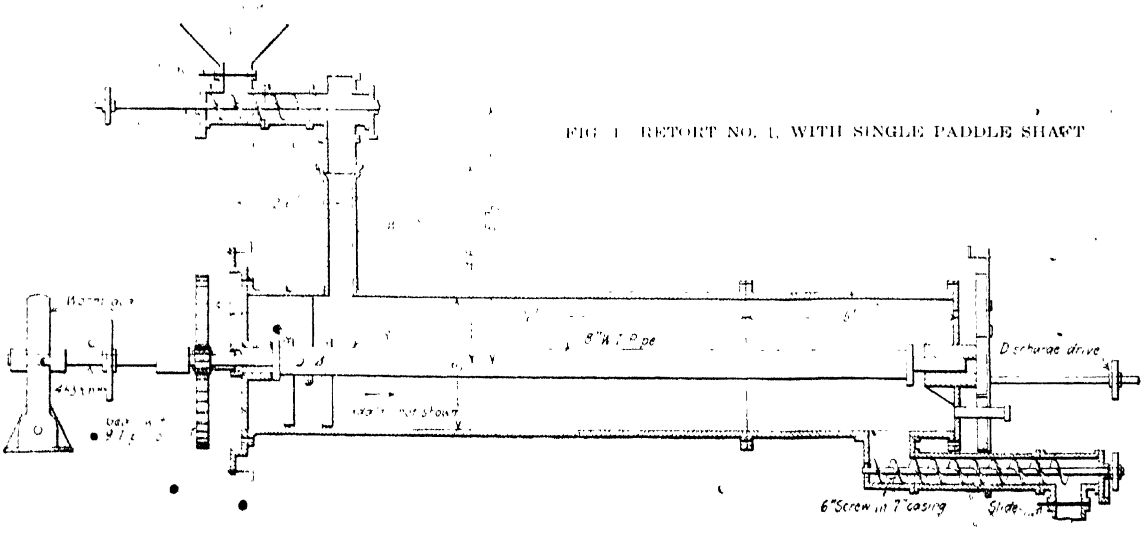


FIG. 1 RETORT NO. 1, WITH SINGLE PADDLE SHAFT

rent patent literature is replete with descriptions of no better retorts, and within the past few years one of the present authors has been asked to report on three low-temperature retorts involving most of the mistakes of this design. Any one familiar with the behavior of a fusing coal when distilled will note from a casual inspection of Fig. 2 that:

a. The feed pipe on this retort would plug as soon as the pipe got hot enough to begin even a very slow distillation of coal at its lower end.

b. That plastic coal mass would wrap around the paddle shaft and paddles and fill the retort so that no more coal could enter.

c. That the paddle shaft, paddles and driving mechanism are too high and would fail.

d. That plastic carbon residue would never get by the slide shown at the foot of the retort.

e. That even if plastic carbon residue got by this slide, it would soon wrap around the discharge screw and plug it.

f. That even if plastic carbon residue would pass the slide and the screw, it would stick in the elbow at the outer end of the screw.

g. That the gas offtake would have to be cleaned every few minutes.

h. That the slide at the bottom of the retort could not be moved after an hour or so of operation.

i. That the life of the metal retort would be short and that no provision is made for replacing it readily.

Retort No. 3

Retort No. 3, which is sketched in Fig. 3, was the first retort built with twin paddle shafts and self-cleaning paddles. This scheme of preventing carbon residue from plugging the retort was entirely successful and was used in all subsequent designs. The feed screw on this retort was located at the floor level of the retort, and gave trouble occasionally; it was eventually moved up so as to discharge above the level of the paddle shafts.

Retort No. 3 was also the first retort to be built with a carborundum lining, such as used later in the Clinchfield retorts. Carborundum possesses the advantages of strength and relatively high heat conductivity. It slowly deteriorates in an oxidizing atmosphere at 1,600 deg. F. (flue temperature), however, and although it was adopted for the commercial Carbocoal plant at Clinchfield, Va., it is probable that better material will be found eventually.

Retort No. 3 had heating flues running lengthwise the retort, with burners at the feed end. In operation it was found best not to use the burners across the top of the retort, and in subsequent designs no provision was made for heating the retort top.

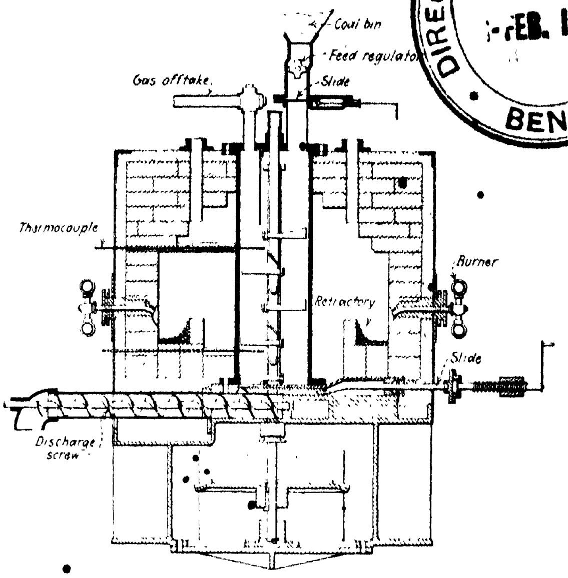


FIG 2—VERTICAL RETORT, WITH SINGLE PADDLE SHAFT

The discharge chute dropped the carbon residue onto a pair of revolving breaker arms, which broke up the larger pieces, and then into a star-wheel which served to seal the retort partly. This discharge gave considerable trouble due to gumming of the star-wheel with heavy tar and plastic carbon residue.

The hydraulic main and gas offtakes on Retort No. 3 gave continuous trouble through plugging with pitch and coke deposit. This equipment was eventually abandoned in favor of the scrubber standpipe installed on the Clinchfield retort. It was proved at Clinchfield a few years later, however, that the successful operation of such a hydraulic main is a matter of using liquor sprays correctly.

In spite of the minor difficulties mentioned above, Retort No. 3 was fairly successful, whereas Retorts No. 1 and No. 2 and the vertical retort were complete failures. Retorts Nos. 4, 5, 6 and 7, and eventually the Clinchfield retort, were modeled more or less on Retort No. 3, with such changes as seemed desirable in the light of accumulating experience.

Retorts Nos. 4, 5, 6 and 7

These four retorts were the prototypes of the Clinchfield retort described below, and were all modeled on Retort No. 3. In Retort No. 4 the burners were placed in two rows along the bottom of the retort, with flues running ribwise around the retort and opening into a large open space over the whole top of retort. Later the heating system was rebuilt so as to run the flues from either side into two separate parallel sole flues running lengthwise the retort as in the Clinchfield retort shown in Fig. 4 below. This change was subsequently made on Retorts Nos. 5, 6 and 7 and the four retorts arranged as a battery.

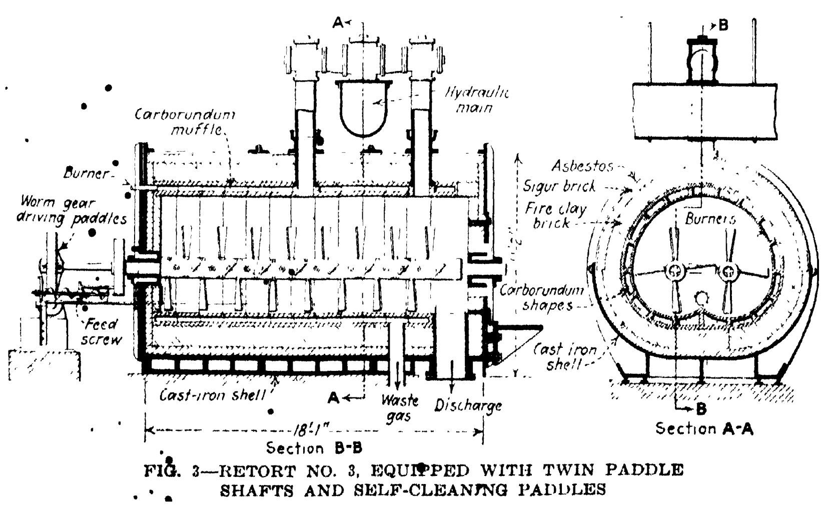


FIG. 3—RETORT NO. 3, EQUIPPED WITH TWIN PADDLE SHAFTS AND SELF-CLEANING PADDLES

Various types of gas offtakes were tried out on Retorts Nos. 4, 5, 6 and 7, but eventually all four retorts were equipped with the scrubber standpipe type, such as shown in Fig. 4.

For discharging the carbon residue, Retort No. 4 was equipped at first with a chute closed by a hand-operated barrel valve. Below the valve the carbon residue fell into a cast-iron cooling chamber, closed at the lower end by a hand-operated door through which it could finally be discharged to a conveyor. As may be guessed, the hand-operated barrel valve soon gummed up and could not be moved. The "Vesuvius" discharge, as later used on the Clinchfield retort, Fig. 4, was finally evolved. This included a pair of breaker arms, overlapping twin screws in a cast-iron casing, with a short vertical chute at the outer end of the screws. The carbon residue brought out by the screws was forced up over a curved floor into a vertical chute and then fell over a dam and down onto a conveyor. By thus forcing the carbon residue up into a short vertical chute, a partial seal over the ends of the discharge screws was secured. Retorts Nos. 5, 6 and 7 were also equipped with this discharge apparatus, and, very unfortunately, it was adopted for the Clinchfield plant.

Retort No. 9

Description of Retort No. 8 will be omitted, since this retort was never set up at Irvington, although it was designed.

Retort No. 9 was built of steel with steel supports which were designed to take care of the expansion of the metal. The essential features of this retort are shown in Fig. 5. Unfortunately, the supporting of the steel retort proved insufficient when the retort was heated and it soon warped so that the paddles dragged on the sides of the retort and it could not be further operated.

The failure of this retort discouraged further large-scale experiments with metal retorts, but small-scale tests have been continued and are still in progress at Clinchfield.

The Clinchfield Retort

The evolution of designs along the general lines of Retorts Nos. 3, 4, 5, 6 and 7 culminated in the Clinchfield retort, adopted for the commercial Carbocoal plant at Clinchfield, Va. This retort is shown in Fig. 4. Including furnace, machinery, etc., it is roughly 37 ft. long, 12 ft. wide and 27 ft. high, in over-all dimensions, while the heart-shaped muffle is 7 ft. 4 in. maximum width and 16 ft. long. The muffle is built of carborundum shapes, the total weight of carborundum per muffle being about 5 tons. The muffle is supported on fireclay saddles 18 in. apart, and is heated by two rows of ten open pipe burners supplied from a fuel gas manifold placed in a tunnel underneath the retort. Air for combustion is drawn through a recuperator, the amount of air to each burner being controlled by a damper block near the burner. There are ten combustion flues on each side of the retort, each set of flues leading to a common flue running lengthwise the retort on top, as shown in Section *B-B* of Fig. 4.

The paddle shafts and paddles are of cast steel, each paddle held in place by a single steel stud bolt passing through the shaft, the shaft being recessed for the nut and reinforced under the nut.

The carbon residue discharged from the retort falls down a vertical chute about 7 ft. long, at the bottom of which a pair of breaker arms crush the larger pieces of material so that it can be handled by the discharge screws. There are two of these screws in a common casing. At the outer end of the screws the carbon residue is pushed up a curved surface into a short vertical chute, and finally falls over a dam formed by cutting away the sides of the vertical chute. (This arrangement is known as the "Vesuvius discharge." See

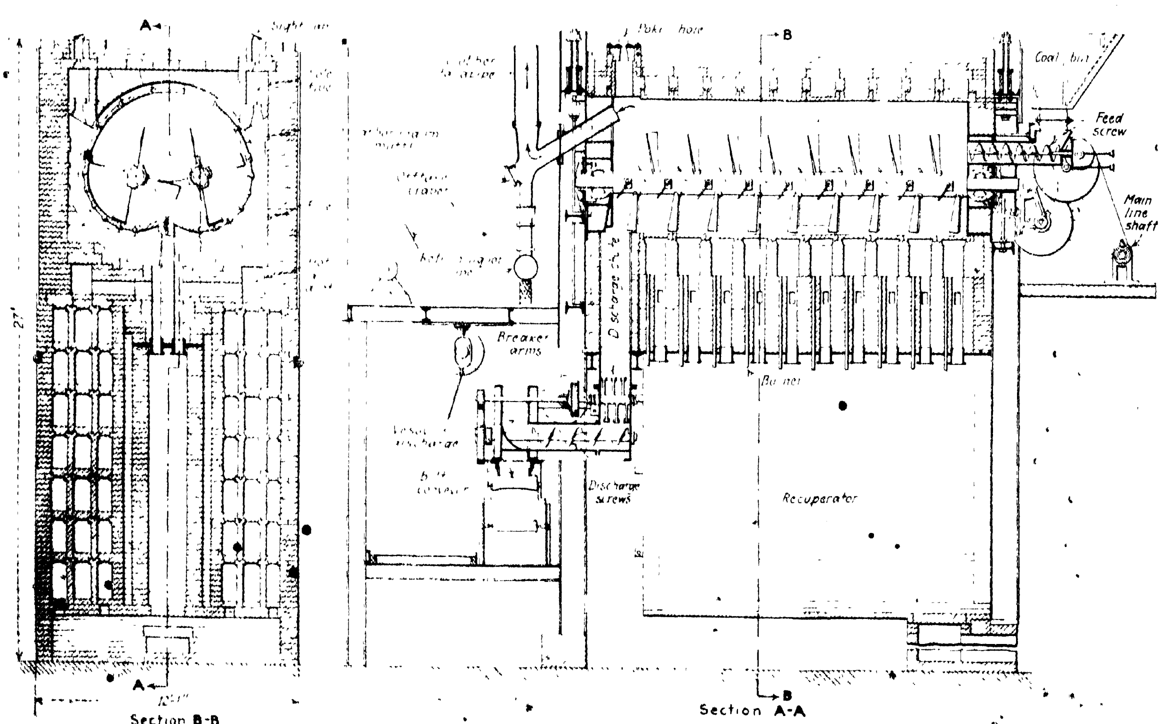


FIG. 4—CLINCHFIELD PRIMARY RETORT

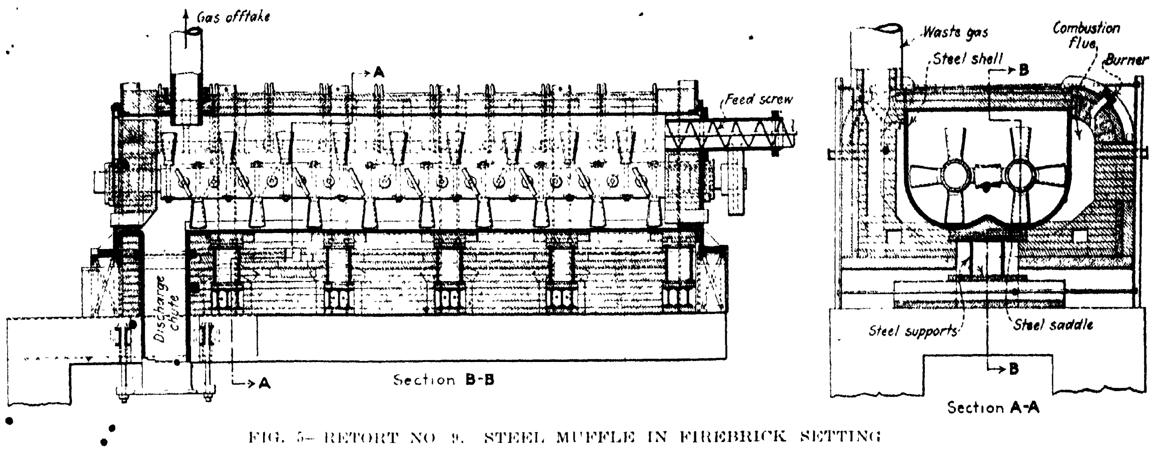


FIG. 5—RETORT NO. 9. STEEL MUFFLE IN FIREBRICK SETTING

reference to it in a later paper.) The carbon residue is carried away by rubber-covered conveyor belts.

The end plates of the muffle are suspended from the top, with means for adjusting the tension on the suspension bolts as the muffle changes elevation due to expansion of supporting masonry. The end plates, however, cannot be raised or lowered independently of the muffle.

At Clinchfield these retorts are built in four batteries of six retorts each, the feed ends of retorts are turned toward each other and four retorts are fed from a common coal bin. The feed screws and paddle shafts for twelve retorts are driven from a single 50-hp. motor.

In a subsequent paper in this series of articles the performance of this retort at the Clinchfield plant will be discussed and further details of construction mentioned. From perusal of Fig. 4 it will be evident that the retort was a costly one to build and those familiar with the art of low-temperature carbonization will readily foresee some of the operating difficulties encountered with this retort at Clinchfield.

Steel Plate Primary Retort

There are several reasons why a metal retort for carbonizing coal at low temperature would be desirable, the chief of these being, of course, the high heat conductivity of a metal compared to a refractory. One of the most serious difficulties in the project of low-temperature carbonization lies in the matter of heat transfer to the coal mass.

It was thought that if a muffle were built of rather thin steel stock, the temperature necessary in the heating flues might be so low that no damage would be done to the muffle. As a test of this idea, a heart-shape muffle was fabricated of half-inch boiler plate, with round about steel ribs, the joints in the muffle being welded. The muffle was essentially of the same dimensions as the carborundum muffle in Retort No. 4 and was substituted for this muffle.

The experiment was unsuccessful, the steel muffle soon warping until it interfered with the paddles.

Briquetting Carbon Residue

In the foregoing pages we have described various commercial retorts built and tested at Irvington, and the retort adopted for the Clinchfield plant. The evolution of a workable retort, however, was only a first step in the production of a marketable, smokeless fuel. The original plan of briquetting the carbon residue while it was still in a plastic condition proved unfeasible, and attention was next turned to methods of briquetting the non-plastic residue. This problem proved to be one of some difficulty also. The carbon residue as it comes from the retort, containing, say, 10 to 12 per cent of volatile, is a light, friable form of semi-coke, which readily begins to burn when exposed to the air. Various systems of handling this material were tried out at Irvington, including pan conveyors, air-jet conveyors and steam-jet conveyors.

The air-jet conveyor (Sims) was out of the question, due to its aggravating the fire trouble and to the difficulty of collecting the coke dust carried out of the bins by the air. The steam-jet was more satisfactory, but was also impractical on account of the very high steam consumption. The pan conveyor was satisfactory so far as carrying the carbon residue was concerned. It was found that the carbon residue could not be stored for longer than about an hour unless it were very thoroughly quenched, and if this were done the wet material would clog the grinding mills. The ground material, however, could be stored for some time without catching fire.

The system finally used at Irvington was to grind the hot, dry carbon residue within an hour or so after it left the retort. The ground material was then stored in a steel bin until briquetted. The ground carbon residue shows little or no tendency to burn explosively, even when ground so that 50 per cent of it will pass a screen of 100-mesh per linear inch.

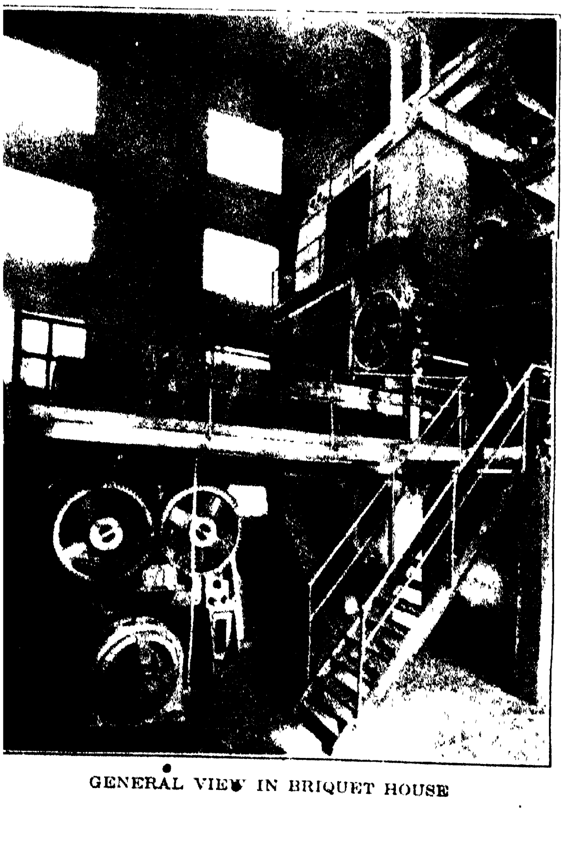
The first step in briquetting carbon residue is the proper grinding of the material. There were tried out at Irvington a Williams hammer mill, a roll crusher and a Mashek hammer mill. None of these was satisfactory. The roll crusher did not give a satisfactory distribution of screen sizes in the ground material, and the hammers on the hammer mill would not stand up under the abrasive action of the carbon residue. The problem of grinding carbon residue was not solved at Irvington. At the Clinchfield plant hammer mills were installed, despite the Irvington experience, and when these failed completely, ball mills were used successfully.

After proper grinding it is a simple matter to flux the ground carbon residue with a binder and briquet it. The percentage of binder required is higher than for coal, and the pressure required in the press somewhat greater, but in general the same principles apply. At Irvington a Belgian type roll press was used successfully. This press formed thin oval briquets, however, and it was thought that a more nearly

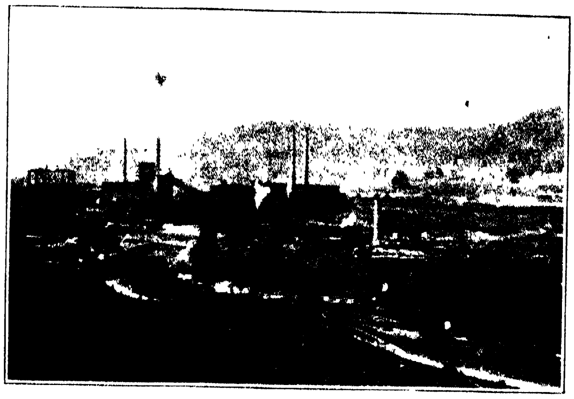
spherical briquet was preferable. To meet this requirement a Komarek press was installed. This is a roll press in which flat-link chains run over one of the rolls, between the rows of briquet dies, yielding oval briquets with flat ends. This press gave good results in the experimental plant at Irvington. It was less successful at Clinchfield when used there later, due to excessive wear on the liner chains.

The briquets formed from carbon residue with suitable binder can be shipped and marketed. They are not smokeless, of course, and if pitch be used as the binder, the tarry smoke which distills out during the first few minutes on the fire is disagreeable and is likely to cause trouble from fires in the chimneys if used in ordinary househould stoves. After the briquets have been on the fire a few minutes, however, the pitch has distilled out and the briquets then burn slowly and without smoke.

It was recognized at Irvington that although briquetting the carbon residue converted it into a salable product, these raw briquets did not represent an ideal solution of the problem. By heating the raw briquets in a muffle it was found that they could be rendered smokeless and an appreciable yield of byproducts obtained. It was discovered, also, that the carbonizing of the raw briquets at high red heat not only rendered them smokeless by distilling out the pitch, as might be expected, but it also changed the internal condition of the briquets so that a finished briquet has a continuous structure, whereas in a raw briquet there are discrete particles of carbon residue cemented by minute globules of pitch. During carbonizing, the particles of carbon residue link to one another more or less firmly. The Carbocoal briquet is harder and denser than the raw briquet, the shrinkage in volume during carbonization being anywhere from 10 to 30 per cent. It



GENERAL VIEW IN BRIQUET HOUSE



GENERAL VIEW OF CLINCHFIELD PLANT AND VILLAGE

was also discovered that the quality of the Carbocoal is dependent to a remarkable degree on the make-up of the raw briquet. There are apparently several factors involved and it became evident that briquetting carbon residue for subsequent carbonization was quite a different proposition and a decidedly more complex proposition than the mere binding of coal or of carbon residue into raw briquets. During the past 5 years experiments in briquetting and carbonizing have been under way continuously. We plan to publish at some later date a summary of the several hundred experiments completed. Suffice it to say here that we now know the general influence of the following factors in the problem:

a. Coking quality of the original coal.
b. Volatile left in carbon residue.
c. Screen analysis of the ground carbon residue before briquetting.
d. Composition of raw briquet mix.
e. Quality and screen analysis of any raw coal added to raw briquet mix.
f. Kind of binder and melting point of same.
g. Method of fluxing, time in fluxer, temperature in fluxer and water in final briquet mix.
h. Temperature of material fed to press.
i. Kind of press used, pressure, shape of briquet, condition of briquet surface.
j. Rate of heating briquet in secondary retort, final temperature reached, time of carbonization, height of briquet charge in the retort.
k. Time between discharging of briquets from secondaries and quenching. Method of quenching.

Not all of these factors are independent of one another, but it is necessary to control each of them within certain ranges which it has been our endeavor to determine.

Carbonizing Raw Briquets

Several commercial retorts for carbonizing briquets were built and tested at the Irvington plant during the 6 years of experimental work there. It was found that ordinary D-shape gas retorts would carbonize the briquet satisfactorily in a few hours, but it was difficult to charge and discharge such retorts with briquets. A Glover-West vertical retort was built and tried, but the column of briquets in this was too high and the briquets at the bottom of the column were crushed before they hardened.

Inclined retorts were finally tried and operated with some success, although there was always some breakage in charging the retorts, and it was very seldom that a charge of carbonized briquets would roll out of a retort without poking it with rods. The secondary retort finally adopted for the Clinchfield plant was of rectangular section, divided into an upper and a lower chamber

by a silica brick partition, each chamber being roughly 4 ft. high, and 25 ft. long, 14 in. wide at the charge and 16 in. wide at the discharge end. The retorts were heated by gas burners, set at the top of vertical flues, the waste gases passing through a recuperator system before entering the main flue.

The main trouble with these retorts was that the column of briquets was too deep and the breakage of briquets was excessive. When the raw briquets were exceptionally good and other conditions very favorable, these secondary retorts would yield fair results, but under the normal conditions of operation they were outside the limits of workable equipment. The experience with these retorts at Clinchfield will be mentioned in a subsequent paper.

Summary

We have described briefly in the foregoing pages the general features of the several primary or low-temperature retorts built and tested at Irvington, N. J., and the evolution of the Clinchfield retort. Mention has been made of the methods tried out in handling the carbon residue from the retorts and the means used to convert it eventually into a fuel resembling anthracite in properties. It has not been possible to make this paper a record of the very numerous minor experiments which were carried out with the low-temperature retorts and with other equipment developed for the Carbocoal process. The program at Irvington also covered a considerable number of subjects connected more or less closely with the Carbocoal process but which lie outside the scope of this paper.

The experimental work at Irvington had been under way for a little over three years when the U. S. Government decided to finance a commercial Carbocoal plant at Clinchfield, Va. The Irvington plant had grown to be a semi-commercial plant meanwhile, with several primary retorts, a complete system for handling the carbon residue, grinding and briquetting equipment, two benches of secondary retorts, screening and loading station for Carbocoal, byproduct units and tar distilling plant.

At the time the Clinchfield plant was constructed complete solutions had not been found for all the problems in the process, but it was thought that the equipment which had been developed would be reasonably satisfactory in a commercial plant. We shall close this paper with a summary of the data available for design of a commercial Carbocoal plant at that time. In the third paper of this series we shall discuss the operation of the Clinchfield plant which was presumably built on the basis of Irvington experience.

In setting down the following items of data available for plant design, it must be recognized that personal judgments come into play. We have endeavored here to reflect the general opinion of men who actually directed operation at Irvington, checking these general conclusions against the operation records.

1. The equipment for handling the coal up to the primary retort, including the track hopper, apron conveyor, Williams hammer mill, bucket elevator and distributing conveyor was entirely satisfactory. The general scheme was adopted for the Clinchfield plant and proved satisfactory there.

2. The proposition of using twin paddle shafts and self-cleaning paddles to avoid plugging of primary retorts by plastic coal mass was entirely satisfactory and subsequent experience at Clinchfield has confirmed the correctness of this design.

3. The single helical screw, carrying coal into the retort above the paddle shafts, was found satisfactory. The same arrangement later proved efficient at Clinchfield.

4. Carborundum blocks proved satisfactory as material for primary retorts at Irvington, being strong enough to permit relatively thin walls and having a high heat conductivity. At Clinchfield later experience has shown that the slow oxidation of the blocks is a serious drawback.

5. The heating system for primary retorts as finally adopted at Irvington was fairly satisfactory, and Clinchfield experience has not added materially to what was known at Irvington. Better methods of heating a primary retort have been developed since Clinchfield construction, however, as will be shown in subsequent papers.

6. As a result of many experiments on discharge mechanisms for the primary retorts, the scheme finally adopted was to drop the carbon residue down a vertical chute onto a pair of revolving breaker arms, below which a pair of helical screws carried it out several feet and forced it up over a dam. This mechanism later proved to be a failure.

7. It was known at Irvington that a carbon deposit formed on the inner walls of the primary retort and that eventually this deposit hardened so as to interfere with the paddles. It was thought, however, that a retort would not have to be cleaned out more than twice a year. This conclusion proved erroneous in Clinchfield operation.

8. It was found at Irvington that the gas offtakes from the primary retorts would plug and had to be reamed out at frequent intervals. This reaming proved troublesome at Clinchfield later.

9. At Irvington the air jet conveyor was shown to be worthless for carrying carbon residue and the steam jet conveyor was found to be extravagant of steam. The pan conveyor gave some trouble mechanically, but was otherwise successful. None of these schemes was adopted for Clinchfield.

10. It was shown at Irvington that it is impractical to store warm unground carbon residue, since it soon begins to burn. This experience was disregarded in Clinchfield design.

11. It was shown at Irvington that hammer mills are not satisfactory for grinding carbon residue. This experience was disregarded in Clinchfield design.

12. The method of proportioning the raw briquet mix worked out at Irvington included a slide-gate with a drag chain conveyor for the ground carbon residue and a weir for the molten pitch. This arrangement was used at Clinchfield. It never gave real control of the proportions of carbon residue and pitch.

13. The Komarek briquet press with flat-link chains running between the dies was adopted at Irvington. It operated well at Clinchfield, but the wear on the chains was excessive.

14. The link-chain cooling conveyor for briquets as they came from the press was satisfactory at Irvington and later proved so at Clinchfield.

15. It was known at Irvington that raw briquets must be handled with reasonable care to avoid excessive breakage. This information was disregarded in Clinchfield design.

16. It was known at Irvington that raw briquets when stored in bins have a tendency to stick together and refuse to flow out of the bin through a discharge door. Large storage bins were installed at Clinchfield.

17. The inclined secondary retorts developed at Irvington were not entirely satisfactory there and proved less so at Clinchfield. It was very rarely that a charge of finished briquets would roll out of the retorts without considerable poking and the breakage was usually high. Several of the factors affecting the quality of the Carbocoal were recognized at Irvington.

Contraction and Shrinkage of Aluminum Alloys

As the result of an investigation of the contraction and shrinkage of aluminum alloys conducted by Robert J. Anderson, metallurgist, at the Pittsburgh, Pa., experiment station of the Bureau of Mines, it has been shown that contraction of a series of forty alloys varied from 0.96 and 1.80 per cent, depending upon conditions, and that it is advisable to make accurate pattern allowances for the various alloys in casting practice.

A Longer College Course for Engineers

By F. E. Turneaure

Dean, College of Mechanics and Engineering, University of Wisconsin

[Apropos recent editorial comments on engineering education for metallurgists and chemists, and correspondence on those matters published in the department headed "Readers' Views and Comments," the following exposition of the longer engineering curriculum by Dean Turneaure will be illuminating. It was contributed to the December, 1922, issue of the Bulletin of the Society for the Promotion of Engineering Education.]

IT SEEMS to me that, broadly speaking, the most important problem before the engineering schools is the old one: What are the requirements which should be met by the engineering school, and how should the curriculum, teaching staff, etc., be organized to meet these requirements? In suggesting this fundamental problem, I am of the opinion that it has never been adequately studied, and that a properly constituted board can do a great deal to crystallize opinion in regard to this very fundamental problem. Perhaps a statement of some of my own notions will explain what I have in mind as to past defects and future possibilities.

Qualifications Demanded for Engineers

First, in regard to requirements of the present day in the matter of the school training of engineers: In attempting to answer this question, a great many fields of engineering activity should be considered. The question cannot be answered by the broad statement that engineers should be trained like lawyers or doctors and that, engineering being a profession, the training should preferably consist of general college courses followed by professional courses requiring altogether 6 or 7 years. I think a certain class of engineers and educators is inclined to consider that this is the ultimate and inevitably correct solution. There are, on the other hand, a good many teachers and also engineers who consider that for many lines of practice a 4-year school period is long enough and that the young man will do better to get into practical work than to remain longer in college. I have myself seen considerable evidence of the truth of the latter position. It is my belief that the technical requirements of an engineer and an engineering education vary over a comparatively wide range and that a careful study of the situation with especial reference to this point will give us some really useful information.

I think this problem can be divided into two parts: (*a*) How much general education should an engineer have, and (*b*) How much technical education should he have? In attempting to answer these questions, all branches of engineering practice should be thoroughly studied and very definite inquiries should be made of men in practice who understand exactly what is wanted. The actual needs of men in various lines of engineering activity should be considered. Highly technical specialties should be recognized as such, and the proportion of engineers in various kinds of work should be information of [illegible]nificance in this connection.

A[illegible]illustration of what I have in mind, consider th[illegible] of highway engineering at the present time. A [illegible] number of men are required at this work, and a large percentage of these men are not engaged (at least for many years) in a kind of work which involves a very large amount of technical schooling. The work of the young engineer, from the technical standpoint, is quite simple, and likely to be so for many years—in fact, the business phase of the work is perhaps of more importance than the engineering phase, especially for men in the more responsible positions. It is true, also, that for certain classes of work an engineer should have a very thorough training in structural design or in bituminous pavements, geology, etc., but the number of men needed for this kind of work is comparatively small, and some of this highly specialized work may well be considered in the category of specialization.

Minor Branches of Engineering

Then there are many other varieties of engineers whose preparation does not need to be highly technical, such as the operating engineers, contracting engineers and, in a sense, railroad engineers. In the various industries there are certainly many lines of work where the technical requirements are not high but where business sense and judgment count more. I believe an effort should be made to analyze requirements very thoroughly along some such line as above suggested.

It is my belief that the time has arrived when it may be expected that any young man desiring to enter any engineering employment, however simple, ought to secure, if possible, a college training of 4 years in length. With the tremendous increase in the high school and college attendance throughout the country and the increasing ease with which young people can secure a college education, I believe that such an education should be required of any young man who goes into a business or profession where he expects, sooner or later, to exert considerable influence with his colleagues or with the public. A college education no longer is an uncommon thing. I am impressed with that fact in looking over our recently published alumni directory and noting the large number of university graduates located in all the smaller cities and many of the villages throughout the state. This number is bound to increase, and an engineering representative of the highway commission in any neighborhood, or the village or city engineer, should be a man who can acquire a standing with the best in the community. It is my belief, therefore, that a 4-year college course of some kind should be the minimum set before the young man as a preparation for any line of engineering.

It is quite true that the technical requirements of some lines of work may be met by means of short courses of 2 or 3 years in length, and that question was discussed by our faculty some years ago. We reached the conclusion that 2-year courses would well satisfy the technical requirements for quite a variety of employment, but did not consider it the function of the university to establish such courses.

Four-Year Course the Minimum

If it is decided that a 4-year college course is sufficient to meet the requirements for general education plus minimum technical requirements, then the problem resolves itself into that of determining the higher technical requirements and how they are to be met in the school: whether by a combination liberal arts course plus graduate work in engineering, or by a 5- or 6-year combination course carrying some engineering work throughout the period. At present our standard 4-year

engineering course as given in most schools is, in my judgment, of a quality which is neither hay nor grass; it cannot be considered a course for a broad education, neither can it be considered a very satisfactory course for those desiring the most advanced training. The first-named objection is more serious than the latter, because a student desiring advanced technical work can get it in graduate study; but the lack of breadth cannot be so easily remedied by the individual student.

To indicate more clearly what I have in mind as to the direction for this phase of the investigation, I might outline what seems to me to be a fairly good solution, and the reasons therefor.

Pre-Engineering Courses

In brief, this would consider a 4-year engineering course (or pre-engineering course) which would be very general in its character. It would contain a large amount of work of general educational value, such as history, economics, language, science, chemistry, physics, mathematics and mechanics, also the elements in applied work in the usual branches of engineering. Such a course I would consider the minimum requirement for any young man who desires to enter the industries or any field of engineering whatever; and for many lines of work it would be a satisfactory preparation. It would also furnish a sufficient foundation in mathematics and science to enable a man of real ability to advance himself in almost any line of engineering activity, even where a longer course of training would be preferable. By the elimination or postponement of a very considerable amount of technical studies, now included in the regular 4-year course, such a course as above indicated could be made quite satisfactory from the standpoint of general education and, on the whole, much more satisfactory than a 4-year course in a college of liberal arts such as would be elected by students planning on an engineering course later. At least it would meet the needs of a great many more students, and I am inclined to think that it would be the best course for practically all.

The 4-year course as above indicated should lead to a degree (such as the B.S. degree), without special designation. Then those students who desire a more thorough engineering education should secure it by further study, either in the form of graduate work or fifth- and sixth-year courses leading to an appropriate second degree. These advanced courses would be well organized, and would be taken by a very considerable number of students, as they would contain a good share of the material now included in our senior year. They would naturally be taken by all students desiring to enter the research field and those aiming to become fairly well posted in any special line. I should suppose that from 25 to 40 per cent of those finishing the 4-year course would continue for a fifth or sixth year, the percentage depending, of course, quite largely upon the curriculum adopted.

Among the advantages of such a scheme as above suggested are possibly the following:

1. It requires all engineering students to secure a much broader general education than is now the case, while at the same time it includes a sufficient amount of fundamental technical work to satisfy the requirements in many cases.

2. It furnishes the well-organized technical work for special and advanced students which will encourage students of ability to thoroughly prepare themselves for research and special work of various kinds. Graduate courses in engineering will be much better organized than is now the case.

3. It is a better arrangement than that frequently proposed of requiring a 2- or 3- or 4-year college course before admission to the engineering school. In any pre-engineering course, a considerable amount of mathematics and science must be required in order to save time, and pre-engineering courses under the control and advice of the engineering faculty can be better adjusted to the students' need than when otherwise administered.

4. It would I believe, solve the problem of the 4-year course, against which so much criticism is directed.

5. It would tend to eliminate from the more advanced and technical work students who are unfitted for such work while at the same time capable of becoming successful engineers in certain lines of employment. With the very great numbers now attending engineering schools, a relief of work in the senior and junior laboratories would be very acceptable in most cases.

There are, of course, many other phases of this study but I believe the very first thing to be done is to determine upon some reasonable solution of the problems above discussed. Engineering faculties are, I feel sure, quite capable of determining upon details and methods of teaching. They are also, in most cases, in very close touch with practicing engineers among their alumni and include among their members many men with considerable engineering practice. I do not believe, therefore, that it is necessary to go far into details. On the other hand, it is true that engineering teachers are, as a whole, quite concerned over the situation, and are prepared to follow the lead of a strong report which will clearly set forth requirements and a way to meet them under the conditions actually existing in the majority of engineering schools. We, I think, are ready to move, but we want to move in reasonable unison, and in a direction that it will not be necessary to retrace in the near future.

European Attempts to Number Steel

Progress Made by Switzerland, Germany and France Toward Standardization

A RECENT conference held in Washington discussed the desirability and possibility of devising some system of numbering whereby kinds or qualities of steel can be designated by code numbers. Lawford H. Fry, of the Standard Steel Works Co., presented a résumé of European practice, as revealed by correspondence with various foreign organizations. It appears that Switzerland, Germany and France have made some attempts to establish such a code.

The Swiss system attempts to show the content of the carbon and of the principal alloys by using the chemical symbol of the elements and adding to each a figure showing the mean percentage. Thus a carbon steel with 0.25 to 0.35 per cent carbon has as its symbol C2n. The suffix "n" shows a maximum allowable content of 0.07 per cent phosphorus and 0.06 per cent sulphur. If the steel is given the symbol C2s, the maximum allowable is 0.04 per cent phosphorus and 0.03 sulphur. If the symbol is written C2 without suffix, neither may exceed 0.02 per cent.

In this manner all steels are classified on the basis of their chemical properties. It does not take into con-

sideration either the manufacturing process (whether open-hearth, electric or crucible) or the use to which the metal is designed to be put—such as rail steel, firebox steel, and so on.

For a chromium-nickel steel with 0.25 to 0.40 C, 2.5 minimum Ni and 0.60 to 0.90 Cr, the symbol is 3-Ni30-Cr8. In the alloy steels the C for carbon is omitted, but the first figure "3" shows a mean carbon content of three-tenths per cent, the Ni30 a mean nickel content of 30-tenths per cent and the Cr8 a mean chromium content of eight-tenths per cent. Following the chemical composition symbols a note is added when the steel is to be annealed or treated, and in the latter case the minimum tensile strength in kilograms per square millimeter is given. Thus the complete designation of the above nickel-chromium steel would be 3-Ni30-Cr8 treated to 80. The standard sheets show the yield point, elongation and notch toughness corresponding to this tensile strength, and these may, if desired, be added to the symbol in ordering.

If the symbol gives no information regarding the condition, it means that it will be received after ordinary slow cooling from the last forging or rolling process. When special attention must be given to other properties, the person specifying must select the correct alloy by reference to the standards. Thus a steel with 80 to 90 kg. per sq.mm. tensile strength (115,000 to 130,000 lb. per sq.in.) can be met by a plain carbon steel. However, if elongation must not be less than 12 per cent, then a nickel steel would be chosen (3-Ni30 treated to 80). If in addition a yield point of at least 85,000 lb. per sq.in. is required, "3-Ni30-Cr8 treated to 80" may be selected.

It appears to Mr. Fry that the Swiss code is open to serious objections unless it is used in close connection with a series of standard specifications. If a symbol standing alone is to be interpreted, misunderstandings may occur. For example: Since the average carbon content is rounded off to the nearest one-tenth per cent, the symbol C4 may indicate a carbon steel with a carbon range from 0.30 to 0.40 per cent (mean 0.35), or with a range from 0.39 to 0.49 per cent, (mean 0.44). Further, in the steels now listed the manganese content varies without any indication of this being given in the symbol.

The system is stated to be capable of indefinite expansion and yet to indicate definitely the steel desired. It appears to Mr. Fry that in practical work much confusion will occur unless the symbols are used in direct connection with the standard sheets.

GERMANY

An industrial standards committee has issued a bulletin covering steels without alloys and untreated. Seven grades are listed, for which tensile strength and elongation in the annealed condition are specified by arbitrary numbers with the prefix St.

Designation	Tensile Strength, Kg. Per Sq. Mm.	Elong. in 100 Mm., Per Cent
St. 0	Not specified	Not specified
St	34-44	25
St. 1	34-42	30
St. 2	42-50	24
St. 3	50-60	22
St. 4	60-70	17
St. 5	70-80	12

The German committee doubts whether it will be practicable to classify all steels in a continuously numbered series. It will possibly be desirable to separate carbon from alloy steels so that a basic number related to the carbon content can be carried through while the alloy steels receive a distinguishing mark.

Another interesting attempt has been made by the Bavarian Motor Works'.[1] It follows somewhat the American Society of Automotive Engineers' system. The first digit of their number corresponds to the degree and kind of alloy; thus, 1 represents carbon steels, 2 a low alloy, 3 represents nickel steels, 4 nickel-chromium, 5 nickel-tungsten, 6 high chromium—greater than 1½ per cent. The second digit represents the carbon content in tenths of 1 per cent. Finally letters are added, designating the quality: *a* for first class construction steels, *b* for standard open-hearth steel, and *c* for ordinary commercial steel of moderate strength. Low-alloy steels of class 2 are all presumably of *a* quality, for these letters are replaced by others representing the alloy content. By this scheme steel 12b represents a plain basic open-hearth steel, S and P up to 0.05 per cent, containing 0.16 to 0.25 per cent carbon. On the other hand, 21m/s is a silico-manganese steel (Mn over 1 per cent, Si over 0.5 per cent), with carbon up to 0.15; 42a will be an electric furnace nickel-chromium steel, Ni about 3.5 per cent, Cr about 1.5, C, 0.25 and Mn 0.4 per cent.

Such a scheme is said to be coming into use by the German Society of Automotive Manufacturers, but evidently a user of the code must always have an explanatory table showing composition limits and physical properties.

FRANCE

A permanent commission for standardization in France has issued a series of specifications for carbon steel bars, blooms, billets and slabs in five classes of steel. No chemical composition is given, but in each specification the steel is divided into grades according to the minimum tensile strength. The numbers of the specifications, the class of material and the grades are shown below:

A-1-UF. Ordinary stock material. Grades by minimum tensile strength of an annealed bar: 35, 40, 48, 55, 70 kilograms per square millimeter.

A_2-2-UF. Material furnished in heat-treated condition. Grades by minimum tensile strength of bar from material as furnished: 35, 40, 48, 55, 70, 80, 90, 100 kilograms per square millimeter.

A_2-3-UF. Material to be heat-treated after delivery. Grades by minimum tensile strength from heat-treated bar: 60, 70, 80, 90, 100, 115 kilograms per square millimeter.

A_2-4-UF. Low-carbon steel for carburizing. One grade only, no tensile.

A_2-5-UF. Low-carbon mild steel. Grades by minimum tensile strength of annealed test specimens: 35, 38 kilograms per square millimeter.

The steels meeting these five specifications are to be marked to indicate the material as follows:

(1) The number of the specification as given above.

(2) A letter indicating the method of manufacture: M—acid open hearth (Martin). C—crucible. E—electric. B—bessemer acid. T—basic open hearth (Thomas).

(3) The number showing the minimum tensile strength specified.

The French Standards Commission, following the advice of the Committee of Arts and Manufacture consulting with it, accepted the principle that symbols in code should not be used. It has therefore arranged its system to designate beyond question a definite grade of steel covered by a complete specification. It appears to Mr. Fry that this principle is sound. A code which is designed to be extensible must lead to ambiguities as it is drawn out to cover new steels.

[1]Described in *Iron Age*, Nov. 9, 1922, p. 1199.

The Nature of Solid Solutions

Solid Solutions Usually Exhibit Space Lattices of Their Dominant Member, Slightly Distorted—In Some Systems the Transition Zones Show Two Co-existing Lattices Where Atoms of Each Constituent Replace the Others in Its Own Space Lattice

BY EDGAR C. BAIN, M.SC.

General Electric Co., Cleveland, Ohio

ENGLISH-SPEAKING scientists have chosen the words "solid solution" to denote the specific state of association of two or more substances entirely homogeneous in the solid. The name has points of merit, even though in some respects the properties of solutions are not apparent. The fact that such solids are capable of a considerable change in constitution and temperature without entailing any phase change urges us to this name. The German "mischkristall" gives us a fine conception of the condition structurally, but unfortunately is translated[1] literally "mixed crystals," which does not give us a picture of the solid solution, but more probably calls to mind a mechanical mixture of two kinds of crystals. If we translate "mischkristall" as "miscible crystal" we get a very clear picture of the condition. Recent investigations of metals with the X-rays[2] have brought out much information about the arrangement of the atoms themselves and the relation of this arrangement to the properties of the aggregate, and naturally the baffling condition of solid solubility has attracted extensive study by this same means. To this end many crystallograms of a great variety of solid solutions have been made in the author's laboratory and the results are here described.

The atomic arrangements of the metals and metalloids have been largely investigated and are shown in Fig. 2, with models of the space lattice types. The reader is requested to refer to this figure as various metals are mentioned.

BINARY SOLID SOLUTIONS

Many pairs of metals are entirely miscible in the liquid state in all proportions, just as are alcohol and water. Some others have such partial miscibility as have phenol and water, the solubility of A in B and of B in A increasing continuously with elevation of temperature. Rarely we find metals which exhibit little or no miscibility in the liquid state.

But there is the more interesting phenomenon of solid miscibility, very frequent in metals but having fewer examples in the non-metals and compounds.[3] With proper annealing two metals which have this mutual property become chemically homogeneous and resemble a pure metal; under the microscope the polyhdral grains are as uniform as a pure metal. But they freeze over a range instead of at a constant temperature; this is a concomitant with the phenomenon of "coring," a complex condition which will be discussed in a second contribution.

It was early discovered[4] that *when a metal A acts as a solvent in taking up metal B in the solid state, the atoms of B replace atoms of A in the A space lattice.* This substitution seems invariably to alter the parameter of the lattice slightly, but never its type until such a quantity is added as will exceed the limit of solid solubility, at which point a new lattice is formed compatible with the increased atomic ratio. This new phase usually involves the formation of a compound, and the metal begins to assume the lattice characteristic of the compound. (We shall consider later the few cases where no new phase appears between pure A and pure B, series known as continuous solid solutions or isomorphous series.)

As examples of limited solubility in the solid state we have investigated tin, zinc, manganese and aluminum as solutes in copper as solvent; cadmium and zinc in silver; tungsten, molybdenum, chromium and manganese dissolved in iron. The following data refer to the completely annealed or homogenized condition.

COPPER-ZINC[5]

When 30 per cent of the atoms of copper (face-centered cubic) are replaced by zinc atoms to form common alpha brass, the lattice is stretched so that

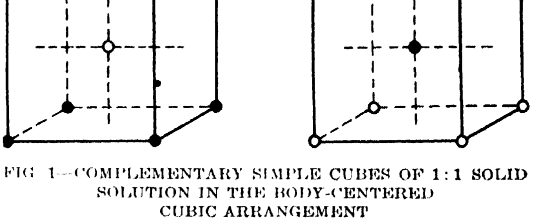


FIG 1—COMPLEMENTARY SIMPLE CUBES OF 1:1 SOLID SOLUTION IN THE BODY-CENTERED CUBIC ARRANGEMENT

Light circles represent one kind of atoms and solid spots the other

the fundamental cube edge a is increased from 3.60 Angstrom units to 3.68 A.u., a linear change of nearly 2.2 per cent or a volume increase of 6.7 per cent in the unit cube. Computing density from atomic spacing and absolute weights of atoms (the hydrogen atom weighs 1.662×10^{-24} grams) we obtain the value of 8.54 as compared to the actually determined value[5] of 8.533.

When zinc is added to copper in excess of about 35 atomic per cent the face-centered lattice is inadequate to absorb it even at room temperature—the electronic distributions or interatomic forces find equilibrium in a body-centered cubic structure. The alloys in the narrow range around equal atomic proportions can be cooled slowly to room temperature, giving what appears under the microscope as homogeneous grains of β brass. The X-ray study shows that the large grains thus produced are truly of a single lattice. The conclusion is then that the structure is as shown in Fig. 1. Either sketch represents the conditions, since the central atoms in one series of cubes build themselves into corners of another series of interpenetrating cubes of exactly the same size. Centers become corners, and *vice versa*, as desired. Further additions of zinc produce a rhombo-

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[1] See "Metallography," Part I, Principles, by S. L. Hoyt, p. 14.

[2] The method of determining atomic arrangement by X-ray diffraction has been described frequently Hull, *Phys. Rev.*, vol. 10, No 6, December, 1917. Bain, *Chem. & Met.*, Oct. 5, 1921

[3] Above 300 or 400 deg. C. NaCl and KCl appear to have complete miscibility in the solid.

[4] *Chem. & Met.*, Oct. 5, 1921, p. 663, "Studies of Crystal Structure With X-Rays," Edgar C. Bain

[5] Private communication from F. G. Smith, American Brass Co., Waterbury, Conn.

*hedral lattice and a structure** *which has no ductility* (γ brass). The structure of the limited η series of very rich zinc alloys is what might be predicted. They consist of the hexagonal zinc lattice in which copper atoms replace a few of the zinc atoms. In interpreting these results in terms of α, β, γ and other brasses represented on the equilibrium diagram, it should be remembered that the ranges for the different crystalline types as established by the X-rays do not correspond accurately with the divisions in the ordinary constitutional diagram drawn from thermal and microscopic investigations.

COPPER-TIN

A 90:10 copper-tin bronze has an atomic ratio of 94.98 Cu to 5.02 Sn. The 5 per cent of tin atoms are over two-thirds as effective in stretching the copper lattice in the alpha bronze as the 30 per cent of zinc atoms in alpha brass. The cube edge of the space lattice for copper is elongated from 3.60 to 3.655 A.u., a linear change of 1.53 per cent, or a volume change of about 4.6 per cent. The absolute or theoretical density calculated from atom weights and spacings is 8.955.

It is a rather interesting fact that in the above solid solutions the lattice is always stretched somewhat less than would be expected from a proportional increase in lattice size computed from atomic volume considerations. This indicates a weak but perfectly definite attraction between unlike atoms. For example, the tin atom is 186 per cent larger than the copper atom, but 5 per cent of tin atoms in copper does not increase the average cube 186 × 0.05 = 9.3 per cent (the proportional increase), but by only 4.6 per cent. Again, the zinc atom is 29.5 per cent larger than the copper atom, but 30 per cent of zinc atoms does not increase the lattice size by 8.87 per cent (the proportional increase), but by only 6.8 per cent. It is also apparent that the tin and copper atoms pack more closely—considering the volume of the tin atom—than do zinc and copper.

COPPER-ALUMINUM

A 91:9 Cu:Al alloy has an atomic ratio of 81.2 Cu to 18.8 Al. Incorporation of that amount of aluminum stretches the lattice 0.91 per cent, equivalent to a volume change of 2.8 per cent. The cube edge becomes 3.633 A.u. as compared to the 3.60 for pure copper. Copper and aluminum show a strong attraction in the alpha solution, for we should expect an increase of 7.52 per cent in volume from the substitution of aluminum in 18.8 per cent of the copper lattice points, since the aluminum atom is about 41.0 per cent larger than the copper atom.

COPPER-MANGANESE

Copper-manganese alloys are often represented as an example of the completely miscible isomorphous series, but X-ray examination has shown that some ranges of composition reveal the simultaneous presence of both the lattice type of copper and the lattice type of manganese in a thoroughly annealed specimen. So there is apparently a limit for solubility of manganese in the copper lattice. A normal copper lattice is extended very slightly by the substitution of manganese atoms. When one out of three copper atoms has been replaced by manganese the original cube edge of 3.60 has become 3.615 A.u. Further additions of manganese seem to be rather more effective in stretching the lattice,

*"X-Ray Analysis of Three Series of Alloys." Mary R. Andrews, *Phys. Rev.* (1921), vol. 18, p. 245.

FACE-CENTERED CUBIC

	a		a
Al	4.05	Pd	3.950
Ca	5.56	Ag	4.060
Fe(γ)	3.60	Ce	5.12
Co	3.554	Ir	3.805
Ni	3.540	Pt	3.930
Cu	3.60	Au	4.08
Rh	3.820	Pb	4.92
		Th	5.04

BODY-CENTERED CUBIC

	a		a
Li	3.50	Fe (α)	2.86
Na	4.30	Mo	3.143
V	3.04	Ta	3.272
Cr	2.895	W	3.150

FACE-CENTERED TETRAGONAL

	a	c
Indium	4.58	1.06

BODY-CENTERED TETRAGONAL

Tin (while the atoms of tin are not arranged exactly as indicated, the lattice appears to consist of two interpenetrating simple tetragonal lattices).
a = 4.00 c = 0.91

HEXAGONAL CLOSE-PACKED

	a	c
Mg	3.22	1.6[illegible]
Ti	2.97	1.59
Co	2.514	1.633
Zn	2.67	1.86
Zr	3.23	1.59
Ru	2.686	1.59
Cd	2.960	1.89
Ce	3.65	1.62
Os	2.714	1.59

RHOMBOHEDRAL

	a	c
Antimony	4.280	2.647
Bismuth	4.54	

The author found the lattice as shown, but very exact work by James and Tunstall, *Phil. Mag.*, vol. 40, p. 233, reveals the fact that half the atoms are very slightly displaced from the position indicated.

HEXAGONAL

Graphite a = 2.47 c = 2.7[illegible]
Alternate planes have large and small spacings with ratio 6 : 1

TETRAHEDRAL CUBIC

Tetrahedral cubic has isometric symmetry, but for comparison it may also be shown on a hexagonal lattice in which the vertical axis is the trigonal axis of the cube. Actually the arrangement consists of two interpenetrating face-centered lattices somewhat removed from the position resulting in the simple cubic arrangement. The horizontal planes have large and small spacings of 3 : 1.

	a	c
Diamond	2.52	2.449
Silicon	3.84	2.449
Tin (gray)	4.57	2.449

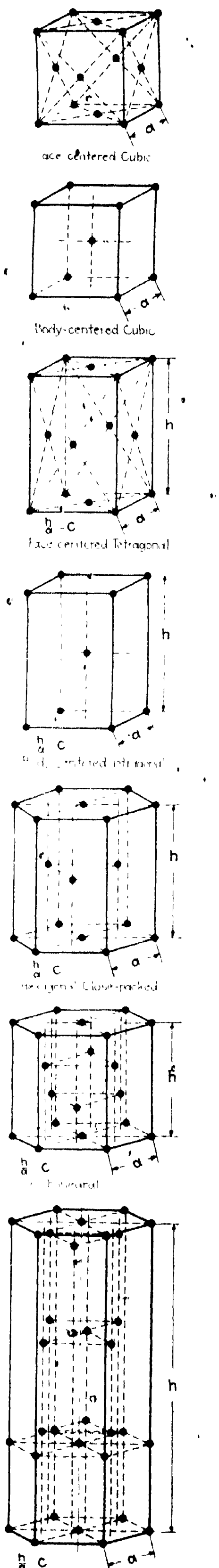


FIG. 2—CRYSTAL STRUCTURE OF SOME METALS AND THEIR ATOMIC SPACINGS

although the change is so small it is difficult to be sure of this fact.

Manganese lattice has not yet been completely deciphered. It has an atomic volume of 7.4, while copper is 7.1. Manganese much more nearly distends the copper space lattice in proportion to its atomic volume than most other atoms; the absolute amount, however, is small, since their atomic volumes are so similar.

SILVER-CADMIUM

If we saturate solid silver with cadmium, we increase the cube edge about 1.1 per cent (a volume change of about 3.5 per cent). This is notably less than the proportional increase due to disparity in atomic volume, as cadmium has an atomic volume 27.4 per cent greater than silver.

SILVER-ZINC

Silver saturated with zinc in the solid decreases the cube edge from 4.06 to 4.005 A.u., a shrinkage of 1.36 per cent, or a volume change of 4.0 per cent. Zinc has an atomic volume only 9.8 per cent less than silver, and this is greater shrinkage than would be expected from the difference in atomic volume. This behavior of the two silver alloys strengthen the idea that there is a mutual attraction between unlike atoms, causing them to pack closer than their separate atomic volumes would warrant.

IRON-CHROMIUM

In iron and chromium we have two metals chemically similar and with atomic arrangement identical in type and differing very little in atomic spacing. We should expect great mutual solubility. As a matter of fact, the alloys resulting from fairly rapid cooling from the melt seem to be all true solid solutions regardless of composition, but there is some reason to believe very prolonged heating at about 1,100 deg. C. develops a new constituent. It is therefore doubtful if the system comprises a continuous series of solid solutions. There is no measurable change in the lattice. The spacings of iron and chromium (2.86 and 2.895 A.u.) are so nearly alike that great accuracy would be required to detect any stretching or shrinking. Very little would be expected.

TUNGSTEN-IRON AND MOLYBDENUM-IRON

These two series, composed of body-centered cubic metals, might be expected to form continuous isomorphous alloys, but both tungsten and molybdenum form the 1:1 compounds WFe and MoFe of a hexagonal type not fully elucidated. Solid iron dissolves a few atomic per cent of both W and Mo, but, strange to say, the space lattice is not measurably altered. The atomic volume of tungsten and of molybdenum is about 10, as compared to 7.1 for iron. The explanation may be that there is an inordinate attraction between these atoms, chemical in nature, which results in the preservation of the smaller iron spacing even in a solid solution. From X-ray examination it appears that very little if any iron can be dissolved in tungsten or molybdenum without the formation of the compound.

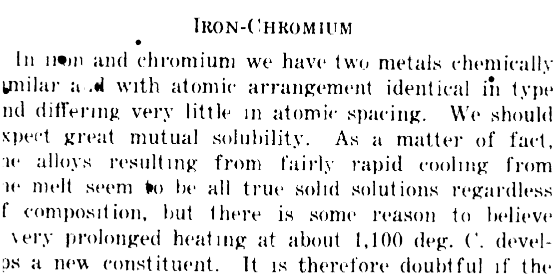


FIG. 3—PROBABLE STRUCTURAL RANGES FOR ANNEALED ALLOYS OF IRON AND MANGANESE

IRON-MANGANESE

Both Gulliver[7] and Desch,[8] quoting Tammann, present the iron-manganese series as an example of complete miscibility in the solid. X-ray diffraction patterns of the series show that three crystal entities in all are present in the system. Fig. 3 shows diagrammatically the regions of each lattice and their overlapping ranges. The alloys examined were cooled very slowly and the data are representative of conditions approaching equilibrium at room temperature. Body-centered ferrite lattice is preserved until about 30 per cent of its points have manganese atoms substituted for the iron. Further additions of manganese develop the face-centered cubic lattice of gamma iron (austenite) and the alloys appear to be wholly of this structure up to about 60 per cent manganese; beyond this point we have the manganese structure appearing, doubtless with iron atoms occupying lattice points in the manganese space-lattice. The purest manganese obtainable has a very complex structure and it has not yet been worked out. It is the author's opinion that if very pure manganese is prepared it may have the body-centered cubic lattice of iron, because X-ray spectrograms made from some manganese-rich alloys produced very definite lines of a body-centered cubic pattern. It may be that the presence of some iron causes the manganese to overcome the action of some slight impurity such as silicon or aluminum, or some other element which induces the complex structure usually found.

Solid Miscibility in All Proportions

It is self-evident that only those elements having the same crystalline type could form a continuous series of solid solutions. If metal A and metal B are of different lattice types and possess great mutual solubility, we must still find solid solutions of both A in B and of B in A. It seems likely that in some ranges of composition these two solutions may exist simultaneously and even have the same composition, the relative amounts of each varying with temperature.

This is certainly the case in the nickel-iron series. Thoroughly annealed specimens are body-centered near the iron end of the series and face-centered in the nickel-rich alloys. Over a great range of intermediate compositions both atomic arrangements are present, the relative amounts depending upon the heat-treatment. Of course, the circumstances are complicated by the allotropy of iron. Early in 1921 the author showed for the first time the allotropic change in iron from body-centered to face-centered atomic arrangement with rise in temperature above 900 deg. C. Following this discovery it was easy to see how the presence of a number of atoms of nickel (whose normal arrangement is that of face-centered gamma iron) can inhibit the transformation to alpha iron, which is body-centered. Why

[7]"Metallic Alloys," G. H. Gulliver, 4th edition, 1921, p. 332.
[8]"Metallography," C. H. Desch, 2nd edition, 1913, p. 401.

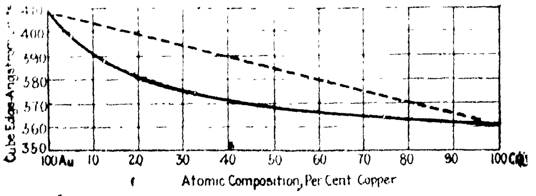


FIG. 4—SIZE OF FUNDAMENTAL CUBE IN THE COPPER-GOLD SOLID SOLUTION SERIES

manganese acts in the same way is not so obvious. The effect of heat-treatment on the relative proportions of the two kinds of solid solutions present in a continuous series is not so marked in the copper-manganese alloys, for instance, as is observed in manganese-iron and nickel-chromium alloys.

It appears that the main reason for classifying these series as continuous solid solutions is the fact that thermal analysis indicates a smooth continuous solidus or liquidus line. If the solubility of A in B cannot quite reach the composition of saturated B in A, the evidence for a region of incomplete miscibility is clear enough, but in some alloy systems they appear to overlap. This leads to an erroneous classification. In the latter group may be put cobalt iron, iron-manganese, indium-lead, cobalt-chromium, chromium-nickel, copper-manganese, manganese-nickel and iron-nickel. It is likely that a suitable etching reagent on well-annealed specimens would reveal two distinct phases under the microscope. Meteoric iron shows two iron-nickel constituents.

But there are quite a large number of truly continuous solid solution series, exemplified by copper-gold, copper-nickel and gold-silver. Several have been studied with X-ray diffraction and are described here. Not all pairs of elements of the same atomic structure form such series of alloys, for many build intermetallic compounds.

Copper-Nickel

The lattice change in these alloys is small but continuous. The contraction due to unlike atoms is so very small as to be immeasurable by the apparatus at present in use. The alloy has already been described from the atomic arrangement standpoint.

Copper-Gold

The series remains perfectly face-centered cubic in structure throughout. The lattice size or spacing changes gradually from copper to pure gold, the cube edge ranging between 3.60 to 4.08 A.u. But this stretching of the copper lattice by substitution of gold atoms is not proportional to the number of gold atoms present. Fig. 4 shows that the alloy is more dense (closer spaced) than the lineal function would demand. It again appears that the unlike atoms attract one another more closely than like ones. Fig. 5 represents the crystalline arrangement of two of the intermediate alloys in comparison with the pure components.

Gold-Silver

Gold and silver have very nearly the same atomic spacing. The whole series has the same spatial arrangement, varying from 4.06 to 4.08 A.u. on the cube edge. There is no measurable departure from the lineal relation between atomic proportion and lattice size.

Molybdenum-Tungsten

This series presents the same aspects as the gold-silver series except that it is of the body-centered cubic type. The cube edge varies continuouslly with composition from 3.143 to 3.150 A.u. Here again we find no measurable attraction of unlike atoms to cause any unexpected lattice size. The inference is that this effect is dependent upon the disparity in atomic volume. That is to say, when large and small atoms are packed in a common lattice, they are drawn more closely than their respective sizes and proportions would indicate, while unlike atoms of about the same size do not show attraction and compression to any extent.

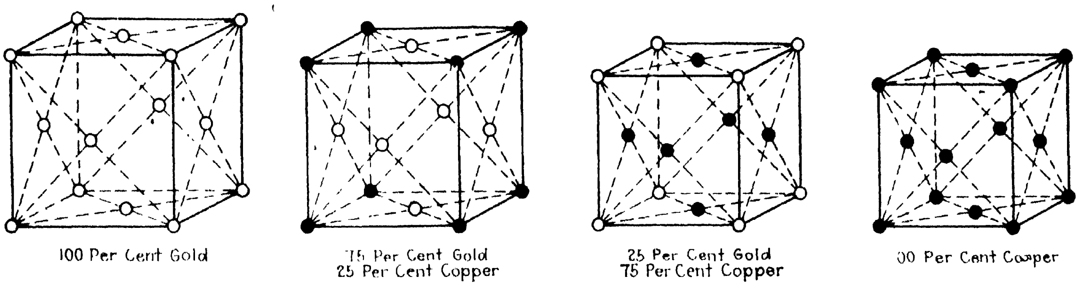


FIG. 5—ARRANGEMENT OF THE GOLD (LIGHT CIRCLES) ATOMS IN SPACE FOR CERTAIN GOLD-COPPER ALLOYS

German Chemical Exports to America

Preliminary returns of Germany's foreign trade in chemicals during the first 9 months of 1922 are given in *Commerce Reports* for Dec. 25, 1922.

The United States purchases of these chemicals for the 9 months included (all quantities in kilos): Alkali metals, etc., 75,800 kilos; white and red phosphorus, 191,300; lactic acid and lactates, 165,600; tartaric acid, 716,100; citric acid, 42,500; crude potash salts, 97,755,000; fertilizer salts, 119,456,900; barium chloride, 285,300; bromides and bromoform, 516,800; ammonium carbonate, 262,600; caustic potash, 4,029,100; pot ashes, 2,087,700; chloride of lime, etc., 3,221,400; potassium chlorate, 1,570,600; sodium sulphate and bisulphate, 5,767,100; potassium sulphate, 45,436,700; copper sulphate, 161,200; alums, 1,576,300; ammonium nitrate, 4,817,700; barium nitrate, 107,800; potassium manganate and permanganate, 228,800; ferricyanides, 114,900; cyanides, 64,300; tartar and tartrates, 443,000; carbonate of strontium, etc., 1,800; zinc salts, 1,029,200; arsenous and arsenic acid, 402,900; magnesium sulphate, 8,303,900; chlorides (calcium, magnesia), 4,448,000; muriate of potash, 102,975,600; ammonium chloride, 1,784,700; potassium and sodium sulphates, 1,062,100; and barium, lead, and nickel compounds, 9,149,800 kilos. The American share of other chemicals exported is not shown in the preliminary official statistics.

Legal Notes

By Wellington Gustin

Public Interest in Every Adjudication Regarding Validity of Patents Emphasized

In a suit brought by the Griscom-Russell Co. against the Standard Water Systems Co. and others, a decree of the United States District Court for the complainant has been reversed by the Circuit Court of Appeals, and claim 8 of patent 1,131,738 for an evaporator was held void for lack of invention, in view of the prior art. (278 Fed., 703.)

The Griscom-Russell Co. charged defendants with infringement of its patent, issued to Reuben R. Row, one of the defendants. The bill charges that the inventor and two other defendants employed by the Griscom-Russell Co. left such employment and associated themselves with the Standard company, with the purpose and intent to injure the Griscom company, by appropriating to themselves and the Standard company valuable data, engineering designs, drawings, etc., which were the property of the Griscom company and that they all conspired together to infringe the letters patent.

The District Court decreed the Griscom company to be the lawful owner of the patent and that the defendants had jointly infringed the patent and that the plaintiff recover profits, gains and advantages; and that an account be stated. An injunction was issued against the defendant company only.

On appeal the Circuit Court of Appeals found no direct testimony of any federation between the individual defendants for the purpose of injuring the plaintiff.

Inventor May Show Limitations by Prior Art

What seemed to weigh most heavily against the defendants, says the court, in this case is the fact that one of them asserted invention to procure a patent which he assigned to the plaintiff, and that, while all of the individual defendants were subsequently associated with their co-defendant, the said co-defendant manufactured and sold devices with the patented improvements embodied therein.

One who asserts and claims an invention and receives a patent therefor is estopped from denying invention, but the court says he is not estopped from showing to what extent his alleged invention is limited by the prior art.

The public is interested in every adjudication with respect to the validity of a patent, and it is the duty of courts having jurisdiction of patent causes to have regard, at all times, of the rights of the public, so that such rights may be rather enlarged than diminished by judicial determination. The public interest in every patent is set out in the case of Hill vs. Wooster, 132 U. S., 693. That opinion emphasizes the doctrine that it is not enough that the thing shall be new, that in the shape or form in which it is produced it shall not have been known before, and that it shall be useful; but it must, under the Constitution and the statutes, amount to invention or discovery. (Hansen vs. Slick, 145 C.C.A., 37.)

Returning to the case at bar, the court says the process of vaporizing water or other liquid to obtain a purer liquid is old. And the apparatus for accomplishing the result desired is old. The claim of the patent is as follows:

"The improvement in evaporating apparatus for obtaining purified liquid, which comprises a containing shell, a door closing an aperture in said shell, a heating pipe structure secured to said door and projecting within said shell, a supporting roller for said structure outside said shell, substantially as described."

The court was of the opinion that there was no invention in the addition of rollers to the evaporator. It says: "The addition of rollers to a desk, in order that it may be moved, so that the carpet could be cleaned under it, was an improvement by the man who added the rollers; but that invention did not add to the dignity of invention or discovery, within the meaning of the Constitution and the laws passed in pursuance thereof, intended to give an inventor an exclusive right for a time, as against the public."

Regardless of the rule that a patentee or an assignee of a patent cannot deny invention, it is the duty of the court to determine lack of invention, where apparent, in order that the public interests may be guarded. Therefore the decree of the lower court was reversed.

Interstate Shipment Is Protected From State Law Until Sale of Original Packages

An interesting point is involved in injunctive proceedings begun in the United States District Court by the Cleveland Refining Co. against W. H. Phipps, director, attacking the constitutionality of an Ohio statute providing for inspection of petroleum products and fixing fees to be charged therefor. The court says that a state has power to enact proper inspection laws and provide for the collection of the necessary expense of inspection and is not required to fix with exactness the fees which will cover such expense, but as applied to articles of interstate commerce the fees must reasonably approximate such cost and not be so excessive as to render the law a revenue measure.

Plaintiff is engaged in the sale and distribution of kerosene, petroleum and their products. It buys in other states, ships into Ohio large quantities of such articles in storage tanks, barrels, cans and packages, and has contracts for such articles which it is bound to consummate.

Plaintiff contended that the inspection fees were excessive, that they interfere with interstate commerce and are an unlawful import duty upon goods shipped into Ohio from other states and as such the law violates the sections 8 and 10 of Article I of the U. S. Constitution. And so the District Court held. The court found the fees charged for inspection were yearly increased until they doubled the cost, and that there was no distinction made between oil produced in the state and that brought in from other states.

The court says that where goods are transported into one state from another in original packages, interstate commerce therein is not completely terminated, and they are protected by the commerce clause of the Constitution against excessive inspection, until after their sale at the point of destination within the state.

Now the fees prescribed by the statute were beyond the cost of legitimate inspection to determine the quality of the articles inspected, and the act is therefore not only a police measure but a revenue measure also. Such cost by necessary operation unduly burdens and obstructs the freedom of interstate commerce and as such commerce cannot be separated from the interstate shipments, the whole tax is void.

Vapor-Recompression Systems for Evaporators—I

An Unprejudiced Survey of the Advantages and Shortcomings of Regenerative Evaporation — A Technical History of Its Development and an Analysis of Recorded Data on Test Runs*

By W. L. Badger
Professor of Chemical Engineering, University of Michigan

IMAGINE a simple evaporating device, with liquid boiling in it at atmospheric pressure. Also assume that it is heated by steam at 10 lb. gage (240 deg. F.), that no heat is lost in heating feed, in radiation or in any thick liquor drawn off, and that the condensate leaves at the temperature of the boiling liquid. To evaporate 1 lb. of water will take 970.4 B.t.u., and 1 lb. of steam will give up 980.4 B.t.u. A very slight change in our fundamental assumptions will make the two exactly equal. Then, what is happening really comes down to converting 1 lb. of steam at 240 deg. and 10 lb. gage to 1 lb. of steam at 212 deg. and atmospheric pressure.

Now if the hot condensed water is returned to the boiler without loss, we will have to add 980.4 B.t.u. to regenerate a pound of heating steam. But the pound of atmospheric vapor formed contains 970.4 B.t.u. more than the condensate. Why not, then, merely add 10 B.t.u. by compressing the steam instead of 980 to raise more steam? By this line of reasoning many times as much evaporation could be obtained per pound of coal burned than by raising steam direct, even after allowing for all kinds of losses.

Much has been written on this subject, but the articles have usually had a partisan bias. It is the purpose of this paper to give as nearly as possible an unprejudiced survey, and show the faults as well as the advantages of the system.

Historical and Descriptive

The first record of vapor recompression is a patent[1] by Pelletan in 1840 (36).† His apparatus is shown in Fig. 1. A pan m has a cover T supported by counterweights. Heating is done by two coils g. High-pressure steam is admitted by E and F to the injector nozzles B. These draw vapors from the pan through pipes a and compress them in the coils. This apparatus was unsuccessful, partly due to faulty nozzle design and partly to the very low boiler pressures then carried.

The Piccard-Weibel System

In 1874 Koerting (25) suggested the use of steam-jet nozzles for drawing non-condensed vapors from the steam spaces of evaporators, and mentioned that these vapors together with the steam which operated the nozzle would be compressed enough to be returned to the steam space (28). Nothing was done, however, till the advent of the Piccard-Weibel system in 1879 (30). It received considerable notice through the '80s (6, 11, 15, 26, 27, 40, 43, 44). Fig. 2 shows the system applied to a single effect evaporator. The reciprocating compressor C takes vapor from the dome A and compresses it to be used in the steam space. This figure shows how early it was realized that in such installations all possible heat must be saved, for the heat interchanger S is provided to heat the feed by the heat of the condensate. If the compressor C were to be steam driven, the exhaust was best utilized in a triple-effect as shown in Fig. 3.

This system was employed in several salt plants in France and Austria, and in a few sugar mills. It was installed in the mill at Pohrlitz in 1882. Weibel (43) reports that the mill of 225 tons per 24 hours sent about one-third of the juice to the thermocompressor evaporator. This was a triple of 150, 50 and 80 sq.m. respectively (vertical tubes). The compressor was 31.5x19.5 in. (fifty strokes per minute), took steam at 59 lb. gage and exhausted at 6 lb. gage. It took vapor at atmospheric pressure from the first effect and compressed it to 6 lb. One lb. of boiler steam theoretically should have compressed 2.5 lb. vapor and furnished 1 lb. of exhaust, which would have evaporated 3 lb. in the triple effect, making a total of 5.5 lb. evaporated per pound steam. A very complete test was later made on this system (31, 42) which showed actually 4.4 lb. of water evaporated per pound of steam. While the Piccard-Weibel system was retained for a considerable time in salt works which had ample water power, it never gained a foothold in the sugar industry because of the excessive size and, at that time, rather poor design (11) of the reciprocating compressors needed.

The Nozzle Compressor

In the later developments, two lines of work have been followed—the nozzle compressor and the turbo-blower. Along the line of nozzle developments the principal place is held by Prache and Bouillon, who in 1905 developed a steam jet nozzle (102), such as is shown in Fig. 4, and which was claimed to be far superior to any other. The nozzle alone cannot make a practical device, and an explanation which anticipates the theory must therefore be introduced.

In order to obtain a satisfactory capacity of the nozzle, the pressure range through which the vapor is compressed must be small. Neglecting minor factors, this pressure range is made up of two parts: (a) The

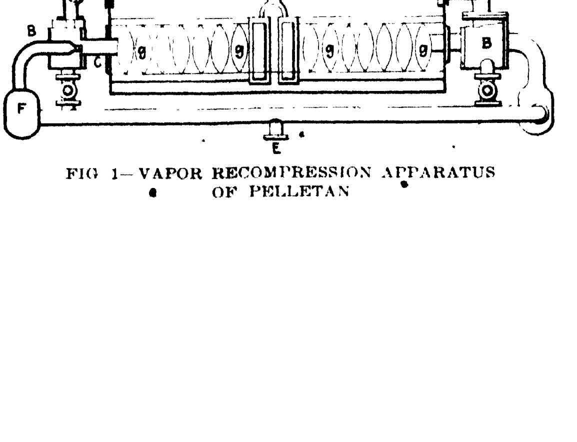


FIG 1—VAPOR RECOMPRESSION APPARATUS OF PELLETAN

*Read before the American Institute of Chemical Engineers at Baltimore, Dec. 9, 1921.

[1]In (12) this date is given as 1834

†Numbers in parentheses refer to bibliography to be published at end of Part II. Numbers below 100 are articles and above 100 are patents.

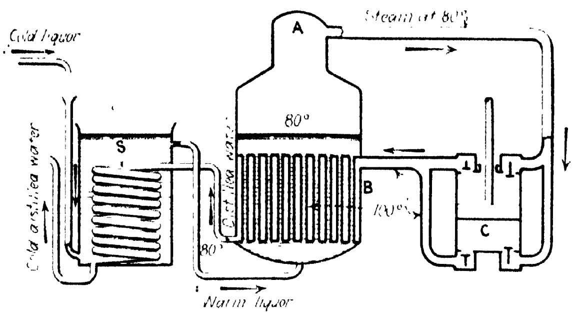


FIG. 2—PICCARD-WEIBEL SYSTEM

elevation in boiling point of the solution, (b) the working temperature drop. The first part cannot be changed, but its effect may be minimized by confining the concentrated liquid to one part of the apparatus; for when an ordinary evaporator works continuously, the whole body is full of liquid at the final concentration. The second factor is, of course, within the control of the designer; but the smaller it becomes the larger must the apparatus be for a given performance. If an evaporator could be designed with an unusually high coefficient of heat transmission, an evaporator for a given duty could operate on a smaller temperature drop than usual without increase in size. Hence the features to be noticed in the recent developments are (1) isolation of the more concentrated parts of the solution, and (2) attempts to increase the heat transmission coefficient.

Prache and Bouillon (or as later organized, La Société d'exploitation de procédés evaporatoires système Prache et Bouillon) first developed the evaporator shown in Fig. 5 (4, 5, 36, 101, 114, 123, 133). Here the liquor space of an ordinary vertical tube evaporator is divided by partitions, P, which extend some distance above the upper tube sheet and also completely divide the liquor space below the tube sheet. Each compartment has its own downtake n, and in the center of each downtake is a pipe O leading to the next compartment. Thus a part of the liquid is continually being passed from compartment to compartment, being finally withdrawn from 7. In this way the solution of highest boiling point is localized in the last compartment and only a part of the heating surface is handicapped by this loss in temperature drop.

The steam space is not divided. Therefore, if the vapors are compressed enough to give the desired working temperature drop for the dilute liquor, the compartments containing concentrated liquor will have a smaller temperature drop. But it is just these compartments which need a larger working drop than the others, because of the effect of their increased viscosity and density on heat transfer. If, on the other hand, the vapor is compressed sufficiently to give a satisfactory working temperature drop for the last compartment, it will result in a range of compression too great to be economical for the others.

A Horizontal Tube Evaporator

Prache and Bouillon later devised another evaporator which was to minimize the effect of boiling point and also increase the heat transfer coefficient. Fig. 6 (4, 38, 134) shows this evaporator, consisting of several compartments side by side, each containing inclined tubes with liquor inside, and arranged in series as to liquor feed. All the compartments discharge into a common header, which is, however, provided with partitions to keep the liquor from each compartment separate from the others. A wide tube E for recirculation is provided at the bottom, and means (not shown) are also provided for transferring the liquid from compartment to compartment. Cold feed from A first passes through the preheater B, then by pipe C to the evaporator, circulating through each compartment and finally leaving at F. Vapors from all the compartments collect in I, are compressed by boiler steam in the nozzle H, and go from compartment to compartment in pipes K. Here evidently the amount of compression for all the vapors is sufficient to overcome the elevation in boiling point in the last compartment.

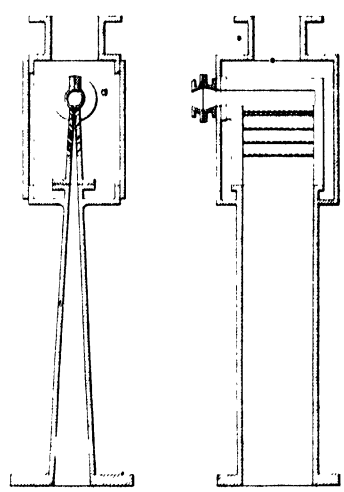


FIG. 4—PRACHE AND BOUILLON NOZZLE

Since the compression is done by a steam jet, there is a continual supply of steam to the apparatus above that which can be condensed by evaporation. Hence

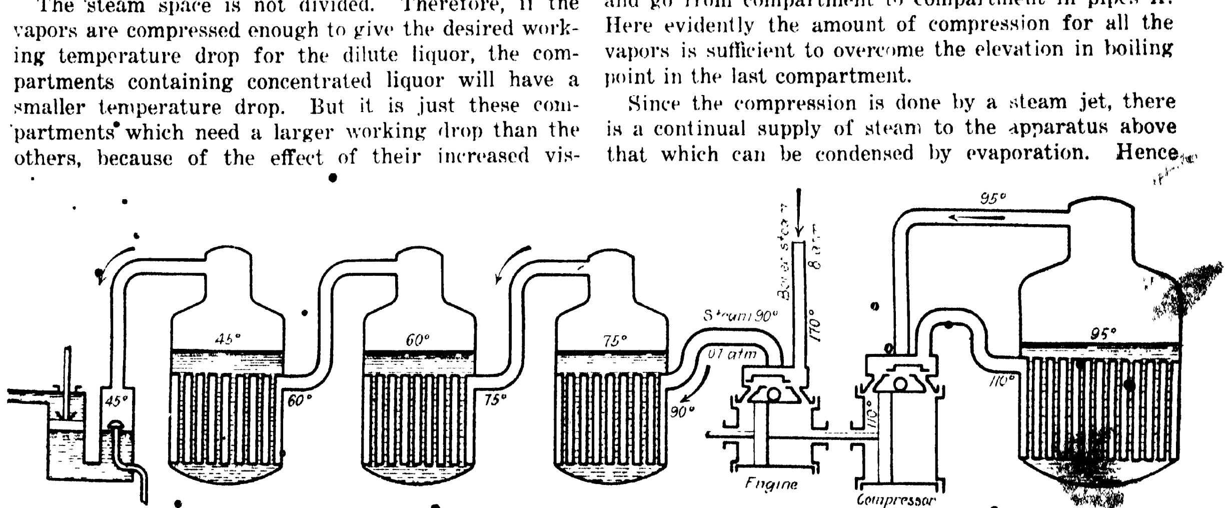


FIG. 3—PICCARD-WEIBEL SYSTEM USING COMPRESSOR EXHAUST

there is a pipe from the steam chamber *I* to the preheater *B*, and from there to an exhaust or to a condenser. The apparatus works in single effect; the compartments differ only in the concentration of the liquid in them, and there will be little drop in pressure along the pipes *K* leading steam from compartment to compartment. The statement is made (4) that the heat transmission coefficients obtained in this evaporator are about double those of an ordinary evaporator. The same writer states that at that time (1916) about seventy-five Prache and Bouillon plants were in operation.

A similar evaporator patented by these workers has the compartments superimposed in one common shell. Fig. 7 (104, 117, 139, 144).

Recently a nozzle as applied to evaporators has been developed by de Baufre at Annapolis (13, 39, 107, 109, 110, 111, 145), and is shown in Fig. 8. In ordinary operation, high pressure steam is expanded through the orifice *B* and nozzle tube *C*. Vapor from the evaporator is drawn in through the inlet, and the mixture of

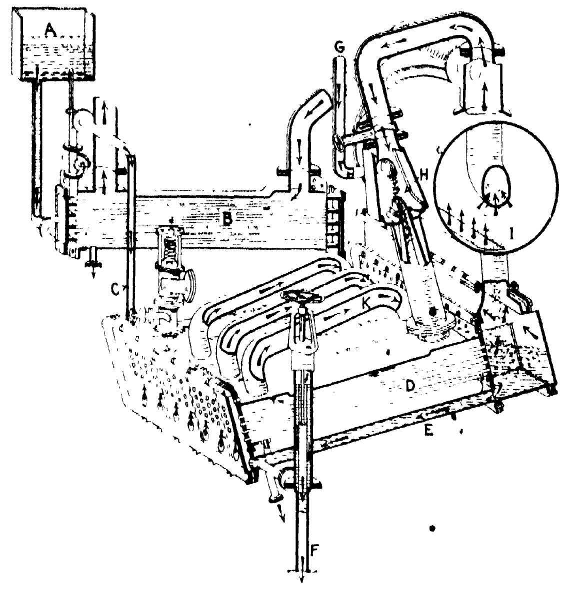


FIG. 6—PRACHE AND BOUILLON HORIZONTAL TUBE EVAPORATOR

compressed vapor and expanded high-pressure steam is discharged through *K* to the evaporator coils.

Nozzle Performance and Design

The performance of nozzles has been studied and some results reported. Eslancher (17) has reported data on the Prache and Bouillon nozzle which have been copied several times (55, 38). From these data Fig. 9 has been drawn. This shows the ratio of (pounds vapor) to (pounds high-pressure steam) for different steam pressures, vapor temperatures and temperature drops. By temperature drop is here meant the difference between the temperature of the steam in the heating space and the temperature of the boiling liquid. It will be noticed that the capacity of a nozzle falls off rapidly as the working temperature drop increases and as the pressure range through which the high-pressure steam is expanded decreases. It is obvious why the working temperature drop for such systems must be held below 10 deg. C.

De Baufre's nozzle has also been tested (13, 39). The data are represented in Fig. 10. The curve for nozzle tip No. 2 is reproduced as Curve 2 in Fig. 11. Curve 1, Fig. 11, is obtained from Fig. 9 for 175 lb. steam (the conditions under which de Baufre's nozzle

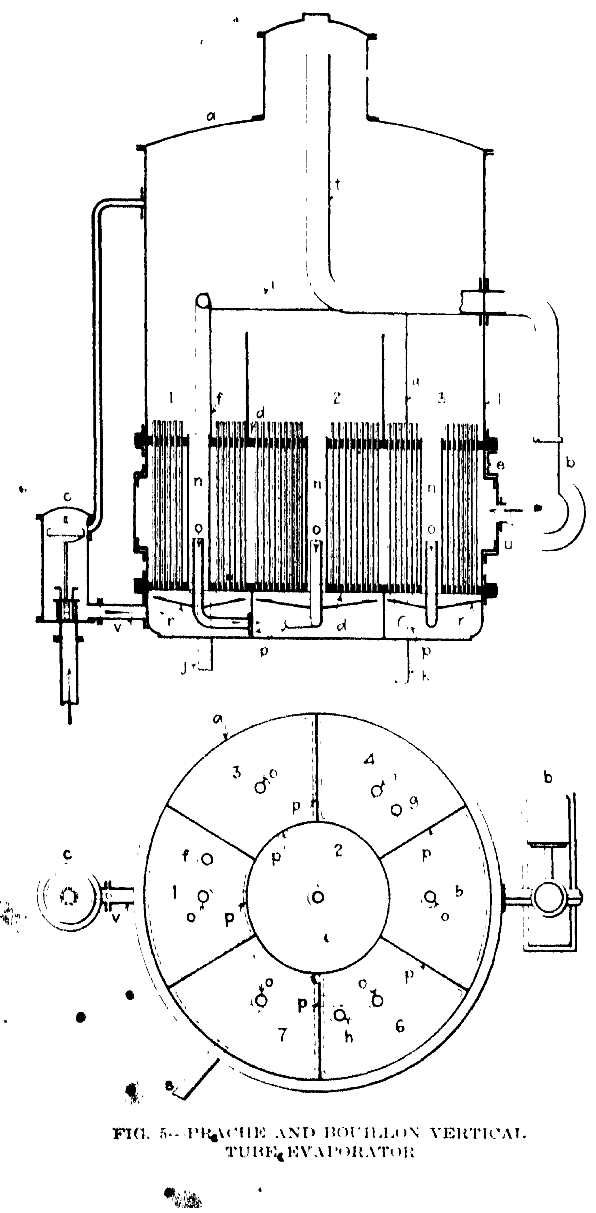


FIG. 5—PRACHE AND BOUILLON VERTICAL TUBE EVAPORATOR

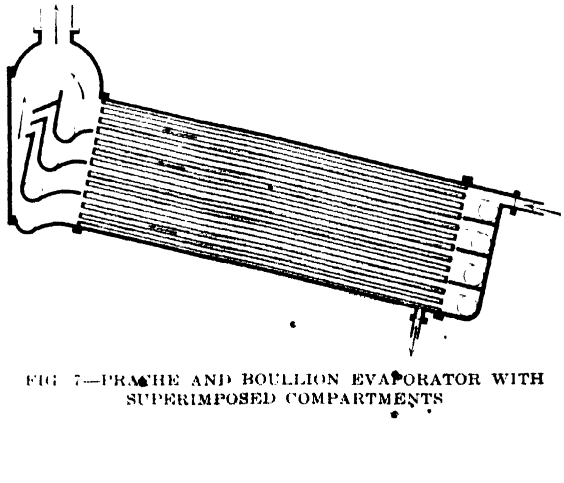


FIG. 7—PRACHE AND BOULLION EVAPORATOR WITH SUPERIMPOSED COMPARTMENTS

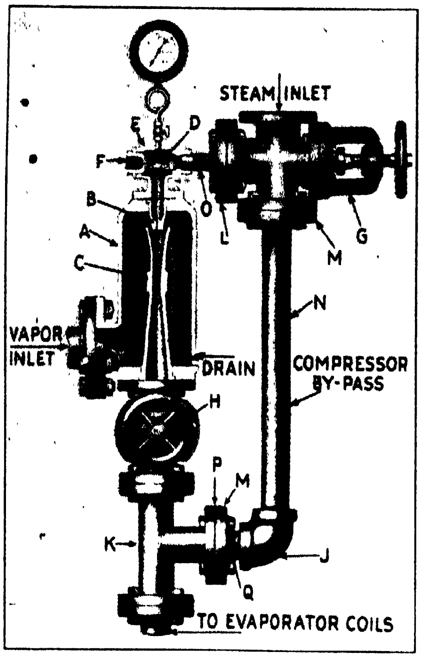


FIG. 8—THE DE BAUFRE NOZZLE

is tested). There have been a number of patents involving the use of nozzles about which there is little or no information available (112, 120, 121, 125, 131, 138, 147, 139).

TURBO-BLOWER DEVELOPMENTS

The other direction in which developments have been made is in the use of a turbo-blower. This has been universally used instead of a reciprocating compressor, in spite of its lower mechanical efficiency, because it can be built in large capacities without excessive size, and because it gives a compressed steam free from oil. The combination of a turbo-blower and an evaporator

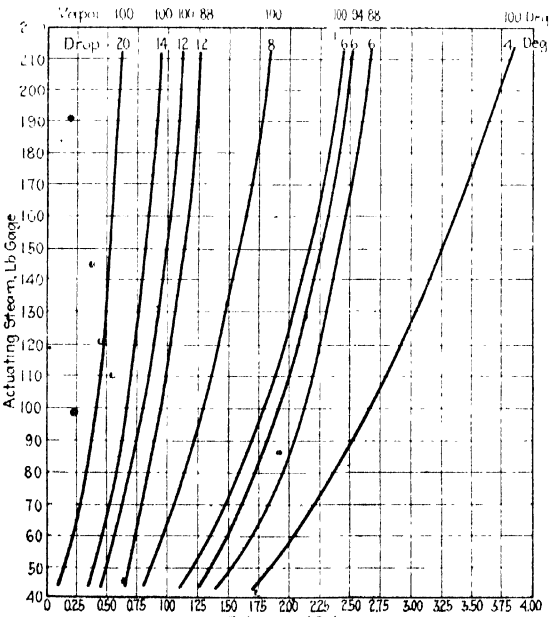


FIG. 9—PERFORMANCE OF PRACHE AND BOUILLON NOZZLE

has been given various proprietary names, such as "auto evaporator," "heat pump," etc. They are rather popular at present especially in Germany. (See 12, 16, 21, 38, 45.)

A well-known series of patents are those taken out by Soderlund and Boberg and assigned to the Techno-Chemical Laboratories, Ltd. (London) (2, 37, 105, 106, 108, 127, 128, 137, 141, 142). They have attempted both to isolate the effect of elevation of boiling point and to get a higher coefficient. This latter has been accomplished in their patents by imitating film evaporators of one type or another. For instance, in the evaporator shown in Fig. 12 (37 and 108), a high coefficient is supposed to result from liquor trickling down the sides of the tubes, distribution being through the device i (shown in the insert) hung in the tops of the tubes. Feed enters the heat interchanger (being preheated by condensate entering at d), and goes to chamber 2, is circulated by pump 4 to chamber h. Vapors are withdrawn from k, compressed by the blower 5, and returned to m. In Fig. 13 (106, 128, 137) high coefficients are obtained by showering the

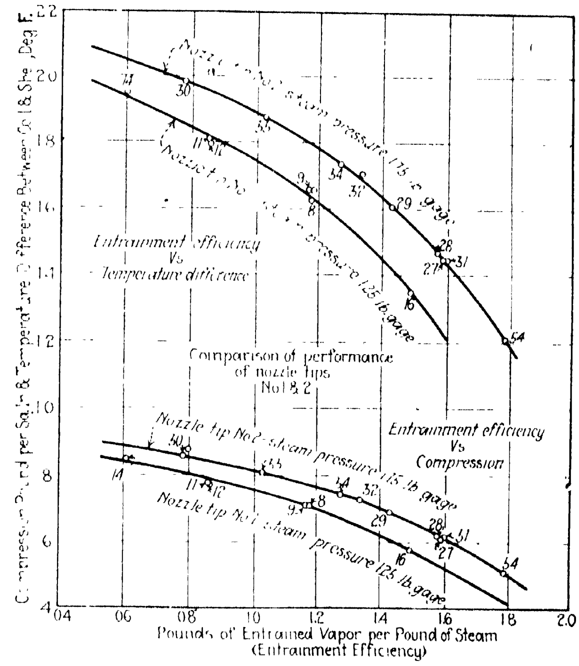


FIG. 10—PERFORMANCE OF DE BAUFRE NOZZLE

liquid over horizontal tubes somewhat as in the Lillie evaporator; and at the same time an isolation of the effect of elevation of boiling point is obtained by running a series of bodies, vapor being stepped up by intermediate compressors to give the proper working temperature drop in each effect. Liquid is fed at 6, preheated by condensate in 7, and fed through float valve 21 into the liquor compartment. It is circulated over the tubes by pump 22, and a part is withdrawn from the first body by pipe 31 to the suction of pump 32 on the second body. The same system is repeated as often as desired. Partitions like 35 on the first body prevent too great mixing of the concentrated liquor falling from the tubes with the thinner feed. A turbo-blower 25 takes vapors from the body and compresses them sufficiently to give a working temperature drop, and also to overcome the elevation in boiling point of the liquid being boiled. The patent claims expressly

call for a working temperature drop of not over 3 deg. C. (5.4 deg. F.). Hence some type of film evaporator must be used, otherwise hydrostatic head would use up all the available drop. Part of the vapors go to the tubes of the first body, part to compressor 29, where they are given additional compression to correspond to the increased elevation of boiling point in the second body, and so on. The patent covers the same principle applied to vertical evaporators like Fig. 11, and also cases where compression is accomplished by nozzles.

There are a number of other patents covering similar devices (113, 115, 122, 124, 132, 143, 146). In general, however, a patented or special apparatus is not necessary. A nozzle or turbo-blower may be adapted to any ordinary commercial evaporator (providing the proper precautions are taken to insure the necessary conditions for satisfactory operation). Such an installation is shown in Fig. 14. The only installations on which actual working data have ever been published are those in which there is no special feature in the construction of the evaporator itself. No information has been published to indicate that the various special and patented designs are successful or practical or necessary.

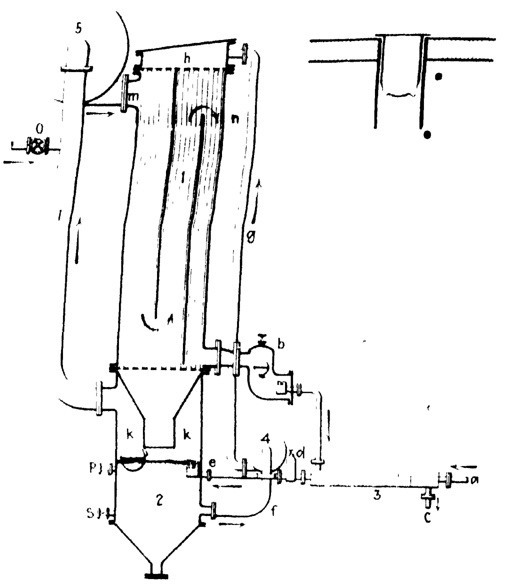


FIG. 12—VERTICAL SODERLUND AND BOBERG EVAPORATOR

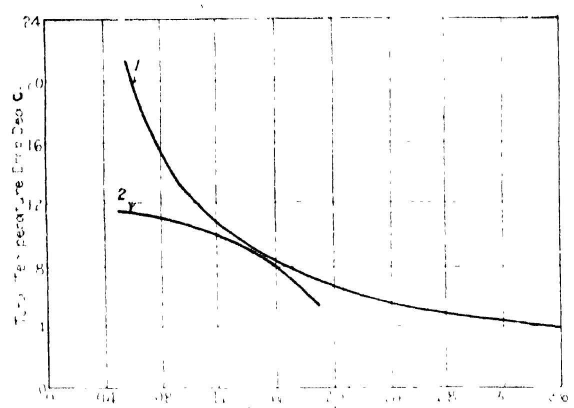


FIG. 11—COMPARISON OF NOZZLE PERFORMANCE USING STEAM AT 17[illegible] LB.

Tusschen (41) and Carlsson (8) have reported results obtained on a small installation built by A. G. Kummler and Matter, Aarau. It evaporates NaOH solution. The same evaporator is described below by Wirth (46) (Apparatus A). A test by Stodola of Zurich Polytechnic showed 36.2 to 37.7 lb. evaporated per kilowatt-hour. Losses, which had to be covered by the direct addition of live steam, amounted to 12.4 per cent, of which 10.7 per cent was heat lost in thick liquor. This was not recovered because the solution could be used hot in the next step of the process. During these tests the elevation of boiling point was 3.6 deg. F. at the start and 12.6 deg. F. at the end of a batch.

Ombeck (29) reports tests on an **evaporator** with vapor recompression. **The apparatus** made distilled water **for ice.** The evaporator is not specially described, except that it had 1,260 sq.ft. of heating surface. Vapor was compressed with a Rateau turbo-compressor. Raw feed water was softened and then preheated in a heat interchanger using the condensate as a source of heat. The principal results, abridged and converted to English units, are shown in Table I.

Runs 8 to 10 were made immediately after installation, runs 1 to 7 after 2 months' operation, and then runs 11 to 15 after cleaning. "Compressor efficiency" is the theoretical work of adiabatic compression divided by the actual power input.

It should be noted that the efficiency of the compressor increases, but the evaporation per kilowatt-hour decreases, as the temperature drop increases. In some cases live steam had to be added to make up for losses in radiation, hot condensate, etc.; but in some cases the

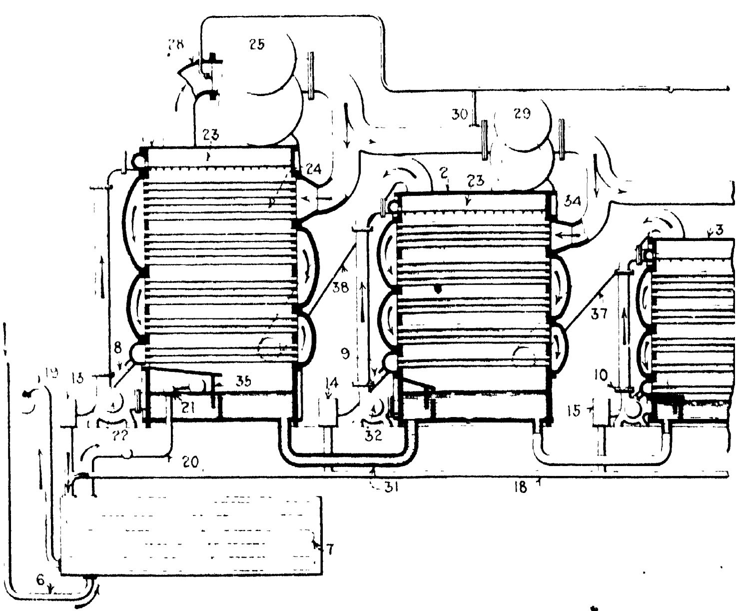


FIG. 13—MULTIPLE BODY SODERLUND AND BOBERG EVAPORATOR

TABLE I—OMBECK'S TESTS ON EVAPORATOR WITH VAPOR RECOMPRESSION

Run	Lb. Distillate Per Hr.	Vapors: Temp., Deg. F.	Vapors: Pressure, Lb. Gage	Steam: Temp. Deg. F., Calc. From Pressure	Steam: Pressure, Lb. Gage	Power Used, Kw.	Compressor Efficiency, Per Cent	Lb. Distillate Per Kw.-Hr.	Feed Temp. Deg. F.	Compressed Steam Temp. Deg. F.	Superheat, Deg. F.	Heat Added as Live Steam, B.t.u.	Apparent Temp. Drop, Deg. F.	Apparent Coefficient
1	2,120	213.5	0.45	220.0	2.51	18.22	32.2	116	210.4	225.3	5.3	55,200	6.5	246
3	3,520	213.0	0.29	222.2	3.16	32.65	41.4	108	210.1	241.7	19.5	26,700	9.2	291
5	4,420	213.1	0.32	224.3	3.96	47.07	44.8	94	210.1	251.6	27.3	2,780	11.2	301
7	4,950	212.8	0.25	226.9	4.90	64.80	45.7	76	210.0	265.9	39.0	0	14.1	269
8	5,420	212.5	0.14	222.8	3.43	42.80	55.6	126	209.7	249.7	26.6	0	10.3	388
10	6,330	213.5	0.43	225.8	4.51	55.90	55.6	113	209.8	254.5	28.7	0	12.3	439
11	3,140	213.4	0.41	219.4	2.30	19.05	42.0	165	210.4	224.1	4.7	47,600	6.0	399
13	4,410	213.3	0.38	220.5	2.65	29.05	46.3	152	210.5	233.7	13.2	27,300	7.2	451
15	5,480	213.8	0.53	222.7	3.41	41.30	50.2	133	210.6	242.4	19.7	15,000	8.9	480

TABLE II WIRTH'S RESULTS WITH COMPRESSION EVAPORATORS

Apparatus	Material Evaporated	Concentration (In Per Cent) Initial	Final	Batch or Continuous	Heating Surface, Sq.Ft.	Elevation of Boiling Point, Deg. F. Start	Finish	Power Used, Kw. Start	Finish	Lb. Evaporated Per Kw.-Hr. Start	Finish	Lb. Evaporated Per Sq.Ft. Per Hr. Start
A	NaOH	5	21	B	280	5.2	15.7	55.5	46.5	46.7	31.3	9.2
B	"Chemical Solution"			C	206			75.2		37.5		13.7
C	Sulphite liquor		1.47 sp.gr.	C	3 x 475					55.2		23.4
D	NaOH		23			18				50.7		
E	NaOH		31		384		41.5			25.4	...	2.87
F	NaOH		35							30.9		

superheat from compression furnished more heat than was lost, so heat had to be discarded from the system by blowing off steam. It should also be noted that this is one of the simplest cases possible; boiling a non-scaling solution of low specific gravity and viscosity and with no elevation of boiling point.

Wirth (46) has given details of a number of installations. A summary of his data will be found in Table II.

There is no special description of the evaporator construction. From the illustrations they seem to be ordinary vertical-tube evaporators with turbo-blowers.

Wirth is connected with A. G. Kummler and Matter

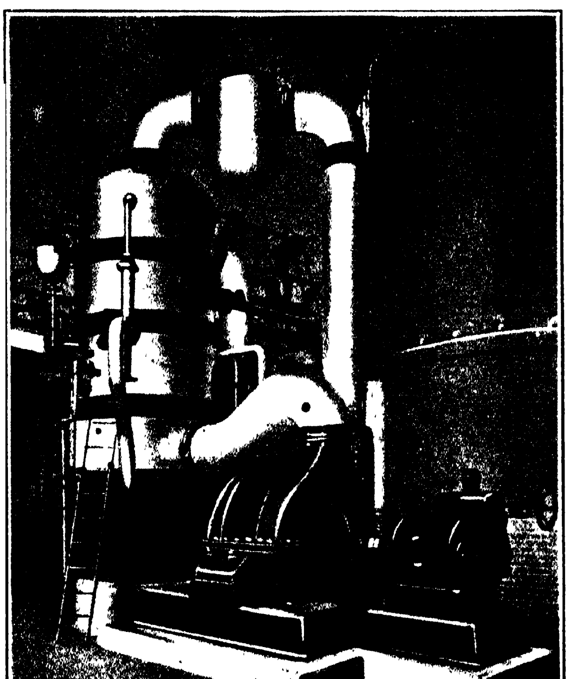


FIG. 14—VERTICAL TUBE EVAPORATOR WITH TURBO-BLOWER

Case *E* is mentioned as the lowest practical rate for thermocompressor operation. Its small rating per square foot evidently means a very small temperature drop. Evaporator *F* has three bodies, all in series as to liquor and in parallel as to vapor. The compressor is in two parts; one part takes vapors from all three and compresses to give the temperature desired for steam to the first two. It delivers some of this steam to the second part, which compresses further for the third body. Mention is also made of a milk evaporator, working with a boiling point of 50 deg. where the heat of compression more than covered the losses so that heat had to be rejected.

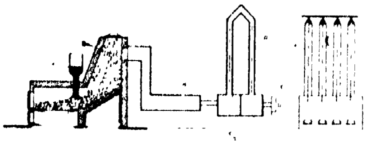
Part II of this series, which will appear in a subsequent issue, gives attention to the general theory of design and construction, together with a comparison of operating economies with single and multiple effect evaporators.

Erosion Cavities in Limestone Deposits

The limestones of the Shenandoah Valley of Virginia and West Virginia are characterized by numerous solution cavities brought about by surface or subterranean stream erosion, states the Bureau of Mines. The quarryman's difficulty is due to the occurrence, even at considerable depth, of erosion cavities, not in the form of open spaces, but filled with red clay. These clay masses are troublesome, and their removal is costly. The problem is of general interest to all limestone quarrymen, for erosion cavities are characteristic of limestone deposits, though they are not generally developed as much as in the district under consideration. Some form extensive caverns in which part of the dissolved calcium carbonate has been redeposited as stalactites and various other ornate forms. Some of the caverns have been illuminated and opened to the public as commercial enterprises. In a few instances the cavities constitute a commercial asset in the valley, yet from the quarryman's point of view they are a decided disadvantage, for they constitute one of his hardest problems. A discussion of stripping problems in limestone quarries in the Shenandoah Valley is contained in Serial 2401, by Oliver Bowles, mineral technologist, which may be obtained from the Bureau of Mines, Washington, D. C.

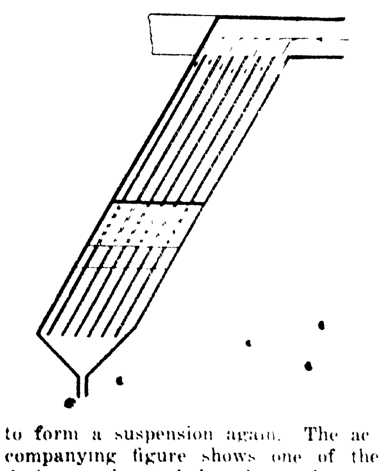
Recent Chemical & Metallurgical Patents

Production of Metallic Arsenic—J. L. Cullen, assignor to the United States Smelting and Refining Metals Co., has patented a process for producing metallic arsenic from the oxides obtained in the metal-refining plants. The present method of distilling mispickel in clay retorts is dangerous. The new method consists in passing vaporized arsenic oxides over red hot charcoal or coke.



Referring to the diagram, (1) is a furnace into which arsenic oxide is fed from a hopper (2), and after volatilization it passes through tower (3) packed with hot coke. Reduction takes place and the gases are cooled in pipes (4) and collected in bags (5). A fan (6) may be used to control the flow of gases. (1,433,533. Oct. 30, 1922.)

Separation of Dust From Gases—N. C. Christensen, Salt Lake City, Utah, has patented an apparatus for settling finely divided solids and liquids out of suspension of gases. The principle upon which this apparatus is based is that settling takes place rapidly if there are no eddy currents in the gas as it is moving along a pipe or in a gas that is still. The apparatus consists then essentially of means of producing a steady flow of gas currents. The inventor also claims that once settled out the solids or liquids can flow with the gases along tubes properly inclined and not be stirred up so as



to form a suspension again. The accompanying figure shows one of the designs submitted by the author to produce a steady flow of gases through the apparatus. The inclined passageways produce both a lateral and a vertical or longitudinal counter flow, and this combination is of great importance in effecting the settling of very finely divided dust. It is claimed that this apparatus will permit the doing away with any filtration of effluent air and thus much simplify present installation. (1,434,090. Oct. 31, 1922.)

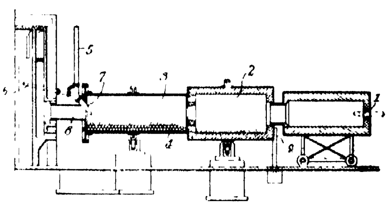
American Patents
Issued Dec. 19, 1922

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem & Met.* readers. They will be studied later by *Chem & Met.*'s staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,439,061—Extraction of Soluble Substances.
1,439,128—Recovery of Phenol Vapors.
1,439,163—Fluid Recording Device.
1,439,171—Method of Treating Oil.
1,439,284—Drier.
1,439,286—Bonded Alumina Refractories.
1,439,291—Ammonia Synthesis.
1,439,292—Catalyst for Ammonia Synthesis.
1,439,293—Cellulose Compounds.
1,439,447—Oxidation of Ferrous Substances.
1,439,505—Production of Smokeless Powder.
1,439,597—Lime Kiln.
1,439,610—Zinc Coating of Metal.
1,439,656—Pyro Smokeless Powder.

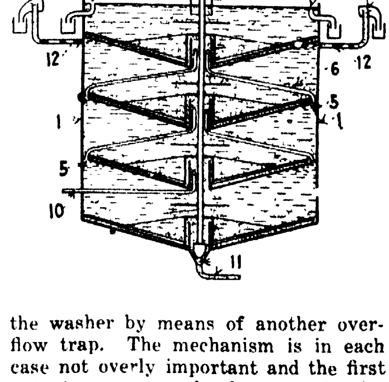
Complete specifications of any United States patent may be obtained by remitting 10c to the Commissioner of Patents, Washington, D. C.

Apparatus for the Production of Sodium Sulphate—M. A. Laury has developed a mechanical furnace for producing salt cake (sodium sulphate) and muriatic acid from niter cake (sodium bisulphate) and salt (sodium chloride). The apparatus is shown in the accompanying diagram and consists essentially of an oil burner (1) supplying heat to a rotary kiln. (2) Here the reaction takes place and there is no balling up of the product because of the fact that it is dried very completely in chamber (3), which is a ball mill. Niter cake and salt are fed into the chamber through leads (5) and (6) in proper proportion and the mixture is ground up and preheated in the ball mill before being introduced into the rotary furnace. The gases of combustion together with hydrochloric acid gas escape at (8) through appropriate ducts and the hydrochloric acid gas is absorbed from the waste gases in the usual manner. Finally the sodium sulphate passes out of the furnace at (9). Sometimes it is found desirable to insert some iron balls in the rotary furnace chamber, but this is usually not essential. The combustion chamber, it will be noticed, is fed on cracks so that it may be rolled up to the rotary and rolled away when the rotary needs relining or cleaning. Trouble with mechanical furnaces in the past has usually been that the charge balls up badly and therefore the reaction does not take its ultimate course. This process is said



to overcome the difficulty by preheating in the ball mill. (1,435,930. Nov. 21, 1922.)

The Counter-Current Washing of Finely Divided Solids—N. C. Christensen, Salt Lake City, Utah, has patented a counter-current washing device. The accompanying diagram shows substantially the principle of the washer. It is based on a tray principle, the various sections of the tray being either horizontal, in which case the solid is moved toward the center by means of plows, or inclined, as in the diagram, in which case the solid flows by gravity toward the center. The thickened pulp moves through a tool then to the next lower compartment and meets there an upcoming current of liquid. It will be noted that the upper tray, onto which the mixture of solids and mother liquids is first pumped, is separate from the rest of the washer and the wash water finally overflows at a point just below the level of the top tray. This permits the separation of the wash liquor from the mother liquor, which is frequently desirable. The solids then continue to settle out of the wash liquor on each of the succeeding trays and are washed as many times as there are trays. Finally, they are discharged from the bottom of



the washer by means of another overflow trap. The mechanism is in each case not overly important and the first patent covers merely the general principle involved. (1,434,089. Oct. 31, 1922.)

German Patents

*For complete specifications of any German patent apply to the German Patent Office, 97 Gitschinerstrasse, Berlin, Germany.

Blue Vat Dye of the Anthraquinone Series — 1-Mercapto-2-amino anthraquinone or salts of 1-mercapto-2 amino anthraquinone are condensed with 1-chloro-2-amino anthraquinone in the presence of condensing agents which effect condensation at the mercapto-group. Hydrogen sulphide is split off with formation of N-dihydro-1:2:2':1'-anthraquinoneazine, which latter also results when salts of 1-mercapto-2-amino anthraquinone are heated to a high temperature. (Ger. Pat. 357,767, which is an addition to German patent 336,922. E. Kopetchin.)

Fire-Extinguishing Compounds and Detergent Compounds — Chlorinated hydrocarbons are acted upon with water in Plauson colloid mills or similarly operating impact mills, eventually with addition of small amounts of protective colloids, such as albumens, glue, rubber latex, soaps, and of organic compounds capable of acting as solvents for the chlorohydrocarbons and water. The addition compounds act as dispersing agents. A mixture composed of 1 part of a chlorinated hydrocarbon and, for instance, 3 parts of water has the same fire-extinguishing effect as the pure chlorinated hydrocarbons, besides being distinguished from the latter by a smaller volatility. (Ger. Pat. 358,572. Plauson's Forschungsinstitut, Hamburg.)

Copper Sulphate From Scrap—Mill scrap or similar residues containing Cu as such or in form of alloys are roasted with chlorides, preferably NaCl (maximum 10 per cent), after the manner of the chloridizing roasting process as applied to sulphide ores, and subsequently treated with sulphuric acid. The Cu-containing scrap material is, prior to roasting, comminuted together with the sodium chloride. When tin-containing scrap is subjected to this process, small amounts of lime, SiO_2, Al_2O_3 or their salts are added to the material to be roasted. (Ger. Pat. 358,611. S. Hiller.)

Green Pigments—Nitroso-β-naphthol, preferably in form of its bisulphite compound, is acted upon with ferrous salts, preferably in the presence of turkey-red oil or similarly acting additions, with or without any of the mediums ordinarily used in the manufacture of lacquers. The formation of these mediums may also be caused to take place simultaneously with the production of the green pigment. Valuable pigments may also be obtained with a ferric salt provided the amount of the latter is less than theory requires. Ferric acetate gives valuable pigments even with the full theoretical amount of Fe. The green pigment is remarkably fast to light, water and alkalis, and is to be used in the production of inks for printing wall paper, books, or for lithographic work. (Ger. Pat. 356,973. Badische Anilin u. Soda Fabrik).

Condensation Products From Phenols and Aldehydes—To the reaction mixture a catalyst is added consisting of those phenols which, in addition to the OH-group or groups, contain any basic group or groups. The added catalyst, such as amino-phenols, methyl- and ethylaminophenols, aminonaphthols, hydroxyquinolines, hydroxydiphenylamines, particularly those aminophenols in which the H of the NH_2 or NH group is partly or entirely replaced by an alkyl-, aralkyl- or aryl-radicle, react with the aldehydes such as CH_2O or its polymers, furfuraldehyde, acrolein, in the same way as the phenols, so that they need not subsequently be removed from the final reaction product. For instance, from C_6H_5OH, CH_2O and p-aminophenol, or from C_6H_5OH, furfuraldehyde and p-aminophenol, homogeneous masses are obtained which are perfectly free from water and bubbles, insoluble and non-fusible, and are readily machined. They are particularly intended for electric insulating purposes. (Ger. Pat. 358,195. Felton-Guilleaume Carlswerk Actien Gesellschaft, Köln-Mühlheim.)

Resinous Condensation Products From Cresols and Xylenols The cresols or xylenols are treated with oxygen or air in the presence or absence of a catalyst. For instance, a current of moist air is passed for 10 to 12 hours through o-cresol heated to 150 to 170 deg. C. or through a phenol-containing crude cresol or m-xylenol, in the presence of a small amount of manganese dioxide or ferric chloride. The phenolic constitutents unacted upon are driven off with steam. The resulting resinous material constitutes, according to the duration of the oxidation treatment and the temperature, when air was used, a dark-brown to black mass which is soft, hard or brittle. Even those resins which are hard at the ordinary temperature may be melted by application of heat. By heating to higher temperatures the softer products are converted into highly lustrous, hard and brittle resins. The products are soluble in dilute NaOH, ether, alcohol, acetone and benzol, but practically insoluble in dilute Na_2CO_3 solution and in cold turpentine. The soft resins are also readily soluble in fatty oils, such as olive oil, whereas the hard resins go into solution only after heating or by prolonged action of the cold oil. The reaction presumably takes place in such a manner that at first the alkyl groups of the phenols are oxidized, and the resulting intermediate reaction products yield polymerization products either with each other or together or with unchanged phenols. (Ger. Pat. 357,756. Chemische Werke Grenznach Aktien-Gesellschaft.)

Washing and Bleaching Compound—Sodium peroxide and sodium bicarbonate are mixed together with soluble glass (sodium silicate) preferably in the presence of protective compounds. A 30 deg. Bé. water-glass solution is mixed with NaO_2, and the resulting mass is stirred with slightly more than equivalent amount of $NaHCO_3$ and the solidified mass is ground and dried. The protective compound to be added to the water-glass solution may be either magnesium or calcium silicate. (Ger. Pat. 357,956. Deutsche Gold und Silberscheideanstalt vorm. Roessler, Frankfurt.)

Liquid or Soluble Organic Compounds From Coal—A coal having a carbon content of not more than 85 per cent (referred to dry, ash-free substance) is subjected to hydrogenation by H_2 under high pressures and high temperatures. About 87 per cent of the coal used is thus converted into liquid or soluble form. No catalyst is used. The coal is subjected to pressure and heat in an atmosphere of hydrogen in the presence of a diluent liquid under the reaction conditions, the diluent used for the starting material to be hydrogenated consisting of high-boiling mineral oils or tar or high-boiling distillates or residues obtained therefrom. Due to the high-boiling diluent local overheating is excluded, and the reaction products are brought into solution. About 88 per cent of the coal is thus brought into a liquid or soluble form. (Ger. Pats. 299,783 and 303,272. Frederick Bergins.)

Conversion of Natural or Synthetic Varieties of Rubber Into Other Varieties of Rubber or Into Masses Resembling Gutta Percha—The hydrohalogen or halogen derivatives of certain kinds of rubber are reduced with metals (Zn) in a dispersive medium such as $CHCl_3$, $C_2H_4Cl_2$, and, if necessary, the resulting masses are washed with water or dilute acids. The resulting rubber has more or less viscous properties, according to the mode of preparation. When ethylene chloride is the dispersive medium, a substance resembling gutta percha is obtained. (Ger. Pat. 354,344. Siemens & Halske Aktien-Gesellschaft.)

Process for Protecting Fur and Wool From Moth and Other Insects—Animal fibers are protected from moth, etc., by treatment with the vapor of α-tetralon (α-tetrahydronaphthaleneketone) or mixtures of this with other suitable substances. The protective effect of α-tetralon is more lasting than that of chlorinated aromatic compounds, since it is less volatile. α-Tetralon is obtainable as an emulsion in soft soap or in the form of a powder, pellets or tables. Paper and fabrics may be treated with solutions of α-tetralon in petroleum spirit of high boiling point. (Ger. Pat. 357,063. Vereinigte Chemische Fabriken J. Norden & Co.)

Ammonium Sulphate From Crude Calcium Cyanamide—$CaCN_2$ is heated with $NaHSO_4$ and H_2O, the residue filtered off, and the liquor evaporated. The proportions of the reacting substances are so adjusted that the solution contains more than 1.3 parts (preferably 3 parts) of Na_2SO_4 to 1 part of $(NH_4)_2SO_4$; on evaporation the whole of the Na_2SO_4 crystallizes out, and by further evaporation of the mother liquor, technically pure ammonium sulphate is recovered direct. (Ger. Pat. 299,131, Bambach & Co.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Code of Ethics Adopted for Engineers

Joint Committee of Engineering Societies Formulates Principles for Elevation of Dignity of Profession

Adoption of a code of ethics, governing its membership of approximately 20,000, is announced by the American Society of Mechanical Engineers. Ultimately, it is expected, this code, prepared by a joint committee of national engineering societies, will apply to the entire engineering profession, embracing more than 200,000 professional engineers.

The mechanical engineers are the first to adopt the code, according to the chairman of the joint committee, Prof. A. G. Christie of Johns Hopkins University. This action, Professor Christie stated, marks an advance in engineering ideals, and, in respect to the government of its members as a whole, places the profession in a position analogous to the professions of law and medicine.

The code commands loyalty to country, personal honor, fairness to contractors and workers and interest in the public welfare. Betrayal of professional confidences, undignified or misleading advertising and questionable professional associations and practices are prohibited.

Text of Code

The text of the code, as given out by John L. Harrington, president of the American Society of Mechanical Engineers, follows:

"Engineering work has become an increasingly important factor in the progress of civilization and in the welfare of the community. The engineering profession is held responsible for the planning, construction and operation of such work and is entitled to the position and authority which will enable it to discharge this responsibility and to render effective service to humanity.

"That the dignity of their chosen profession may be maintained, it is the duty of all engineers to conduct themselves according to the principles of the following code of ethics:

"1. The engineer will carry on his professional work in a spirit of fairness to employees and contractors, fidelity to clients and employers, loyalty to his country and devotion to high ideals of courtesy and personal honor.

"2. He will refrain from associating himself with or allowing the use of his name by an enterprise of questionable character.

"3. He will advertise only in a dignified manner, being careful to avoid misleading statements.

"4. He will regard as confidential any information obtained by him as to the business affairs and technical methods or processes of a client or employer.

"5. He will inform a client or employer of any business connections, interest or affiliations which might influence his judgment or impair the disinterested quality of his services.

"6. He will refrain from using any improper or questionable methods of soliciting professional work and will decline to pay or to accept commissions for securing such work.

"7. He will accept compensation, financial or otherwise, for a particular advice, from one source only, except with the full knowledge and consent of all interested parties.

"8. He will not use unfair means to win professional advancement or to injure the chances of another engineer to secure and hold employment.

"9. He will co-operate in upbuilding the engineering profession by exchanging general information and experience with his fellow engineers and students of engineering and also by contributing to work of engineering societies, schools of applied science and the technical press.

"10. He will interest himself in the public welfare, in behalf of which he will be ready to apply his special knowledge, skill and training for the use and benefit of mankind."

The joint committee which drew up the code was composed as follows:

American Society of Civil Engineers—C. C. Elwell, New Haven, Conn.; A. M. Hunt, New York.

American Institute of Mining and Metallurgical Engineers—J. Parke Channing and Philip W. Henry, New York.

American Society of Mechanical Engineers—Prof. A. G. Christie, Johns Hopkins University, Baltimore; H. J. Hinchey, Chicago; Charles T. Main, Boston; J. V. Martenis, Minneapolis; Robert Sibley, San Francisco.

American Institute of Electrical Engineers—Prof. Comfort A. Adams, Harvard University; C. Paccioli, Pittsfield, Mass.; George F. Sever, Toronto, Ont.; L. B. Stillwell, New York.

American Society of Heating and Ventilating Engineers—Frank T. Chapman and Perry West, New York; S. A. Jellett, Philadelphia.

Reclassification of Federal Employees Delayed

Although several hearings have been held by a sub-committee of the Senate Appropriations Committee, the final report on the bill to reclassify the employees of the federal government and readjust salaries has not been formed and in view of the heavy work devolving upon the Appropriations Committee because of the annual supply bills, fears are expressed that the reclassification measure will not be brought to action on the floor in time to assure passage at the present session of Congress. Senator Smoot, chairman of the sub-committee in charge of the bill, has stated, however, that a report may be expected shortly.

Friends of the reclassification bill are dubious of its passage in the present Congress, even if a report is forthcoming in January, because of the doubt over the shape in which the bill will appear when it emerges from committee.

Bill Has Had Stormy Career

The Civil Service Committee of the Senate considered this measure some weeks and reported it on Feb. 8 last with a recommendation that it be passed. Because of the financial features of the bill, it was referred to the Appropriations Committee for further study. The Civil Service Committee made a number of changes in the bill from the form in which it was passed by the House. While the sessions of the sub-committee on appropriations have been executive, with a number of government officials testifying as to their ideas, it is generally understood that further changes have been seriously considered by this committee. Senator Smoot himself is the author of another reclassification bill which originally projected reforms based upon a somewhat different theory than those contained in the Lehlbach-Sterling bill, which was the basis of the one now under consideration.

It is said that the Appropriations Committee has been considering further reductions in the number of classes outlined in the bill and that there has been serious thought of eliminating workers in the field and confining the measure to government employees within the District of Columbia. Changes in title and in relative pay for professional and sub-professional workers also have been suggested, it is said, because these men, especially technical workers, are leaving the service in increasing numbers.

Wisconsin Plans Colloid Studies Under Svedberg

Lecture Courses and Symposium Under Swedish Expert Expected to Attract Leaders in Field

The department of chemistry of the University of Wisconsin desires to call attention to the program for colloid chemistry which will be conducted by Prof. Thé Svedberg during the coming semester, commencing Feb. 1, 1923, and summer session, commencing June 25, 1923.

Prof. Thé Svedberg, of the University of Upsala, Sweden, will be in residence at the university from Feb 1 to Aug. 5. He will give two lectures a week on the general theory of colloids and will direct the experimental researches of a number of graduate students during the second semester. In the summer session the course of lectures given during the second semester will be repeated. Every necessary facility will be provided for the successful prosecution of researches. Those desiring to work under Professor Svedberg's personal direction, either during the second semester or during the summer session, should communicate promptly with Prof. J. H. Mathews, since only a limited number can be accommodated. The opportunity of hearing Professor Svedberg's lectures and doing work under his direction during the summer session will appeal to a great many professors and instructors at other educational institutions. A considerable number have already signified their intention of embracing this opportunity.

SEMINARY AND NATIONAL SYMPOSIUM PLANNED

Professor Svedberg will also conduct a seminary in colloid chemistry which will meet weekly during the second semester. The first half will be devoted to general theory and the second to biological applications of colloid chemistry. In the latter half of the work he will be assisted by Prof. Elmer Sevringhaus, of the department of physiological chemistry. Admission to the seminary will be open to chemistry students who have had a course in physical chemistry and who possess at least an elementary knowledge of the theory of colloids; and to advanced workers in the biological sciences.

From June 12 to 15, inclusive, a national symposium on colloid chemistry will be held at Madison to which all scientists interested in colloid chemistry are invited. A program of exceptionally interesting papers is now being formulated, and definite assurance of the attendance of nearly all of the most prominent American workers in the colloid field has already been given. About twenty papers will be presented by the authors in person and there will be ample time for thorough discussions. These discussions will be led by Professor Svedberg. More detailed information concerning the program of papers to be presented will appear in these columns later.

Fertilizer Manufacturers Confer With Agricultural College Officials

Representatives of fertilizer manufacturers conferred with officials of agricultural colleges and experiment stations from the New England states in Boston, Dec. 30. The officials explained the soil improvement needs of their states and what they are trying to accomplish for the benefit of agriculture. Policies and measures were pointed out, whereby fertilizer manufacturers and their salesmen may cooperate to better advantage.

The conference was called on the invitation of Prof. S B. Haskell, director of the Massachusetts State Experiment Station. Horace Bowker, vice-president of the American Agricultural Chemical Co., was selected as head of the fertilizer delegation, which included corporation officials, sales managers and field salesmen.

The meeting was in connection with the convention of the American Association for the Advancement of Science, which was held in Boston, Dec. 26 to 30. New England is one of the sections where high-analysis commercial fertilizers have been used to the exclusion of the poorer grades, owing to the nature of the principal crops raised there.

C.C.N.Y. Offers New Courses in Chemistry

The evening session of the College of the City of New York is offering, for the first time, courses in potable and industrial water and the chemistry of commerce in addition to the usual courses in chemistry.

Course 249—"Potable and Industrial Water"—deals with the special analytical work required for the analysis of water and with the interpretation of the findings of the analysis. Some attention is paid to water bacteriology. Prerequisite for this course is quantitative analysis and general bacteriology.

Course 269—"Chemistry of Commerce"—deals with the economics of the production and disposition of chemical products. It treats of the sources of raw materials and markets for the intermediate and finished product. The sources of energy and the conservation of waste by the utilization of byproducts is considered and the patent laws are discussed. Seminar work on the economic history of the development of various chemical industries is included. A knowledge of applied organic and inorganic chemistry is required for admission to this course.

Besides these courses, the regular courses in inorganic and organic chemistry, qualitative and quantitative analysis and electrochemistry will be given, all courses starting about Feb. 8, 1923.

Further information may be obtained from the director of the evening session, College of the City of New York, 189th St. and Convent Ave., New York City.

Customs Official and Coal-Tar Men Confer

Concentrate Efforts on Untangling Snarls in Chemical Schedule of New Tariff Law

Manufacturing interests were represented at a series of conferences on the proposed rules and regulations which if adopted will govern the entry of dyes under the new tariff law, held at the United States Appraiser's Stores in New York, last week.

Experts from the Bureau of Standards, the Treasury Department and the Tariff Commission conferred with importers and their representatives at the conferences. Tentative rules were drafted, and these are now being submitted to all parties interested before being forwarded to Washington for approval and adoption.

SNARL IN CRESOL DUTY

One of the problems with which the customs division of the Treasury Department is wrestling is an apparent conflict between the coal-tar products paragraph of the dutiable list of the new tariff act and the corresponding paragraph of the free list. Congress, in the "inclusive clause" of the dutiable paragraph, created two classifications, while only one is specified in the free list.

The specific case arose over imports of cresol, an intermediate used in a number of medicinal preparations and for some other purposes. This product is not mentioned by name in the tariff act, but falls within the inclusive clause.

In the paragraph placing a duty on intermediates, it is provided that: "All distillates of coal tar . . . which on being subjected to distillation yield on the portion distilling below 190 deg. C. a quantity of tar acids equal to or more than 5 per cent of the original distillate, or which, on being subjected to distillation, yield in the portion distilling below 215 deg. C. a quantity of tar acids equal to, or more than, 75 per cent of the original distillate," shall be dutiable There are two specifications in this classification, either one of which apparently would make the product dutiable.

PROPERTIES OF CRESOL OR SCHEDULE MUST BE MODIFIED

The free list paragraph, however, omits the 75 per cent below 215 deg. specification and provides that a product which does not yield 5 per cent or more of the original distillate below 190 deg. C. shall be admitted free. Cresol does not yield 5 per cent below 190 deg., but does yield 75 per cent below 215 deg. This fact would include it in the second specification of the dutiable list but inasmuch as this is omitted from the free list paragraph and below 5 per cent is to be admitted free, appraisers are at a loss as to how to proceed.

A number of other coal-tar products are said to be in a similar position. A decision is not expected in the case for several weeks

Opportunities for Research in Compiling Critical Tables

Board Encounters Gaps in Available Data Which Make Ideal Subjects for Theses and Research

In preparing for publication the data on physical properties of chemical substances, the editorial staff of International Critical Tables will find from time to time that important physical properties of substances of technical and scientific importance are missing from the literature. As fast as missing data of this character come to light, it is the policy to formulate research problems covering such missing data and to endeavor to interest chemists and physicists in undertaking the necessary investigations to supply the required data.

Most of the research problems formulated in this way will be suitable for bachelors' or masters' theses and in a few instances topics sufficiently broad to be suitable for doctors' theses will also be available. Many of them will be suitable for experimental problems in the ordinary laboratory courses in physical chemistry and physics. Thus, for example, the laboratory experiment covering the determination of solubility might to advantage deal with substances whose solubility is needed but is unknown. The average of the determinations made by a class of students, while not as accurate and reliable as the determinations made by a skilled investigator, will nevertheless be very valuable when they constitute the only data available on the subject. Moreover, the average student will be more interested in a laboratory experiment the results of which are of actual value and worthy of publication than he would be in repeating the measurement of a property of some system which has been measured many times before.

Problems Sought

International Critical Tables will be glad to submit to interested instructors in universities and colleges lists of problems of this character and to advise as far as it can concerning suitable apparatus and methods of measurement. It may be possible also in some instances to secure moderate financial assistance to aid in the purchase of materials and apparatus for investigators interested in carrying out work of this character. The results of such work may be published by the investigator in any appropriate publication medium and they should also be reported in duplicate to the office of International Critical Tables on completion of the work.

Problems Now Available

A number of problems on the following subjects are available at the present date: Heats of combination of solid oxides and iron compounds; specific heats of brass, solid oxides, steels, oils and fats, petroleum products, metals, salts, iron compounds, asphalts; latent heats of fusion of brass and metals; heat conductivity of steels; latent heats of vaporization of petroleum products; viscosities of industrial materials; rates of drying; hydrolysis of industrial materials; catalysis; transpiration of moisture; strength of industrial materials; thermal expansion of steels and iron compounds; freezing-point solubility diagrams of salts, acids, metals in water and soaps; boiling points of solutions; solubility of gases in molten metals and in water; chemical equilibrium; dissociation pressures at 1 600 deg. C.; electrical conductivity of metals and refractories; properties of colloidal systems; vapor pressures of metals and solutions; specific rotatory power of gliadin; index of refraction of solids; density of certain organic compounds and solutions; flash points and surface tensions of solutions.

Chicago Chemists Observe Pasteur Centennial

Life and Work of Great French Scientist Discussed From Many Angles at Meeting of Chicago Section

In commemoration of the Pasteur Centennial, the meeting of the Chicago section, American Chemical Society, held Dec. 15, was devoted to the life and work of the great French scientist. The address of the evening was delivered by Dr Edwin O. Jordan, head of the department of bacteriology and hygiene, University of Chicago. In a fascinating manner Dr. Jordan brought out the human side of Pasteur. Much of the work on the preparation of vaccines was carried out only through Pasteur's intense determination to seek scientific truth, for he was so extremely sensitive to suffering in others—whether animals or human beings—that he experienced mental and physical torture during the operations which were necessary for the studies. In view of this phase of his character, the violent attacks made upon him as an inhuman vivisectionist seem to us ridiculous and amusing.

Before the Biologic Group, Dr Morris Fishbein, associate in medical history, Rush Medical College, read a very interesting paper outlining the development of the Pasteur method of treating rabies—from the preliminary work on animals until the eventful day when the treatment was first applied to a human being. The result was successful and recognition of the value of the method was rapid. It is interesting to note that the treatment used today varies only in perhaps a few unimportant details from that developed by Pasteur.

Topics discussed before the other groups were: "Pasteur and His Work With Polarized Light," W. V. Evans, department of chemistry, Northwestern University; "Pasteur and the Fermentation Phase of the Baking Industry," George L. Teller, Columbus Laboratories; "Organic Mercury Compounds," Lyman Chalkley, Jr., Sprague Memorial Institute.

Development Work on Canadian Tar Sands

Further testing of Athabasca tar sands in the Canadian west on a practical scale is to be carried out during the winter at the laboratories of the University of Alberta in Edmonton, Alta. A report was recently submitted to the Advisory Scientific Research Council of Alberta by Dr. K. A. Clarke, who has been in charge of the experimental work of separating sand from bitumen for the past year or more, and the results therein announced were so encouraging and satisfactory that it was decided to continue along the lines already tried out and to make an actual test in road paving.

Bitumen Paving Material

With the sand brought from the McMurray district of Alberta, Dr. Clarke will apply the water-separation process of extracting the bitumen which he has developed, and will in this way obtain a stock of bitumen which will be available for future use as paving material. Other materials are exceptionally scarce in this district. Dr. Clarke has not had his process patented.

Dr. S. C. Ells of the federal department of mines, who is considered the premier authority in Canada on matters pertaining to the bitumen deposits and who has made a study of this mineral for the past 14 years in the West Indies, the United States, France and other portions of the European continent considers that commercial separation does not present greater difficulties than many other industrial problems which have already been solved satisfactorily. In 1913 Dr. Ells undertook the first systematic study of the McMurray deposits, regarding which at that time probably nothing of a definite nature was known. Since then every outcrop has been examined, accurate samples obtained and analyzed and topographical mapping of large areas completed. During the winter of 1915, in the face of serious difficulties, Dr Ells shipped to Edmonton the first large consignment of the McMurray sand. Subsequently the engineer assembled in Edmonton a small plant, and designed and laid the first pavements in which Canadian tar sands were used on a large scale. The signal success which marked this work demonstrated clearly the value of Alberta tar sands as a material for the surfacing of streets.

Water Separation Feasible

Subsequently realizing that large commercial development would depend upon the evolving of a satisfactory separation process, Dr. Ells spent months in considering the relative values of various separation and distillation methods. Owing to the war this work was not completed, but from the preliminary results obtained it appeared that the uses of heated water to which certain inexpensive reagents were added afforded the best chance of success.

Is Public Ready for Broad Scope in Technical Education?

President of Columbia Reports Signs of Tardy Recognition of Value of Fundamentals of Science and Humanities

President Nicholas Murray Butler of Columbia University, in his annual report to the trustees, says that opinion is moving in the direction of a policy of higher standards of admission and instruction in engineering schools. The time has come, in Dr. Butler's opinion, to give more special and concentrated attention to the advanced and research work of the university in the whole field of engineering.

"The line of separation between pure and applied science is increasingly difficult to discern and maintain," continues Dr. Butler. "The real distinction would appear to lie not so much in the subject matter as in the spirit with which the work of research is carried on.

"The applications in industry and in commerce of the principles and facts which constitute chemistry, physics and mechanics, for example, are made possible only by reason of a thorough understanding of those principles and facts. When research in the field of natural and experimental science was young in the United States, and when the dominant motive and interest of the people were largely material, it was perhaps not difficult to distinguish between what came to be called the field of pure science and that of applied science. Conditions have, however, sharply changed during the past generation, and the intermingling of the two is very considerable, even if it be not complete.

Place of Fundamentals in Curricula

"The policy of Columbia University in accepting 8 years ago the recommendation of the faculty of applied science to elevate the standard of admission to the Schools of Mines, Engineering and Chemistry, and to turn those schools definitely to the task of training leaders of the engineering profession and research workers, has resulted in greatly reducing the enrollment of students, and has left several departments of instruction overequipped for the work which they have to do, at least during the period when the new policy is establishing itself.

"There are signs that opinion is moving in the direction of the policy that was adopted 8 years ago. The dean of the faculty of applied science points out in his report that the importance attached here at Columbia to the humanities and to fundamental scientific studies as the basis of an advanced technical or professional training is increasingly recognized elsewhere.

Merit of Longer Courses

"A group of representatives of the most important engineering schools in the Middle Western states have unanimously approved a 5-year program of study for engineering students, with a view to giving the time gained to the study of the humanities and fundamental scientific subjects. Whether the program of engineering study be one of 5 years or 6 years is probably of less importance than its content and the possibility of the fundamental instruction being given by a large number of colleges and scientific schools, many of whose students would naturally transfer to Columbia to complete their engineering course.

"That there is ground for careful examination of all that relates to the program of study in the Schools of Mines, Engineering and Chemistry is obvious, and steps are taken to make that examination in the broadest way possible and with complete sympathy for the ideals which the university has set up."

Civil Service Openings

The United States Civil Service Commission announces open competitive examinations for laboratory assistant, junior grade and senior aid, and for junior chemist. The examinations will be held throughout the United States on Feb. 14 to fill vacancies in the Bureau of Standards, Department of Commerce, Washington, D. C. The entrance salary for laboratory assistant, junior grade, is $1,000 a year, plus the increase of $20 a month granted by Congress; for senior aid, $900 a year, for junior chemists $1,200 to $1,800, also plus the increase. The written examination consists of physics and chemistry, mathematics (through trigonometry) and mechanical drawing. The element of education and experience is weighted at 50 per cent.

The Bureau of Standards covers a wide field of work in physics, chemistry, engineering and industrial technology, and offers unparalleled opportunity for the study of a profession.

Full information and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or secretary of the Board of U. S. Civil Service Examiners at the post office or custom house in any city.

Improved Service Arranged in Distribution of Fertilizer Statistics

The Bureau of the Census has agreed to the proposal of the National Fertilizer Association that the census of sulphuric acid and of acid phosphate be taken as of Jan. 1, rather than as of Nov. 30. The later date will permit the compilation of much more representative figures, it is contended. The association also pointed out the increased worth of the figures if there is no delay in making them public. In that connection the bureau is in a position, it was stated, to make the figures available forty-eight hours after the last return has been received. The fertilizer association is co-operating in an effort to obtain prompt answers to the questionnaire and a high percentage of responses.

Copper and Brass Research Association Summarizes First Year's Activity

In connection with the conclusion of the first full year of the Copper and Brass Research Association's activity as an unincorporated, voluntary organization of the brass and copper industries R. L. Agassiz, president of the Calumet & Hecla Mining Co., who is president of the association, said, at the meeting on Dec. 5:

"The research and educational work of the Copper and Brass Research Association has played an important part in the rapid growth of consumption of brass and copper during the past year—for, despite uncertain business conditions, copper consumption in this country is now substantially greater than in pre-war years. Having digested an unprecedented quantity of war-time scrap metal, the industry is now in a strong position.

"Our plan is to provide through the instrumentality of the Copper and Brass Research Association a technical and advisory service which may be freely called upon by users of our metals—a service which no one copper or brass producer or manufacturer could reasonably be expected to undertake alone.

Officers for the coming year were elected as follows: President, R. L. Agassiz; vice-presidents, C. F. Kelley, F. S. Chase, E. J. Rowland, Walter Douglas and U. T. Hungerford; treasurer, Stephen Birch; secretary, G. A. Sloan; and manager, William A. Willis.

Fertilizer Association Plans Annual Convention

With the idea of making its annual convention one of the features of next year's work, the National Fertilizer Association already is taking steps to that end. The executive committee of the association has fixed the time of the convention for the week of June 10. It will be held at White Sulphur Springs. Particular attention is to be given at this convention to the whole subject of cost accounting.

The executive committee at its meeting considered that portion of the report which the uniform cost-accounting committee has completed. At the same meeting John I. Tierney, the Washington representative of the association, reviewed the car and traffic situations.

Philadelphia Chemical Club Plans Course for Salesmen

The Philadelphia Chemical Club is perfecting plans for a course of instruction in chemistry for chemical salesmen, covering primarily a comprehensive series of lectures of practical value to men selling chemical products of various kinds. A committee was appointed to arrange for the proposed course, developing the important details and topics for lectures. Officers of the society elected for the coming year are: John H. Stutt, Jr., president; F. S. Havens, vice-president; W. H. Davis, secretary; and W. J. Thorne, treasurer.

Chemistry Fundamental to National Defense

Assistant Secretary of War Recognizes Importance of Industry to Welfare of Country in War or Peace

Assistant Secretary of War Wainwright, in a recent issue of the United States Army *Recruiting News*, recognizes the fundamental importance of the chemical industry to the national defense. This evidence of growing appreciation of the value of a highly developed chemical industry and chemical research is of special interest in view of Mr Wainwright's recent action in appointing an advisory board of chemical engineers from the industry.

"Being charged as I am by law with the responsibility of making adequate provision for the mobilization of material and industrial organizations essential to wartime needs," says Mr. Wainwright, "I have taken certain steps which may be interesting to describe briefly to you The War Department exists in time of peace largely for providing for the defense of the country in time of need. Therefore it is necessary in time of peace to make plans for war I am therefore giving a great deal of attention to planning how to utilize the commercial industries of the country to best advantage in time of war.

ALL WARFARE "CHEMICAL"

"As Assistant Secretary of War I am charged by law with the 'supervision of procurement of all military supplies and all other business of the War Department pertaining thereto and the assurance of adequate provision for the mobilization of material and industrial organizations to wartime needs' This responsibility makes the 'relations of the chemical industry to national defense' of paramount interest to me The requirements of the War Department in time of war for material produced directly or indirectly by the chemical industry of this country are stupendous in size and multitudinous in range

"There has been a popular use in the last few years of the term 'chemical warfare' as pertaining solely to the use of poison gases and other gaseous materials. Practically all modern warfare is 'chemical warfare.' Chemistry is just as seriously involved in high explosive ammunition, in shrapnel and in high explosive drop bombs as it is in poison gas. The manufacture of smokeless powder and high explosives, of which hundreds of millions of pounds are used in a year in modern warfare, are chemical processes involving chemically educated people, chemical facilities and chemical principles

IMPORTANCE IN MUNITIONS

"In fact, the most important contribution of chemical industry is its contribution toward the supply of munitions, and therefore I shall touch more fully upon that particular phase than any other. We have had it impressed upon us by the last war that munitions are the controlling factor in exerting a nation's maximum effort in combat. Man power can be mobilized and trained and placed in the field almost a year before the necessary munitions can be manufactured and supplied to them. Therefore, it becomes of paramount importance to the War Department to utilize every industry to assist in expediting munitions production."

New Denaturing Formula for Motor Fuel Alcohol

Approval of Gasoline as Denaturant Should Reduce Cost of Product to Compete With Gasoline

A new formula for the marketing of ethyl alcohol for use as a motor fuel has been approved by the prohibition unit of the Treasury Department Manufacturers of industrial alcohol believe it will reduce the cost of the blend to a point where it may be sold in competition with gasoline and thus enlarge the field of their product.

The formula is simple, being merely one part of gasoline, of specified grade, to 100 parts of alcohol, the gasoline rendering the blend unfit for human consumption Heretofore, the principal formula for industrial alcohol for use as a motor fuel has been 95 per cent alcohol blended with 5 per cent benzol, ether and alcohol.

The quantity of alcohol used as a motor fuel in the United States at present is small, but considerable was used during the war, although it is said that alcohol is used more than gasoline in Hawaii The new formula was evolved by an industrial alcohol manufacturer who foresees that the increasing consumption of gasoline is creating an inviting field for a competitive motor fuel.

The new formula, drawn by Dr J M Doran, head of the industrial alcohol division of the prohibition unit, and signed by D. H. Blair as commissioner of internal revenue, follows.

> The following formula, to be known as specially denatured alcohol Formula No 28-A, is hereby authorized for use in the manufacture of motor fuels
>
> For every 100 gal of ethyl alcohol of not less than 198 deg proof add 1 gal of gasoline of the quality specified below
>
> Volatility and distillation range When 5 per cent of the sample has been recovered in the graduated receiver, the thermometer shall not read more than [illegible] deg. C nor less than 50 deg C When 50 per cent has been recovered in the receiver, the thermometer shall not read more than 95 deg C
>
> The distillation test above outlined shall be made in the apparatus and in the manner described in Navy Department Specifications 7G1, dated Oct 2, 19[illegible], particularly referring to Grade A, fighting aviation gasoline

The blending must be at the point of manufacture.

Distribution of Fertilizer in Pennsylvania

The Bureau of Chemistry of the Department of Agriculture of the Commonwealth of Pennsylvania has issued a report showing a distribution of 325,000 tons of fertilizer and 275,000 tons of agricultural lime among the farmers of the state in 1921, with an approximate gross value of $12,000,000.

Paper Industries Show Scheduled for Spring

Grand Central Palace Will Be Scene of Newest Addition to Industrial Expositions

A new venture, of particular interest to the pulp and paper industry, is announced by the International Exposition Co., which will conduct a "Paper Industries Exposition" in the Grand Central Palace, New York, during the week of April 9, 1923. The executive committee of the American Paper and Pulp Association recently came to the conclusion that such a project would be well received by the industry and voted to support the undertaking. Accordingly, the International Exposition Co. is planning a "paper show" along the same lines as the chemical and other expositions, which have become institutions. The time was chosen so that the exposition would be held during the same week as the meeting of the American Paper and Pulp Association, the National Paper Trade Association and other associations of the paper industry.

The exposition will tell the complete story of paper, starting from the forest and the measures used to prevent waste, to encourage reforestration of cut-over lands to insure a supply of paper raw material for the future, the handling of the raw materials entering into paper, through the machinery with auxiliary apparatus and instruments with which the finished paper is made and the various products therefrom. Among the latter will be shown the newest products of the paper maker and converter

A committee has been organized for the exposition, comprising organized and unorganized groups of paper manufacturers, the trade publications, educational institutions, engineers and manufacturers of paper machinery. The committee comprises: Hugh P. Baker, secretary American Paper and Pulp Association; H. J. Berger, Editor *Paper Trade Journal*; Charles N. Bicknell, president National Paper Trade Association; F. D. Cowdery, Albany Felt Co.; Joseph L. Fearing, International Paper Co. of Chicago; Hardy S. Ferguson, paper mill engineer; E. B. Fritz, publisher of *Paper Industry*; Phil A. Howard, president American Paper Merchants; C. W. Hurtubis, Hammermill Paper Co.; Thomas J. Keenan, editor of *Paper*; Ralph H. McKee, Columbia University; John H. O'Connell, president American Pulp and Paper Mills Superintendents' Association; Frank W. Power, National Paper Trade Association; L. D. Post, publisher of *Paper Mill*; Walter J. Raybold, president American Paper and Pulp Association; George W. Sisson, Jr., Racquette River Paper Co.; E. C. Spear, Cheney Bigelow Wire Works; Tom Walden, editor of *U. S. Paper Maker*; George E. Williamson, president Technical Association, Pulp and Paper Industry; Louis E. Wise, N. Y. State College of Forestry; Fred W. Payne and Charles F. Roth, managers.

Calcium Arsenate Supply Adequate

Federal Inquiry Believed to Have Established Absence of Corner in Arsenic

Ample calcium arsenate will be available by the time it is needed for use in boll weevil control next summer. This is understood to be the finding of the representatives of the interested bureaus who made an intensive study of the situation in response to a Congressional resolution. The report probably will go to Congress before the end of January.

The shortage of calcium arsenate in 1922 resulted in the loss of cotton which could have been marketed for sums variously estimated from $5,000,000 to $100,000,000. As a result there is strong pressure on the federal bureaus concerned with the production, use and manufacture of arsenic and its compounds. An effort will be made to prevent a recurrence of such a shortage. The studies which have been made by the government's specialists indicate that unusual combinations of circumstances prevented a correct estimate of the 1922 demand for the poisons of which arsenic is the base.

SHORTAGE DUE TO SUPPLY AND DEMAND

There is no tendency to attach blame to the manufacturers of these products. There is no evidence that there was any conceived effort to advance prices. The fact that the 1921 demand for these materials was abnormally small left large stocks at the close of that year. With these stocks on hand, producers naturally did not enter into large output for 1922. Their failure to make contracts caused the price to slump to the point where it no longer was profitable for the smelters to refine their gray arsenic. The demand which wiped out the stocks came suddenly, with the result that production could not be brought quickly to the point necessary to supply the demand. It is believed that conclusions along these lines will be laid before Congress. It is probable that the prediction will be made that ample supplies of calcium arsenate, lead arsenate and paris green will be available to the cotton, fruit and truck growers, respectively, in time for their 1923 crops.

Countervailing Duties Fixed for Canadian Chemical Imports

The Treasury Department has declared countervailing duties on several chemicals when imported from Canada, to equalize the difference between the rates named in the new United States tariff and the corresponding duties imposed by the Canadian tariff on imports from this country. These rates are: calcium acetate, crude; calcium nitrate, cyanamide or lime nitrogen, 17½ per cent ad valorem, unless they are to be used as fertilizers, when they are entitled to entry at 10 per cent ad valorem.

U. S. Sulphur Producers Make Bid for Export Trade

That the sulphur producers of the United States intend to become even a greater factor in the world market is indicated by the formation of the Sulphur Export Corporation. The Union Sulphur Co., the Freeport Sulphur Co. and the Texas Gulf Sulphur Co. are members of the association, as are the following individuals: Henry Whiton, Clarence A. Snider, Eric P. Swenson, S. Magnus Swenson, Walter H. Aldridge and Wilbur Judson. Mr. Snider is president of the corporation, S. Magnus Swenson is vice-president, James T. Kilbreth secretary, and Charles W. Kemmler treasurer. All of the individuals mentioned reside in New York.

Sulphur to the extent of $30,000,000 was shipped from American mines in 1920. During that year the exports of sulphur were valued at $8,994,350.

Personal

Prof. E. C. BINGHAM, Lafayette College, has been elected chairman of the Lehigh Valley (Pa.) section of the American Chemical Society, Allentown. Dr. C. WITMER has been elected vice-chairman; Dr. A. BOGUE secretary and treasurer; and JOHN T. LITTLE councilor.

C. L. BRYDEN spoke on "Filters and Filtration" at the Gayley Chemical Laboratory of Lafayette College, Dec. 14.

W. D. COLLINS spoke before a joint meeting of Committee C 7 of the A.S.T.M. and Philadelphia section of the American Chemical Society on Nov. 17. His topic was "Hardness of Large Public Water Supplies in the United States."

CHARLES C. CONCANNON, acting chief, chemical division, Bureau of Foreign and Domestic Commerce, Washington, D. C., was in New York City conferring with representatives of the chemical industry during the week of Dec. 25.

Dr. EDWARD C. FRANKLIN, professor of organic chemistry of Leland Stanford Junior University, has been elected president of the American Chemical Society, succeeding Dr. Edgar F. Smith, of the University of Pennsylvania.

E. B. GERMAIN has been elected president of the Dunlop Tire & Rubber Corporation of America, with local plant on the River Road, Buffalo, N. Y.

Dr. ARTHUR A. HAMERSCHLAG has been elected president of the Research Corporation, vice Elon H. Hooker, resigned.

G. OENSLAGER, of the B. F. Goodrich Co., addressed the Cleveland section of the American Chemical Society, Dec. 27, on "The Rubber Plantation Industry in the Far East and the Preparation of Rubber."

CLARENCE W. POTTEIGER, of Reading, Pa., formerly city chemist and assistant engineer in the State Department of Health, engineering division, has been appointed secretary of the State Engineering Board, Harrisburg.

RICHARD PENFIELD, formerly chief engineer in the research department of The Barrett Co., has recently joined the engineering force of the Grasselli Chemical Co. at Cleveland.

[illegible]T, president of the Perth Amboy Tile Works, Inc., Perth Amboy, N. J., has been elected president of the local New Jersey Clay Miners' & Manufacturers' Association.

Prof. THE SVEDBERG, of the University of Upsala, will be in residence at the University of Wisconsin from Feb. 1 to Aug. 8, 1923. He will give a course of lectures on the general theory of colloids and will direct the experimental researches of graduate students.

GEORGE H. TABER, JR., has resigned as president of the Sinclair Crude Oil Purchasing Co., Philadelphia, Pa., to take active charge of the new oil refinery now in course of construction at Marcus Hook, Pa., for the parent organization, the Sinclair Refining Co.

JOHN MORRIS WEISS, until recently director of development of The Barrett Co., and CHARLES RAYMOND DOWNS, formerly chief chemist of The Barrett Co. and more recently engaged in special plant development work at the Buffalo plant of the National Aniline & Chemical Co., have formed a partnership as consulting chemists and chemical engineers under the name of Weiss & Downs. They have taken an office in the Chemists' Building, 50 East 41st St., New York City, and will shortly have laboratory facilities available there. Both of them are known for their inventions in the fields of coal-tar products, synthetic organic chemicals and catalysis. Recently they received an award of the Howard N. Potts gold medal from the Franklin Institute for the production of maleic acid by the catalytic oxidation of benzene.

Obituary

HERBERT H. HEWITT, founder and president of the Hewitt Rubber Co., Buffalo, N. Y., died at his home Dec. 19, aged 67 years.

FRED A. MARSH, general purchasing agent of the Link-Belt Co., died Dec. 11, at the age of 52, at his home in Chicago. Mr. Marsh was a member of the Link-Belt organization for over 38 years and was one of the organizers of the Purchasing Agents Association of Chicago, serving as its first president.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

Business Conditions in 1922 and the New Year's Prospects

Volume of Production During the Past Year Has Been Satisfactory, Although Not Always Profitable. Outlook for 1923 Is for Greater Stability and Continued Activity

LOOKING BACK over 1922, the reviewer cannot help but be impressed by the substantial gains which have been made in the general business situation. Following the drastic deflation of 1920 and the subsequent depression, it was necessary for business to undergo many fundamental readjustments. And it was these changes that characterized 1921 and the early part of the year just passed. But as the stocks of raw materials and finished products which had piled up during 1921 began to disappear with the first approach of business revival, a very insistent demand for production was developed. At first affecting only the more basic industries, this demand gradually spread until it affected practically every line of business. Furthermore, since this manufacture was almost entirely for current consumption, it may well be expected that the increased productive activity will continue on into the new year.

The improvement during 1922 was made in the face of labor troubles of unprecedented severity, of a discouraging lack of favorable developments abroad and of a serious maladjustment of commodity prices that drastically curtailed the buying power of the country. With these obstacles largely removed, however, and a comparative stability attained both in production and distribution, the new year brings with it every prospect for further improvement both as regards volume of business and the margin of profit in its operation.

SOME COMPARISONS WITH 1921

Production of manufactured commodities in 1922 was about 50 per cent greater than in 1921, according to figures compiled by the Department of Commerce. Textile mills were about 20 per cent more active than in 1921, the iron and steel industry increased its output from 60 to 70 per cent over 1921, non-ferrous metals from 50 to 95 per cent, petroleum 15 per cent, coke 40 per cent, paper 20 to 30 per cent, rubber 40 per cent, automobiles 50 per cent, building construction 50 per cent, lumber 35 per cent, brick 50 per cent, cement 15 per cent, leather 20 per cent, sugar 45 per cent, and meats about 5 per cent. Agricultural receipts were in general higher than in 1921. The only declines of outstanding importance were 7 per cent in bituminous coal and 17 per cent in anthracite.

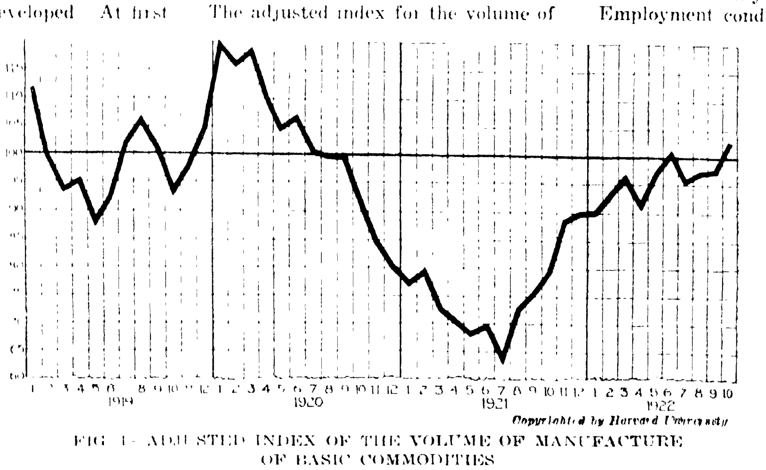


FIG. 1—ADJUSTED INDEX OF THE VOLUME OF MANUFACTURE OF BASIC COMMODITIES

The adjusted index for the volume of manufacture, which is compiled monthly by the Harvard Economic Service, stood at 99.7 for October, 1922, an increase of 6.3 over September and the highest point reached since September, 1920. This rise in the general index, it was pointed out, was due primarily to an increase among the industries producing basic commodities. Thus the Harvard index of basic commodities, which is shown in Fig. 1, rose from 97.3 in September to 102.8 in October, the highest figure reached since June, 1920. The prediction is made that further expansion is to be expected during the first half of 1923.

It is interesting to note that textiles and leather, two industries that are numbered among the largest consumers of chemicals, are now showing record activity. Thus for textiles the index was 117.6, the highest in nearly 3 years. The leather index was 106.8, coincident with the greatest activity since the middle of 1919. With the lower prices for hides and the relatively stable leather market, the tanner's margin of profit has been materially improved.

Employment conditions, perhaps better than any other factor, indicate the change in industry that has occurred since the beginning of 1922. The story in brief is a transformation from widespread unemployment to an acute labor shortage. The 3,233 establishments that report the volume of their employment to the Department of Labor are among 43 manufacturing industries and employ 1,556,537 persons. For each month since August there has been an increase over the preceding month. In November increases in the total number of employees were shown in 31 of the 43 industries. In the 42 establishments that produce chemicals there was a gain of 3.5 per cent in the number of employees and of 1.7 per cent in the amount of the payroll. Among other *Chem. & Met.* industries to show gains are the following: Glass 5.7 per cent in number and 8.6 per cent in amount, iron and steel 2.4 and 8.0 per cent, leather 2.8 and 3.8 per cent, pulp and paper 1.1 and 1.0 per cent and petroleum 3.4 and —5.2 per cent (a decrease).

Wholesale prices have made a gradual rise in 1922 and the index number of the Department of Labor is over 10

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	**171.30**
Last week	168.35
January, 1922	141
January, 1921	181
January, 1920	242
April, 1918 (high)	286
April, 1921 (low)	110

The sharp advance in this week's index number is attributable chiefly to the rise in the price of cottonseed oil and bleaching powder—two of the most important commodities on the list. Slightly lower prices were noted for glycerine and citric acid.

per cent greater than a year ago. Farm products and metals had the greatest relative gains. The index numbers of *Dun's* and *Bradstreet's* showed larger increases during the year, the former rising 13 per cent and the latter 21 per cent.

An increase during November from 154 to 156 in the "all commodities" index of the Bureau of Labor Statistics brings this figure to the highest level since February, 1921, as will be noted in the accompanying chart (Fig. 2). This price curve has shown a tendency to flatten out in recent months and it is this apparent stability that has most favorably affected business.

Chemical Prices

Chemical prices, on the other hand, have followed a somewhat less regular course. After paralleling the general curve in its precipitous drop during the first 5 months of 1921, the *Chem & Met.* weighted index of chemical prices showed a reaction to fairly high levels until October. Another slump, however, which reached its low point in February, 1922, brought the index number down almost to the previous low point in May, 1921.

From January until June of the present year there was a rapid improvement, but this was directly followed by a decline during the summer months of over 10 points. The greater industrial activity that began in October and to some extent the passage of the new tariff on Sept. 21 have been largely responsible for the sharp advances that have resulted in an increase of 17 points since Oct. 1. The trend is clearly shown in Fig. 2, in which chemical prices are compared with those of all commodities.

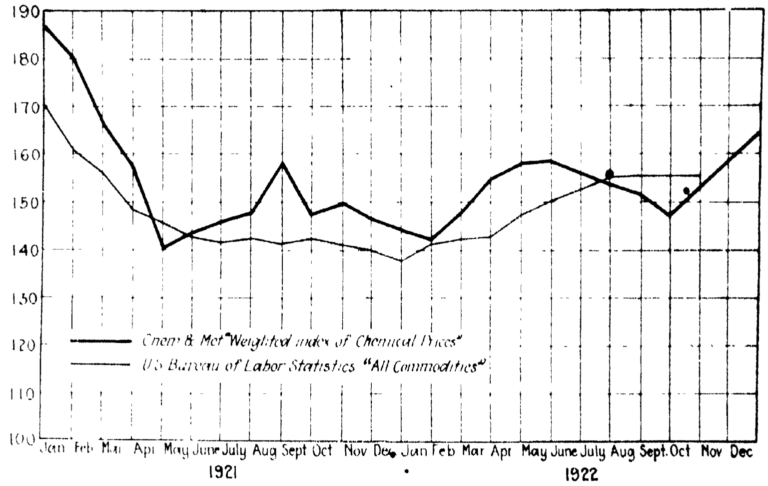


FIG. 2—THE TREND OF WHOLESALE PRICES IN 1921 AND 1922

The Chemical and Allied Markets in 1922

Higher Prices and a More Stable Market Are the Features of a Review of the Year's Activity Among the Sellers of Chemicals and Related Materials

At the close of 1922 the entire chemical list, with the exception of a few commodities of minor importance, were at much higher levels than at the beginning of the year. Although business in general was not up to the expectations of most of the producers, the market was more stabilized and prices throughout were well sustained.

The most important features of the year were the sharp advance of all wood chemicals and solvents and the rise in insecticide prices. Methanol, quoted at 61c. per gal. in January, was advanced to \$1.23 in December. This advance affected all acetates and most of the solvents. Calcium acetate advanced from \$1.75 per 100 lb. to \$3.50. Formaldehyde, quoted at 10½c. in January, was steadily advanced to 16c. per lb. in December. Fusel oil showed a gain of \$1 per gal. for the year. Prices opened at \$2.50 and closed at \$3.50 per gal. Amyl acetate was also advanced from \$2 per gal. to \$2.80. Glacial acetic acid showed a gain of 3c. per lb. for the year. All other grades were advanced on the same basis.

COMPARISON OF THE AVERAGE MONTHLY PRICES IN THE NEW YORK MARKET FOR 45 IMPORTANT CHEMICALS

Article	Unit	Average Price for Month of Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov.	Dec
Acetic acid, glacial	Lb	$0 10	$0 09	$0 09	$0 09	$0 09	$0 08½	$0 09½	$0 12	$0 11½	$0 11	$0 11¼	$0 13
Muriatic acid, 20 deg	100 lb	1 25	1 15	1 15	1 10	1 10	1 10	1 10	1 10	1 10	1 10	1 00	1 00
Nitric acid, 40 deg	Lb	06¼	06¼	06¼	06	06	06	06	06	06	06	05	05½
Oxalic acid	Lb	14	14	14	11½	13½	14	14½	16	17	14½	14½	13½
Sulphuric acid, 66 deg	Ton	16 50	16 00	16 00	17 00	15 50	15 00	15 00	14 50	15 00	15 00	14 50	14 50
Acetate of lead	Lb	10¼	10¼	09¾	09¼	09¾	09¾	09¾	10½	10½	11½	12	.12
Ammonia alum, lump	Lb	03½	03½	03½	03½	03½	03½	03¼	03¼	03¼	03½	03½	03½
Aluminum sulphate, iron free	Lb	02½	02½	02½	02½	02½	02½	02½	02½	02½	02½	02½	02½
Sal ammoniac, white gran	Lb	06½	06¼	07	07	07	06¼	06¼	06¼	06¼	06½	06¾	.06½
Ammonium sulphate	100 lb	2 35	2 50	3 25	3 75	3 60	3 30	.3 50	3 55	3 75	3 65	3 60	3 60
Amyl acetate	Gal	2 00	2 00	2 00	2 00	2 00	2 00	2 00	2 00	2 35	2 35	2 35	2 80
Arsenic, white powder	Lb	07	07¼	07¼	07	07	07¼	08	08¼	08½	10½	13	16
Barium chloride	Ton	50 00	56 00	75 00	95 00	105 00	93 00	90 00	87 00	95 00	100 00	95 00	94 00
Bleaching powder	100 lb	2 25	2 10	1 75	1 60	1 60	1 60	1 60	1 60	1 90	2 00	2 00	2 25
Calcium acetate	100 lb	1 75	1 75	1 75	1 75	1 75	1 75	2 35	2 35	2 35	3 00	3 50	3 50
Camphor..	Lb	90	92	90	82	79	79	80	82	83	86	90	.93
Copperas	Ton	15 00	15 00	15 00	15 00	20 00	20 00	20 00	20 00	20 00	20 00	25 00	25 00
Copper sulphate, crystals	100 lb	5 65	5 60	5 55	5 50	5 75	6 00	6 50	6 50	6 00	5 75	5 75	6 00
Epsom salts, U S P	100 lb	2 65	2 65	2 60	2 50	2 50	2 50	2 00	2 00	2 00	2 00	2 50	2.50
Formaldehyde, 40%	Lb	10½	10	08¼	08½	08½	08¼	07½	08	09½	13½	14	16
Fusel oil, refined	Gal	2 50	2 50	2 50	2 15	2 15	2 25	2 25	2 25	2 75	2 75	3 00	3 55
Glaubers salt	100 lb	1 25	1 15	1 00	85	90	95	90	90	85	85	85	85
Glycerine, c p	Lb	16½	16½	16	15¼	15	14½	15½	16½	17½	18½	18½	18½
Methanol, 95%	Gal	61	59	58	57	57	57	57	57	60	90	1 00	1 23
Nickel salt, single	Lb	12	11	11	11	11	.10½	10	11	12	12	12	11
Phosphorus, red.	Lb	45	45	45	45	45	45	45	45	45	40	40	35
Potassium bichromate..	Lb	10½	10¼	10½	10¼	09½	09¼	09½	10½	10½	10	10	09¾
Potassium bromide, gran	Lb	14	13½	18	17	17	17	17	17	17	17	17	17
Carbonate of potash, 80-85%	Lb	04½	04¼	04½	05	04¾	05	05	05	05	.06	06	05¾
Chlorate of potash, crystals	Lb	05½	05½	05¾	06¼	06¼	06½	06½	06½	07½	07½	07¾	07¾
Caustic potash, 88-92%	100 lb	6 00	5 75	6 00	5 80	5 85	5 75	5 50	6 50	6 50	6 25	6 50	6 25
Permanganate of potash, U.S.P	Lb	14	13½	15	15	14½	14	14	13	15½	16	16	16
Prussiate of potash, yellow	Lb	25	25	26	27	31	32	31½	32½	36	37	38½	38
Salt cake, bulk	Ton	17 00	17 00	17 00	18 00	20 00	20 00	20 00	18 00	25 00	25 00	25 00	25 00
Soda ash, light, 58%	100 lb	1 75	1 70	1 80	1 80	1 90	1 80	1 75	1 75	1 75	1 75	1 75	1 75
Bichromate of soda	Lb	07½	07¾	07¼	07½	07¼	07¼	07	07½	07½	07½	07½	07½
Fluoride of soda..	Lb	10½	09¾	09½	09½	09	10	09½	09½	09	09	09½	09
Cyanide of soda	Lb	26	23½	23½	22	22	22	21	19½	19½	19½	19½	.19½
Caustic soda, solid 76%	100 lb	3 25	3 35	3 65	3 65	3 85	3 80	3 60	3 70	3 60	3 45	3 50	3.50
Nitrate of soda......	100 lb	2 37½	2 37½	2 85	2.90	2 70	2 55	2 60	2 50	2 40	2 45	2 45	2 57½
Prussiate of soda	Lb	17½	18	17½	16½	21	22	21	20½	23	23	21½	.19
Sulphide of soda, 60%....	Lb	.04½	04½	04½	04½	04½	.04½	04½	04	04½	04	.04	.04½
Sulphur, crude......	Ton	18.00	18.00	18 00	18 00	18 00	18 00	18 00	18 00	18 00	18 00	18.00	18.00
Zinc chloride, gran	Lb.	09	09	06	05½	05½	06	.06	06	06	06	.07	.07
Zinc oxide........	Lb.	.07½	.07½	07½	.07½	.07½	07½	.07½	07½	.07½	.07½	.07½	.07½

Arsenic was the most outstanding single commodity of the entire list. Prices showed very little change during the first 6 months, but September importations were unusually small and the demand from the agricultural industry increased considerably. Domestic producers tried hard to keep prices within the reach of consumers, but speculative interests advanced quotations to 16c. per lb. There seems to be very little relief in sight and higher prices are quite probable for 1923. Lead arsenate was advanced in sympathy with the arsenic scarcity and prices showed a gain of 8c. per lb. January figures were around 15c. per lb. They declined to 13c. in July and closed the year at 21c. per lb. Prussiates showed a strong tendency, especially in the potash group. Yellow prussiate of potash was quoted at 24c. in January and continually advanced to 38c. per lb. Red prussiate opened the year at 30c. per lb. and rose to 92c. per lb. at the close.

The alkali market for export was a complete disappointment to producers. The only relief was the very active demand for domestic consumption. Alkali prices showed little variance for the year, with January figures at \$3.25 per 100 lb. and December prices at \$3.50 for caustic soda. Soda ash held at \$1.75 per 100 lb. throughout. Bleaching powder became quite active during the past 2 months and producers reported a heavily sold up market at the works. Prices are due for a rise early in 1923, in view of the strong demand and the pronounced scarcity.

Contract Prices for Bleach are Advanced by the Principal Producers

Holidays and Inventory Period, However, Are Responsible for a General Lack of Buying Interest in the New York Chemical Market

THE chemical market in New York City during the past week has been quite inactive, due to the intervening holidays and the inventory period. Producers of bleaching powder, however, announced an advance for contracts and future shipments and reported a well sold up condition at the works. Second hands have not shown an eager desire to dispose of any stocks and buyers have found some difficulty in locating round quantities. Manufacturers of alkalis and heavy acids reported a satisfactory volume of contract business for 1923 and were quite optimistic regarding business conditions for the new year. Arsenic still remains the bright spot of the market, with spot supplies practically extinct. Formaldehyde prices are being well sustained at recent levels. Prussiates have shown a tendency to ease off and both the potash and soda were fractionally lower. Barium chloride, caustic potash, permanganate of potash and copper sulphate were somewhat firmer at slightly higher levels.

HIGH SPOTS OF THE MARKET

Arsenic—Spot transactions were quite scarce due to the limited stocks. Futures were quoted at 15@15½c. per lb. January delivery. The general range, however, was around 16@16½c. per lb.

Bleaching Powder—Producers announced an increase due to the strong demand and scarcity of stocks. Prices range around \$2 per 100 lb., f.o.b. works, large drums, for futures and contracts. Spot quotations were heard at \$2.25 per 100 lb., in large drums.

Copper Sulphate—Producers have advanced quotations ¼c. per lb. for large crystals, due to the heavy demand for agricultural and export purposes. Quotations range around \$6@\$6.25 per 100 lb.

Caustic Soda—Buying has slackened considerably for spot requirements and the only business consummated is for contract over 1923. Producers quote futures at \$2.50 per 100 lb., basis 60 per cent, f.o.b. works, carload lots. Export quotations range around \$3.50@\$3.60 per 100 lb. standard brand.

Formaldehyde—Resale stocks have greatly diminished and the best price heard on spot was 16c. per lb. Producers quote carload lots at 16c. per lb. and lesser quantities at 16½c. The demand continues quite active.

Prussiate of Soda—Demand has eased off considerably and prices were quoted down to 19c. per lb. on spot. Some stressed lots were heard as low as 18½c.

COMPARISON OF THE AVERAGE MONTHLY PRICES IN THE NEW YORK MARKET FOR 35 IMPORTANT COAL-TAR PRODUCTS

Article	Unit	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
		Average Price for Month of											
Benzene, c.p	Gal	\$0 29	\$0 29	\$0 29	\$0 29	\$0 29	\$0 30	\$0 30	\$0 30	\$0 30	\$0 30	\$0 30	0 30
Cresylic acid, 95-97%	Gal	60	45	45	48	48	50	51	51	51	55	55	55
Dip oil, 25%	Gal	31	27	24½	24	24	24	24	24	24	25	25	25
Solvent naphtha, water, white	Gal	25	25	25	25	25	27	27	27	27	27	37	.37
Toluene, water, white	Gal	30	30	30	30	30	30	30	30	30	30	40	40
Xylene, pure	Gal	40	40	40	40	40	40	40	40	40	40	45	45
H acid	Lb	97	90	85	85	85	85	85	75	72	72	75	75
Phthalic anhydride	Lb	37	37	35	36	35	35	35	35	35	35	37	40
Salicylic acid, tech	Lb	20	18	23	23½	25	25	23	.25	25	29	35	35
Alpha naphthylamine	Lb	.28	28	30	30	30	30	28	28	28	29	28	28
Aniline oil	Lb	17	17	16½	16	15½	14	14	14	15	16	16	.16½
Aniline salt	Lb	25	24	24	24	22	22	22	22	22	22	22	24
Anthracene, 80%	Lb	75	75	75	75	75	75	75	75	75	75	75	75
Benzaldehyde, U.S.P.	Lb	1 35	1 30	1.25	1 25	1 25	1 25	1 25	1 30	1 25	1 25	1 25	1 35
Benzoate of soda, U.S.P.	Lb	52	55	55	55	50	50	53	53	57	57	57	57
Benzidine, base	Lb	85	85	85	85	85	85	85	85	85	85	.85	85
Benzidine, sulphate	Lb	75	75	75	75	75	80	80	80	80	80	75	.75
Beta naphthol, tech	Lb	31	29	28	27	25	23	23	22	23	23	25	.25
Dichlorbenzene	Lb	06	06	06	06	06	06	06	06	06	06	07	07
Dinitrobenzene	Lb	21	21	23	23	22	22	20	20	20	20	20	20
Diethylaniline	Lb	90	95	1 15	85	65	65	65	65	50	50	.50	.50
Dimethylaniline	Lb	40	41	38	38	37	36	36	32	32	32	39	39
Dinitrophenol	Lb	38	35	33	33	33	33	33	32	32	32	32	34
Diphenylamine	Lb	60	60	59	59	59	59	55	54	54	54	54	54
Naphthalene, flake	Lb	07	06¾	06¾	06½	06½	06½	06½	06½	06½	06½	06	06
Naphthalene, ball	Lb	08	07½	08	08	08	08	07½	07½	07½	07½	06½	06½
Nitrobenzene	Lb	10	10	10	10	10	10	10	10	10	10	10	10
Ortho-nitro-toluene	Lb	15	15	12	12	12	10	10	10	10	12	10	12
Para-phenylenediamine	Lb	1 60	1 55	1 50	1 50	1 55	1 55	1 55	1 55	1 55	1 55	1 50	1 50
Para-amidophenol, base	Lb	1 25	1 25	1 25	1 25	1 25	1 25	1 30	1.20	1 20	1 20	1.20	1 15
Para-amidophenol, HCl	Lb	1 45	1 35	1 30	1 30	1 30	1 30	1 35	1 25	1 25	1 25	1 25	1.20
Para-dichlorbenzene	Lb	16½	17	15	15	13½	17	17	17	17	17	.17	.17
Paranitraniline	Lb	77	77	75	75	.75	73	72	72	72	72	.72	.75
Phenol, U.S.P.	Lb	11¾	12	11½	12¼	.14	14	15	23	35	35	34	34
Resorcinol, tech	Lb	1 45	1 30	1 30	1 30	1 30	1 30	1 30	1 50	1 50	1 50	1.50	1.50
Toluidine, mixed	Lb	32	32	32	30	.30	30	30	30	30	30	.30	.30

PRICES OF PRINCIPAL VEGETABLE OILS BY MONTHS, JANUARY-DECEMBER, 1922

Article	Unit	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Castor oil, AA, in bbls	Lb	\$0 11½	\$0 11½	\$0 11½	\$0 11½	\$0 12	\$0 12	\$0 12	\$0 13	\$0 12½	\$0 12½	\$0 12½	\$0.12½
China wood oil, in bbls	Lb.	13½	14¼	14½	13¾	13¾	13¾	12¾	.12½	12½	12½	.12½	.12½
Coconut oil, Ceylon grade in bbls	Lb.	09	08¾	09	08¾	08¾	08½	08½	.08½	08¼	08¾	08½	.08½
Corn oil, crude, in bbls	Lb.	08	08¾	11	11	11½	11¼	11	.10½	10	09	.09	.10½
Cottonseed oil, crude tank cars f.o.b. mill	Lb	07	08½	.10	09¾	10	10	09½	.08½	07½	.07½	.08½	.09
Cottonseed oil, summer yellow	Lb	09	09¼	11¼	12	12	.11¼	11	.10¼	11	.11½	10½	.10
Linseed oil, raw, in bbl., domestic	Gal	70	83	81	84	87	82	89	.87	.88	.90	.86	.90
Palm oil, lagos	Lb.	08	.08	.08	07½	07½	.07½	07	.06½	.06¾	07	.07½	.07½
Peanut oil, crude, tank cars, f.o.b. mill	Lb	07¾	08½	10	09¾	.10	.10	.09½	.09½	.08½	.08½	10	.12
Rapeseed oil, refined, in bbls	Lb	82½	84	.85	.84	.83	.84	.82	.82	.79	.78	.77	.79
Soya bean oil, in bbls. N.Y.	Lb	08½	09	10½	10½	11½	12	12	11½	[illegible]	[illegible]	[illegible]	[illegible]

Coal-Tar Products and Vegetable Oils in 1922

The coal-tar products market has shown practically the same features as the chemical market. All basic commodities, such as benzol, cresylic acid, phenol and toluol, have shown exceptional strength and materially affected the otherwise quiet intermediate market. Although producers of crudes have not advanced prices to any noticeable extent, a pronounced scarcity has existed throughout the year at the works and second hands have demanded a premium on any spot material. Cresylic acid is quoted at 60c. per gal. for future delivery. Resale material, on the other hand, has brought as high as $1 per lb. Aniline oil and beta naphthol have completely recovered from their recent slump and producers have reported a satisfactory volume of business during the past 2 months. Phenol was quoted at 12c. per lb. during the early part of the year and steadily advanced to 34c. per lb at the close. Producers reported a completely sold up market at the works since August and very little relief seems to be in sight for the early part of 1923

Conditions in the market during the last quarter seemed quite satisfactory to leading dealers. Prices for most commodities were at higher levels at the close of the year than at any time during 1922 Cottonseed oil was quoted at 7c. per lb in January and advanced to 9c. per lb in December All indications point to a higher market for 1923 Linseed oil recorded a gain of 20c per gal. for the year. Prices early in the year were quoted at 70c. per gal and gradually advanced to 90c

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The Other Side of the Ledger

In a recent editorial in the *Nation's Business* it has been pointed out that even in the boom year of 1920 not all corporative enterprises were successful. In fact, a large proportion of them showed no net income at all, according to the income tax statistics which have just been published by the Treasury Department. Ten thousand firms were "in the red." Of the corporations producing chemical and allied products, 47 per cent showed no income. This proportion was exceeded by only two industries—namely, mining and quarrying, with 60 per cent, and rubber and rubber goods with 58 per cent.

The proportion of corporations showing no net income for the year 1920 follows:

Industry	Per Cent
Mining and quarrying	60
Rubber and rubber goods	58
Chemical and allied products	47
Textiles and products	45
Food products, liquor and tobacco	45
Leather and products	43
Transportation and other public-utilities	37
Trade	34
Metal and metal products	33
Public service, professional amusements, hotels, etc	32
Finance, banking and insurance	30
Construction	30
Stone, clay and glass	37
Lumber and wood products	27
Printing and publishing	21
Paper, pulp and products	20

Steel Market Ends Year in Good Condition

Price Situation Better Than Was Expected a Few Months Ago—Mills Sustaining Production

PITTSBURGH, Dec. 29, 1922.

While it would be extravagant to say that the steel market is ending the year in a blaze of glory, it is ending it much better than was expected. An outstanding feature of the general condition, indeed, is that a rather large volume of business is being put through with a minimum of excitement. Orders are placed smoothly and easily, one mill or another being able to arrange the delivery desired provided the buyer is willing to pay the full market price The business that fails to go through is the business the buyer expects to place at a price concession. The market presents a strong contrast with that of the summer and early autumn in that excitement is lacking, but the volume of tonnage is not to be judged by such appearances The mills are quietly filling up. Some will soon be completely filled for first quarter, while others, which 2 months ago seemed likely to be unable to maintain production even to the end of the year, are now in comfortable position and with several weeks of full operation already assured

The market is in much better condition than was expected a month or two months ago It is more or less customary for buyers to ask mills to discontinue or decrease shipments in December, to lighten the work of inventory taking, but no such disposition has been exhibited this year. Only in very occasional instances have mills decreased production in the past month, although there are some cases of departments being closed for repairs.

PRICE SITUATION STRONG

The price situation is correspondingly strong and is better than was expected. Bars, shapes and plates were expected by many observers to be lower by this time, even 1.75c. having been mentioned a couple of months ago as a possibility. Instead, the regular 2c. price is more strictly observed than was the case in November. The market may indeed be described as firm at that level. Some large consumers have been expecting a concession on their first quarter requirements, but have been offered nothing outside of the regular price, and it is now hinted they may not receive full supplies if they delay further in placing their commitments.

In the sheet market the reports current 3 weeks ago of two or three mills making slight concessions from the regular price have disappeared. The market seems to be very firm on the basis of 3.35c., for common black, with galvanized at 4.35c. and blue annealed at 2.50c. The announcement of the Brier Hill Steel Co. of an advance in its price from 3.35c. to 3.50c. is now, however, taken seriously by other sellers. Incidentally, arrangements have been practically concluded whereby the Youngstown Sheet & Tube Co. will absorb this interest. Special finish sheets have been in particular demand, and of all the sheet mills, those that make special finish sheet mills have the larger order books. According to delivery and other conditions automobile sheets are bringing 4.70c., 4.85c. and 5c.

Tin plate is moving in a moderate way, with little contracting for the half year but with heavy buying in specific orders for the early months. The regular price of $4.75 is being generally observed. Many independent producers had expected the Steel Corporation to make an advance in naming its prices for the new period. Predictions in the trade are that domestic consumption in 1923 will be very large, stocks of canned goods being quite moderate. On the whole, domestic consumption in the past year was probably well ahead of that in any previous year. Production was about 1,400,000 gross tons, against 1,512,000 tons in the record year, 1917, but exports were much lighter.

Demand for tubular goods continues heavy. The open weather has helped building operations as well as work in the oil fields. The National Tube Co. has most of its finishing departments closed this week for necessary repairs, but is maintaining steel production as far as possible. It has just purchased 10,000 tons of bessemer billets from a Pittsburgh independent at $36.50 Pittsburgh, the regular market, to supplement its regular supplies in making butt weld pipe

Demand for wire products continues heavy, with some producers sold as far ahead as they usually care to sell. Prices are firm on the basis of 2.45c. for plain wire and $2.70 for nails.

COKE AND PIG IRON

Foundry pig iron at valley furnace has advanced another dollar a ton, being firm now at $27 furnace, while the first quarter buying movement, early in December, was at $25. There was more iron bought on that movement than furnaces expected to sell when they made the price offer. All producers of foundry iron seem to be in comfortable position as to sales, while some are probably not in comfortable position as to coke supplies, since the advancing market of the past fortnight, due to purchasers for domestic consumption, has produced prices quite out of line with pig iron prices. Basic iron has not responded to the general stiffening tendency to any great extent, probably because there are several steel works willing to sell iron, but the market seems to be at about $25 valley, which compares with a few sales made recently at about $24.25. Bessemer is quiet at $27.50.

Buying of Connellsville coke by Eastern distributers for domestic use has been lighter in the past week, simply because there is no longer much coke to be picked up. Some domestic demand from the West has developed this week. The market is quotable at $9@$9.50, rather irrespective of grade, an advance of $2.50 to $3, from the recent minimum.

Current Prices in the New York Market

FOR CHEMICALS, OILS AND ALLIED PRODUCTS

Although these prices are for the spot market in New York City, a special effort has been made to report the American manufacturer's quotations whenever available. In many instances these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported and resale stocks are reported when of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb	$0 39 –	$0 41
Acetone drums	lb	21	21½
Acid, acetic, 28%, barrels	100 lb	3 50	3 60
Acetic, 56%, barrels	100 lb	7 00	7 15
Acetic, glacial, 99½%, carboys	100 lb	12 80	13 25
Boric, crystals, barrels	lb	11½ –	11¾
Boric, powder, barrels	lb	11 –	11
Citric, kegs	lb	49 –	50
Formic, 85%	lb	18 –	19
Gallic, tech	lb	45 –	50
Hydrochloric, 18 deg., tanks	100 lb	80 –	1 00
Hydrofluoric, 52%, carboys	lb	.11 –	11
Lactic, 44%, tech., light, barrels	lb	11 –	11½
Lactic, 22%, tech., light, barrels	lb	05 –	05½
Muriatic, 20 deg., tanks	100 lb	1 00 –	1 10
Nitric, 36 deg., carboys	lb	04½	05
Nitric, 42 deg., carboys	lb	06	06½
Oleum 20%, tank	ton	17 00	18 00
Oxalic, crystals, barrel	lb	13	13½
Phosphoric 50%, carboy	lb	07½	08
Pyrogallic, resublimed	lb	1 50 –	1 60
Sulphuric, 60 deg., tanks	ton	9 00	10 00
Sulphuric 60 deg., drum	ton	12 00	14 00
Sulphuric, 66 deg., tanks	ton	14 50	15 00
Sulphuric, 66 deg., drum	ton	19 00	20 00
Tannic, U.S.P., barrels	lb	65	70
Tannic, tech., barrels	lb	40	45
Tartaric, imported, cry., barrels	lb	30½	31
Tartaric, imported, powd., barrels	lb	31 –	32
Tartaric, domestic, barrel	lb		32
Tungstic, per pound of WO_3	lb	1 00	1 20
Alcohol, butyl, drums	gal	18	23
Alcohol, ethyl (Cologne spirit), barrels	gal	4 75	4 95
Alcohol, methyl, 95%, barrel	gal	1 23	1 25
Alcohol, methyl, 97%, barrel	gal	1 25	1 27
Alcohol, denatured, 188 proof No. 1	gal	39 –	41
Alcohol, denatured, 188 proof No. 5	gal	38	40
Alum, ammonia, lump, barrels	lb	03½ –	03¾
Alum, potash, lump, barrels	lb	03¼ –	03½
Alum, chrome lump, potash, barrels	lb	05	05¼
Aluminum sulphate, com., bags	100 lb	1 50	1 65
Aluminum sulphate, iron free, bags	lb	.02½ –	02¾
Aqua ammonia, 26 deg., drums	lb	06¾	07¼
Ammonia, anhydrous, cyl.	lb	.3	30½
Ammonium carbonate, powd., casks	lb	09	09½
Ammonium nitrate, tech., casks	lb	07¼ –	07½
Amylacetate tech., drum	gal	2 80	3 05
Arsenic, white, powd., barrels	lb	16	16½
Arsenic, red, powd., kegs	lb	13½ –	14
Barium carbonate, barrels	ton	75 00	77 00
Barium chloride, barrel	ton	94 00	100 00
Barium dioxide, drums	lb	18 –	18½
Barium nitrate, casks		08½ –	08
Barium sulphate, barrels	lb	04 –	04½
Blanc fixe, dry, barrel	lb	04 –	04½
Blanc fixe, pulp, barrels	ton	45 00 –	55 00
Bleaching powder, f.o.b. wks., drums	100 lb	2 00	2 50
Bleaching powder, drum, resale	100 lb	2 25	2 50
Borax, barrels	lb	05½	05¾
Bromine, cases	lb	27	28
Calcium acetate, bags	100 lb	3 50	3 60
Calcium carbide, drums	lb	04 –	04¼
Calcium chloride, fused, drums	ton	22 00	23 00
Calcium chloride, gran., drums	lb	.01½ –	01¾
Calcium phosphate, mono., barrels	lb	.06½ –	07
Camphor, cases	lb	95 –	96
Carbon bisulphide, drums	lb	07 –	07¼
Carbon tetrachloride, drums	lb	.10 –	10¼
Chalk, precip.—domestic, light, barrels	lb	04¼ –	04½
Chalk, precip.—domestic, heavy, barrels	lb	03½ –	03¾
Chalk, precip.—imported, light, barrels	lb	$ 04½ –	$ 05
Chlorine, liquid, cylinders	lb	06 –	06½
Chloroform, tech., drums	lb	35 –	38
Cobalt oxide, barrels	lb	2 10 –	2 25
Copperas, bulk, f.o.b. wks.	ton	20 00 –	22 00
Copper carbonate, barrels	lb	20	20½
Copper cyanide, drums	lb	50 –	55
Copper sulphate, crystals, barrel	100 lb	6 00 –	6 25
Cream of tartar, barrel	lb	25 –	26
Dextrine, corn, bags	lb		–
Epsom salt, domestic, tech., barrels	100 lb	2 10 –	2 25
Epsom salt, imported, tech., bags	100 lb	1 10 –	1 25
Epsom salt, U.S.P., domestic, barrel	100 lb	2 50	2 75
Ether, U.S.P., drums	lb	13 –	15
Ethyl acetate, com. 85%, drum	gal	80 –	85
Ethyl acetate, pure (acetic ether 98% to 100%)	gal	95 –	1 00
Formaldehyde, 40%, barrels	lb	16	16½
Fullers earth, f.o.b. mine	net ton	16 00	17 00
Fuller earth, imported, powd.	net ton	30 00	32 00
Fusel oil, ref., drums	gal	3 55 –	4 05
Fusel oil, crude, drums	gal	2 30	2 40
Glauber's salt, f.o.b. wks., bags	100 lb	1 20	1 40
Glauber's salt, impt., bags	100 lb	1 00	1 25
Glycerine, c.p., drums extra	lb	18 –	19
Glycerine, dynamite, drums	lb	16 –	17
Iodine, resublimed	lb	4 50 –	4 60
Iron oxide, red, casks	lb	12 –	18
Lead:			
White, basic carbonate, dry, casks	lb	08 –	08½
White, in oil, kegs	lb	10½ –	12
Red, dry, casks	lb	10½	10½
Red, in oil, kegs	lb	12 –	14
Lead acetate, white crystals, barrel	lb	12	12½
Lead arsenate, powd., barrels	lb	21	22
Litharge, com., casks	lb	09½ –	10
Lithophone, barrels	lb	06½ –	06½
Magnesium carbonate, tech., bags	lb	07 –	07½
Nickel salt, double barrels	lb	10	10½
Nickel salts, single barrels	lb	11 –	11½
Phosgene	lb	60 –	75
Phosphorus, red, cases	lb	35 –	40
Phosphorus, yellow, cases	lb	30 –	35
Potassium bichromate, casks	lb	09½ –	10
Potassium bromide, granular, barrel	lb	18	25
Potassium carbonate, 80-85%, calcined, casks	lb	05 –	05½
Potassium chlorate, powd.	lb	07½	08
Potassium cyanide, drums	lb	47 –	50
Potassium hydroxide (caustic potash) drums	100 lb.	6 25 –	6 50
Potassium iodide, cases	lb	3 55 –	3 65
Potassium nitrate, barrels	lb	.06½ –	06¾
Potassium permanganate, drum	lb.	16 –	16½
Potassium prussiate, red, casks	lb.	92 –	95
Potassium prussiate, yellow, casks	lb	38 –	39
Salammoniac, white, gran., casks	lb	06½ –	06¾
Salammoniac, gray, gran., casks	lb	08 –	08½
Salsoda, barrels	100 lb	1 20 –	1 40
Salt cake (bulk)	ton	25 00 –	27 00
Soda ash, light, 58% flat, bags, contract	100 lb	1 60 –	1 67
Soda ash, light, basis 48%, bags, contract, f.o.b. wks.	100 lb	1 20 –	1 30
Soda ash, light, 58%, flat, bags, resale	100 lb	1 75 –	1 80
Soda ash, dense, bags, contract, basis 48%	100 lb	1.17½ –	1 20
Soda ash, dense, in bags, resale	100 lb	1 85 –	1 90
Caustic soda, 76%, solid, drums, f.a.s.	100 lb.	3 50 –	3 75
Caustic soda, 76%, solid, drums, contract	100 lb.	3 35 –	3 40
Caustic soda, basis 60%, wks., contract	100 lb.	$2.50 –	$2 60
Caustic soda, ground and flake, contracts	100 lb.	3 80 –	3 90
Caustic soda, ground and flake, resale	100 lb	$4 00 –	$4 15
Sodium acetate, works, bags	lb	07½ –	07¾
Sodium bicarbonate, barrels	100 lb.	1 75 –	1 85
Sodium bichromate, casks	lb	07½ –	07¾
Sodium bisulphate (niter cake)	ton	6 00 –	7 00
Sodium bisulphite, powd., U.S.P., barrels	lb	04¼ –	04½
Sodium chlorate, kegs	lb	06 –	07
Sodium chloride	long ton	12.00 –	13 00
Sodium cyanide, cases	lb.	19½ –	23
Sodium fluoride, barrels	lb	09 –	09½
Sodium hyposulphite, barrels	lb	03 –	.03½
Sodium nitrite, casks	lb	08¼ –	09
Sodium peroxide, powd., cases	lb	.28 –	30
Sodium phosphate, dibasic, barrels	lb.	.03¼ –	.04
Sodium prussiate, yellow drums	lb.	.19 –	20
Sodium silicate (40 deg. drums)	100 lb	1.25 –	1 30
Sodium silicate (60 deg. drums)	100 lb	2 25 –	2 40
Sodium sulphide, fused, 60-62%, drums	lb	04½ –	04¾
Sodium sulphite, crys., barrels	lb.	03½ –	03¾
Strontium nitrate, powd., barrels	lb	09½ –	10
Sulphur chloride, yellow drums	lb	04½ –	05
Sulphur, crude	ton	18 00 –	20 00
Sulphur dioxide, liquid, cyl.	lb	08 –	08½
Sulphur, flour, barrels	100 lb	2 50 –	3 15
Sulphur, roll, barrels	100 lb.	2 15 –	2 20
Talc—imported, bags	ton	30 00 –	40.00
Talc—domestic powd., bags	ton	18 00	25 00
Tin bichloride, barrels	lb	10½ –	10¾
Tin oxide, barrel	lb	45 –	47
Zinc carbonate, bags	lb	14 –	14½
Zinc chloride, gran., barrels	lb	07 –	07½
Zinc cyanide, drums	lb	42 –	44
Zinc oxide, XX, barrels	lb	07½ –	08
Zinc sulphate, barrels	100 lb.	2 75 –	3 00

Coal-Tar Products

Alpha-naphthol, crude, barrels	lb	0 95 –	1.00
Alpha-naphthol, ref., barrels	lb	1 05 –	1.10
Alpha-naphthylamine, bbl	lb.	.28 –	.30
Aniline oil, drums	lb	16½ –	.17
Aniline salts, barrels	lb	24 –	25
Anthracene, 80%, drums	lb.	75 –	1.00
Anthracene, 80%, imp. drums, duty paid	lb.	.65 –	.70
Anthraquinone, 25%, paste, drums	lb	.70 –	.75
Benzaldehyde, U.S.P., carboys	lb	1.35 –	1 40
Benzene, pure, water-white, drums	gal	30 –	35
Benzene, 90%, drums	gal	28 –	32
Benzene, 90%, drums, resale	gal	37 –	40
Benzidine base, barrels	lb	.85 –	90
Benzidine sulphate, barrels	lb	75 –	80
Benzoic acid, U.S.P., kegs	lb.	70 –	.75
Benzoate of soda, U.S.P., barrels	lb.	57 –	.65
Benzyl chloride, 95-97%, ref., drums	lb	25 –	.27
Benzyl chloride, tech., drums	lb	.20 –	.23
Beta-naphthol, sublimed, barrels	lb	.55 –	.60
Beta-naphthol, tech., barrels	lb	.25 –	.26
Beta-naphthylamine, tech.	lb	1 00 –	1.25
Carbazol, barrels	lb	.75 –	.90
Cresol, U.S.P., drums	lb	14 –	.20
Ortho-cresol, drums	lb.	18 –	.22
Cresylic acid, 97-99%, drums	gal.	60 –	.65
Cresylic acid, 95-97%, drums	gal.	.55 –	.58
Cresylic acid, 97%, resale, drums	gal.	1.00 –	1.05
Dichlorbenzene, drums	lb.	07 –	.09
Diethylaniline, drums	lb.	.50 –	.60
Dimethylaniline, drums	lb.	.39 –	.41
Dinitrobenzene, barrels	lb.	.20 –	.22
Dinitroclorbenzene, barrels	lb.	.22 –	.23
Dinitronaphthalene, barrels	lb.	.3	.32

Dinitrophenol, barrels	lb.	$ 34 -	$ 36
Dinitrotoluene, barrels	lb	22 -	.24
Dip oil, 25%, drums	gal	25 -	.30
Diphenylamine, barrels	lb	54 -	56
H-acid, barrels	lb.	.75 -	.80
Meta-phenylenediamine, barrels	lb.	95 -	1 00
Michler's ketone, barrels	lb	3 75 -	3 85
Monochlorbenzene, drums	lb	08 -	10
Monoethylaniline, drums	lb	95 -	1 10
Naphthalene crushed, barrels	lb	05½-	06
Naphthalene, flake, barrels	lb	06 -	06½
Naphthalene, balls, barrels	lb	06½-	07
Naphthionate of soda, barrels	lb.	.58 -	.65
Naphthionic acid, crude, barrels	lb	60 -	65
Nitrobenzene, drums	lb	10 -	12
Nitro-naphthalene, barrels	lb	30 -	35
Nitro-toluene, drums	lb	15 -	17
N-W acid, barrels	lb.	1 20 -	1 30
Ortho-amidophenol, kegs	lb	2 25 -	2 30
Ortho-dichlor-benzene, drums	lb	17 -	20
Ortho-nitro-phenol, barrels	lb	85 -	90
Ortho-nitro-toluene, drums	lb	12½	14
Ortho-toluidine, barrels	lb	14 -	16
Para-amidophenol, base, kegs	lb	1 15 -	1 20
Para-amidophenol, HCl, kegs	lb	1 20 -	1 25
Para-dichlorbenzene, barrels	lb	17 -	20
Paranitroaniline, barrels	lb	75 -	80
Para-nitrotoluene, barrels	lb	55 -	65
Para phenylenediamine, barrels	lb	1 50 -	1 55
Para-toluidine, barrels	lb	85 -	90
Phthalic anhydride, barrels	lb	40 -	50
Phenol, U S P, drums	lb	34 -	35
Picric acid, barrels	lb	20 -	22
Pyridine, domestic, drums	gal	1 60 -	1 75
Pyridine, imported, drums	gal	1 40 -	1 60
Resorcinol tech, kegs	lb	1 50 -	1 55
Resorcinol pure, kegs	lb	2 00 -	2 10
R-salt, barrels	lb	55 -	60
Salicylic acid, tech, barrels	lb	35 -	37
Salicylic acid, U S P, barrels	lb	.40 -	42
Solvent naphtha, water white, drums	gal.	37 -	40
Solvent naphtha, crude, drums	gal	22 -	24
Sulphanilic acid crude, barrels	lb	20 -	22
Thiocarbanilide, kegs	lb	35 -	38
Toluidine kegs	lb	1 20 -	1 30
Toluidine mixed, kegs	lb	30 -	35
Toluene, tank cars	gal	35 -	37
Toluene drums	gal	40 -	43
Xylidine drums	lb	40 -	45
Xylene pure, drums	gal	45 -	50
Xylene pure tanks	gal	45 -	
Xylene, com, drums	gal	40 -	42
Xylene com, tanks	gal	30 -	

Naval Stores

Rosin B-D, barrel	280 lb	$6 10	
Rosin E-I, barrel	280 lb	6 20 -	
Rosin K-N, barrels	280 lb	6 30	$6 85
Rosin W G W W, barrels	280 lb	7 75 -	8 25
Wood rosin, barrels	280 lb	6 25	
Spirits of turpentine, barrels	gal	1 36 -	1 37
Wood turpentine, steam dist, barrels	gal	1 35 -	
Wood turpentine, dest dist, barrels	gal	1 25 -	
Pine tar pitch, barrels	200 lb	-	6 00
Tar, kiln burned, barrels (500 lb)	bbl	-	12 50
Retort tar, barrels	500 lb	-	11 00
Rosin oil, first run, barrels	gal	43 -	
Rosin oil, second run, barrels	gal	51 -	
Rosin oil, third run, barrels	gal	53 -	
Pine oil, steam dist	gal	-	90
Pine oil pure dest dist	gal	-	85
Pine tar oil, ref	gal	-	46
Pine tar oil crude, tank f o b Jacksonville, Fla	gal	-	35
Pine tar oil, double ref, barrels	gal	-	75
Pine tar, ref, thin barrels	gal	-	.25
Pinewood creosote, ref, barrels	gal	-	.52

Vegetable Oils

Castor oil, No 3, barrels	lb.	$0 12 -	$0 12½
Castor oil, AA, barrels	lb	12½-	13
China wood oil, barrels	lb.	.12½	.12¾
Coconut oil, Ceylon grade, barrels	lb.	08½-	.08¾
Coconut oil, Cochin grade, barrels	lb.	.09 -	09¼
Corn oil, crude, barrels	lb.	.10½-	.10¾
Cottonseed oil, crude (f o b. mill), tanks	lb.	.09 -	
Cottonseed oil, summer yellow, barrels	lb.	.10½-	11
Cottonseed oil, winter yellow, barrels	lb.	.11 -	.11½
Linseed oil, raw, car lots (domestic), barrels	gal.	.90 -	.91
Linseed oil, raw, tank cars (domestic)	gal.	.86 -	87
Linseed oil, boiled, 5-barrel lots (domestic)	gal.	92 -	.93
Olive oil, denatured, barrels	gal.	1 05 -	1 12
Palm, Lagos, casks	lb.	.07½-	.07¾
Palm kernel, barrels	lb.	.08 -	.08½
Peanut oil, crude, tanks (f.o.b. mill)	lb.	.12 -	.12½
Peanut oil, refined, barrels	lb.	.13½-	.14
Rapeseed oil, refined, barrels	gal.	.79 -	.80
Rapeseed oil, blown, barrels	gal	$ 86	$ 87
Soya bean oil (Manchurian), barrels	lb	11½-	
Soya bean oil, tank, f o b, Pacific coast	lb	09½-	09¾

Fish Oils

Light pressed menhaden, barrels	gal	$0 60 -	.
White bleached menhaden, barrels	gal	64 -	65
Blown menhaden, barrels	gal	.68 -	.69
Whale Oil No 1 crude, tanks, coast	lb	06 -	06½

Dye & Tanning Materials

Divi-divi, bags	ton	$38 00	$39 00
Fustic, sticks	ton	30 00	35 00
Fustic, chips, bags	lb	04 -	05
Logwood, sticks	ton	28 00 -	30 00
Logwood chips, bags	lb	02½ -	03½
Sumac, leaves, Sicily, bags	ton	65 00	
Sumac, ground, bags	ton	55 00	60 00
Sumac, domestic, bags	ton	35 00 -	
Tapioca flour, bags	lb	03¾ -	05

EXTRACTS

Archil, conc, barrels	lb	$0 18 -	$0 20
Chestnut, 25%, tannin tanks	lb	02 -	03
Divi-divi, 25%, tannin, barrels	lb	04 -	05
Fustic, crystals, barrels	lb	20 -	22
Fustic, liquid, 42 deg, barrels	lb	08 -	09
Gambier liquid, 25%, tannin barrels	lb	08 -	.09
Hematine crystals, barrels	lb	14 -	18
Hemlock, 25%, tannin, barrels	lb	04 -	05
Hypernic solid, drums	lb.	.24 -	.26
Hypernic, liquid, 51 deg, barrels	lb	14 -	17
Logwood, crystals, barrels	lb	.19 -	.20
Logwood, liquid, 51 deg barrels	lb	09 -	10
Quebracho solid, 65%, tannin, barrels	lb	04¼-	.05
Sumac, domestic, 51 deg, barrels	lb	06½-	.07

Waxes

Bayberry, barrels	lb	$0 28 -	$0 30
Beeswax, refined, dark, bags	lb	30 -	32
Beeswax, refined, light, bags	lb	34 -	35
Beeswax pure white, cases	lb	39 -	40
Candelilla, bags	lb	34 -	35
Carnauba No 1, bags	lb	39 -	40
Carnauba No 2 North Country bags	lb	23 -	24
Carnauba, No 3 North Country, bags	lb	17½-	18
Japan, cases	lb	15 -	15½
Montan, crude, bags	lb.	03½-	04
Paraffine, crude, match, 105-110 m p	lb.	.04 -	04¼
Paraffine, crude, scale 124-126 m p, bags	lb.	02½-	02¾
Paraffine ref, 118-120 m p, bags	lb	.03½-	.03½
Paraffine, ref, 125 m p bags	lb.	.03¾-	03½
Paraffine, ref, 128-130 m p, bags	lb.	.04 -	.04¼
Paraffine, ref, 133-135 m p, bags	lb.	.04½-	04¾
Paraffine, ref, 135-137 m p, bags	lb	05 -	05¼
Stearic acid, single pressed, bags	lb	.10 -	10¼
Stearic acid, double pressed, bags	lb	10½-	10¾
Stearic acid, triple pressed, bags	lb	11 -	.11½

Fertilizers

Ammonium sulphate, bulk, f o b works	100 lb	$3 20 -	$3 25
Ammonium sulphate, f a s, N Y, double bags	100 lb	3 65 -	3.75
Blood, dried, f o b, N Y, bulk	unit	4 60 -	.
Bone, 3 and 50, ground, raw, bulk	ton	30 00 -	35 00
Fish scrap, dom, dried, f o b works	unit	5 00 -	5 10
Nitrate of soda, bags	100 lb	2 57½-	2 60
Tankage, high grade, f o b Chicago	unit	4 60 -	4 65
Phosphate rock, f o b mines, Florida pebble, 68-72%	ton	3 50 -	4 00
Tennessee, 78-80%	ton	7 00 -	8 00
Potassium muriate, 80%, bags	ton	35 55 -	38 25
Potassium sulphate, bags	unit	1 00 -	. . .

Crude Rubber

Para—Upriver fine	lb.	$0 25½-	.25¾
Upriver coarse	lb	17½-	.17¾
Upriver caucho ball	lb.	.20½-	.20¾
Plantation—First latex crepe	lb.	.27½-	.27¾
Ribbed smoked sheets	lb.	.27½-	.27¾
Brown crepe, thin, clean	lb	.23 -	.23½
Amber crepe No. 1	lb.	.23 -	.23½

Miscellaneous Materials

Asbestos, crude No 1 f o b, Quebec	short ton	$650 00	$700 00
Asbestos, shingle, f o b, Quebec	short ton	60.00 -	80 00
Asbestos, cement, f o b, Quebec	short ton	15.00 -	17 00
Barytes, ground, white, f o b mills, barrels	net ton	16 00 -	20 00
Barytes, ground, off color f o b mills bulk	net ton	13.00 -	21 00
Barytes, floated, f o b St Louis, barrels	net ton	23.00 -	24 00
Barytes, crude f o b mines bulk	net ton	8 00 -	9 00
Casein, barrels, tech	lb	.12 -	14
China clay (kaolin) crude, f o b Georgia	net ton	6.00 -	8.00
China clay (kaolin) washed, f o b Georgia bulk	net ton	8.00 -	9 00
China clay (kaolin) powd, f o b Georgia, bulk	net ton	14.00 -	20 00
China clay (kaolin) crude f o b Virginia	net ton	8.00 -	12 00
China clay (kaolin) ground, f o b Virginia	net ton	13 00 -	20 00
China clay (kaolin), imp lump, bulk	net ton	14 00 -	20 00
China clay (kaolin), imp, powd, bulk	net ton	40 00 -	45 00
Feldspar, No 1 pottery grade, bulk	long ton	5 50	7 00
Feldspar No 2 pottery grade, bulk	long ton	4 00 -	5 50
Feldspar, No 1 soap grade bulk	long ton	7 00 -	7 50
Feldspar, No 1 Canadian f o b mill bulk	long ton	20.00 -	21 00
Graphite, Ceylon lump first quality f o b N Y, barrels	lb	.05 -	.05½
Graphite, Ceylon chip, barrels	lb.	.04 -	04½
Graphite high grade amorphous crude, bulk	ton	35.00 -	50 00
Gum Arabic, amber, sorts, bags	lb	.15 -	16
Gum tragacanth, sorts, bags	lb	.50 -	60
Gum tragacanth No 1, bags	lb.	1.75 -	1 80
Kieselguhr, f o b, Cal, bulk	ton	40.00 -	42.00
Kieselguhr, f o b N Y, bulk	ton	50.00 -	55 00
Magnesite, crude, f o b Cal, bulk	ton	12.00 -	15 00
Pumice stone imp, casks	lb.	.03 -	.05½
Pumice stone, dom., lump, barrels	lb.	.05 -	05½
Pumice stone dom, ground, barrels	lb	.06 -	.07
Shellac, orange fine, bags	lb.	.74 -	.75
Shellac, orange superfine, bags	lb.	.76 -	.77
Shellac, A C garnet, bags	lb.	.75 -	.77
Shellac T N, bags	lb.	.72 -	.73
Silica, glass sand, f o b Indiana, bulk	ton	1.75 -	2 50
Silica, sand blast material f o b Indiana, bulk	ton	2.50 -	5 00
Silica amorphous, 250-mesh, f o b Illinois, bulk	ton	17.00 -	17 50
Silica, building sand, f o b Pa, bulk	ton	2 00 -	2 75
Soapstone, coarse, f o b Vermont, bags	ton	7.00 -	8 00
Talc, 200 mesh, f o b Vermont, bags	ton	7.00 -	12 00
Talc, 200 mesh, f o b Georgia, bags	ton	7.50 -	12.00
Talc, 200 mesh, f o b Los Angeles, bags	ton	15.00 -	17.00

Refractories

Bauxite brick, 56% Al_2O_3, f o b Pittsburgh	ton	$45-50
Chrome brick, f o b Eastern shipping points	ton	50
Chrome cement, 40-50%, Cr_2O_3	ton	23-27
Chrome cement, 40 45%, Cr_2O_3, sacks, f o b Eastern shipping points	ton	23 00
Fireclay brick, 1st quality, 9-in shapes, f o b, Pa, Ohio and Kentucky works	1,000	43-46
Fireclay brick, 2nd quality, 9-in shapes, f o b Pa, Ohio and Kentucky works	1,000	39-41
Magnesite brick, 9-in straight (f o b works)	ton	70-75
Magnesite brick, 9-in arches, wedges and keys	ton	85-90
Magnesite brick, soaps and splits	ton	90
Silica brick, 9-in sizes, f o b Chicago district	1,000	48-50

Silica brick, 9-in sizes, f.o.b. Birmingham district	1,000	$50 53
Silica brick, 9-in sizes, f.o.b. Mt Union, Pa.	1,000	45–47
Silicon carbide refractory brick, 9-in	1,000	1,100 00

Ferro-Alloys

Ferrotitanium 15-18 %, f.o.b. Niagara Falls, N. Y.	ton	$200 00	$225 00
Ferrochromium, per lb. of Cr contained, 6-8% carbon	lb	11	11½
Ferrochromium, per lb. of Cr contained 4-6% carbon	lb	11½	12
Ferromanganese, 78-82% Mn, Atlantic seaboard duty paid	gross ton	100 00	105 00
Spiegeleisen, 19-21%, Mn	gross ton	38 00 -	39 00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb	2 00	2 25
Ferrosilicon, 10-15%	gross ton	38 00	40 00
Ferrosilicon, 50%	gross ton	75 00 -	80 00
Ferrosilicon 75%	gross ton	115 00	120 00
Ferrotungsten, 70-80 %, per lb. of contained W	lb	85	95
Ferro-uranium, 35-50 % of U, per lb. of U content	lb	6 00	
Ferrovanadium, 30-40 % per lb. of contained V	lb	3 50	4 00

Ores and Semi-finished Products

Bauxite, domestic, crushed and dried, f.o.b. shipping points	ton	$6 00	$9 00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22 00	23 00
Chrome ore, 50%, Cr_2O_3, c.i.f. Atlantic seaboard	ton	18 50	19 00
Coke, foundry, f.o.b. ovens	ton	8 50	9 00
Coke, furnace, f.o.b. ovens	ton	8 50	9 00
Fluorspar, gravel, f.o.b. mines, New Mexico	ton	17 50	
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	ton	$21 50	$22 00
Ilmenite, 52% TiO_2, per lb. ore	lb	01¼	01
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	45	
Manganese ore, chemical (MnO_2)	ton	75 00	80 00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb	70	75
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	lb	06	08
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	11½	12
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	11½	12
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb	12	
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	8 50	8 75
Tungsten, wolframite 60%, WO_3 and over, per unit of WO_3, N. Y. C.	unit	7 50	8 00
Uranium ore (carnotite) per lb. of U_3O_8	lb	3 50	3 75
Uranium oxide, 96%, per lb. contained U_3O_8	lb	2 25	2 50
Vanadium pentoxide, 99%	lb	12 00	14 00
Vanadium ore, per lb. of V_2O_5 contained	lb	1 00	
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb	04½-	13¼

Non-Ferrous Materials

	Cents per Lb
Copper, electrolytic	14 65
Aluminum, 98 to 99%	22 00- 23 00
Antimony, wholesale lots, Chinese and Japanese	6 35
Nickel, ordinary (ingot)	36 00
Nickel, electrolytic	39 00
Nickel, electrolytic, resale	32 00 33 00
Nickel, ingot and shot, resale	36 00
Monel metal, shot and blocks	32 00
Monel metal, ingots	35 00
Monel metal, sheet bars	38 00
Tin, 5-ton lots, Straits	38 875
Lead, New York, spot	7 25
Lead, E. St. Louis, spot	$7 05
Zinc, spot, New York	7 25–7 30
Zinc, spot, E. St. Louis	6 90–6 95

OTHER METALS

Silver (commercial)	oz	$0 63½
Cadmium	lb	1 15
Bismuth (500 lb. lots)	lb	2 45
Cobalt	lb	3 00@3 25
Magnesium, ingots, 99%	lb	1 00@1 05
Platinum	oz	$118 00
Iridium	oz	240 00@275 00
Palladium	oz	65 00
Mercury	75 lb	72 50

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb
Copper sheets, hot rolled	20 00
Copper bottoms	30 00
Copper rods	19 75
High brass wire	18 75
High brass rods	16 75
Low brass wire	19 60
Low brass rods	20 25
Brazed brass tubing	23 00
Brazed bronze tubing	28 00
Seamless copper tubing	24 75
Seamless high brass tubing	22 00

OLD METALS The following are the dealers purchasing prices in cents per pound

Copper, heavy and crucible	11 00@11.25
Copper, heavy and wire	10 50@10 75
Copper, light and bottoms	8 50@ 8 75
Lead, heavy	4 50@ 4 75
Lead, tea	3 25@ 3 50
Brass, heavy	5 50@ 5 75
Brass, light	5 00@ 5 25
No. 1 yellow brass turnings	5 50@ 5 75
Zinc	2 25@ 2 50

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers warehouses in the cities named

	New York	Chicago
Structural shapes	$2 90	$2 90
Soft steel bars	2 80	2 80
Soft steel bar shapes	2 80	2 80
Soft steel bands	3 40	3 40
Plates, ¼ to 1 in. thick	2 90	2 90

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

TUSCALOOSA—The Thress Brick Co., recently organized, has plans in progress for the construction of a new plant on local site, with initial capacity of about 60,000 bricks per day. A number of kilns, updraft type, will be constructed, with machinery installation to provide for a mechanical drying capacity of 600,000 bricks. The new plant is estimated to cost in excess of $50,000. J. H. Thress is vice-president and general manager.

TUSCUMBIA—W. T. Archer and Thurmond Harris, Tuscumbia, are planning for the organization of a company to construct and operate a cement mill and lime-manufacturing plant in the vicinity of the Keller quarry. The proposed works is estimated to cost about $200,000, with machinery.

BIRMINGHAM—The McWane Cast Iron Pipe Co. has filed plans and will commence the immediate construction of the first unit of its proposed new foundry, on site recently acquired at East Birmingham, to cost approximately $50,000. The plant will specialize in the production of small-sized cast iron pipe.

California

LOS ANGELES—W. P. Fuller & Co., 135 North Los Angeles St., manufacturers of paints, varnishes, etc., have plans in progress for the erection of a new 5-story and basement building, 180x250 ft., on San Bernardino Road, near Barranca St., to be used in connection with its local works. Morgan, Walls & Morgan, Van Nuys Bldg., are architects. The company recently awarded a contract for a similar plant building on Ave. 22, 120x125 ft., to cost about $45,000.

PITTSBURG—The Columbia Steel Co. has plans in progress for the construction of a new 6-mill sheet rolling mill at its local plant. It is estimated to cost close to $200,000 and will be equipped with modern electrically operated machinery in the different departments.

SALINAS—The National Stone-Tile Co., San Francisco, has preliminary plans under way for the construction of a local plant for the manufacture of hollow cement brick and kindred products.

SAN BERNARDINO—The Shell Oil Co., 343 Sansome St., San Francisco, is negotiating for property at the foot of F St., near Rialto Ave., approximating 30,000 sq.ft., as a site for a new distributing and storage plant, estimated to cost about $80,000, with equipment.

Colorado

COLORADO SPRINGS—The Van Briggle Tile & Pottery Co. is completing plans for extensions in its plant, to include the construction of a new kiln, and the installation of additional equipment. I. F. and J. H. Lewis head the company.

Florida

EUSTIS—A. J. Wolz & Sons, operating a local plant for the manufacture of brick and kindred burned clay products, are planning for the installation of additional equipment for plant enlargement. A new kiln will be constructed.

Georgia

ATHENS—The Georgia Brick Co. has plans in progress for the rebuilding of the portion of its plant recently destroyed by fire, with loss estimated at about $10,000, including equipment. H. H. Hinton heads the company.

Illinois

CHICAGO—The Goldsmith Brothers Smelting & Refining Co., 29 East Madison St., has completed plans and will soon commence the construction of its proposed new plant at Throop and 58th Sts., comprising two 1-story buildings, estimated to cost close to $200,000, with equipment. Frank D. Chase, Inc., 645 North Michigan Ave., is architect and engineer.

MT. VERNON—The Bitumacite Coal Co., 37 West Van Buren St., Chicago, W. W. Ketchem, president, has completed plans for the construction of a new 1-story plant on local site, 50x100 ft., for the manufacture of fuel briquets, estimated to cost about $55,000, with equipment.

Indiana

SHELBYVILLE—The Kennedy Paper Co. is taking bids for the construction of its proposed 1-story plant addition, 50x180 ft., estimated to cost approximately $30,000. Work will be placed under way at an early date. Rubush & Hunter, American Central Life Bldg., Indianapolis, are architects.

Kentucky

MARION—The Big Four Fluorspar & Ore Co., Farmers' Bank Bldg., Pittsburgh, Pa., has plans under way for the construction of a local fluorspar mining and milling plant with initial capacity of about 75 tons per day. It is estimated to cost approximately $100,000, including machinery. A. H. Reed is local manager.

PROVIDENCE—The Island River Fluorspar Co., recently organized, is considering plans for the installation of a local mining and milling plant, estimated to cost approximately $75,000. The company is capitalized at $250,000, and is headed by S. K. Holland and Thomas O. Long.

BOWLING GREEN—The Rock Asphalt Co. of America, recently organized, has preliminary plans in progress for the installation and operation of a plant in this vicinity for the production of commercial asphalt. W. E. Massey, Louisville, is president.

Louisiana

BASTROP—The Bastrop Pulp & Paper Co. is planning for the installation of additional machinery at its plant, for the manufac-

ture of kraft papers, and will increase the output about 50 tons per day. Work has been commenced on a new 1-story power house.

MONROE—The Southern Carbon Co is said to have plans under way for the construction of additional plant units to cost more than $1,000,000, with machinery.

Maryland

CAMBRIDGE—The Dorchester Lime & Fertilizer Co. will soon take bids for the construction of the first building at its local plant to replace the structures recently destroyed by fire It will cost about $30,000 Another building will be erected in the near future Webster N Andrews is general manager

BALTIMORE—The Inter-Ocean Oil Co is planning for the rebuilding of its gasoline storage and distributing plant at East Brooklyn, recently restroyed by fire with loss totaling $50,000, including equipment

BALTIMORE—A complete laboratory will be installed in the new school of hygiene and public health to be erected at the Johns Hopkins University, estimated to cost about $1,000,000 Archer & Allen Central Savings Bank Bldg are architects

Massachusetts

WORCESTER—The George C Whitney Co, manufacturer of paper products, will break ground at once for the erection of a 6-story plant addition, 55x60 ft, near School St to cost close to $50,000 Lockwood Greene & Co, 24 Federal St, Boston, are architects and engineers

BROCKTON The local plant of the Keith Oil Co was partly destroyed by fire recently with loss etsimated at about $12 000 It will be rebuilt

BOSTON—The Hunt-Spiller Mfg Co 383 Dorchester Ave, manufacturer of iron castings has work under way on a new 1-story plant addition, estimated to cost close to $30,000 The company recently took out a charter under state laws, with capital of 15,000 shares of stock, no par value Wallace L Gifford is president, and Robert F Blake, 212 Beacon St, treasurer

WOBURN—The Welch Japanning Co, Park St, will break ground at once for the erection of a new 2-story japanning works, 38x40 ft, at 38 Park St

SOUTH HADLEY The Holyoke Gummed Products Co 9 Suffolk St, manufacturer of gummed paper products will commence the immediate erection of a 1-story addition 140x147 ft, estimated to cost about $40,000. Contract has been awarded to the Austin Co, 217 Broadway New York Maurice Moriarty is treasurer

Michigan

PORT HURON The New Egyptian Portland Cement Co, 1213 Ford Bldg, Detroit, has commenced work on the remodeling of the former local railroad shops, lately acquired for a new cement-manufacturing plant The work with machinery installation, is estimated to cost in excess of $80,000 John A Decker, 708 State St Port Huron, is consulting engineer. John Gillespie is president.

ST CLAIR—The Diamond Crystal Salt Co has foundations in progress for a new 1-story plant addition, 50x150 ft, to be equipped as a machine shop and mechanical department Henry Whiting is president

Missouri

WEST PLAINS—The National Rendering Co., Kansas City, Mo, has plans under way for the construction of a new local plant for the manufacture of soaps and greases Tankage and fertilizer will be secured from the works of the West Plains Serum Co, Lincoln Ave. W R Ross heads the company.

CONTINENTAL—The Alpha Portland Cement Co., Easton, Pa., is planning for the erection of an addition to the plant of the Continental Portland Cement Co, recently acquired for a consideration said to be $1,000,000. The new unit will cost approximately $500,000, with machinery. The local mill will be the ninth plant to be operated by the Alpha company, and will be increased in capacity from 3,200 to 4,500 bbl per day

New Jersey

EAST NEWARK—The John Hewitt Foundry Co. has tentative plans under consideration for the rebuilding of the portion of its plant on Sherman Ave., destroyed by fire recently with loss estimated at about $10,000.

BOUND BROOK—The Rubberoid Co., a subsidiary of the Standard Paint Co., manufacturer of composition roofing, roofing paints, etc., has completed plans for the erection of a 1-story building at its local works, 100x120 ft.

NEWARK—The Pittsburgh Plate Glass Co., 290 Elizabeth Ave, has work in progress on the first unit of its new linseed oil mill at Riverside and Chester Aves., adjoining its paint works at this location. The plant, with grain elevators and machinery, will cost approximately $300,000, and will give employment to about 100 men It is expected to be ready for service early in March. Headquarters of the company are in the Frick Bldg Pittsburgh, Pa

TRENTON—The Jointless Fire Brick Co, 1130 Clay St, Chicago, Ill, has acquired a local site for the erection of a new fire brick and refractory plant, estimated to cost close to $75,000, with machinery. It will be equipped for an output of 2 carloads per day

New York

GOUVERNEUR—The W H Loomis Talc Co, Main St, has plans nearing completion for the erection of a new 1-story plant on local site, 40x110 ft, estimated to cost approximately $50,000, with pulverizing and other machinery W H Loomis is head

OGDENSBURG The Ogdensburg Paper Co has tentative plans under consideration for the erection of a new 1-story mill addition to cost about $150,000, including equipment George G McKee is in charge.

North Carolina

ALBEMARLE The City Council is taking bids until Jan 11 for extensions and improvements in the municipal waterworks, including filtration plant, with chemical house and other departments The Gilbert C White Co, Durham, N C, is engineer

Ohio

NILES The Ohio Galvanizing & Mfg C is taking bids for the construction of a new 1-story plant addition, 72x120 ft and will break ground at an early date. E F Bentley is head

CINCINNATI—Fire, Dec 17, destroyed two buildings at the plant of the Jarecki Chemical Co., at St Bernard, near Cincinnati, with loss estimated at about $150,000 including equipment and stock It is planned to rebuild

ALLIANCE Charles B. Smith and L C Cook of the Manufacturers' Sales Co, Alliance, have organized a new company to operate the pottery now in course of erection on site secured through the local Chamber of Commerce, between Sebring and Alliance The initial structure will be 1 story 85x200 ft, and will be devoted to the decorating of whiteware and chinaware products Two decorating kilns will be erected at the present time, and four additional such units at a later date It is planned to commence operations late in January

Oregon

SPRINGFIELD The Carbolineum Wood Products Co, Portland, has arranged for the establishment of a new wood-treating and creosoting plant on local site The present works at Alder will be removed to this location and additional equipment installed to provide a capacity of 1 carload per day

Pennsylvania

POTTSTOWN The Model Tire Co. has broken ground for the erection of a 1-story addition to its plant George H. Starkweather heads the company.

AMBRIDGE—The Standard Seamless Tube Co, 313 6th Ave., Pittsburgh, manufacturer of steel tubing, is considering the erection of an addition to its local plant to cost about $75,000 H E Wharton is company engineer

MIDLAND—The Pittsburgh Crucible Steel Co. has commenced the installation of a new liquid purification plant at its local works, to be equipped for a capacity of 12,000,000 cu.ft. It will be used to purify coke oven gases, and is expected to be ready for service early in March.

ALLENTOWN—The Royal Paper & Bag Co, 16 North 7th St., has authorized plans for the rebuilding of the 3-story plant, 60x230 ft., at 37-41 North 7th St., recently destroyed by fire.

Texas

HOUSTON—The Sinclair Refining Co. is said to have tentative plans under way for the erection of an addition to its oil refinery on the Houston ship channel for considerable increase in capacity.

PIONEER The American Oil Co., Tulsa, Okla., has commenced the erection of the first unit of a new refining plant on local site, and will inaugurate work on the second unit at an early date. The total plant will have an output of about 5,000 bbl. per day and is estimated to cost approximately $100,000. T J Ryans is president.

Virginia

GRAHAM Sutphin & Snell are planning for the establishment of a local plant for the manufacture of shale brick, with daily output of about 50,000 bricks Inquiries are being made for machinery and operating equipment

GALAX—Work will be commenced at once on a new filtration plant at the municipal waterworks, to have a capacity of about 500,000 gal gross The Carolina Engineering Co, Wilmington N C is engineer

Washington

OLYMPIA The West Coast Pulp & Paper Co, recently organized to construct and operate a local paper mill, will be operated by the same interests as control the Hawley Pulp & Paper Co, Oregon City, Ore In addition to the acquisition of a local site for the proposed new mill secured in co-operation with the Olympia Manufacturers' Association the company has purchased a former brewery at Tumwater and will remodel the structure for another paper mill The larger mill to be constructed will cost close to $750,000 instead of $500,000, as previously announced, and is expected to be ready for service in about 12 months

West Virginia

CHARLESTON The Libbey-Owens Sheet Glass Co, Nicholas Bldg, Toledo, O, is completing plans for the erection of the proposed addition to its local plant, to include a number of new buildings, with machinery, estimated to cost approximately $2,000,000 The Owens Bottle Co, same address, a subsidiary organization, is also perfecting plans for the new addition to its Charleston works comprising additional structures than those initially considered, increasing the estimated investment to about $750,000, with machinery The Devore Co., Nicholas Bldg, Toledo, is engineer for both projects and E D Libbey heads the companies

CHARLESTON—The Evans Lead Co is planning for immediate operations in the portion of its new local plant just completed, giving employment to about 100 workers The plant will specialize in the production of red and white leads Tentative plans are now under consideration for the erection of two additional factory units

Mexico

SANTA EULALIA—The San Toy Mining Co has tentative plans under way for extensions and improvements in its plant to cost about $100,000, including the installation of considerable new equipment An appropriation of the amount noted has been arranged Charles M Schwab, head of the Bethlehem Steel Co, Bethlehem, Pa, is interested in the company

Cuba

CAMAGUEY The Estrella Sugar Central, Ltd, has plans under consideration for the rebuilding of the portion of its mill and power house at Cespedes, recently destroyed by fire, caused by an explosion

Capital Increases, Etc.

THE ROESSLER & HASSLACHER CHEMICAL Co, 709 6th Ave., New York, has filed notice of increase in capital from $1,300,000 to $3,250,000

THE FRENCHTOWN PORCELAIN CO., Frenchtown, N J., manufacturer of electrical porcelain products, has arranged for an increase in capital from $100,000 to $350,000.

THE BOYDELL BROTHERS WHITE LEAD & COLOR CO., 432 East Lafayette St., Detroit, Mich, has filed notice of increase in capital from $150,000 to $337,500 for general expansion.

THE INDIANA ZINC CREOSOTING CO., Terre Haute, Ind., has arranged for a change of name to the Indiana Wood Preserving Co.

THE UNION CARD & PAPER CO., 45 Beekman St, New York, N. Y., has arranged for an increase in capital from $150,000 to $500,000.

THE PERTH AMBOY CHEMICAL WORKS, INC., 71 Buckingham St., Perth Amboy, N. J., has filed notice of increase in capital from $40,000 to $1,000,000 for proposed expansion.

Industrial Developments

PAPER—All of the paper mills at Windsor Locks, Conn., have adopted a capacity schedule, covering day and night forces on an 8-hr shift. The plants include the American Writing Paper Co., C. H. Dexter & Sons, and the Windsor Locks Paper Mills, Inc., the last noted being operated by J. L. Smyth Co., New York.

Paper and pulp mills at Fort William, Ont., have increased operations and are now running on a heavier production schedule than for a number of months past.

The Spruce Falls Co., Kapuskasing, Ont., has completed the construction of a local sulphite pulp mill and will operate at the plant at maximum capacity for an indefinite period.

CERAMIC—A complete settlement has been effected in the general ware branch of the pottery industry, following a 10 weeks strike, with a compromise wage advance of 1½ per cent over previous schedule. The men asked for a 7 per cent increase.

The Creighton Brick & Tile Co., Creighton, Mo., is perfecting plans for the early resumption of production at its local plant following a shut-down for a number of months.

The Independent Brick Co., Trenton, N. J., is maintaining active operations at three of its four brick manufacturing plants at Bordentown and vicinity, and expects to continue on this basis throughout the winter season.

The Kenyon Brick & Tile Co., Oklahoma City, Okla., is continuing production on a capacity schedule, and purposes to make a number of plant additions to develop a maximum of 40,000 bricks per day, as well as building tile and other burned clay products.

General ware potteries at Trenton, N. J., are advancing production, following the settlement of the strike with the operative potters. Philadelphia, Pa., potteries are also increasing their outputs, and the majority of plants in this district are now running close to 100 per cent.

The Perth Amboy Tile Co., Perth Amboy, N. J., is maintaining full capacity at its local works and has extensions under way for early increase.

The Birmingham Hollow Tile Co., Ensley, Ala., is running full, with regular working force. Orders on hand are said to insure continuance on this basis throughout the winter season.

The Standard Brick Mfg. Co., Evansville, Ind., is running at both of its plants at normal capacity, and plans to continue at least one of the factories in service during the winter months.

RUBBER—The General Tire & Rubber Co., East Akron, O., is completing the erection of three new plant additions at its local works, and proposes to place the units in full service in January or February. The present output is on a basis of 2,500 tires daily, and this production will be doubled as soon as the new units are ready.

The Kelly Springfield Tire Co., Akron, O., is maintaining production on a capacity schedule and will continue on this basis for an indefinite period.

METALS—Following the closing of a contract with the American Smelting & Refining Co. for the purchase of its entire output of zinc concentrate for a period of 5 years, the Callahan Zinc & Lead Co., Coeur d'Alene, Idaho, is arranging to increase production at its local plant. The Callahan company has acquired a substantial interest in the Galena Mining Co., operating in this same district, and proposes to advance the output at the works.

The Bay View Foundry Co., Sandusky, O., is arranging for the reopening of its plant early in January, after a shut-down for more than 4 months.

The International Nickel Co. has advanced production at its Port Colborne, Ont., plant to the highest point since the close of the war, giving employment to a large increased working force. For the first time in 4 years the entire production of Monel metal is being shipped from the plant.

The brass foundry of the New Holland Machine & Foundry Co., New Holland, Pa., has increased production to a full time basis, giving employment to the regular working force for the first time in a number of weeks past.

The Mohawk Mining Co., Calumet, Mich., is running two heads at its stamp mill, under a 3-shift working day, on a production schedule of handling 36,000 tons of rock per month.

IRON AND STEEL—The Woodward Iron Co., Woodward, Ala., is arranging to blow in its No. 1 furnace early in January. The unit was closed down recently for necessary repairs.

The National Tube Co., Pittsburgh, Pa., a subsidiary of the United States Steel Corp., is advancing operations at its Riverside works, Wheeling, W. Va., a plant that is used for reserve service in times of heavy demand. Both blast furnaces have been blown in, while two bessemer converters are operating, five of seven welding furnaces will also be active for an indefinite period.

The Minnesota Steel Co., Duluth, Minn., is running on a capacity basis and will continue on this schedule for an indefinite period.

The Trumbull Steel Co., Youngstown, O., is developing increased production, and record shipments are being made from the mill. A new high average was attained in November, with a moved finished tonnage of 32,000 tons of sheets, strip steel and tin plate. A full working force is being employed.

The Carnegie Steel Co., Pittsburgh, Pa., has blown in several additional furnaces during December, and will soon have 15 or 16 stacks in blast.

In the district bounded by Johnstown, Pa., Wheeling, W. Va., and Warren, O., a total of 99 blast furnaces out of 139 stacks are now in operation, the largest number in more than 2 years.

The Republic Iron & Steel Co., Birmingham, Ala., has two furnaces in blast at its local works and will keep the stacks active for an indefinite period. The Central Coal & Iron Co., in this same district has one stack in service, as has also the Alabama Co.

MISCELLANEOUS—The Oak Extract Co., Newport, Pa., manufacturer of sulphuric, nitric and other acids, has resumed operation at its plant, following a curtailment for several months due to difficulty in securing raw materials.

The Taylor Brothers Co., Rockdale, Tex., has completed the installation of equipment for an increase from 75 to 100 bbl. per day at its oil-topping plant and has placed the unit in service on a full production basis.

Cotton oil mills at Charlotte, N. C., and vicinity have increased production to full-time basis operations, and will maintain this schedule until early in February.

The Corn Products Refining Co. is giving employment to a total of 650 persons at the new mill at North Kansas City, Mo., on a full-time operating basis.

New Companies

THE HEDGES & DIVINE ZINC CO., 3039 East 92nd St., Chicago, Ill., has been incorporated with a capital of $30,000, to manufacture zinc and other metal products. The incorporators are M. J. J. Rieck, C. W. Kraft and F. A. Thulin.

THE HUDSON ALCOHOL CO., West New York, N. J., has been incorporated with a capital of $10,000, to manufacture denatured alcohol and kindred products. The incorporators are Nicholas and Dominick Curcio, 761 Bergenline Ave., West New York. The last noted represents the company.

THE GREENWICH CHEMICAL CO., New York, N. Y., care of S. V. Ryan, attorney, Albany, N. Y., representative, has been incorporated with a capital of $200,000, to manufacture disinfectants, insecticides and other chemical products. The incorporators are S. C. Wood and H. C. Hand.

THE ALBERT H. BECK CO., Philadelphia, Pa., has been incorporated with a capital of $50,000, to manufacture glass products. R. M. Beck, 3335 North 7th St., Philadelphia, is treasurer and representative.

THE RAYNAUD CONRAD PAINT CO., New Orleans, La., has been incorporated with a capital of $100,000, to manufacture paints, varnishes, oils, etc. The incorporators are Joseph Raynaud, C. Carlisle Conrad and George Steck, all of New Orleans.

THE WILLIMANTIC RIVER PAPER CO., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., has been incorporated under Delaware laws with capital of $375,000, to manufacture paper products, with mill in New England.

THE CHARLES WALSH CO., Philadelphia, Pa., has been incorporated with a capital of $50,000, to manufacture brick, tile and kindred products. F. E. White, 6132 Lebanon Ave., Philadelphia, is treasurer and representative.

THE KEENE CHEMICAL CO., New York, N. Y., care of S. S. Winter, 261 Broadway, New York, representative, has been incorporated with a capital of $100,000, to manufacture chemicals and chemical byproducts. The incorporators are S. M. Morecy, J. Weissbaum and E. H. Barker.

THE SOUTHERN ATLANTIC FERTILIZER CO., Augusta, Ga., has been incorporated with a capital of $15,000, to manufacture fertilizer products. The incorporators are R. C. Neely, Sr. and Jr., and S. H. Wilcox, all of Augusta.

THE ANT-ROACH POWDER CO., Newark, N. J., has been incorporated with a nominal capital of $5,000, to manufacture insect powders and other chemical specialties. The incorporators are Edward H. Zimmerman, George C. Weber and John A. Berringer, 83 South Orange Ave., Newark. The last noted represents the company.

THE RAYDNT CORP., Pittsburgh, Pa., care of the Capital Trust Co. of Delaware, Dover, Del., representative, has been incorporated under Delaware laws with capital of $25,000, to manufacture varnishes, polishes, etc.

THE AMAREX CORP., New York, N. Y., care of Holmes, Rogers & Carpenter, 20 Broad St., New York, representatives, has been incorporated with a capital of $20,000, to manufacture chemical products. The incorporators are F. Ferranti and O. Rodinella.

THE PITTSBURGH OIL & REFINING CO., Pittsburgh, Pa., is being organized to manufacture refined oils. The incorporators are Robert A. Rundle, George Faunce, Jr., and Clyde D. Beistel. Application for a state charter will be made on Jan. 8. The company is represented by J. Merrill Wright and Robert A. Rundle, 624 Frick Bldg., Pittsburgh.

THE L. J. TILLERY OIL CO., Beaumont, Tex., has been incorporated with a capital of $85,000, to manufacture petroleum products. The incorporators are L. J. Tillery, J. D. Campbell and C. G. Hooks, all of Beaumont.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 2 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York City.

AMERICAN ENGINEERING COUNCIL, executive organ of the Federated American Engineering Societies, will meet in Washington, D. C., Jan. 11 and 12, 1923.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its annual meeting in New York City during the week of Feb. 19, 1923.

AMERICAN SOCIETY FOR STEEL TREATING will hold its winter sectional meeting in the City Club, Chicago, Feb. 15 and 16, 1923.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL FOREIGN TRADE COUNCIL will hold its annual conference April 25, 26 and 27, 1923, in New Orleans, La.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

A PAPER INDUSTRIES EXPOSITION will be held in Grand Central Palace, New York City, during the week of April 9, 1923, by the International Exposition Co.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City; Jan. 5—American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
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H. C. PARMELEE, Editor

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Problems in the Production of Sodium Sulphide

DURING the years 1917 to 1920 there was an annual production of sodium sulphide in this country of 45,000 tons. The size of this industry has been the cause of considerable surprise, for it is not generally recognized that sodium sulphide is so important a commodity. It is obtained both by the reduction of salt cake, sodium sulphate, with coal, and as a byproduct of the barium industry. Since the ultimate survival of the barium industry in this country is at least partly dependent upon the tariff, it cannot be regarded as a basic source of sodium sulphide. Future progress in production, therefore, is rather definitely limited to improvements of the technology of the salt cake process.

The furnacing of salt cake to produce sodium sulphide is a good example of a common type of problem met in chemical industry. The technology is surprisingly primitive and improvements are easy to visualize. But when it comes to the point of changing the process, it is impossible to show *a priori* a distinct advantage for the improvement, even on paper, because of the many variables. Moreover, the industry is bound by conservatism to an extraordinary extent.

At present salt cake is mixed with about half its weight of coal and treated in a rotary or reverberatory furnace. The material is gradually heated until it melts and reduction begins. As the reduction nears completion the mass becomes more and more solid until finally the charge is dumped and the cycle is repeated.

Perhaps the first thought that occurs to the average chemical engineer who observes this process is to make it continuous. But a continuous process must take care of all three stages—preheating, fusion and reduction. The character of the charge changes fundamentally during the reaction from a mixture of finely divided solids to a mobile liquid and partly back to solid again. To attempt to carry out such a reaction in a rotary furnace would require a much longer one than is at present used, the operation being perhaps analogous to that of cement burning. But the changes of state which the charge undergoes would present grave if not insurmountable operating difficulties and these would be enhanced by the fact that sodium sulphide burns rapidly after the reduction is complete.

Thus the time factor is seen to be of vital importance. This is the reason why the continuous process used for the reduction of sulphate in the paper industry cannot be applied to the manufacture of sodium sulphide, for in the paper industry reduction is not complete and the presence of sodium carbonate, the product of sodium sulphide decomposition, does not represent a serious loss.

Other methods, which get away entirely from the rotary furnace process, have been suggested. One of the most promising consists in injecting a finely divided mixture of coal and salt cake at the top of a stack. The tower would be heated by means of tuyeres and the mixture would work to the bottom where the products would be removed. The improvements in yield and replacement cost which would result from this or any other radical change can be estimated only after complete investigation. Meanwhile the cost of the investigation, the high investment in present equipment and the lack of any positive assurance of satisfactory results have held back investigation and consequently defeated progress.

Long-Term Credits And the Fertilizer Industry

PROMINENT men in the fertilizer industry have stated frequently during the past 2 years that the sale of fertilizer on long-term credit is one of the very serious problems. Stated briefly, the situation is this: Fertilizer is delivered before the crop is planted and paid for after the crop is sold. If, as in 1921, there were large financial losses and many failures on the part of the farmers, the bills would not be paid until the harvesting of the next year's crop. Naturally this would have to affect the price of fertilizer during the following year, as at least the interest on the money involved would have to be absorbed.

Several statesmanlike addresses have been made on the subject to fertilizer manufacturers in which the imperative need for doing cash business was urged. It is a real handicap for the industry to have to act as banker for its consumers and it militates against the proper development of local banking. Of course historically the industry has only itself to blame. For the practice was started in order to increase sales and to establish the confidence of the consumer in the product. Now the producer can't let go. During this last year an increase of cash business has been reported, but we learn from those associated with the industry that it is very doubtful if it will ever be able to emancipate itself from the granting of long-term credits.

To the outsider it looks as though severe competition actually has proved undesirable for the consumer, which is a peculiar anomaly. So anxious is the individual manufacturer for business that if one producer were to offer cash terms only, the customer could shop for material elsewhere and get it on the old terms, which almost amounts to "pay when you get ready." So the net result is that because of intense competition the industry must still adhere to the antiquated procedure and carry the customer till after harvest. This must cost the customer more than straight interest which he would pay as discount on a commercial loan at a local bank, for there is much more risk for the manufacturer than there would be for the local banker, who is in

closer touch with conditions. Here is a case where a gentleman's agreement ought to be of distinct benefit to the consumer, to say nothing of the producing industry.

Our Problem Of Immigration

SINCE 1882, when Congress passed the first general immigration law, this country has been experimenting with various measures designed in one way or another to curb or limit the incoming stream of foreigners. In all that time, however, we have never formulated what might be regarded as a permanent immigration policy. To find the reason for this it is necessary to go back a bit into history.

In the past 40 years our attitude toward immigration has completely changed. For several decades before the war the subject was regarded purely as an economic problem and the immigrant's effect on American industry and American wages was the paramount consideration. Little thought was given to the social aspects of immigration; the capacity of our great melting pot was believed to be unlimited. But the developments of the war very abruptly changed our viewpoint. The racial characteristics and the quality and character of the incomers were more carefully studied. Their attitude toward American institutions and toward our standards of living completely overshadowed any economic questions involved. Already it had become apparent that there was danger of too much infusible material in our melting pot and that slag inclusions were threatening to weaken the pure metal of American citizenship.

This change in attitude was to some extent attributable to a very important change that has occurred in the character of immigration. From 1870 to 1890 practically 90 per cent of our immigrants were of the Nordic races, coming from northwestern Europe—including the British Isles, Germany, Scandinavia, Belgium, the Netherlands and France. But about 1900 a different trend became evident and the Slavic races appeared on our shores in ever-increasing numbers. Soon Italy, Austria-Hungary, Greece and the other countries of southern and eastern Europe were supplying as much as 80 to 85 per cent of all our immigrants. And these newer arrivals were less stable, inclined to be radical and somewhat more than a third of them were illiterate. Furthermore, they were not readily assimilated.

While the Nordic immigrants had gone largely to the farms and factories, the Slavic were generally unskilled laborers and were satisfied to remain so. Still another complication in recent years has been the increase in the proportion of Jews of a type inclined to enter trade rather than industry or agriculture.

The present 3 per cent immigration law, admittedly an emergency measure, has not contributed a great deal to the situation. Designed to limit admission from any particular country to 3 per cent of the number of that country's nationals shown in our 1910 census, the law made the fatal mistake of failing to take into account the number who returned to their former countries. This accounts for such inconsistencies as the admission of only 42,000 Italians last year during a period when 58,000 former immigrants actually returned to Italy. The principal good that has come from the present law, however, has been the material reduction in the proportion of undesirables. Southern and eastern Europe, instead of supplying 750,000, as in many past years, was limited under the quota law to 155,000. Needless to say, the quotas from these countries are always filled. Thus the maximum number of Greeks and Turks to be admitted during the year ending June 30, 1923, had already been supplied as early as November, 1922.

As the present business revival continues there is a clamor in many industries for more workers—in fact, it cannot be doubted that in many localities there is an actual dearth of unskilled labor. Pressure is being brought to liberalize the immigration laws, to let down the bars in order to satisfy the economic needs of the country. As a nation it would seem that we are confronted with the problem of polluting our blood stream in order to get economic relief or of preserving our blood stream pure and suffering an economic loss.

What, then, is the way out? In formulating a permanent economic policy toward immigration (and we can never get anywhere until we do) we are confronted with the necessity of effecting a working compromise between these views. But, at the same time, a number of other factors must be considered. Qualitative selection of the immigrants to be brought in and their intelligent distribution after they arrive would certainly seem advantageous. After excluding the undesirables, the aliens in the country might be registered and their movements followed closely for the first year or so in order to observe their progress in Americanization and their industrial occupation and service. Finally, it might be possible for an immigration commission to keep informed about available supplies of foreign labor, in order that we might know where to turn for the sort of man power needed by our industries.

While the framing of an immigration policy is still in a formulative stage, those of us in industry can contribute to the situation by making the closest study of our own labor problems in their particular relation to the foreign-born worker. It will be only when we can furnish our legislators with definite quantitative information regarding labor shortage, turnover and efficiency and interpret this in terms of nationality, race and length of service that we can expect to have a scientific solution of our immigration problem.

The Menace of Loosely Drawn Contracts

PROBABLY a vague security is felt by a manufacturing organization in contracting for all of its "requirements" in a given commodity, for the practice is widely followed. In many cases it is harmless, as when a relatively large producer agrees to take care of a relatively small consumer. In such a case the maximum requirements of the consumer will hardly be an appreciable percentage of the producer's output. But where producer and consumer are more nearly the same size and where variations in consumption may be a relatively large percentage of the total output, the contract must be drawn with considerable care. Loosely drawn contracts are especially a menace in such a case and the court records are filled with disputes about them. Exactly the same thing is true of the converse, where the total output of a factory is contracted for. The many cases cited by WELLINGTON GUSTIN elsewhere in this issue strikingly confirm this fact.

The reasons back of the practice of making loosely drawn contracts are probably more fundamental than mere carelessness or ignorance. There is a tendency to believe that in vagueness of expression lies a flexibility from which advantages may accrue. It is usually forgotten that flexibility is a two-edged sword and that the advantage may lie with the other party. In addition there is also the contract which does not express ac-

curately the purposes of both parties. This is caused by loose thinking which makes for inaccurate wording. Such a contract may be made with perfect good faith on both sides.

Nothing more completely destroys the friendly good will which is the leaven of business relations than a dispute about money—a dispute in which both sides feel that they are being wronged. Mr. GUSTIN'S article is of great value because it focuses attention on a fundamental principle which must be periodically called to mind. Good faith alone is not adequate in business dealings, but must be supported by accurate expression and complete understanding in and through business contracts. Good contracts are promoters of business health.

Dirt In Steel

PRIOR to the war most all steelmakers thought that slag and metal had some mutual repulsion, like oil and water. They would not mix, and if you gave the metal a chance to settle quietly in the furnace, ladle or even in the ingot mold, all the slag would gather on top, separated clearly from metal free of the last traces of slag. Then if the ladle and mold were clean of dirt, the resulting steel would be sound, except perhaps for a few surface seams or blisters which perhaps were healed in rolling, some blowholes which could always be welded shut, and maybe some pipe or shrinkage cavity in the top, which could be cropped.

Some steelmakers, and big ones at that, think so yet. They are sure that those little black spots which must be hunted for with a microscope cannot have any influence on the quality of steel; things so little don't count. Anyway, the chemical analysis is all right—sulphur and phosphorus are both low. Gas? "Why, how can there be any gas in that solid, dense metal? Besides a cubic foot of gas is almost too light to weigh, and that much steel weighs 500 pounds; if there ever was any in the blowholes it is all squeezed out. You scientific men are always looking for troubles which do not exist—here's good, sound dependable metal we can make in large tonnage. Why are you so fussy about it? Perhaps there's a bad piece in it now and then, but we'll gladly replace those, and it's good uniform stuff. We stake our reputation on it. Would you think that Professor Micrograph knows more about steel making than our experts and the combined lifelong experience of the Tonnage Steel Co.? If a ½-in. section gives you a few failures, use a ¾-in. section."

But there are some problems which can't be solved that way. During the war, recoil cylinders and gun tubes had to be made in great numbers, strong against great bursting pressures and yet light enough to be manageable in field pieces. And for the life of them, the Tonnage Steel Co. and all its experts could not pass the inspection more than ten times in a hundred. Alloy steels were blamed. If only carbon steel were specified, of course that would have been a different matter!

The war is over, but like the peace such metallurgical troubles are still with us. We are more and more interested in high-speed transportation. Forgetting airplanes and subways (although the matter applies to them as well), automobiles are driven at 50 miles per hour oftener than they were sent 35, five short years ago. Every increase in speed increases the required power much faster, throws stresses into each member at a greater rate and searches out hidden defects in all parts ceaselessly. So the world moves, and because a certain brake drum made from Tonnage Steel Co.'s carbon steel has been turned out by the million, there is no reason to suppose that that design is the best there is, that it will be used forever, or that disastrous failures will never occur with faster and faster driving.

In fact, such a condition actually exists. We have in mind a manufacturer of a very fine automobile which has built up an enviable record for quality and reliability. Each part going into the machine is carefully made, under constant and minute inspection; stock parts are tested by lots before assembly and each finished car is taken out on a test run by a driver determined to jar loose anything that is loose. Production had practically been standardized, yet without any very great difference observable in the routine tests, the number of failures during test runs gradually increased in both carbon and alloy steel parts to an alarming proportion. What was worse, reports of one or two failures in service began trickling back.

After intensive investigation the cause of these failures was found to be almost invariably the same as the cause of our old enemy "flakes" in alloy steel: dirt. Close visual inspection of finished parts or fresh fractures would not reveal any sign of trouble. Nor would there be anything wrong in the chemical analysis. Microscopic examination of etched samples seemed also to give acceptable structures—not particularly free from ferrite banding and ghosts, and yet not noticeably worse than acceptable material. However, a polished unetched section invariably shows a great number of round black spots apparently hidden by etching, many $\frac{1}{16}$ in. across or larger and not more than ¼ in. apart at 100 magnifications. Often these are arranged in rows, whereupon a service-fracture would follow a series of these rows and exhibit an appearance of stairsteps. If a broken connecting rod was pickled deeply, all manner of seams appeared, apparently the vestiges of laps, pipes and unwelded blowholes.

Of course, the Tonnage Steel Co. would not accept the blame, nor be held to a specification demanding less dirt. It wouldn't admit that any dirt was there! But less conservative concerns were willing to make smaller heats of steel, exerting the most extreme care and the utmost resources of modern electrometallurgy. The result, while not perfectly clean steel, is certainly far ahead of anything to be had on the open market. And the proof of the matter is this: that when a troublesome part is made of clean steel, alloy or carbon, failures suddenly cease!

So, at the present time, most of the energies of the metallurgists of that motor company are devoted to an endeavor to get cleaner steel for forgings and bar stock. Their specifications now read, in effect, "The steel shall be free of blowholes, internal defects and solid non-metallic inclusions—the purchaser to be the judge of this requirement." Microscopic sections are taken of all highly stressed parts regularly and examined for dirt. It has even been found necessary in a number of cases to specify steel made by certain processes as being superior to ordinary material in the matter of cleanliness and cleanliness only. It has been found that certain makers furnish far cleaner steel than others, apparently as well equipped. They get the business.

Viewing this compelling fact, we take hope that eventually the Tonnage Steel Co. will become convinced that dirty steel is not a mere scientific speculation.

British Chemical Industries

From Our London Correspondent

London, Dec. 20, 1922.

CHEMICAL markets continue in quite a cheerful and healthy state and there is nothing abnormal about the usual falling off of business because of the Christmas holidays and stock taking. There is no doubt that the demand for general and heavy chemicals is likely to be greater in the New Year not only on account of the general improvement in the industrial outlook but also because of the government's roadmaking and shipbuilding programs and the schemes for the relief of unemployment. The threatened wage dispute in the chemical trade has also been avoided for the time being, and all these factors, together with the continued fall in contract prices for heavy chemicals, justify a considerable amount of optimism.

Briquetting Plants Close Down

The position in regard to pitch is at the present time one of peculiar interest. A few months ago the price was $5.50 per ton and since then it has been rising steadily until a level of about $12.50 per ton was reached. The reasons for this enormous increase are not only the closing down of a number of coke-oven plants but an increase in the demand for pitch for roadmaking purposes and the probability of a still further demand as progress is made with the government's program of additional roads and maintenance throughout the country, part of which is in relief of unemployment. Bitumen, of course, has been increasingly used owing to the pitch shortage, but a certain amount of pitch seems to be indispensable in the mixtures usually adopted for making coal briquets. The result has been rather curious, inasmuch as the manufacturers of briquets and patent fuel for anthracite slow-combustion stoves and the like have been unable to pay the high prices demanded for pitch and a number of briquetting plants have had to close down. This has already steadied the advance in prices, but the situation is very uncertain.

Progress in China Clay Industry

The past year has witnessed a remarkable recovery in the china clay industry, the quantity marketed representing more than 75 per cent of the pre-war production and the export trade having been more than double that of 1921. Cornish methods of handling china clay and refining it for the market have always appeared crude and inefficient to the uninitiated. Furthermore, some of the improved machinery installed just before the war was requisitioned by the government. The improvement in consumption has revived interest in improved methods, but it is unlikely that economies are really practicable except as regards fuel and improved grading of the finished product. The new plant of the Standardized China Clay Co. is about to begin operations and comprises four 36-in. Gee centrifugal separators, in which the china clay is automatically divided into four or more grades both as to fineness and quality, the coarser product containing a higher percentage of silica and other impurities. At the same time moisture is brought down to as low as 25 per cent in the machines and an improved gas-heated drier leads to further economies. The high-grade material from these machines commands a considerably enhanced price and it merely required standardization and educational propaganda to enable an increased over-all [illegible] to be obtained. There is also the possibility of further purifying and regrading the inferior product from these machines.

The further study of china clay for its use in chemical manufacture as distinct from those in paper making, pottery, cotton goods and so forth seems well worth while, as there is ample scope for widening the china clay market.

Sulphur Dioxide in Coal Mining

Coal mining is one of the few industries in which the chemist has not yet penetrated, but a recent investigation by Dr. Lessing has opened up the possibility of using purely chemical means instead of explosives or mechanical cutters, which have hitherto been regarded as irreplaceable. In 1882 the hydration of quicklime was suggested, the expansion acting as a mild explosive in shattering coal. The present suggestion, which is now being tried out on a practical scale at the Brereton Colliery, is that of passing moist sulphur dioxide gas through acid-proof tubes into the bore holes and allowing it to permeate through the coal for some hours. The gas is avidly absorbed by the coal and the calcium and other carbonates, which constitute the bulk of the interfacial layers or partings which cement the coal together, are decomposed, whereupon the coal can be very rapidly broken up and removed. It is stated that 1 ton of sulphur dioxide should suffice for 1,000 tons of coal, corresponding to about 5 cents per ton, and that there is no trace of leakage of gas into the atmosphere of the mine, although in any case the quantity of the gas used would be insufficient to produce injurious effects. Treatment in this way also seems to raise the ignition temperature of the coal after treatment and may therefore constitute a safety factor in coal mines apart from the possibility of replacing explosives by chemical methods of disintegration. The details of routine operations on a large scale should not be difficult to elaborate, but considerable interest has been attracted to the process and to the experiments which are now in progress, especially in mining districts where sulphur dioxide gas is or may be a waste product.

Other Industrial Developments

Other recent industrial developments include the use of carbon dioxide from the waste combustion gases of greenhouse boilers, for the purpose of increasing the yield of tomatoes, cucumbers and other hot-house products by approximately doubling the carbon dioxide content of the air in the houses. The possibility of applying this principle to crops in the neighborhood of blast-furnace plants is foreshadowed and two installations are in course of erection. A new process for utilizing blood and tankage for molded articles, insulating purposes and impregnation is being tried out and will be referred to in a subsequent contribution.

The Federal Council for Pure and Applied Chemistry has now published an appeal for funds to enable it to develop its work on an adequate scale. It is pointed out that while today's financial conditions prevent the realization of the large scheme outlined by the late Lord Moulton, it is now essential to make a beginning in the direction of the compilation of chemical compendia and for the cultivation of the social side of chemistry. In this connection the Council has given its official blessing and its co-operation to the excellent work of the Chemical Industry Club, which has just held its very successful fourth annual dinner, at which T. R. Duggan, of the Chemists' Club, New York, was an honored guest.

Microscopy of Paint And Rubber Pigments*

By Henry Green
Research Laboratory, New Jersey Zinc Co.

A New Conception of the Place of Microscopy in the Examination of Pigments Involving a Distinct Technique — Uncanny Insight Into Manufacturing Processes Is Made Possible by Development of Science

LIKE ANY SCIENCE, microscopy is composed of distinct divisions, from each of which a separate art is derived; so we find useful application made of the microscope by the bacteriologist, the petrologist, the metallographer, etc. There is one division, however, which, in comparison with the others, is still very much of an infant; in fact it has not even been christened. For convenience it will be called "pigment microscopy." Undoubtedly there exists sufficient literature on this subject to establish it as a distinct and useful branch of microscopy in itself, but the tendency has been, apparently, to treat it, not as a branch of microscopy at all, but rather as a problem incidental to more important ones in the domain of paint and rubber research.

The plan in presenting this paper has been to reverse the customary procedure and study the subject of pigments mainly from the microscopist's viewpoint, and incidentally point out its utilitarian aspects for the benefit of paint and rubber investigators.

As there is nothing in particular about a *mass* of pigment sufficiently characteristic to be of interest to the microscopist, his endeavor will naturally tend toward an attempt at resolving this mass into its ultimate units or *individual particles*. It is natural to expect that here might be found something that would not only differentiate various pigments but, in addition, throw some light on their behavior when subsequently used in paint or rubber.

The simple procedure of studying the individual pigment particle under the microscope seems like such an obvious thing to do that one would expect that nearly everything in this line had been accomplished some time ago. As a matter of fact, the number of technologists interested in the use of pigments having a clear conception of the appearance and particle size of such materials is almost negligible. About 5 or 6 years ago it was practically impossible to find a paint manufacturer even willing to admit that pigment particles could be seen in this manner. Perhaps a quotation from Bottler and Sabin[1] will help to visualize the situation as it stood then. Sabin states in reference to a microscopic examination of the major portion of elutriated basic carbonate of white lead (one of the coarser pigments):

> . . . and as to the residue comprising portion 5, which makes up the greater part of the pigment, it is not merely hopeless, it is as absolutely impossible (to measure) as it is to "average" the apparent size of the stars in the sky, where each increasing telescopic power reveals new infinites of star-dust.

And again,

> A microscope is an interesting and useful instrument; but the person who uses it is sometimes neither interesting nor useful, and microphotographs may be made and interpreted in all sorts of ways.

All of which indicates that the technologist believed then (and even now, in most cases) that pigments were too fine grained to be seen under the microscope.

Distinctive Technique

When it is taken into consideration that microscopists have for years devoted a considerable part of their time to the study of the minute structure of test diatoms, to the resolution of Nobert lines and to test plates, etc., it is not so obvious why technologists, though admittedly not trained microscopists, should have been unable to cope with a subject as "easy" as the coarser pigments. The answer lies in the fact that pigment microscopy is in itself a distinct division of the parent science. If we do not expect the metallographer, for instance, to excel, without previous preparation, in the use of the petrographic microscope, or the petrologist to feel at home in the bacteriologist's laboratory, then it is unfair to criticise adversely the investigator possessing but a temporary interest in the subject for not having acquired a correct technique for the successful microscopic analysis of pigments.

Recently there have been appearing indications of a keener interest in the subject of pigment microscopy than heretofore. This has been particularly true in the rubber industries. With this in mind and hoping to stimulate further research in this field, the necessary apparatus, methods of mounting, photographing, etc., for such work will be described. It is not to be inferred that this information is exclusively for the rubber investigators, for with few exceptions it will be of a general nature intended for use by anyone interested in pigments.

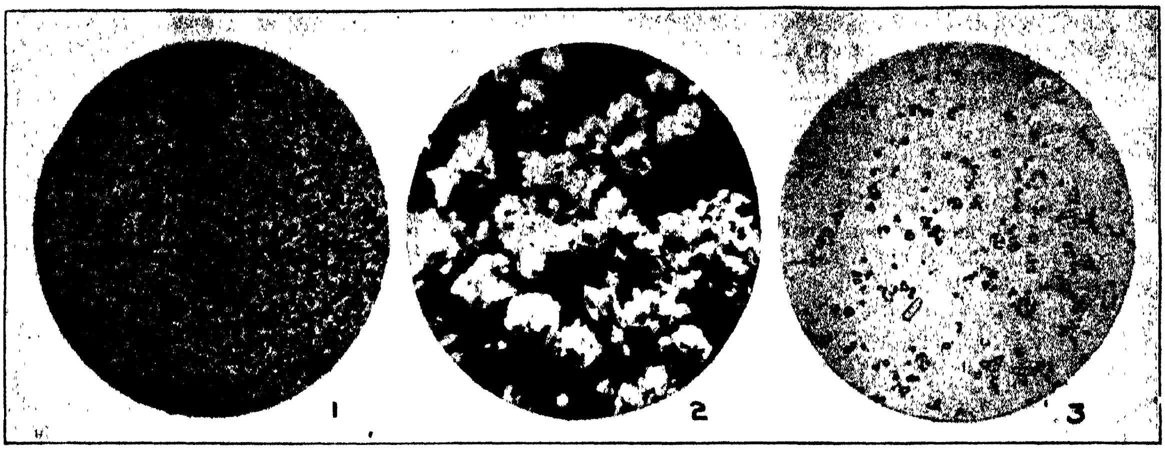
Apparatus Used in Pigment Study

The investigator working in the laboratory of a company either using or manufacturing pigments can gain for himself considerable knowledge of the nature of these materials by simple visual observation with the microscope. However, if this information is to be passed on to various department heads, etc., who seldom, if ever, visit the laboratory, the easiest procedure is to resort to photography; by this means a permanent record of what has been seen is obtained that is often easier to understand than any verbal or written description. Bearing this in mind, the beginner should acquire his apparatus and develop his laboratory accordingly, for eventually, when fully equipped, photomicroscopy will constitute the chief part of his work.

It is convenient, though not absolutely necessary, to have two microscopes. One is to be used for visual work for examining mounts, to note if they are properly dispersed. The second instrument is permanently fixed to a photographic stand and is to be used only for taking photomicrographs. The best stand is the upright type in which the camera can be swung aside to enable the operator to look into the microscope and

*Presented before the Technical Photographic and Microscopical Society, New York, Sept. 14, 1922.

[1] "German and American Varnish Making," by Bottler and Sabin.



FIGS 1, 2 AND 3

Fig. 1—This photomicrograph is an attempt to duplicate the kind often appearing in print and illustrates the following faults: 1—Magnification and resolving power both too low. 2—Illumination off center. 3—Illumination not critical. 4—Out of focus. 5—Overexposed. 6—Overdeveloped. 7—Pigment not dispersed.

Fig. 2—A fine grain pigment as taken from its package. Each pellet contains many thousands of pigment particles. Magnification 25 diameters.

Fig. 3—American process zinc oxide taken at 1,500 diameters, showing the characteristic crystalline outlines.

adjust the illumination, which, of course, must be maintained critical and centered. Each microscope should contain its own set of lenses, comprising a 16, 4 and 2 objective and a medium- and high-power eyepiece. A well-corrected oil immersion condenser is required for high-power work. Any of the standard illuminants may be used. The author prefers the blue band of the magnesium spark spectrum to any one of the others. This source of illumination is convenient, easily centered, does away with the necessity of filter screens, and the light is monochromatic and sufficiently intense to take photomicrographs at 1,500 diameters with 30-second exposures. Medium speed plates should be used giving neither great nor slight contrast.

The remainder of the apparatus will include the usual paraphernalia found in any microscopist's laboratory, such as turntables, slides, cover glasses, brunswick black, reagents, etc. A thickness gage should always be on hand in order to obtain correct cover glass thickness for the 4 mm. objective and proper thickness for the slides. The rubber investigator will require in addition a microtome capable of adjustment to 0.5 μ.

Mounting

It has been stated that "photomicrographs can be made and interpreted in all sorts of ways." This is quite true, but the pigment microscopist need not feel any apprehension concerning such a fact. It is very easy to decide whether a pigment photomicrograph is correctly made or not, and if not there is no reason why anyone should attempt to interpret it at the risk of arriving at a faulty conclusion. A properly made pigment photomicrograph can tell only a true story.

If we select almost any series of the published paint pigment photomicrographs and examine them critically, a number of instructive facts become apparent. The first is that there is nothing characteristic about any one of them serving to distinguish one pigment from another. Secondly, if we had no previous knowledge of the subject, it would be impossible to decide if the photomicrograph showed individual particles or not. Our natural conclusion would be that pigment photomicrographs are an excellent example of misdirected energy. In order to avoid such a conclusion, let us ascertain what faults exist that make work of this kind valueless and then determine the best means for correcting them.

Referring to Fig. 1, it is obvious that:

1. The illumination is neither critical nor properly centered.

2. Magnification and resolving power are both inadequate, being much too low.

3. The mount is not properly made. No attempt at dispersion.

With regard to No. 1, this fault exists so universally that it is the rule rather than the exception. Any textbook on the subject gives full explanation of how to avoid it.

The second fault can be attributed to the facts that, first, the cost of high-class objectives is often prohibitive for the small technical laboratory, and second, the untrained microscopist finds such lenses difficult to use. For the most satisfactory work with fine pigments a 2 mm. oil immersion objective is essential.

It is undoubtedly in the third fault where the beginner meets with the greatest trouble. It never occurs to him that the construction of the microscope is such that it is best adapted for the examination of *minute* objects, and, to within reasonable limits, the smaller the objects and the more completely dispersed they are the better suited they become for microscopical examination. As the result of this lack of information attempts are made to look at a great mass of material in which no effort has been taken to spread it out into sufficiently thin sections.

Various States of Subdivision

If we examine any pigment as it is taken from the package, it will be noticed, especially with the aid of a hand lens, that it is composed of small pellets which are soft and quite easily rubbed out between the fingers. (Fig. 2.) The size of these pellets is not necessarily dependent upon the nature of the material, and is in no way likely to influence the quality of the paint or rubber in which the pigment is ultimately used. In fact, these pellets are of no particular interest to the microscopist, but it has been necessary to mention them, for there are instances where technologists have taken such for individual particles. As a rule they are composed of many thousands of particles.

When these pellets are rubbed out on a glass slide in a liquid medium such as water, permitted to stand a few seconds and then examined under the microscope, it will be noticed that the particles have collected into

groups or flocculates. It is on account of this flocculating tendency that it is sometimes so difficult to obtain well-dispersed mounts of pigments.

So far we have recognized three states in which pigment particles will be found to exist—namely, dispersed, individual particles clearly shown; flocculated, individual particles seen only with difficulty; soft pellets, individual particles not discernible.

There is still another condition that has not been mentioned, and that is one which sometimes occurs in precipitates like lithopone. In materials of this type there can often be found small undispersable aggregates composed of a half dozen or more particles firmly cemented together. These aggregates differ materially from the pellets, being very much smaller, visible only at high magnification and function as individual particles.

It is necessary for the beginner to become acquainted with the dispersed state and the three states of aggregation so that he can recognize each one without effort or doubt as to what type it is. The next step is to learn how to make a properly dispersed mount suitable for photomicroscopy.

There are four essential qualities found in a properly made mount.

(1) Proper particle density.

(2) Correct proportion of the largest and smallest particles.

(3) Suitable dispersion.

(4) All particles in a single plane.

In other words, there should not be too many nor too few particles in the field of the microscope; the largest particles as well as the smallest should be present and not pushed off to one side; pellets should be completely rubbed out and flocculation prevented; and all particles should lie in the exact plane of the microscope slide. The instructions for accomplishing these results were first given by the author in the *Journal of the Franklin Institute*, November, 1921. A pigment mount, made in the manner there described, can be used not only for visual observation but, on account of the fact that the particles are cemented in a single plane and free from brownian motion, can be satisfactorily photographed at high magnification. This should be carried out with transmitted light.

Nothing is gained, and in fact a great deal lost, by attempting to employ dark ground illumination, or the ultra-microscope. In this latter case it is impossible to distinguish small aggregates from individual particles.

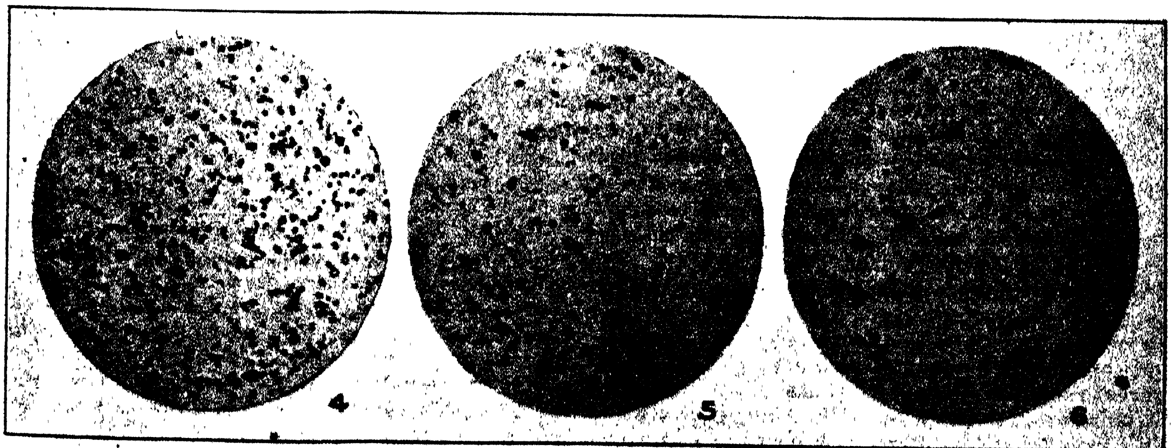
Photomicrographs of zinc oxide, lithopone, iron oxide, gas black, lamp black, sublimed white lead and corroded white lead should be made at 1,500 diameters, preferably with a 2 mm. apochromatic objective and a medium power compensating ocular. When moderate speed plates are used with a 5 ampere arc and a Wratten C filter about 1 or 2 seconds exposure is necessary, if the illumination is properly adjusted. With the blue band in the magnesium spark spectrum (as supplied with the Zeiss ultra-violet microscope) about 30 seconds is required for correct exposure.

The first requisite of a good pigment photomicrograph is that it shall unmistakably show the outlines of the ultimate particle. Preferably the particles should be separated and not touching or overlapping. When this is accomplished, all of the common pigments can be recognized and distinguished from one another without difficulty.

Characteristics of Common Pigments

Zinc Oxide. When this material is made by the so-called American process (Fig. 3), it yields its most characteristic forms. The single crystal particle is a hemimorphic hexagonal prism with acicular tendency. It readily forms twins, threelings and fourlings, all typically characteristic of this pigment. The particle size averages from 0.4 μ to 0.6 μ according to the method of manufacture. When made by the French process (Fig. 4), the particles are much less acicular and there seems to be no tendency for twinning; also the particle size is smaller, usually running from 0.3 μ to 0.4 μ on an average.

The addition of lead sulphate during the process of manufacture produces a solid solution with the zinc oxide causing the crystals to become short and thick. Fumed zinc oxide is always crystalline, though it is often erroneously referred to as amorphous. Microscopic examination of zinc oxide will show whether the material is a "straight" zinc oxide or a leaded one, and in the latter case will often indicate approximately how much lead is present. Furthermore, it can tell by what process the oxide was made and sometimes the type of furnace employed.

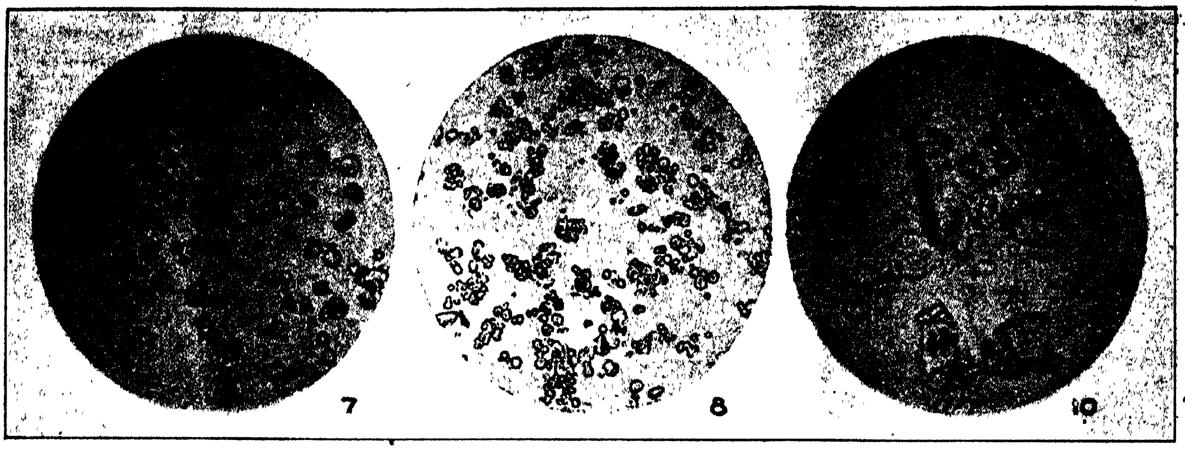


FIGS. 4, 5 AND 6

Fig. 4—French process zinc oxide, 1,500 diameters. There is less tendency here to form needles and twins than in the American process zinc oxide.

Fig. 5—Lithopone, 1,500 diameters. Note fine grain, different refractive indexes of particles and absence of any large particles.

Fig. 6—Lithopone, 1,500 diameters, taken with quartz lenses and ultra-violet light, showing clearly the transparent $BaSO_4$ as distinct from the opaque ZnS.



FIGS. 7, 8 AND 10

Fig. 7—Basic carbonate of white lead, 1,500 diameters, showing the characteristic hexagonal outlines of these crystals.

Fig. 8—Basic sulphate of white lead (sublimed white lead), 1,500 diameters. There is a slight tendency, not well shown in the photograph, for this pigment to form cubes.

Fig. 10—Barytes, 800 diameters.

Lithopone. Contrary to usual belief, lithopone is a fine-grain material, the average particle size falling between 0.3 μ and 0.4 μ. The misconception has arisen from the fact that lithopone rubs down in oil with a "pebbly" grain, but this should not be taken as an indication of the presence of large particles.

Under the microscope the material appears to be non-crystalline, the particles roundish in form, some having a high index of refraction and some low (Fig. 5). With the fluorescence microscope, sunproof lithopones appear dark, while the non-sunproof are beautifully fluorescent. Ultra-violet microphotographs show that these materials are composed of two ingredients, one transparent ($BaSO_4$) and the other opaque (ZnS) (Fig. 6).

Basic Carbonate of White Lead. On account of the large, well-defined hexagonal-shaped particles, this pigment is one of the best subjects with which to start in the study of pigment microscopy (Fig. 7). This material averages in particle size from 0.75 μ up to 2.0 μ and over, according to the method used in manufacturing it. When made by the Mathewson process, it is composed of large rough plates with a tendency toward the hexagonal outline.

White lead particles are never acicular, but always tabular. There are occasions, however, when this pigment contains elongated prisms of great size, but these are probably an impurity in the form of "normal" lead carbonate. Unlike zinc oxide, white lead is transparent to the ultra-violet wave length, 0.275 μ.

Basic Sulphate of White Lead (Sublimed White Lead). There is very little that is characteristic of this pigment. The particles are apparently non-crystalline, roundish in form, with here and there a tendency toward the cubical in form. The average particle size is about 0.65 μ (Fig. 8).

Gas Black. This substance is one of the most difficult subjects for microscopy (Fig. 9). This material can be successfully photographed only with the use of ultra-violet light. It is difficult for any one to see the gas black particle unless he possesses the trained eye of the microscopist. The individual particle does not look black, but slightly grayish or brownish, and seems to be more or less translucent. In size it is about 0.15 μ. Gas black has very strong tendencies to flocculate in all media and consequently it is not easy to obtain a well-dispersed mount of it. All gas black contains large lumps of undispersable material which are probably adamantine.

On the other hand, lamp black particles appear black under the microscope and are noticeably larger than those of gas black, about 0.3 μ to 0.4 μ. It is never possible to mistake one of these blacks for the other.

The Inerts. Barytes (Fig. 10), silica, asbestine and whiting (Fig. 11) are some of the principal inerts met with in paint and rubber. They are not difficult to recognize after the microscopist has become familiar with their characteristic features. In order to distinguish between barytes and silica it is sometimes a help to have on hand two liquid media of refractive indices of 1.54 and 1.64; silica is nearly invisible in the first

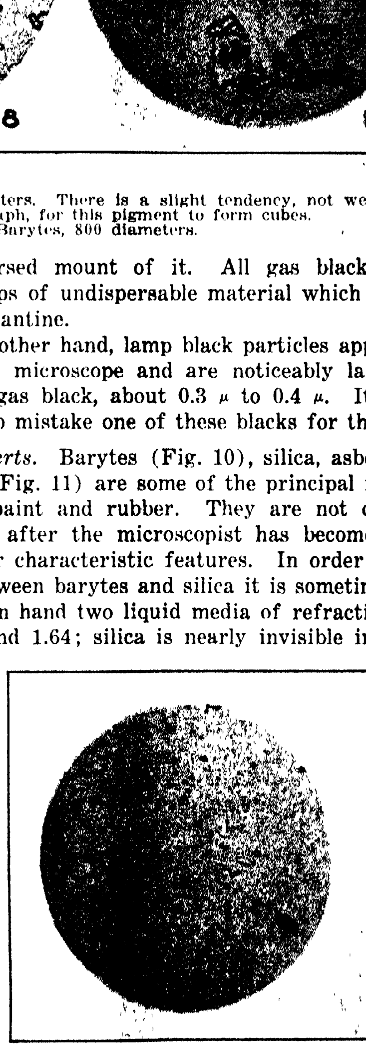


FIG. 9—GAS BLACK, 1,500 DIAMETERS
Taken with 1.7 mm. quartz monochromat and ultra-violet light.

and barytes in the second of these, giving an easy means for determining which material is being examined. Asbestine contains the characteristic rods of asbestos, though never so long as in the mineral itself. Whiting is easily recognized from the round "doughnut"-like shells of foraminifera which it contains.

The inerts possess such a low order of uniformity[2] that it is difficult to determine their particle size by the photomicrographic method, but as a rule they probably average from 5.0 μ to 10.0 μ in diameter.

[2] "A Photographic Method for the Determination of Particle Size of Paint and Rubber Pigments," by Henry Green, J. Frank. Inst., November, 1922.

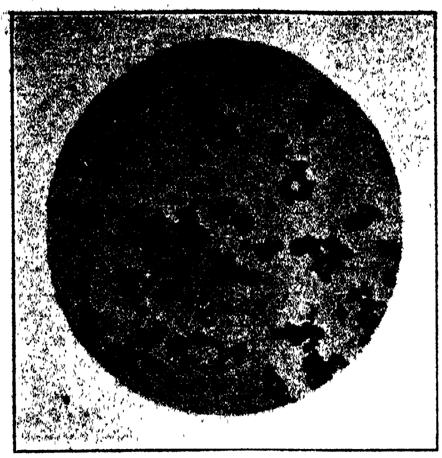


FIG. 11—WHITING, 500 DIAMETERS

Though the inerts are coarse in size, they are not "easy" subjects for the beginner, on account of their low index of refraction, making them difficult to see and impossible to photograph unless mounted in a medium of comparatively high refractive index.

Application to Research

When investigators finally become convinced of the fact that the ultimate working unit—the individual particle—can be seen and photographed through the microscope, then it should not be long before ways are found to apply the science of pigment microscopy to research problems.

The particle size of pigments is of the greatest importance to both the paint and rubber industries. In paint, particle size influences hiding power and consistency; in rubber, the resistance offered to abrasion. In order that as much guesswork as possible be eliminated from the estimation of particle size by the use of the microscope a method has been developed for the accurate measurement of pigment particles from negatives taken at a carefully ascertained magnification.[3] Prior to this research very little information as to the relative sizes of the common pigments was available. Investigators had made rough estimates of these for themselves, but they were admittedly only approximations and as a rule usually ran from 100 to 500 per cent too high. On the other hand, concerns manufacturing materials claimed to be colloidal often underestimate the particle size of their products to an even greater extent. Knowledge of proper methods for mounting pigments and the ability to use high-power lenses would soon correct these unnecessary misconceptions and pave the way for important advances in pigment technology.

Flocculation of Pigments

Perhaps one of the most important properties of pigments when incorporated in either rubber or paint vehicles, and one completely ignored until recently,[3] is that of flocculation. This property—or more correctly, the force which causes it—gives rise to the plastic nature of paints[4] and to the "stiffness" of compounded rubber. So far no microscopic method has been devised capable of giving more than a rough estimation of the magnitude of this force, but simple microscopic observation will always reveal its presence or comparative absence. In order to see it well in paints the material should be thinned with some of its own vehicle. This property depends entirely on the degree of wetting between the dispersed and continuous phases.

Flocculation of the pigment filler takes place in rubber, probably when its mobility is at its highest—that is, during vulcanization; the flocculates, having once formed, became permanent and can be studied in microsections made from the finished product. Rubber, of course, is plastic; consequently even when its mobility is high it still retains a yield value which, if greater than the force of flocculation of the filler, will tend to prevent the pigment particles from grouping. This is the case when rubber is compounded with zinc oxide. Here the wetting is of a comparatively high order, the flocculating tendency is weak, and the result is that microsections show very complete dispersion of this pigment in rubber.

The degree of wetting of the blacks by rubber is evidently low, for microsections show these pigments decidedly flocculated. It should be mentioned in this connection that poor incorporation of gas black will show as dense black lumps and should never be confused with flocculation, an entirely different phenomenon. Rubber microsections are made by first hardening the sample in a carbon tetrachloride solution of sulphur chloride,[5] or in melted sulphur,[6] or liquid air.[7] Sections are made from 0.5 μ to 5.0 μ in thickness according to the kind and quantity of pigment incorporated. Valuable information can sometimes be obtained from microscopic examination of stretched sheets of rubber instead of sections.[8]

Conclusion

Only three of the possible uses of pigment microscopy have been touched upon in this paper—namely, pigment identification, particle size measurement and the study of pigment flocculation. It requires very little imagination to visualize the innumerable problems which usually crop up during the course of a year's research on pigments, a large portion of which could be solved by the use of a knowledge of pigment microscopy. It has not been the intention, as stated earlier, to emphasize the application of this work to paint and rubber so much as to lay down the elementary principles upon which to erect a new science—the science of the microscopy of paint and rubber pigments, and as such, it is hoped, this endeavor will be found useful.

F. G. Breyer was, in all probability, the first investigator successfully to use the microscope in the study of zinc oxide. He recognized the crystalline nature of this material, which was supposed to be amorphous, and clearly distinguished between oxides made by different processes. At his suggestion the work, briefly given in this paper, was commenced about 6 years ago, and during that time has constantly received the benefit of his encouragement and enthusiasm, for which the author gives grateful acknowledgment.

Palmerton, Pa.

[3] "Pigment Flocculation—Its Relation to Paint Consistency," by Henry Green. Read before the September, 1922, meeting of the American Chemical Society.

[4] See Note 3. Also, "Further Development of the Plastometer and Its Practical Application to Research and Routine Problems," by Henry Green, A.S.T.M., vol. 20, Part II, 1920.

[5] "Recent Development in the Art of Rubber Microsectioning," by Henry Green, *J. Ind. Eng. Chem.*, vol. 13, No. 12, December, 1921.

[6] "The Microscopic Examination of Rubber Containing Antimony Pigments," by A. F. Hardmann. Read before September, 1922, meeting, American Chemical Society.

[7] "Some Microsections Cut From Vulcanised Rubber Articles," by H. A. Depew and I. R. Ruby, *J. Ind. Eng. Chem.*, vol. 12, 1920.

[8] "Volume Increase of Compounded Rubber Under Strain," Henry Green, *J. Ind. Eng. Chem.*, vol. 13, No. 11, November, 1921.

German Brown Coal Compared With American Lignite

Is Almost Two-thirds Water, Ours One-third; Has 2½ to 13 Per Cent Agglutinating Matter, Ours Less Than 1½ Per Cent

BY O. P. HOOD
Chief Mechanical Engineer, U. S. Bureau of Mines

ALTHOUGH I had read many reports about the brown-coal industry of Germany, actual inspection gave me several impressions for which I was not prepared. We had fallen into the careless habit of thinking about German brown coal and American lignite as similar material. The great briquetting industry which has been built upon German brown coal has been frequently pointed to as an example of what we should do with our own lignites. This puts one in a frame of mind to expect a greater similarity in raw material than actually exists.

Analyses of the two materials indicate a great difference in water content. Our lignite has approximately 35 per cent moisture, whereas German brown coal in the Cologne district has about 60 per cent. Along with this difference in the moisture content is a considerable difference in physical character. Brown coal is much more like earth than like rock. It is far less consolidated than our lignites. We would not think of trying to force a spade into a bed of our lignite, but this would be quite possible with much of the German brown coal.

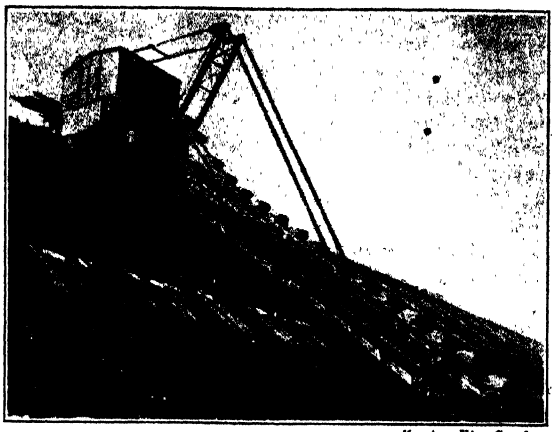
PHYSICAL CHARACTERISTICS

A piece of brown coal slightly consolidated and 3 in. thick is readily broken with the fingers like a piece of corn bread. Throughout a mass of brown coal small pieces of wood are much in evidence. The binding material between the annual layers of wood growth has almost disappeared, leaving the thin chips to curl and crumble when exposed to the sun. One small pile of brown coal exposed to the weather for a couple of months had the appearance of a chip pile.

These woody pieces had turned a dark chocolate brown, and they have various degrees of friability. Occasionally large chunks of wood are found that would offer considerable resistance to any digging device. The beds in various places vary in the proportion of fine and coarse material but in general the material is distinctly earthy. When taken to the briquetting plant the brown coal is passed over screens which take out pieces over about 3 in., and these are diverted to the boiler house for steam making.

The remaining material above ¼ in. is readily broken up in a disintegrator. Our own lignite would have to be put through rolls or a jaw crusher. The vegetable growth that furnished these great beds varied from time to time, so that in some places there is a distinctly banded appearance, the color varying from various shades of chocolate brown to a light yellowish brown. In mining by hand the material is easily dislodged with pick and shovel. Blasting seems unnecessary, and the excavating machinery scrapes it off a steeply inclined face.

Our own lignite, however, is consolidated, so as to be quite comparable in hardness with our more familiar bituminous coal. It is mined in the same manner as is soft coal, by the use of coal-cutting machines and explosives. It usually occurs, also, in measures that have rock above and below, whereas in the German


Keystone View Co., Inc.
CHAIN BUCKET CONVEYOR DIGGING BROWN COAL IN THE NIEDER LEUSITZ DISTRICT

measures the overburden is sand, gravel and clay. These differences are responsible for the different methods of working. The greater part of German brown coal is taken from open pits by machinery.

There is a limit, of course, to the depth of the overburden, as compared with the thickness of the coal, that can be economically removed, and when this limit is exceeded underground mining methods are used. Those parts of the beds that can be worked from open pits are developed first, but as the industry grows older the deeper lying portions will be worked by underground mining at a higher cost.

Our own lignite can in places be stripped of the overburden by excavating machinery, and can be loaded into cars by the same machines. This work probably would be done by our standard dipper excavators, and machines of this type are to a limited extent used in brown coal, but the relatively easy digging together with the uniformity of material has led the German engineers to develop in high degree the chain bucket excavator for this work.

CHEMICAL DIFFERENCES

Besides these physical differences there are important chemical contrasts. Certain materials in brown coal, on being heated, form an excellent binder and waterproofing material. The temperature at which this material develops is well below that of the distillation of any of the other coal substances. The percentage of this binder in the raw material must be at least 2½ per cent if briquets are to be produced by the German method. This method, briefly, is to subject the brown coal, which has been dried to a moisture content of about 13 per cent, to high pressure, pushing it through a converging die which generates sufficient heat by friction to melt the inherent binder and thus waterproof each particle. Different brown coal beds possess this natural binder in varying quantities up to 13 per cent.

The low-temperature distillation of this material yields lubricating greases and paraffine from which candles are made. Most of our American lignites have binding material of this sort in quantities less than 1½ per cent. This immediately suggests that our own problem of briquetting is fundamentally quite different from that of the German brown-coal area. We are quite justified in looking to the development of the brown-coal industry as an excellent example of what can be done when it is necessary to beneficiate a low-grade fuel, but we are not justified in looking to

this example for specific technical detail as a solution of our own lignite problem.

America has a lignite problem that must be solved in our own way to fit our own raw material and to suit our own economic conditions. The German brown coal occurs in well-populated districts where there is a high degree of industrial development coincident with a scarcity and relative high price of other fuels. It is in the possession, also, of a people who have not always had the choice of an abundance of the best coal and who have already acquired an attitude of thriftiness toward the use of heat.

Our own lignite occurs in districts furnishing a far less concentrated market and a much smaller degree of industrial development, and where the distances from coal field to a market are much greater. Our lignite also occurs among a people quite familiar with some of the best coals on earth and with habits of using heat in quantity, particularly for domestic purposes, quite unknown to European habit.

The brown coal industry of Germany at the present time is rapidly developing, as a result of the scarcity of industrial fuel. There is a real shortage of fuel which can be met in the most expeditious manner by the development of brown coal. While a relatively small percentage of Germany's total fuel resources are in the form of brown coal, they are turning to this portion for rapid development at this time. There is enough of this material to last from eighty to a hundred years, and the methods of mining and treating have been developing since about 1856, so that practices are substantially standardized and can be applied with little risk and uncertainty.

In 1921 the total output of brown coal was 123,000,000 tons, while more than 28,000,000 tons of briquets were produced. The raw brown coal is used for industrial purposes on step grates, but since it has only from 3,200 to 4,500 B.t.u. per pound, it is quite evident that it cannot be transported any great distance, except under extreme need. The briquets, on the other hand, make a most excellent fuel for industrial and domestic consumption.

It takes about three tons of brown coal to produce one ton of briquets, one ton of the raw material being required to reduce the remaining two tons to one of briquets. Their heat value is about 8,600 B.t.u. per lb.

Platinum in 1922

During the first 9 months of 1922 the imports of crude and unmanufactured platinum amounted to 72,410 oz., which is nearly 11,000 oz. more than the imports during the whole of 1921. Colombia supplied about half the crude platinum that reached the United States, and some Russian platinum came in through England and other countries. As the domestic supply of platinum and related metals is now almost completely dependent on imports, it is reasonable to expect a considerable increase in the quantity of new metals recovered by refiners. Stocks of platinum at the beginning of the year were about normal, amounting to 64,647 oz.

The large supply was reflected in the price of refined platinum, which throughout most of the year was from $87.50 to $90 an ounce but which early in the fall advanced to $108. Palladium remained at $55 to $60 an ounce without fluctuation. The price of iridium was fairly regular at $160 to $175 an ounce until fall, when a shortage of supply caused a considerable advance in price.

Oxidation-Reduction Indicators

Dr. William Mansfield Clark, chief chemist of the Hygienic Laboratory, spoke before the Chemical Society of Washington, Dec. 14, on "Oxidation-Reduction Indicators" and gave a demonstration of equipment used.

The speaker gave a brief description of the method used in the study of the oxidation-reduction equilibria among organic dyes. Titrations were carried out in a closed vessel under the protection of pure nitrogen. Electrode measurements were made against a saturated KCl calomel electrode and the single potential differences were reduced to the hydrogen scale. In all cases the dye solutions were buffered against change in hydrogen-ion concentration, as was also the titanous solution used for reduction.

It was shown that when the hydrogen-ion concentration was maintained rigidly constant the curves relating single potential differences to percentage reduction conformed to Peter's equation

$$E = E_0 - \frac{RT}{nF} \log_e \sqrt{\frac{reductant}{oxidant}}\,.$$

The value of n, as this is determined from the slope of the curve, is found to be 2 in the case of all dyes so far studied. The accuracy obtained by this method was as high as has been observed in the study of inorganic systems. The speaker particularly emphasized the necessity of controlling the hydrogen-ion concentration in measurements of this type and then pointed out the shift which occurs in the equilibrium potentials on change of acidity. Unlike most inorganic systems which require for their favorable study intense acidities or intense alkalinities, many of the organic systems may be swung through the whole gamut of acidity-alkalinity. When so handled they reveal the influence of hydrogen-ion concentration in details which have hitherto not been appreciated. To illustrate this the speaker showed his extensions of the data on ferrocyanide-ferricyanide mixtures and on the quinhydrone system. Carrying this into regions of p_H which have hitherto not been studied, it was shown that there is an orderly transition from regions where p_H has no influence upon electrode potentials to regions where the potential varies in an orderly manner with p_H.

There was then developed the mathematical treatment outlined in the speaker's book, "The Determination of Hydrogen Ions," 2nd edition, Chapter XVI. By means of the mathematical relations it was predicted from the chemical nature of certain of the dyes that the curve relating the potential at 50 per cent reduction to p_H should have at 30 deg. various slopes in various regions of p_H. By assigning arbitrary acidic and basic dissociation constants, equations were developed which fitted the experimental facts, and the constants so assigned agreed with independent estimations where these are available.

Taking as an example the substituted indophenols, the influence of substitution upon equilibrium potentials is revealed, and a new method of studying the influence of substitution is opened up. Substitution in any one type of dye was shown to have relatively little effect, a greater effect being found in the transition from one type of structure to another.

By selecting a series of dyes, the equilibrium potentials of which have been determined, it is possible to construct a system of oxidation-reduction indicators comparable in their own field with the acid-base indicators.

The Low-Temperature Carbonization of Coal

II—Results of Applying the Carbocoal Process to Various Types of Coal in Small-Scale Apparatus

BY HARRY A. CURTIS AND WALTER J. GELDARD

IN a previous paper[1] in this series the authors described the development of the Carbocoal process on a commercial scale at Irvington, N. J. In its final form this process consisted essentially of the three steps: first, carbonizing the coal at low temperature; second, grinding and briquetting the carbon residue, and third, carbonizing the briquets to render them smokeless. The Carbocoal process and the experimental plant at Irvington presently aroused a great deal of interest; inquiries began to come in from all parts of the United States, from England, France, Japan, Canada and elsewhere. Coal operators wanted to know whether their particular coals were suitable for making Carbocoal and what yields of byproducts could be obtained. In several cases carload lots of coal were shipped to Irvington, and tested in the commercial retorts, but the cost of such tests was high and it was difficult to measure accurately the byproduct yields from a few carloads of coal. To meet the situation there was finally developed at Irvington a complete miniature plant in which the various steps of the Carbocoal process could be carried out with 100-lb. batches of coal. In the following pages this small-scale apparatus is briefly described and the results obtained with several typical coals is discussed.

APPARATUS USED

Primary Carbonization—The low-temperature carbonization of the coal was carried out at 500 to 550 deg. C. in a cast-iron retort, shown in Fig. 1. This retort was mounted in a firebrick setting and heated by three surface combustion burners. In the early tests with this apparatus the paddle shaft was turned by hand, but later a motor drive was substituted. It will be noted in Fig. 1 that the retort is so designed that all the coal is within the heated area of the retort.

It was customary to carbonize three batches of coal of 33⅓ lb. each in this retort before disconnecting the byproduct apparatus. It would have been better to have had a larger retort and to have made a single charge of 100 lb.

Collection of Byproducts—The volatile matter distilled from the coal was passed successively through a condenser, a water scrubber, an exhauster, an acid scrubber and four wash-oil scrubbers, the residual gas passing to a holder. Arrangement of the apparatus is shown in Fig. 2. During the test, tap water was circulated through the condenser. One liter of water was placed in each water scrubber, 1 liter of 10 per cent H_2SO_4 in the acid scrubber, 1½ liters of wash-oil in each of the oil scrubbers. The wash-oil used was the ordinary high-boiling petroleum oil commonly used in byproduct coke plants. It was later shown by one of our co-workers[2] that, for the absorption of light oils from coal gas and for its subsequent analytical determination, absorbent charcoal is a much better, cleaner and more easily handled reagent. Accordingly, the four wash-oil scrubbers were removed and two tin tubes, in series, each containing 600 cc. of absorbent charcoal, were substituted. This change increased greatly the facility of setting up and handling the apparatus, as well as the accuracy of the analytical results.

During a run, tar and ammoniacal liquor collected in the condenser, the two water scrubbers, and a little in the sulphuric acid scrubber. The ammonia was distributed in the tar, the liquor, the water scrubbers and largely in the acid scrubber, while the light oil in the gas was removed by the wash-oil or charcoal scrubbers.

Briquetting—The carbon residue accumulated from the primary carbonization was ground to the proper screen in a small Hardinge ball mill, mixed with crushed pitch and then fluxed with live steam in a vertical fluxer. Briquets were made in a small Komarek press, the briquets being approximately the same size as made in the larger plant presses.

Secondary Carbonization—The briquets were carbonized at 1,000 to 1,100 deg. C. in a carborundum muffle 10 in. diameter by 36 in. length, the byproducts being collected just as during the primary carbonization of the coal.

DATA TAKEN DURING TEST

It is not possible in a brief paper to set down all the details of operating procedure with the small-scale apparatus described, nor to discuss all the precautions used in taking samples, in recording various measurements and in chemical analyses. It is perhaps worth while, however, to list below the items of information which each complete test yielded:

a. Proximate analysis, thermal value, ash fusing point, sulphur and nitrogen on coal tested.

b. Yield of gas, tar, ammonia and light oil during primary carbonization of coal and during secondary carbonization of the briquets.

c. Specific gravity and calorific value of primary gas and of secondary gas.

d. Specific gravity and distillation fractions for primary tar and secondary tar, with specific gravity and tar acid content of each fraction.

e. Yield of carbon residue and proximate analysis of same.

f. Screen analysis of carbon residue used in raw briquet mix, melting point of pitch used in same, and relative proportions of ingredients.

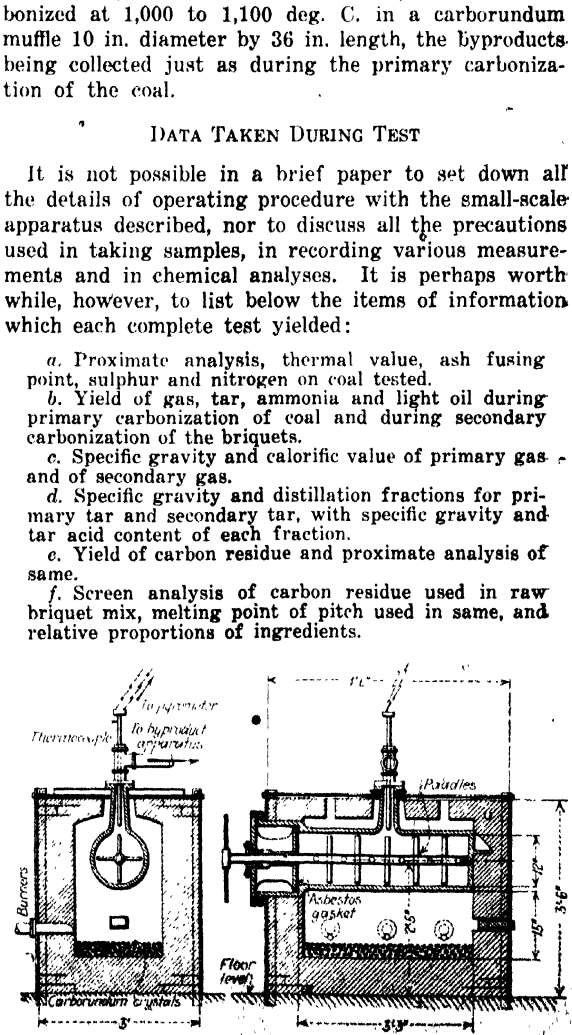


FIG. 1—SMALL-SCALE RETORT FOR LOW-TEMPERATURE CARBONIZATION

[1] Chem. & Met., vol. 28, No. 1, Jan. 3, 1923, p. 11.

[2] A. L. Davis. Data not yet published.

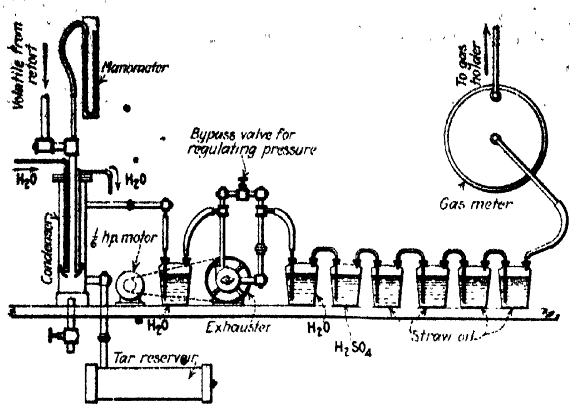


FIG. 2—APPARATUS FOR COLLECTING BYPRODUCTS DURING SMALL-SCALE TESTING OF COAL

g. Yield of Carbocoal and proximate analysis of same. Sulphur content, nitrogen content, calorific value, and usually a "drop test" of the Carbocoal.

The complete test of a coal in the small-scale plant described above came to be known in the company's records as the "Buffalo furnace test." There were something over 150 complete tests made at the laboratory at Irvington. It is not feasible to give the results of all these tests, but the attempt is made below to pick out various types of coals and summarize the data for these coals.

EXAMPLE 1. HIGH VOLATILE BITUMINOUS COAL

This particular coal was received as a carload shipment from the Russell mine of the Warner Collieries at Tiltonville, Ohio.

Item I—Proximate Analyses

	Coal As Rec'd	Coal Dry	Carbon Residue Dry	Carbocoal Dry
Moisture, per cent	4 5	......	......	......
Volatile, per cent	37 4	39.2	8 9	4.4
Fixed carbon, per cent	47 4	49 6	75 0	77.7
Ash, per cent	10 7	11.2	16.1	17.9
	100	100	100	100
Sulphur, per cent		4 75	......	2 06
B.t.u.		13,483	......	11,551
Ash fusing point, deg. F.		1,810 to 1,840	......	......

Item II—Raw Briquet Data

Distribution of the 2,000 lb. of coal in process: 1,846 lb. coal (dry) to primary retorts and 154 lb. of powdered coal (dry) used in raw briquet mix.
Composition of raw briquets: Carbon residue, 80 per cent; powdered coal, 10 per cent; coke-oven pitch, 10 per cent.
Melting point of pitch, 170 deg. F.

Item III—Yields Per 2,000 Lb. Dry Coal

	Primary Carbonization	Secondary Carbonization	Total From Process
Carbon residue, lb.	1,234	....	....
Carbocoal, lb.	....	....	1,223
Dry tar, gal.	33.40	5.35	38.75
Ammon. sulphate, lb.	10.2	9.9	20.1
Light oil from gas, gal.	....	....	2.02
Gas, cu.ft.	3,622	3,690	7,312

Item IV—Gas Data

	Primary Gas	Secondary Gas	Total From Process
B.t.u. (average)	893	379	633
Sp.gr. at 60 deg. F.	0.65	0.59	0.62

Item V—Tar Data

Fractions	Primary Tar Sp.gr. 1.05 Vol., Per Cent	Sp.Gr.	Tar Acids, Per Cent	Total Tar From Process Sp.gr. 1.07 Vol., Per Cent	Sp.Gr.	Tar Acids, Per Cent
0-170 deg. C.	4.77	0.824	11.5	4.20	0.824	11
170-230 deg. C.	16.76	0.938	37.5	14.55	0.938	38
230-270 deg. C.	14.90	0.992	59.0	13.75	0.992	58
270-300 deg. C.	8.17	1.006	32.5	7.95	1.006	29
300 deg. pitch	7.04	1.065	30.0	10.29	1.053	16
Pitch (170 deg. F.M.P.)	48.36	......	......	49.51	......	......

TABLE I—GENERAL RESULTS WITH MISCELLANEOUS COALS

Test No.	Source of Coal	H_2O in Coal	Analysis of Coal On Dry Basis Vol.	F.C.	Ash	B.t.u. in Coal	B.t.u. in Carbocoal	F.P. of Ash, Deg. F.	Yields Per Ton of Dry Coal Semi-carbo.	Carbocoal	Dry Tar	Light Oil	Am. Sulph.	Gas	B.t.u. of Gas	Sp.Gr. of Tar	Distillation of Dry Tar Percentages by Volume 0–170	170–230	230–270	270–300	300–End	175 Deg. F. Pitch	Analysis of Carbocoal Vol.	F.C.	Ash	Name of Coal or Mine or Seam
16	Wilder, Va.	2.2	35.3	56.5	8.2	14,225	12,458	2,300	1,393	1,543	29.1	2.2	19	7,644	640	1.07	2.7	14.3	11.6	9.5	20.2	41.7	6.2	79.4	14 4	Clinchfield Mine 6
20	Japan	1.6	39.2	55.8	5.0	13,883	11,055	2,240	1,281	1,387	33.9	2.46	16	8,890	602	1.06	4.6	13.9	12.2	9.6	16.3	43.4	4.9	82.3	12.8	Takashima Coal
31	Upshur Co., W. Va.	1.3	34.9	57.4	7.7	14,110	12,950	2,550†	1,281	1,346	32 55	1.09	18	7,553	581	1.08	....		Tar not distilled				4.9	81.7	13.4	Upper Freeport
32	Dawdon Col., Eng.	2.8	33.6	63.2	3.2	14,900	12,945	2,000	1,290	1,308	34.66	1.52	16	8,701	622	1.05	....		Tar not distilled				3.2	88.5	8.3	Low Main Seam
34	Maher Collieries	5.1	40.7	49.8	9.5	12,560	12,309	1,840	1,240	1,301	41.19	1.99	17	8,255	615	1.09	4.3	14.1	12.5	10.7	4.8	53 6	3.6	80.2	16.2	Maher Mine 9
37	Montceau, Fr.	4.1	31.9	57.9	10.2	14,018	.. ...	2,320	1,300	1,356	27 02	1.48	14	7,846	621	1.10	3.2	10.9	11.2	8.8	13 2	52.7	6.0	80.7	13.3	Blanzy Coal
65	Lundale, W. Va.	1.2	32.9	61.8	5.3	14,481	13,419	2,640†	1,324	1,404	34.73	1.83	21	9,070	573	1.07	....		Tar not distilled				3.8	87.0	9.3	Cedar Grove Mine
10	Edmonton, Can.	18.2	38.9	46.4	14.7	10,315	.....	1,980	1,282	1,347	9.46	0.95	21	7,420	368	1.07	....		Tar not distilled				6.7	71.5	21.7	Medicine Hat Lignite
16	Rock Springs, Wyo.	10.4	42.8	54.0	3.2	13,117	13,364	1,985	1,240	1,125	31.04	1.84	34	9,345	487	1.06	4.2	13 1	11.7	12.8	8.2	50.0	4.1	89.7	6.2	U. P. Mine 10, Seam 7
26	Japan	14.1	45.0	34.5	20 5	10,202	9,377	2,280	1,188	1,183	34.22	1.82	25	9,722	525	1.02	2.5	14.4	15.6	13.0	11.4	43.1	7 9	61.8	30.3	Ibaraki Lignite
14	Bush, Ill.	5.4	34.6	48.8	16.6	12,329	12,096	1,990	1,356	1,373	24.54	1.64	19	7,871	541	1.12	4.8	14.0	13.2	12.0	4.8	51.2	3.9	77.3	18.8	Western Coal & Min. Co.
19	Neff, Ohio	2.9	39.3	49.7	11.0	12,906	11,195	1,790	1,205	1,285	37.12	2.79	21	6,835	608	1.10	3.1	12 1	13.0	10.6	9.8	51.4	4.3	78 6	17.1	Maher Collieries
38	Ellsworth Col., Eng.	3.0	30.9	59.1	10.0	13,568	12,450	1,980	1,353	1,403	26.64	2.05	14	8,924	510	1.10	....		Tar not distilled				2.3	82.5	15.2	Duff Coal, Maudlin
18	Welbeck Col., Eng.	3.7	34.6	50.7	14.7	13,070	11,320	2,010	1,367	1,404	25.39	2.13	30	9,080	571	1.09	....		Tar not distilled				3.7	77.2	19.1	New Hucknall Slack
17	Cramlington, Eng.	9.3	37.3	54.4	8.3	13,298	12,249	1,925	1,329	1,331	27.78	1.2	32	9,288	432	1.10	....		Tar not distilled				4.6	81.6	13.8	....
13	Glebe Col., Eng.	1.5	38.8	59.2	2.0	15,050	......	2,080	1,295	1,274	34.02	1.72	32	8,870	515	1.14	....		Tar not distilled				4.7	90.7	4.6	Holly Lane, Fenton
	Units	%	%	%	%	Per lb.	Per lb.	Deg. F.	Lb.	Lb.	Gal.	Gal.	Lb.	Cu.ft.	Per Cu.ft.		%	%	%	%	%	%	%	%	%	

Remarks:
Test No. 130—Briquet mix: 78 per cent semi-Carbocoal, 12 per cent coke-oven pitch, 10 per cent bituminous coal.
Test No. 131—Briquet mix: 80 per cent semi-Carbocoal, 10 per cent coke-oven pitch, 10 per cent bituminous coal.
Test No. 128—Briquet mix: 80 per cent semi-Carbocoal, 10 per cent Ibaraki pitch, 10 per cent bituminous coal.
† Fusing point of ash: Values given are lower limits of fusing range.

EXAMPLE 2. TEXAS LIGNITE

This particular sample of lignite was sent in by the Big Lump Lignite Co. from Rockdale, Tex. The results given below are of particular interest just now, since a plant is being built to carbonize and briquet this lignite.

Item I—Proximate Analyses

	Coal As Rec'd	Coal Dry	Carbon Residue	Carbocoal
Moisture, per cent	29.4			....
Volatile, per cent	32.7	46.3	13.2	7.7
Fixed carbon, per cent	30.1	42.7	69.3	74.2
Ash, per cent	7.8	11.0	17.5	18.1
	100	100	100	100
Sulphur, per cent		1.12	1	1
Nitrogen, per cent		1.45	1.5	
B.t.u.		12,155		10,541

Item II—Raw Briquet Data

Composition of raw briquet mix:

Lignite carbon residue	80
Powdered coal (coking coal)	10
Coke-oven pitch	10

The pitch from lignite is not suitable for binder if used alone, but can be used if it is blended with asphalt or with coke oven pitch

Item III—Yields per 2,000 lb. Dry Lignite Plus the Powdered Bituminous Coal and Extra Pitch Used in Raw Briquets

	Primary Carbonization	Secondary Carbonization	Total From Process
Carbon residue, lb.	1,143		......
Carbocoal, lb.			1,091
Dry tar, gal.	13.67	7.17	20.84
Ammonium sulphate, lb	11.75	6.70	18.45
Light oil from gas, gal			2.61
Gas, cu.ft.	6,475	4,651	11,126

Item IV—Gas Data

	Primary	Secondary	Total
B.t.u. of gas	603	291	473

EXAMPLE 3. MEDIUM VOLATILE, HIGH-ASH, BITUMINOUS COAL

This sample came from the Snowdown Colliery, near Dover, England.

Item I—Proximate Analyses

	Coal As Rec'd	Coal Dry Basis	Carbon Residue Dry Basis	Carbocoal Dry Bas
Moisture, per cent	2.3			.....
Volatile, per cent	24.6	25.2	7.6	4.5
Fixed carbon, per cent	55.8	57.1	68.4	72.2
Ash, per cent	17.3	17.7	24.0	23.3
	100	100	100	100
Sulphur, per cent		3.4		1.62
Nitrogen, per cent		1.9		
B.t.u.		12,462		11,358
Ash fusing point, deg. F			1,980 to 2,020	

Item II—Raw Briquet Data

Distribution of coal in process to primary retorts, 1,785 lb; to raw briquet mix, 215 lb.

Composition of raw briquets:

Carbon residue, per cent	78
Pitch, per cent	10
Powdered coal, per cent	12
	100

Item III—Yields per 2,000 lb Dry Coal

	Primary Carbonization	Secondary Carbonization	Total From Process
Carbon residue, lb	1,396	..	....
Carbocoal, lb.	..		1,505
Dry tar, gal.	16.3	7.5	23.8
Ammonium sulphate, lb	5.1	10.1	15.2
Light oil from gas, gal.	0.83	0.32	1.15
Gas, cu.ft.	2,552	5,019	7,571

Item IV—Gas Data

	Primary Gas	Secondary Gas	Total
B.t.u.	851	348	518
Sp.gr.	0.625	0.57	0.59

Item V—Tar Data

Sp.gr. of primary tar	1.062
Sp.gr. of secondary tar	1.181

Distillations not made.

EXAMPLE 4. MISCELLANEOUS COAL

In Table I there are given in less detail than in the foregoing examples the data obtained with a variety of coals. The table is meant to show only the general results from such coals and should not be used to draw conclusions by comparing the individual coals, since each test involved many details not mentioned in the table. It should be remembered that the results given in this table refer to the Carbocoal process complete and not to the low-temperature distillation alone.

Economic Status of Nitrogen Fixation in Germany

Present Production Still Inadequate to Meet Domestic Requirements—Recent Developments Compared With Pre-War Situation*

BY W. T. DAUGHERTY

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THE importance of synthetic nitrogen for Germany's agriculture as well as for her industries is greater now than before the war. The present financial condition of that country prevents her purchasing Chilean and Norwegian nitrates in great quantity as she did in 1913. Furthermore, the necessity for increased domestic production of foodstuffs to free Germany from foreign supplies, for which she can ill afford to pay at present world-market prices, is now much more pronounced.

The result is a consistent effort to increase the fixation of nitrogen from the air—an effort which had its first real impetus when Germany went to war and was automatically cut off from importing Chilean nitrates. Germany's experience with nitrogen fixation has thus far been highly satisfactory, certainly from the standpoint of meeting the emergencies for explosive manufacture created by the war and the demands for the progressively intensive agriculture after the war. Although crop statistics for the past year, compared with 1921, would seem to belie an increase in the use of artificial nitrogen fertilizer, the real reason for the decrease in agricultural yields is probably to be sought elsewhere. German crops suffered from unfavorable weather this year and nitrogenous rehabilitation is still much needed to compensate for previous neglect resulting from the demands made by the ammunition industry on war-time artificial nitrogen production.

Germany's comparatively new synthetic nitrogen industry, as developed most efficiently by the inventions of Haber and Bosch, must be regarded as a very important scientific achievement, likely to compete in the world market of the future against native nitrate salts, as well as against the air-fixed products of Norway and Switzerland.

THE SUPPLY IN 1921-1922

German production in terms of nitrogen content in the fertilizer year[1] 1921-22 amounted to 300,000 tons, according to the most reliable estimate, while the needs of agriculture and industry are estimated at from 500,000 to 600,000 tons. Two-thirds of this production was credited to the two plants employing the Haber-Bosch process for the production of synthetic ammonia,

*Special report No. 35, dated Nov. 7, 1922, at Berlin, Germany.
[1]The German fertilizer year begins on May 1.

from which, with the aid of catalyzers, nitrate salts are produced. The nitrogen content of these salts is estimated at about 20 per cent, which indicates a production of 1,000,000 tons. One-sixth of the 1921-22 production of synthetic nitrogen in Germany is credited to the Frank-Caro process yielding calcium cyanamide (19 per cent N) for commerce, and an equal share belongs to the coke and gas factories, yielding ammonium sulphate (20 per cent N). The total production in 1921-22 was about 41 per cent above production in the previous year, and the ratio of increase was more or less uniformly distributed among the three processes of manufacture.

According to official statistics, the consumption of fixed nitrogen by German agriculture alone was 300,000 tons natural organic, but this included other nitrogenous fertilizers not discussed here. The German industries—e.g., dyes, sulphuric acid, celluloid, meat preserving, etc.—are accustomed to use about one-fifth of Germany's nitrogen supply. Net imports of Chilean and Norwegian saltpeter during the 1922 fertilizer year amounted to 17,768 tons of salts, equivalent to about 2,500 tons of nitrogen, accordingly but a fraction of the needs of the industry.

Pre-War Nitrogen Supply

Before the war, Germany imported more than half of her total supply of nitrogen. In 1913, her net imports of nitrates from Chile amounted to 746,811 tons of salts (containing roughly 120,000 tons of nitrogen) and from Norway, Switzerland and Sweden 48,141 tons of salts (containing roughly 6,000 tons of nitrogen). In this connection it must be remembered that the actual value of nitrates as plant food is somewhat greater than that of ammonium sulphate, although the latter contains a relatively higher percentage of pure nitrogen. The superiority of nitrates lies in the readier assimilation of their nitrogen by plant life. The ratio of their assimilation, as compared with that of ammonium sulphate, has been computed[2] as 100:98.

In the fertilizer year 1913-14 Germany produced about 110,000 tons of pure nitrogen from the operations of her coke and gas factories, about 5,000 tons by the Frank-Caro method, and about 7,000 tons by the Haber-Bosch process. The latter process was then in its infancy, while the former, now as then, is less economical, at least when dependent upon the power sources for electrical energy which Germany is able to offer.

Germany's gross supply of nitrogen for agriculture and industry in the calendar year 1913 (Note: The above production figures were for the "fertilizer year") was approximately 248,000 tons. Agriculture absorbed 210,000 tons of this amount, the remainder being used by industry. By similar computations, it is calculated that Germany's gross supply of nitrogen in 1912 was approximately 230,000 tons, with a similar ratio of consumption by agriculture and industry, and in 1911, about 185,000 tons.

It is interesting to note the increase in the use of synthetic nitrogen in Germany in the last 10 years. Besides having the poorest soil of any of the larger nations of Europe, Germany now has new difficulties in feeding her dense population, because of inability to buy abroad on a pre-war scale. Dr. Caro, head of the Bayerische Stickstoffwerke at Trostberg, which employs the process bearing his name (and also operated in America), has stated that if Germany's annual production of synthetic nitrogen is increased to 500,000 tons of nitrogen she can be freed from importing foreign grain. Others estimate that 600,000 tons would be required. It is assumed that Dr. Caro presupposes that German soil would also be adequately supplied with potash and phosphates, but even so his estimate seems very optimistic.

In connection with the general fertilizer situation, it is stated that German soil was overfed with phosphates before the war and that sufficient reserves are in the soil to allay any fears of an imminent phosphate shortage. The average ratio of nitrogen to phosphate and potash absorption by all German crops is estimated at 1 to ½ and 1 to 1½ respectively.[3]

The War Developments

The war revolutionized Germany's supply of nitrogen by building up a fixation industry. The process was by no means unknown when the war broke out. The arc process of producing nitric acid was already in use. Frank and Caro had discovered calcium cyanamide, and Haber and Bosch had perfected their process of producing ammonia by the direct combination of hydrogen and nitrogen.

It was the latter process that was destined to grow from small beginnings to the greatest single enterprise of its kind in the world. The Oppau plant, at Ludwigshaven-am-Rhein, operated by the Badische Anilin und Soda Fabrik, is now credited with an annual capacity for production of 100,000 tons of nitrogen; the Leunawerke at Merseburg with 200,000 tons. Probably only Germany's acute coal shortage and the explosion in the Oppau plant on Sept. 21, 1921, prevented capacity output in 1921-22.

The Situation in 1914

Germany had about 50,000 tons of combined nitrogen when she entered the war. Reserve stocks of Chilean nitrates contained about 25,000 tons; ammonium sulphate, about 20,000 tons, while about 5,000 tons was captured in Belgium, northern France and in the East during the first invasions. Relatively small amounts were imported from Norway and other neutrals. She was potentially able to produce 122,000 tons, 110,000 tons alone being from her byproducts coke and gas manufacture. The German steel industry, however, suffered a setback at the beginning of the war, so that this source of supply was diminished to about 65,000 tons in 1914-15. From her visible resources, Germany, then, was able to rely on 130,000 tons of nitrogen during the first year of the war. Her minimum requirement in 1914-15, it has been estimated, was between 200,000 tons and 220,000 tons to meet the needs of (1) the army and navy, for the manufacture of ammunition, (2) agriculture and (3) industry. The manner in which she developed her own resources in an endeavor to meet this demand affords one of the most interesting chapters in the history of science.[4]

It goes without saying, however, that the prior claims made on Germany's nitrogen supply by the ammunition industry during the war affected agriculture unfavorably, and that from the first year of the war German soil was progressively inadequately fertilized with nitrogen.

The main burden of responsibility for increased syn-

[2] "Stickstoffduengemittel," by Chemicker Dr. Harter, 1919. Fraenkische Ges. Druckerei, Wuerzburg.

[3] Gerlach. "Die Ernaehrung der Landwirtschaftlichen Kulturpflanzen im Zeichen des Phosphorsauermangels," 1919. Die Deutsche Landwirtschaft Gesellschaft, vol. 200, p. 79.

[4] Discussed in "Die Stickstoffversorgung der Welt" by Walter Eucken, published in 1921 by "Deutsche Verlags-Anstalt," Stuttgart and Berlin.

thetic nitrogen production fell upon the two processes of Haber and Bosch and of Frank and Caro. The Oppau plant was already in operation, and it was immediately enlarged. The Leunawerke was erected in 1917 as an extension on the brown coal deposits in the Halle district, where cheap power was available. The Frank and Caro process was in operation at Trostberg, where the Bayerische Stickstoffwerke had its plants. Extensions for the emergency created by the war were created at Knapsack-bei-Köln; Gross Kayna, bei Halle; Waldshut; Piesteritz, and Chorzow, in Upper Silesia (since lost to Poland), all using the Frank and Caro process.

Production During the War

It was estimated that all of these plants working at capacity would be able to cover Germany's demand sufficiently to meet all exigencies. With the adoption of the Hindenburg military program in 1916, first estimates of Germany's need were far surpassed and production was, in consequence, always insufficient. It is interesting to note that the first year's estimated need of the army and navy, amounting to 50,000 tons, increased eventually, with the extension of military operations, to approximately 240,000 tons annually. Production lagged behind this estimate, the 1916-17 output being approximately 100,000 tons from coke and gas manufacture, 58,000 tons from Frank and Caro plants, and 64,000 tons from Haber and Bosch plants, or a total of 222,000 tons. This amount was increased in 1917-18 to a total of 271,000 tons, 100,000 tons being from coke and gas plants, 105,000 tons from Haber and Bosch plants, and 66,000 tons from Frank and Caro plants.

Future of the Industry

Production of fixed nitrogen in the fertilizer year 1922-23 will probably amount to 350,000 tons, or an increase of by 50,000 tons over the previous year. The main burden of production, as in the year past, will fall upon the Haber-Bosch process, which, as has been said, produced two-thirds of Germany's total output last year. While it is difficult to gage future competition of Haber-Bosch salts with natural nitrates, the costs of these salts on the inland markets are now much less than world market prices, so that for the present and immediate future the process represents a substantial economy.

That production costs can be kept down to the present level indefinitely is unlikely. All of Germany's synthetic nitrogen plants are located purposely on or alongside of natural sources of power, as for instance, the Leunawerke on the brown coal fields of the Halle District and the Trostberg works beside the swift current of the River Alz in Bavaria. Cheap and abundant power is a prerequisite for the development of the industry.

Calcium cyanamide manufacture, on the other hand, does not appear to have as promising a future. It depends upon the utilization of electrical energy, which is not as cheap in Germany as, for instance, in Norway and Switzerland. All in all, calcium cyanamide manufacture for fertilizer in Germany must be considered rather as an emergency enterprise made necessary by the war, and to a certain extent, as a less desirable but much-needed fertilizer during Germany's post-war reconstruction period, while she lacks ability to purchase the better nitrates on the world-market.

In order to cover the spread between an estimated 1922-23 inland production of about 350,000 tons of nitrogen and an estimated need of from 500,000 to 600,000 tons, Germany would have to import from 900,000 to 1,500,000 tons of 16 per cent nitrates in order to meet her maximum demand. Negotiations are reported to be in progress now among the government, agricultural interests and the trade to determine how far it will be possible to import "several hundred thousands of tons" of Chilean nitrates as a spring order for German soil. In case the government comes to the conclusion that it can make this investment, the trade has already promised to rush its order for spring fertilizing. If it were possible to do this, the claim is made that later Germany would not have to import any foreign grain, or at least only relatively small quantities, for the feeding of her population. All predictions of agricultural self-sufficiency, however favorable the fertilizer situation may become, must, however, be taken with great reserve.

Irrespective of any large purchases of Chilean nitrates that Germany may be obliged to make this year or next year, it is most probable that the former German market is permanently lost, and Chilean producers will doubtless seek a compensating market in the United States or elsewhere.

Manganese in 1922

Manganese ore containing 35 per cent or more of manganese shipped from domestic mines in 1922, according to figures compiled by the United States Geological Survey from reports of producers of manganese, amounted to about 13,500 gross tons, valued at $457,000. The ore of this grade shipped in 1921 amounted to 13,531 gross tons, valued at $495,097. The figures for 1922 represent the actual production for 11 months plus an estimate of the production in December. More than 10,000 tons of this ore was mined in Montana.

The new tariff act, which became effective Sept. 21, 1922, provides for a duty of $8 a ton on ore containing 40 per cent of manganese, $9 a ton on ore containing 45 per cent of manganese, $10 a ton on ore containing 50 per cent of manganese, and so on. Manganese should therefore bring an average price on the eastern seaboard amounting to the present average price of foreign ore plus about $9 a ton. The new tariff has not yet greatly affected the domestic manganese market, for even under its provisions not many domestic mines can be operated at a good profit; but the owners of mines that have heretofore been worked profitably have shown a renewal of interest in the industry, and some of the mines that are already developed and that yield ore of high grade will probably be reopened.

About 352,000 gross tons of ore containing 10 to 35 per cent of manganese, valued at about $1,232,000, was mined in 1922, as compared with 8,439 gross tons, valued at $42,755, in 1921. About 308,000 tons of ore of this grade shipped in 1922 was mined in Minnesota.

About 251,000 gross tons of ore containing 5 to 10 per cent of manganese, valued at about $630,000, was shipped from domestic mines in 1922, as compared with 62,670 gross tons, valued at $147,576, in 1921. About 248,000 tons of the ore of this grade shipped in 1922 was mined in Minnesota.

Up to Sept. 21, manganese ore amounting to 286,969 gross tons, valued at $2,824,989, had been imported into the United States in 1922, most of it from Brazil.

Cored Crystals and Metallic Compounds

Each Cored Dendrite Contains Many Small Crystals With Similar Lattices but Slightly Differing in Composition and Dimension—Intermetallic Compounds Usually Have Complex Lattices Giving Little Opportunity for Slip, Hence Are Brittle

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THE history of the solidification of binary alloys which form solid solutions over a range is such an important factor in their structure that it may be well first to review briefly the current views on what takes place when a melt of a single pure metal solidifies.

MECHANISM OF SOLIDIFICATION FROM MELT

When a metal is retained above its melting point, its atoms (or molecules composed of two or more like atoms) are isotropic, so far as is known. A melt cannot be said to possess directional properties. It is true that some bodies have been studied[1] which exhibit such slight rigidity that they could not be thought of as anything other than liquids, but which do have the anisotropic properties of crystalline bodies to a discernible extent. On the other hand, the glasses are not crystalline and are isotropic, but possess great rigidity; they must, therefore, be classed as liquids of enormous viscosity. If we omit these two exceptional types of substances, we have rigidity and anisotropy as the outstanding properties of solids.

Fortunately these two "borderland" types are not known in metals. When the liquid metal cools to its freezing temperature, the atoms become anisotropic. If two or more like atoms are associated as a molecule in the liquid, they separate before solidification and perhaps in so doing acquire directional properties. If these centers of newly acquired properties form within the melt with sufficient speed the whole mass becomes crystalline even during a very rapid fall in temperature such as a quench from the molten state. Metals act in this way. In a few "solid amorphous" bodies we know, such as silicate, these centers cannot form rapidly upon cooling. Lowered temperature brings on a molecular sluggishness or viscosity which prevents rearrangement of the atoms and the isotropy is retained when the mass is very rigid.

It is well to remember that the molecule loses its identity in the solid state. It may well be that in liquid NaCl one chlorine atom may be bound more or less permanently to a certain sodium atom and remain thus coupled except as some electromotive force causes a transfer, but in the solid state there is no assurance that any particular combination represents a molecule. In solid NaCl any one sodium atom has equal chances of pairing off with six different chlorine atoms all equally remote and nearer than any other atoms, as can be seen in Fig. 1.[2] Similarly, if we regard the beta brass range as depending upon the compound CuZn (as noted in the previous contribution[3] on "The Nature of Solid Substances," crystallizes in the body-centered cubic system), each copper atom has equal chances of combining with eight surrounding zinc atoms for a molecule of CuZn.

The number of nuclei which form in unit time in re-

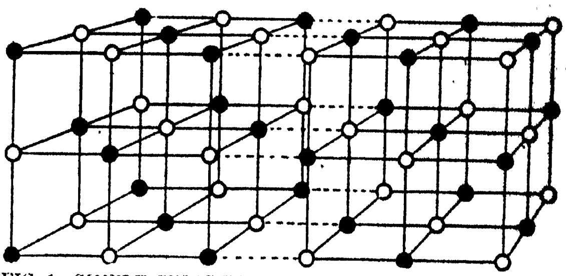

FIG. 1—SIMPLE CUBIC PATTERN OF SALT CRYSTAL (NaCl)

lation to the rate at which they grow determines the grain size. In metals the number of nuclei which form in a quenched specimen is so great that a very fine structure results when a melt is poured into cold water. Yet even here the whole mass is largely crystalline; X-rays are diffracted surprisingly well by even these tiny planes which form the three dimensional grating. It is quite likely, however, that the grain size may well be in the colloidal range.

On the other hand, the opposite extreme is possible. If a crucible of melted metal is maintained accurately just above its melting point, a single crystal touches the surface and provision is made for a slow conduction of heat so that the point of contact of liquid and solid is very slightly below the freezing point, no new nuclei form, but the crystal grows by addition of atoms from the melt. If now this single crystal be elevated and slowly removed from the melt at a carefully chosen rate, the crystal will grow at the same speed and a rod as long as desired can be produced with but one orientation present—it is a single crystal.

AMORPHOUS METAL

In the last analysis absolutely perfect crystallinity cannot be said to obtain in any piece of metal containing many polyhedral grains. Even when entirely pure there is some of the metal which does not have the regular atomic spacing of the normal crystalline body. This portion lies in the grain boundaries. It is commonly spoken of as amorphous metal. This expression probably describes quite well the condition of the thin zone of metal at the common boundary of two grains. When we consider that an atom retains its position in a space-lattice not alone by its own properties but by the established directional forces of all its neighbors, we are forced to postulate a zone of compromise existing between grains of unlike orientation. A "space-lattice distortion gradient" is formed between the two grains, and since the atoms are not in the normal relation to one another, then the arrangement is in many respects amorphous, although caused by and following definite force relations. This strained condition of the interatomic balance alters its electrochemical properties. Indeed, it is quite likely that the surface of any crystal has an altered structure to a depth of several atom rows or layers, since it is the common boundary of two unlike media. The author believes that the depth of the distortion zone—or in effect, the width of a grain

[1]"Liquid Crystals. Die Struktur Flüssiger und Weicher Kristalle beim Fliessen," O. Lehmann, *Z. Metallkunde*, vol. 13, Nos. 3, 4 and 5.

[2]From "The Non-Molecular Structure of Solids," by Arthur H. Compton, *J. Frank. Inst.*, June, 1915, p. 745.

[3]*Chem. & Met.*, vol. 26, No. 1, Jan. 4, 1922, p. 21.

Chem. & Met., Jan. 25, 1922.

boundary—is a function of the *absolute* elastic limit of the material. In squeezing and pulling apart the atoms, so as to change gradually from one orientation to another, no single atomic spacing can exceed a limiting value; therefore a space sufficient for the purpose must be used up. Possibly in no case is it necessary to use more than a few hundred atom rows for this zone of readjustment, and perhaps much fewer for two grains whose orientations are not greatly different.

Solidification of Binary Alloys

When a melt of two mutually soluble metals is permitted to cool to the freezing point, we find the atoms arranging themselves in a space lattice starting from many nuclei, exactly as does a pure metal. In this space lattice we find both kinds of atoms. But a complication arises. The first crystallites are richer in the higher melting metal than is the melt. This well-known behavior is depicted in the constitution diagram by liquidus and solidus lines. It should be remembered that these lines represent only the equilibrium condition: if considerable time is allowed for cooling the first precipitated solid metal constantly changes its constitution by diffusion and grows richer in the metal of lower melting point until, when the last trace of liquid (now very rich in the lower melting metal) is solidified, the solid is uniformly of the original composition of the melt.

But it is very difficult to get such a condition except with extremely slow cooling. Actually the first deposited crystallites of dendritic structure cannot diffuse out their excess of higher-melting metal rapidly enough to maintain homogeneity with successive additions of new composition. Hence, the composition of the diminishing liquid phase grows inordinately richer and richer in the low-melting element and accordingly aggravates the disparity in composition of successive layers of deposited solid. (An alloy whose composition corresponds to a minimum in a solid solution, where the liquidus and the solidus are tangent, solidifies precisely as a pure metal and the phenomenon of coring does not occur.)

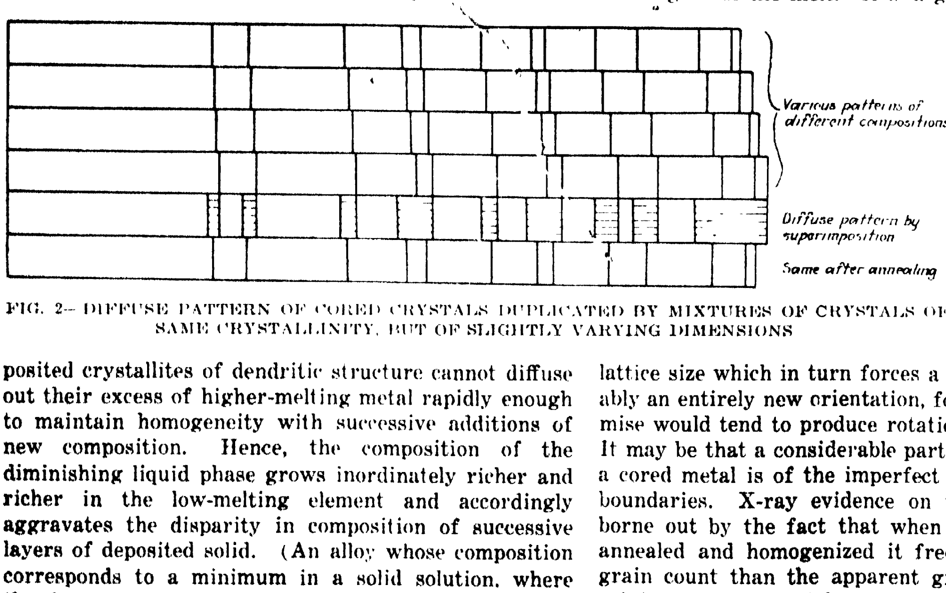

FIG. 2—DIFFUSE PATTERN OF CORED CRYSTALS DUPLICATED BY MIXTURES OF CRYSTALS OF SAME CRYSTALLINITY, BUT OF SLIGHTLY VARYING DIMENSIONS

In a cast metal exhibiting marked coring we discover usually a very comprehensive network of the first solidified material. This is a result of the directional tendency of grain growth: long spars of the crystals shoot out into the melt. The interstices fill in later. This effect can often be observed on the surface of metals which shrink greatly upon solidification—the first network formed is left high above the surface last to freeze.

The fundamental or primary grains of such cored structures are quite easily seen by etching—the boundaries either appear as dark lines, or there is an abrupt change in the orientation of the rectilinear streaks of the differently etched compositions. Frequently there is a very sharp demarcation of the coring, almost as if an abrupt change of chemical composition occurred or a new phase appeared. The action of chemical reagents on solid solutions varies quite rapidly with change in composition in the metal, so that no new phase need fill in the interstices between the primary dendrites to cause this appearance.

But when these large-cored grains are examined by the X-ray spectrometer, we do not obtain the characteristic spotted patterns of large grains, but the well-demarked spectrogram of smaller grains,[4] further modified by what must be a mixture of space lattices of various sizes. The patterns are identical with those which would be obtained from the fine mixed powders of a number of various alloys covering a broad range in a binary solid solution series. The first few diffraction lines are somewhat sharp, but become broader and more diffuse until at 30 or 40 deg. they are entirely lost. Such a cored alloy after prolonged heating near the melting point gives a normal pattern. Fig. 2 shows how the assortment of sizes of the same atomic arrangement produces, by superimposition, the diffuse, faint pattern. When the mechanism of coring is analyzed we come to the conclusion that the resultant alloys are actually an assortment of many crystals of varied spacings. The apparent grain boundaries inclose several orientations.

Let us consider a primary dendrite or crystallite just forming from the melt. It is a grain composed of two kinds of atoms. This grain can grow only so long as the added atoms can conform to the original lattice size or spacing within its elastic limit.[5] But its growth is inhibited. As shown in Fig. 3, the change in composition of subsequent layers forces a change in lattice size which in turn forces a new grain (and probably an entirely new orientation, for the zone of compromise would tend to produce rotation at some localities). It may be that a considerable part of the entire mass of a cored metal is of the imperfect crystallinity of grain boundaries. X-ray evidence on this point is further borne out by the fact that when badly cored metal is annealed and homogenized it frequently has a higher grain count than the apparent grain structure of the original cast material would indicate. This is very conclusive evidence, since grain growth occurs as they are permitted to attain equilibrium, except where allotropic changes interfere. The probable mechanism of this action is that two or more regions within the cored grain become grain-growth centers and are differently oriented even after diffusion has made them the same compositions.

Many of the alloys studied by the writer were made by mixing very fine powders and then heating to a temperature which would permit complete diffusion and homogenization entirely in the solid. It is possible in

[4] See "X-Ray Data on Martensite Formed Spontaneously From Austenite," by Edgar C. Bain, *Chem. & Met.*, March 22, 1922, vol. 26, p. 542.

[5] Elastic limit is low at high temperature.

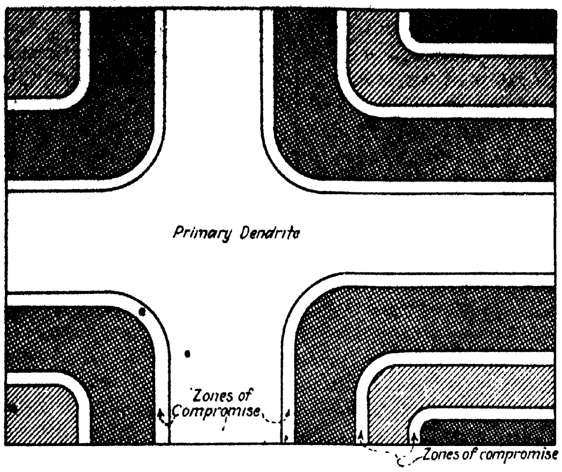

FIG. 3—THE PROBABLE STRUCTURE OF CORED METALS COMPOSED OF SHELLS OF DIFFERENT SIZED LATTICES

this manner to obtain perfectly uniform composition in less time than by melting the constituents and then destroying the cored structure resulting from the solidification. The aggregate paths of diffusion are shorter in fine powder than from zone to zone of the cored structure, for the latter is frequently coarse. Some mechanical deformation is most efficacious in removing cores. Fig. 4 shows the pattern of the mixed powders of gold and copper and after heating below the melting point.

The Ultimate Homogeneity in Solid Solutions

Obviously the most even and uniform distribution of two kinds of atoms in a space lattice is an arrangement of geometrical symmetry. For some atomic proportions this is quite simple. Let us consider an example. Fig. 5 is reproduced from the preceding contribution[5] which discussed the gold-copper series, and shows the arrangement for 3:1 and 1:3 atomic proportions in a face-centered cubic lattice. The 1:1 ratio in the body-centered arrangement or in the simple cubic pattern of rock salt (Fig. 1) is equally simple. For more complex ratios the geometrical arrangement is very much involved and may only be represented by groups of a certain ratio separated at frequent intervals by a leaner or richer zone.

The author has obtained conclusive evidence of the existence of such structures in a very few cases only. It comes about in this manner: The atoms of one metal alone may be considered as having their own space lattice. Thus, in a $25A:75B$ atomic proportion in the face-centered lattice shown in Fig. 5, the A atoms occupy a simple cubic lattice composed of the corners of the face-centered cubes. A little study will show that the B atoms occupy the corners of three equal systems of interpenetrating simple cubes.

Its pattern (Fig. 6) contains more lines than the face-centered lattice of both kinds of atoms. If these lines appear ever so weakly on a film, then there is ample proof of the arrangement. But to obtain such evidence there must be a difference in reflecting power in the atoms. Disparity in atomic weight is the usual cause. It should be remembered that it is the discontinuity in mass distribution which causes the lines on the patterns and excess mass is no more effective in causing interference minima (i.e., lines in the X-ray spectrogram) than the absence of matter.[6] In such simple geometric proportions as 3 to 1 or 1 to 1 we have the characteristic structure of compounds. Equal atomic proportions of molybdenum and tungsten (body-centered cubic system) show best the extra lines in the spectrogram which give us the clue to the atomic arrangement. Tungsten has almost twice the atomic weight of molybdenum and the spectral lines produced by the wide spaces between its planes alone cannot be "interfered out" by the weaker reflections of the molybdenum reflections 180 deg. out of phase. In the equal atomic ratio both molybdenum and tungsten atoms taken separately are in the simple cubic arrangement; the corners of one system are located in the center of the other.

There is another condition of the atoms in solid solutions offering a degree of homogeneity midway between this one of geometrical symmetry and the cored condition (which is similar to mixed powders of different composition). It is found in electroplate of two metals deposited out of solution simultaneously or in alloys which do not core and which have been cooled quickly from solidification. The space lattice is of uniform size and the atoms are of uniform concentration over a considerable area, but their arrangement is at random in the lattice. Neither kind of atoms considered alone could be said to possess a regular spacing. Prolonged heating near the melting point develops the final geometrical distribution.

Tammann has used a very expressive word for the rearrangement of the atoms which take place at high temperature. The word is "Platzwechsel"—place interchange. Its occurrence marks the temperature at which the mobility of the atom is such that it may migrate between and past its neighbors—one of these then taking its former position. In the new edition of his "Lehrbuch der Metallographie" a long chapter deals

[6]The X-ray method for crystalline analysis has been outlined by Bain in *Chem. & Met.*, Oct. 5, 1921, vol. 25, p. 657, and by Jeffries and Archer in *Chem. & Met.*, May 4, 1921, vol. 24, p. 771.

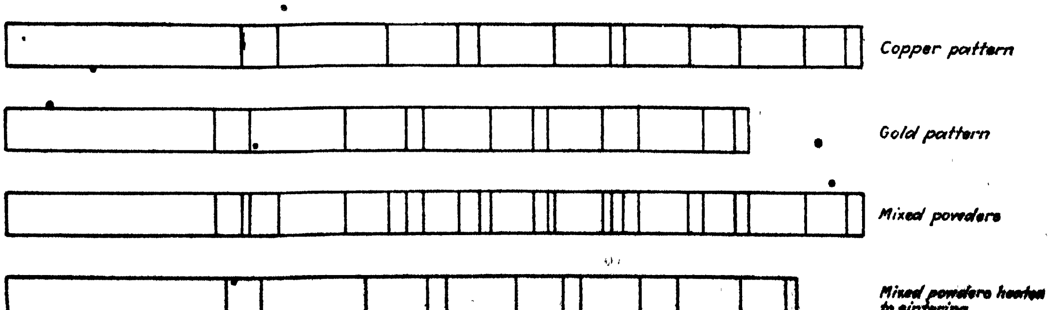

FIG. 4—PATTERN OF MIXED COPPER AND GOLD POWDERS, BEFORE AND AFTER SINTERING

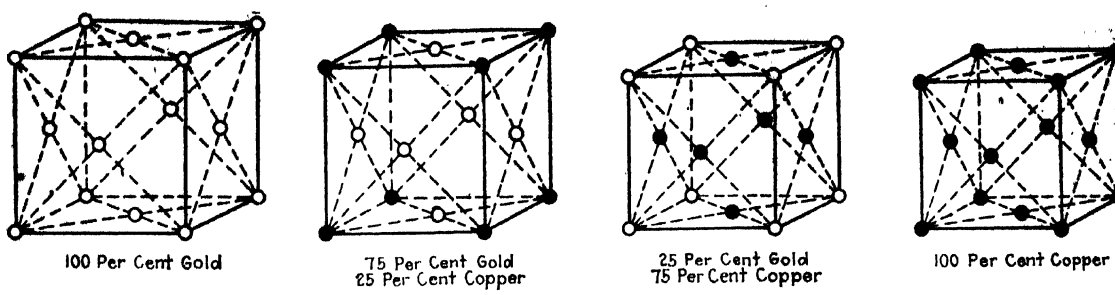

FIG. 5—ARRANGEMENT OF THE GOLD (LIGHT CIRCLES) ATOMS IN SPACE FOR CERTAIN GOLD-COPPER ALLOYS

with the change in chemical behavior observed when metals have been heated to bring about this final change in atomic distribution. In metals composed of two kinds of atoms which are not distributed with geometrical symmetry the change in single potential or chemical activity varies with change from one composition to another only as the theory of probability would indicate. The atoms of the nobler metal (i.e., with lower single potential) protect the other atoms to an extent dependent directly upon composition alone. But after "place interchange" has taken place, very abrupt changes in single potential with change in composition develop. These changes nearly always mark some simple atomic ratio. Thus: copper-gold alloys are rapidly attacked by nitric acid when there are fewer gold atoms than copper atoms in the alloy, but alloys richer in gold than 50 atomic per cent are attacked scarcely at all. The protective action begins abruptly at this definite composition. Therefore, there must be some subtle effect in the atomic distribution.

It appears that the situation is substantially one of availability of atoms for reaction. When the inactive atoms exceed a certain proportion and are arranged well-annealed alloys, while this chemical behavior is to be observed in almost any solid solution series. The author had, however, found the significant supernumerary lines in the spectrograms of certain alloys of simple atomic proportions before the publication of these chemical and electrochemical data. The failure to find the extra spectrogram lines significant of geometrical arrangement of two kinds of atoms in other instances is easily explained. They are necessarily always extremely weak. Furthermore, an exact ratio (say 1:3 or 1:1) can never be obtained in any alloy which has to be weighed out and prepared. Compounds could be prepared in which considerable fragments might conceivably have an exact ratio of atoms, even though the number of atoms reached "astronomical" figures. But, in a single grain of an alloy there will likely be a small excess of one or the other atoms. Somewhere, then, in the grain (fortunately perhaps at or near the boundary where the crystallinity is less perfect) we shall have a discontinuity. This discontinuity, if involving an even number of atom rows, will not destroy the extra spectrogram lines, but if involving an odd number completely obliterates the lines. The

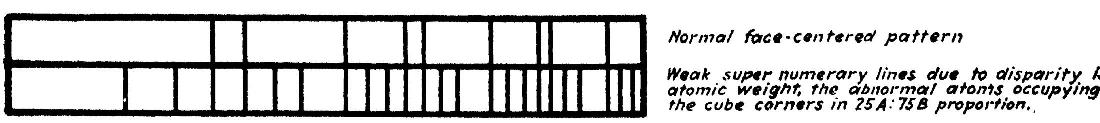

FIG 6—FACE-CENTERED PATTERN WITH SUPERPOSED LINES FROM SIMPLE CUBE

in the symmetrical positions for that particular proportion, there is no path for the reagent to penetrate the lattice and reach the active atoms. The protective action is then in effect. Below this proportion there are continuities of active atoms which can be reached successively after the surface lattice is caused to collapse. For a particular instance, consider the 75Au:25Cu lattice shown in Fig. 5. If that particular cube is located on the surface of the metal, it is seen that after the copper atoms on the corners of the top faces are removed, the next layer just below consists entirely of gold atoms.

Copper decomposes silver nitrate with the precipitation of metallic silver; gold does not possess this property. In the completely annealed series of copper and gold the alloys containing less than 1:7 Au:Cu decompose silver nitrate, while alloys richer in gold have no action with this reagent. If, however, the experiment is tried with a series of alloys which have not been heated long enough or at sufficiently high temperature to perfect this distribution, the reactivity simply falls off gradually with no definite limits.

As was stated, X-ray data give only limited information on the actual location of the separate atoms in result then becomes problematical indeed, and chance seems rarely to give us the evidence sought. At any rate the enlightening work of Tammann and his deductions from his observation—exactly in accord with what crystal analysis has shown in a small way—have given us an astounding conception of the forces which tend to produce the utmost homogeneity in metals by diffusion.

Intermetallic Compounds

Intermetallic compounds are said to possess no ductility. It seems that this condition is not a result of the chemical nature of the atomic association so much as it is the result of the circumstance that intermetallic compounds have lattice types which offer little opportunity for slip.[7] They have been investigated somewhat, and appear to possess low symmetry as a rule. As has been stated,[8] beta brass (if based on a compound) is an exception, for it is body-centered cubic in structure and has some ductility. Fused silver chloride might be said to possess some indications of ductility and the compound is one of strong chemical

[7]It is perhaps unnecessary to remark that when ductile metals are overstrained, they deform by intercrystalline slip.

nature in comparison to many of the intermetallic compounds. The silver atoms alone are arranged in a face-centered cubic structure, as are also the chlorine atoms alone, but both together form a simple cubic lattice. Fig. 1 shows the exactly similar lattice of NaCl. It is obvious that the like atoms, taken by themselves, build up face-centered lattices, interpenetrating. The compound Cu_3Sn is close packed hexagonal in type (like zinc).

The outstanding feature of the intermetallic compounds is their ability to retain the lattice form over a considerable change in constitution. We can scarcely conceive of any portion of sodium chloride or ferrous sulphide or calcium oxide as having any variation in composition from the "atom for atom" ratio, even though the compound is formed where one constituent is in great excess. On the other hand, we find sometimes that the crystalline structure of an intermetallic compound is formed with a composition which depends on the composition of the melt from which it is developed. In other words, in a compound which would normally contain say three atoms of A with one of B (A_3B), there is nothing to prevent the substitution of a few B atoms in the A lattice points. This ability to retain the crystalline phase intact despite a change in constitution probably is a result of the same fundamental structure within the atom which gives many metals their outstanding property of ductibility or malleability by slip-plane formation.

Lines of Attack on Future Problems

Of the array of interesting problems which may find a solution in the study of crystal structure there is one which is worthy of considerable investigation. It is the author's belief that in some cases a solid solution may form by the annexation of small atoms to large ones while these large atoms retain their usual lattice position. Thus, when carbon dissolves in gamma iron it is conceivable that the carbon atoms might associate with certain iron atoms—not displacing them, but simply "adding on." There is evidence on both sides of this question, and the facts will surely be discovered by X-ray examination. Experiments are now well under way in the author's laboratory to determine the point.

And again, austenite formed by the solution of carbon in gamma iron may be rapidly quenched to inhibit the carbide formation and grain growth but allow the allotropic change. The question then arises, "What is the relation between the carbon atom and the new alpha iron lattice comprising the tiny ferrite grains forming martensite?" It has been styled a solution of carbon in alpha iron—but the word "solution" is not well chosen, for there is only mechanical stability in martensite. The carbon is atomically dispersed, probably, in freshly quenched martensite, but at best it is only a "pseudo solid solution."

Such problems at present have little hope for solution except by some very subtle sort of examination involving the atoms themselves, such as by X-ray spectrometry.

Acknowledgments

The author desires gratefully to acknowledge the assistance of two of his co-workers in the investigation of the numerous alloys. To W. P. Sykes thanks are to be given for the preparation of a number of alloys from mixed powders and to A. B. Gladding thanks are due for the careful computation of several space lattices.

Increase in Science Department Students at Princeton

According to figures compiled by the registration department, Princeton University, Princeton, N. J., there has been a pronounced decline of interest in the classics in the last year, and a corresponding increase of interest in science. This change is illustrated by the number of students taking the courses in the two departments in 1921 and 1922. In the first-noted year there were 730 men in the university taking either Latin or Greek; at the present time this has decreased to 659; the increase of students in modern languages this year was from 1,249 to 1,459. In 1921 the number of men taking either chemistry, biology, physics or geology was 1,712, while at the present time the science department has 1,842 students. A library of industrial relations is being established at the institution under the direction of Prof. Robert F. Foerster, made possible through a donation of $60,000 by John D. Rockefeller, Jr., for this purpose.

Electron Emission From Heated Metals*

When metals are heated in high vacuum, electrons, or atoms of negative electricity, evaporate from their surfaces. If there is another electrode in the evacuated space which is given a positive charge, the electrons drift over to this electrode (anode) so that a current flows between the two electrodes. Dushman has recently derived an equation which should supersede the well-known Richardson equation, giving the relation between the electron current and the temperature of the cathode. The advantage of this new equation is that there is only one constant which we need to know for each different cathode material, instead of two constants which were necessary for the Richardson equation.

The electron emissions from a large number of different materials have recently been measured. The thoriated tungsten cathode gives a current at a temperature of 1,500 deg. C. absolute, which is about 130,000 times greater than that from ordinary tungsten. Measurements have also been made of cathode materials that have even much greater emissions.

In order to get all the current that a cathode is capable of giving, it is necessary to apply to the anode a high enough voltage to overcome what is known as the space charge effect. By putting in gases positive ions are formed in the space between the electrodes, and these neutralize the negative space charge and allow the current from the cathode to pass across the space with much lower anode-voltages. In other words, the effect of gases is to increase the current-carrying capacity of the two. Such an effect is used in the Tungar rectifier. Care must be taken what gas is used for the purpose, for many gases have the effect of poisoning the cathode, and cutting down its emission to a small value.

If very high voltages are used on the anode, so as to produce intense electric fields, it is possible to pull electrons out of the cathode. In fact, it is possible to pull electrons even out of cold cathodes—that is, cathodes at ordinary temperatures. The currents obtained this way from the cathode come from very minute areas, but in these areas the current density amounts to more than one hundred million amperes per square inch.

*Abstracted from a lecture by Dr. Irving Langmuir, Pittsburgh, Pa., Nov. 29, 1922.

Menace of Loosely Drawn Contracts

Much Litigation Caused by Inadequate Expression of Intention of the Parties—Examples of Court Decisions Under Varying Conditions

BY WELLINGTON GUSTIN
Member of the Chicago Bar

WHEN does a contract provide for the sale to fill a buyer's requirements over a given period and when does it provide for the sale of a seller's output? These are questions of real seriousness. When two contracting parties close a deal for an output of one's plant or factory over a given period, or for one's requirements for his plant, factory or business over a period they should take special precaution to see that the instrument called a contract embodying their agreement expresses their intention. For the intention of parties to a contract determines the construction a court will ultimately place upon it, and this intention will be gathered from the instrument itself where possible and ordinarily the parties will not be permitted to explain this intention. If the contract as written purports to be a complete contract, their outside testimony or evidence will not be heard to explain what this intention was and what the contract means. A reason for this rule is that the parties themselves dispute and their written expression must be looked to. Another rule is that the language used or employed by one will be construed most strongly against the user.

INTENTION MUST BE CLEARLY WRITTEN

In the ordinary case of dispute in these matters there is an agreement in the intention of the parties to the contract well known at the time of its execution. The error made by the parties is that their intention is not certainly and completely expressed in the writing to which they resort in order to embody their agreement. Herein is the mistake that results in most of the litigation over contracts for "outputs" and "seasonal requirements" and the like. Such contracts are of such supreme importance to a plant or industry that one should ordinarily be surprised to find difficulties and misunderstandings as to the meanings of the agreements with a resultant failure to keep engagements.

But one may wonder if a great portion of such disagreements over one's undertakings is not really an attempt to avoid a bad bargain. In some cases arising since the war it is certain that parties did enter into contracts which proved exceedingly fortunate for some and exceedingly unfortunate for the others. Some used maximum requirements under contracts where otherwise they would have used minimum requirements; others were fortunate in having no limit attached to their requirements. Similar conditions existed on all sides. Most of the parties adjusted inequalities. Some openly violated their agreements to furnish at specified prices, and sold to the highest bidders. The extraordinary times were responsible for extraordinary measures being taken between parties.

CONTRACT SHOULD EMBODY FULL INTENTION

Honesty in contract obligations does not concern us here, but as a matter of precaution and information, the many cases here cited should warn parties contracting in the future to embody their full intention and agreement in language that cannot be misinterpreted and misconstrued by others when nothing but the cold type or writing can be resorted to, as when it is made the basis for a court action or defense. And where contract obligations are sought to be avoided, whether honesty and honor in business undertakings enter in or not, the party who finds that the language of the contract expresses with certainty what he intended it should will be fortunate indeed, while if he has ignorantly or negligently and carelessly used language that does not express his intention he may be surprised to wake up in the hour of greatest need for certainty in his contract to find that he has a contract which cannot be enforced, or otherwise, with actual or contemplated profits wiped out.

In a case arising in 1900 in Illinois the court says: "The contract in question is for appellee's "requirements" in stove bolts from Dec. 14, 1898, to Jan. 1, 1901, and this means such amount of stove bolts as appellee should need in the regular course of its business and not what appellee might choose to require from appellant." Russell, Burdsall & Ward vs. Excelsior Stove & Manufacturing Co., 120 Ill., App. 23.

In this case the price of the bolts soared and the claimant's requirements not being satisfied by the seller, the buyer went out into the open market and bought the goods and the additional cost above the contract price to the buyer was charged to the seller.

CASE INVOLVING ENTIRE OUTPUT

In another case on "output" the Supreme Court of Illinois said that a contract whereby a cement company agrees to sell, and a sand company agrees to buy, the entire output of the cement company's plant for a year at a certain price per barrel is compiled with if all cement manufactured at the plant is shipped to the buyer.

And if the manufacturer has shipped to the buyer all the cement produced at the plant in question, the buyer has no right to refuse payment under the contract upon the ground that the manufacturer's delay in filling orders has caused a loss to the buyer, and upon the buyer's refusal to make payment the manufacturer may treat the contract as terminated, discontinue shipments and sue for the balance due on goods already delivered. Garden City Sand Co. vs. Wellington R. Burt, 237 Ill., 473.

In the above case the test of quality for the cement to be manufactured was the standard of the specifications of the American Society of Engineers. The court here held that if the buyer contended the quality of the product delivered was not up to the standard of the warranty the burden of proof rested upon the buyer to show that fact.

The buyer contended that it appeared from the contract and from extraneous facts and circumstances in evidence that the parties intended that the plant should be operated to its full capacity, and that the buyer should receive during the year what cement could reasonably be produced by the plant when run at its full capacity. The court said the contract did not so state and the court could not import into the contract a provision which the parties have omitted therefrom. "Ordinarily," it says, "a reference to what are called surrounding circumstances is allowed for the purpose of ascertaining the subject matter of a contract or for an explanation of the terms used—not for the purpose of adding a new and distinct understanding." And in another case, Knox vs. Lee, 12 Wall, 475, the court there said: "There is a well-recognized distinction be-

tween the expectation of the parties to a contract and the duty imposed by it. . . . Were it not so, the expectation of results would be always equivalent to a binding engagement that they should follow."

Questions of price and quantity are interesting in a case recently decided by the U. S. Circuit Court of Appeals and affirmed by the denial of a certiorari by the U. S. Supreme Court, 42 Sup. Ct. 586. Plaintiffs, Taylor, Lowenstein & Co., brought an action at law against the Louisville Soap Co. to recover damages for a breach of contract for the purchase of rosin, in which defendant filed a cross-petition to recover overpayments made by it.

The contract provided for the sale by plaintiffs to the soap company of a quantity of standard quality grades G, H and I rosin. The defendant's cross-petition was based upon its construction of this contract in reference to price, and sought to recover payments in excess of the contract price. Two questions were presented to the court: first, as to the quantity covered by the contract, second, as to the price to be paid.

In reference to quantity the contract provided: "Louisville Soap Co.'s requirements from April 1, 1918, to March 31, 1919, 20,000 round barrels minimum, 40,000 round barrels maximum. Should buyer's requirements be for more than the maximum amount stipulated herein, orders for such excess are to be submitted to seller. If seller cannot supply, buyer will be privileged to buy such excess elsewhere."

Under this contract the soap company ordered and received, within the year, 12,989 round barrels of rosin, for which it paid in full, and which amount constituted its entire requirements. Plaintiffs brought this action to recover damages for the failure of the soap company to take 7,011 round barrels, the difference between the amount they did actually order, receive and pay for, and the minimum amount of 20,000 round barrels specified in the contract.

Dispute as to "Requirement"

The soap company contended that this was a "requirement" contract and that the provision "20,000 round barrels minimum, 40,000 round barrels maximum" is a mere estimate of the amount of rosin it would require for the year, and that therefore it was not obliged to take any rosin in excess of its actual requirements.

In reference to the second question as to price, the contract reads: "to be 50c. per 280 lb. over the official closing Savannah, Ga., market on date order is received at Mobile, Ala. In the event of two closing prices, the average is to apply."

The soap company contended that this provision in which the price was to be determined by the official closing price of a board of trade, instead of a fixed, definite and certain contract price to be paid, regardless of the market price, was further evidence of the intentions of the parties that the actual requirements of the soap company was the dominant provision of the contract as to quantity.

Adversely, Taylor, Lowenstein & Co. claimed that the soap company was required by this contract to accept and pay for this minimum amount of 20,000 round barrels regardless of its requirements, and as many more barrels as they required for their factory; that the provision in regard to requirements applied only to the difference between the minimum 20,000 bbl. and the maximum 40,000 bbl., which maximum quantity the Taylor company obligated itself to furnish the soap company if the requirements would amount to so many barrels, and if the soap company's requirements exceeded the maximum amount, then it had the right to elect whether or not it would accept or reject any orders in excess thereof.

Specifications as to Maximum and Minimum Held to Be Dominant Measure of Quantity

The court said there appeared to be an irreconcilable conflict between the courts as cited by the opposing counsel in support of their respective claims. But the various cases show that each was decided in reference to the particular contract involved, or upon a consideration of the "obviously dominant measure of quantity" in each contract. In the present case the contract does not suggest that the minimum and maximum amounts named are merely estimates. On the contrary, from the substantial difference between these figures it appears that the parties intended that the requirements should control between these two amounts, but should be neither less than the minimum nor more than the maximum. And it is specifically provided that if the requirements should exceed the maximum quantity named, the seller should not be obligated to furnish the same, except at its option. This maximum is specifically set up the contract as the limit of the seller's liability to furnish, said the court. Therefore it is a definite controlling quantity and not a mere estimate. And it would seem absurd to say that the parties intended that the maximum should be the dominant measure of quantity as to the seller's obligation to furnish, but that the minimum should not be the dominant measure of quantity as to the buyer's obligation to take.

Now in the case of Taylor, Lowenstein & Co. vs. Louisville Soap Co., above mentioned, it was insisted upon the part of the soap company that if the minimum and maximum named in the contract should be held to be the measure of quantity to be furnished thereunder, it would take all the meaning out of the further provision of the contract in reference to the company's "requirements." The court says that, on the contrary, such a construction would give full force and effect to both these provisions in relation to quantity, for there is a large scope for the operation of the provision as to requirements between 20,000 and 40,000 round barrels. While on the other hand, if the company's requirements were to be construed as the absolute measure of quantity, then the provision as to minimum and maximum quantity would be meaningless. Hence the court concluded that this contract required the buyer to accept and pay for the minimum of 20,000 round barrels of rosin, and it likewise required the manufacturer to furnish this amount and any amount in excess thereof, up to the maximum of 40,000 bbl., limited in that respect only to the buyer's needs.

Price Clause Also Uncertain

In this instant case another interesting point of uncertainty in the contract is shown. This relates to the price to be paid from time to time for the product. Under the contract for rosin it was to be paid for at a stated price above the official closing Savannah, Ga., market, which was intended to be the official closing price posted by the Savannah Board of Trade. It appeared that under the rules of that Board of Trade the official price could be determined only from actual transactions between factors and buyers, and that dur-

ing the last 2 months of the contract period there were no sales on which the closing price could be based. On this point the court held that there was no closing price within the meaning of the contract, although during that period the committee did post the closing price as determined by the last sale.

And where the price of goods sold was to be determined by the official closing price of a board of trade on the day the order was received, and during the last part of the contract period there was no closing price in that market so that the contract price could not be determined, both parties were relieved of their obligations under the contract. (Here was uncertainty again in the contract.)

But where the buyer ordered and received some of the goods after there was no closing price, though the last price determined by actual sales was daily posted as the closing price, and the seller made no misrepresentations which would prevent the buyer from ascertaining the true facts in regard to the posted closing price, the payment for the goods in accordance with the posted price was an acceptance of such price and the buyer thereafter could not recover such or excess payments.

OTHER TYPICAL CASES

For the benefit of those who may contract "outputs" or "requirements" the following cases are cited briefly:

The Louisville Soap case is found to be identical in language to the contract involved in another case, the Diamond Alkali Co. against Aetna Explosives Co., 107 Atlantic Reports 711. Here the contract provides, in reference to the quantity, "Buyer's entire requirements during 1916; minimum quantity 180 tons per month and maximum 250 tons monthly." In this case the court held:

"The minimum and maximum quantities fixed in the contract were not merely probable estimates of the quantities which the appellant was to take . . . but were definitely fixed quantities which the appellant could demand and the appellee was required to deliver."

In the action brought by the Staver Carriage Co. against the Park Steel Co., 104 Federal Reports 200, on contract, the instrument provided as to quantity: "All the tire steel, of good and suitable quality, which will be used in buyer's works prior to Sept. 1, 1899, not to exceed 14,000 sets, nor to be less than 10,000 sets."

Here the court held that this was a valid and binding contract within the different amounts specified; that the seller was obligated to furnish at least the 10,000 sets and as many more up to 14,000 sets as was actually needed for use in the buyer's work prior to Sept. 1, 1899, citing National Co. vs. Keystone Manufacturing Co., 110 Ill., 427, also Stover vs. Park Steel.

In another suit, Budge vs. United Smelting Co., 104 Fed., 498, the contract required the seller to furnish "all the mining timbers required and used at buyer's mine, about 600 pieces of the larger dimensions and about 15,000 pieces of the smaller dimensions." Here the court held that this was a distinct promise to receive and pay for about 600 pieces of one kind of timber and 15,000 of another.

In still another case, Highlands Chemical Co. vs. Mathews, the contract required the seller to deliver to the buyer, if required by him, 10,000 carboys of oil of vitriol, the defendant to take at least 7,000 carboys during the same time. In this case it was held that the defendant was bound to take the minimum amount, whether he needed it or desired it for the purpose of his business or not; and the correlative obligation rested upon the seller to deliver any amount within the maximum fixed by the contract if the buyer's needs required the same. Here the minimum of 7,000 carboys and the maximum of 10,000 carboys are obviously the "dominant measure" of quantity.

In a U. S. Supreme Court case, Smoot vs. United States, 35 Supreme Court 540, the contract provided for 140,200 cu.yd., more or less, of filter sand, for a specific construction of twenty-nine filter beds. It appeared from the contract itself that the quantity mentioned therein was approximate only. It was insisted, however, by the United States that a letter written by the government engineer, subsequent to the contract, specifically fixed the quantity at 151,000 cu.yd. This, however, did not allow for shrinkage, and the actual requirements of the government were 179,231 cu.yd. The Supreme Court held that a letter from the engineer in charge of the construction, to a contractor, who had entered into a written contract with the United States to furnish material at a specified price, could not modify the original contract or constitute a new one; that under the terms of the original contract the amount named therein was clearly an approximate amount only; and that the needs of the government for this particular construction was the obviously dominant measure of the quantity to be furnished.

POINTS ON PROPER CONSTRUCTION OF CONTRACTS

Thus it will be seen, from these many cases cited, that much litigation occurs from lack of attention to the provisions of so important a class of contracts involving whole outputs of plants and all requirements for plants and industries. As was said in one of the cases: "Where the parties have entered into written engagements, with express stipulations, it is manifestly not desirable to extend them by implication. The presumption is that having expressed some, they have expressed all the conditions by which they intend to be bound under the instrument . . . and it is one thing for the court to effectuate the intention of the parties to the extent to which they may have even imperfectly expressed themselves, and another to add to the instrument all such convenants as upon full consideration the court may deem fitting for completing the intention of the parties, but which they, either purposely or unintentionally, have omitted." The former construes that which is written, "the latter adds to the obligation by which the parties have bound themselves, and is, of course, quite unauthorized, as well as liable to great practical injustice in the application."

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Vapor Recompression System for Evaporators—II

Regenerative Evaporation Is Critically Discussed, With Particular Reference to the General Theory of Design and Construction—Comparison of Operating Economies With Single and Multiple Effect Evaporators—Bibliography of Patents and Literature References*

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General Theory

THERE have been a number of discussions of the general theory of vapor recompression. Of these the papers by Claassen (9, 15),† Flugel (18), Holmes (20), and Wirth (46) are the most important.[1]

Nozzles

The nozzle systems are perhaps the easiest to discuss qualitatively. From the curves of Figs. 9, 10 and 11‡, any case that is apt to arise may be calculated. It is evident that for high efficiency (in the sense of vapor compressed per pound high-pressure steam used) it is necessary to work with a small temperature drop and very high-pressure steam. From Fig. 9 it will be seen that to get double effect efficiency (1 lb. vapor entrained per pound high-pressure steam) the total temperature drop may not be over 18 deg. F. for 100 lb. steam, 22 deg. F. for 150 lb. steam, or 22.5 deg. F. for 175 lb. steam. Ordinarily evaporators are designed to operate with 5 to 15 lb. steam. If a single effect evaporator with a nozzle compressor be compared with a double working between 10 lb. and 26 in. vacuum, we find that the double has a total available temperature drop of 100 deg. F. against, say, 20 deg. for the other. Hence, on material of no elevation in boiling point, the double would have five times the capacity of the single, twice the heating surface, and would require the same amount of steam, condensing water and accessories.

On the other hand, if we assume that the plant has exhaust steam to spare, then the comparison is still more strongly in favor of the double. If a nozzle is used, either the power units must be run condensing, or exhaust must be wasted. If an ordinary double is used, it saves either all the high-pressure steam used in the nozzle (if exhaust was available which would otherwise be wasted) or it saves all the condensing equipment and condensing water otherwise needed for the prime movers.

The best use for the nozzle is the plant where all exhaust from prime movers is used in the evaporators and in addition make-up has to be supplied as live steam. A nozzle may be substituted for the usual reducing valve on the make-up steam line; provided, of course, that the evaporator in question is a multiple effect with a small enough temperature drop in the first effect to make the nozzle efficiency appreciable. Here again attention must be paid to the rapidly decreasing efficiency of the nozzle as the steam pressure drops; because if the amount of make-up needed is variable, the nozzle will give useful results only when the throttle valve is wide open. Under conditions demanding less than the maximum amount of make-up steam, its capacity will be negligible. This has been discussed by Claassen (9), who suggests several small nozzles in parallel to be cut in or out one at a time as the demand for make-up varies, but each to be either completely closed or wide open, never throttled.

Mechanical Compressors

Thermal Efficiency of Evaporators.—If the conditions are properly chosen and certain important considerations omitted, it is possible to show that vapor recompression systems are very desirable. For comparative purposes, let us assume that an ordinary evaporator uses steam at 5 lb. gage, and returns the condensate to the boilers at 180 deg. F. Then to regenerate 1 lb. of steam takes (1,155 — 180) or 975 B.t.u. Considering losses by radiation, heating feed, withdrawal of hot thick liquor, etc., let us assume that 1 lb. steam will evaporate 0.85 lb. water per effect. Then, for purposes of comparison, we will have as the performance of an ordinary evaporator:

Effects	B.t.u. Supplied in Boiler Per Lb. Evaporated
1	1,150
2	563
3	382
4	286

Let us also assume that the power used to drive the turbo-blower is generated in steam prime movers whose water rate is 20 lb. per kilowatt-hour. This rate, however, applies to steam of 160 lb. gage, which requires (1,195 — 100) or 1,095 B.t.u. to regenerate a pound. This assumes condensate returned to the boilers at 100 deg. F. because vapor recompression evaporators usually use a heat interchanger which cools the condensate and heats the feed. Ombeck's tests show 75 to 165 lb. evaporated per kilowatt-hour, or 3.5 to 8.25 lb. per pound boiler steam. This gives from 312 to 133 B.t.u. supplied in boilers per pound water evaporated. Wirth's data show 25 to 55 lb. evaporated per kilowatt-hour; or 875 to 400 B.t.u. per pound evaporated. Hence Ombeck's best tests correspond to 8.5 effect operation, and his poorest to 3.5 effect. Wirth's range from 1.5 effect to double effect efficiency. Such tests as Ombeck's and such reasoning as the first paragraphs of Article I are the basis for the claims so often made of "multiple effect efficiency in a single body."

It should be pointed out again that Ombeck's tests were run on that combination of conditions which is the most favorable to recompression. Wirth's data represent much more general cases. The efficiencies which have been calculated by advocates of thermocompression have not been confirmed by submitting operating data.

Capacity

The principal factors omitted by partisans of the thermocompressor are power generation and capacity of the evaporators. It is obvious that the turbo-blower must work on a small temperature drop. Thus Ombeck works with from 6 to 14 deg. F. Wirth gives no data but his evaporation per square foot per hour indicates

*Read before the American Institute of Chemical Engineers at Baltimore, Dec. 9, 1921. Part I of this article appeared in *Chem. & Met.*, vol. 28, No. 1, Jan. 3, 1923, p. 26.

†Numbers in parentheses refer to bibliography at end of this article. Numbers below 100 are articles and above 100 are patents.

‡See figures published in Part I.

[1]See also 1, [illegible].

a similar or larger temperature drop. Ombeck evaporates 1.7 lb. per square foot with 6.5 deg. drop and 3.9 lb. with 14 deg. Hence, assuming similar coefficients, Wirth must be working with 10 to 60 deg. drop. This explains Wirth's lower efficiency rating. Most discussions have been based on a drop of 18 deg. F.; and Soderlund and Boberg specify 5 deg. F.

Now ordinary evaporators usually run on about 100 deg. F. temperature drop. Hence if the discussion has to do with an ordinary evaporator in single effect, the thermocompressor evaporator must have from two to ten times the heating surface to do the same work if the coefficients are the same. The lower figure for heating surface corresponds to so large a temperature drop that it would involve less than double effect efficiency. In an ordinary single effect evaporator, the boiling point will be lowered corresponding to the vacuum. Hence there will be difficulty from increased viscosity, hydrostatic head, etc. The thermocompressor, working at atmospheric pressure, will have slightly better conditions so far as these factors are concerned. Ombeck's coefficients, the only ones so far reported, are no larger than are regularly obtained under good conditions in ordinary evaporators.

A double effect will have an average temperature drop of 50 deg. per effect. Hence if a thermocompressor could work with double effect efficiency on a 50 deg. drop with double the ordinary coefficients of heat transmission, it would do in one body all that an ordinary evaporator will do in two, both from the standpoint of thermal efficiency and of capacity. It would then remain to balance the cost of turbo-blower and driving unit on the one hand against the extra body of the evaporator and its condenser on the other. Similarly, the two methods are equal (except for difference in cost between the blower and the two bodies) if a thermocompressor could give triple effect efficiency on a 30 deg. drop with three times the ordinary coefficients. Wirth does not get triple effect efficiency in any case, and Ombeck gets it only on a 14 deg. drop. There is no evidence to support the assumption of higher coefficients in evaporators using recompression. Hence it may be definitely stated that a thermocompressor will call for much more expensive equipment than an ordinary evaporator.

Superheat.—Another factor which may affect the capacity of vapor recompression evaporators is superheat in the compressed steam. Pure adiabatic compression will necessarily result in some superheat. Turbo-blowers have a mechanical efficiency of 60 to 70 per cent according to size. This loss of 30 to 40 per cent of the power input should reappear as additional superheat in the compressed steam. Ombeck's blower had efficiencies from 45 to 68 per cent, but his results show superheat only a little greater than called for by adiabatic compression. This was probably due either to long pipe lines between blower and evaporator, with the measurements made near the evaporator; or to faulty measurements of the temperature of the steam. This is a very difficult determination to make with even moderate accuracy. The superheat on large working temperature drops may be over 100 deg. F.

The effect of superheat has never been settled because, even with large amounts of superheat, the heat present as superheat is small, and is transmitted in the first fraction of the heating surface. No tests have ever been made where an appreciable part of the heat available for evaporation was superheat.

It is generally supposed that the presence of superheat considerably lowers coefficients of heat transmission from steam to metal. This comes from the well-known fact that permanent gases give up their heat very slowly. The actual data available are entirely insignificant, and it is still an open question as to what effect superheat may have. If it has any effect, then evaporators using turbo-blowers must suffer greatly and cannot show normal coefficients of heat transmission.

In general, then, an evaporator using thermocompression will call for a larger investment in apparatus than an ordinary evaporator; and where it does not, it shows no special saving in steam.

Power Generation

Such a discussion as the above tells only half the story. No problem in evaporation should ever be discussed without including the question of power generation in the same plant. In the case above of the ordinary evaporators run on 5 lb. steam, the steam would in practice be exhausted from prime movers. Obviously, if the power demands of the plant are provided for and all exhaust used in existing equipment, adding a new evaporator would call for the generation of more steam and the comparison just made would need no modification. If exhaust steam were going to waste, the turbo-generator could not be considered, because the ordinary evaporator would run on exhaust, making no additional demands on the boilers. The thermocompressor would have to have high-pressure steam direct from the boilers.

Single Effect Operation

Consider a new department where both power and evaporation are to be provided and plans may be made for co-ordinating the two. The total amount of evaporation to be accomplished will call for a single effect only. In one case let us assume steam raised in the boilers at 160 lb. gage, expanded to 5 lb. in turbines, and sent to evaporators. The turbines generate power which can be used in the plant or sold. In the other case, let us assume 160 lb. steam raised in the boilers, part being used in condensing turbines to generate power equivalent to the power in the first case, and part used to operate evaporators. Let us base the comparison on 1 kw.-hr. under the first case, and consider that there is enough evaporation to be done to use all the exhaust there provided. The assumption made previously that 1 lb. steam to the first effect will evaporate 0.85 lb. of water per effect will still be made. The various possibilities are as follows:

Case *A*—1 kw. of power used, generated in non-condensing prime movers, exhaust to single effect evaporator operating on 100 deg. temperature drop.

Case *B*—1 kw. used, generated in condensing prime movers, additional steam used for single effect evaporator.
- (1) Steam raised at high pressure, expanded through reducing valve for an evaporator which is same as in Case *A*.
- (2) Same as (1), but expanded through a nozzle which compresses 1.2 lb. vapor per pound steam through an 18 deg. temperature drop.
- (3) The additional steam generates additional power in condensing prime movers, this power being used to drive a turbo-blower.
  - (*a*) Blower gives 70 to 80 lb. evaporation per kilowatt-hour on a 14 deg. temperature drop (Ombeck).
  - (*b*) Blower gives 40 lb. evaporation per kilowatt-hour on a 25 deg. temperature drop (Wirth).

A comparison based on 40 lb. boiler steam raised, would give:

	Case A	Case B (1)	(2)	(3a)	(3b)
High-pressure steam to be raised	40 lb.	20 lb. for power 20 lb. for evaporator	20 lb. for power 20 lb. for nozzle	20 lb. for power 20 lb. for blower turbine	20 lb. for power 20 lb. for blower turbine
Power units	1 kw. non-condensing turb-generator	1 kw. condensing turbo-generator	1 kw. condensing turbo-generator	2 kw. condensing turbo-generator, motor-driven blower	2 kw. condensing turbo-generator, motor-driven blower
5-lb. steam available for evaporators:					
Exhaust or expanded	40 lb.	20 lb.	20 lb.	None	None
Compressed	None	None	24 lb.	70-80 lb	40 lb.
Total	40 lb.	20 lb.	44 lb	70-80 lb	40 lb.
Total evaporation	34 lb.	17 lb.	37 lb.	60-68 lb.	34 lb.

A comparison based on 34 lb. of evaporation in all cases would give:

	Case A	Case B (1)	(2)	(3a)	(3b)
Total steam to be raised	40 lb.	60 lb	36 lb.	30 lb.	40 lb.
Water for condensers:					
Power condensers	None	500 lb.	500 lb.	750 lb.	1,000 lb.
Evaporator*	850 lb.	850 lb.	850 lb.	None	None
Total	850 lb.	1,350 lb	1,350 lb.	750 lb.	1,000 lb.
Heating surface of evaporators	x sq.ft.	x sq.ft	$3.7x$ sq.ft.	$4.8x$ sq.ft.	$2.7x$ sq.ft.

* In order to make a clearer picture, consider a case in which the total evaporation to be accomplished is 1,000 gal. per hour. On a conservative rating the evaporator in Case *A* should have about 350 sq.ft. The steam consumed in Case *A* will be 9,800 lb. per hour (0.85 lb. evaporation per lb. steam), which corresponds to about 250 kw. power for the plant. Based on the preceding table we shall have:

	Case A	Case B (1)	(2)	(3a)	(3b)
Total steam needed per hour	9,800 lb.	14,700 lb	8,800 lb.	7,400 lb.	9,800 lb.
Total water needed per hour	25,000 gal.	40,000 gal.	40,000 gal.	22,000 gal.	29,000 gal.
Heating surface	350 sq.ft.	350 sq.ft.	1,300 sq.ft.	1,700 sq.ft.	950 sq.ft.

Too many factors come in to make a hard and fast comparison of costs. The following table shows, very roughly, however, what may be expected in an average case. Overhead (interest, depreciation, repairs, etc.) is estimated at 20 per cent per year (300 working days). Labor is considered equal in all cases, and hence omitted. Steam is not brought into the cost, as its cost is too uncertain; but data for steam consumption have been given and steam cost may be inserted as desired. Water is taken at 5c. per 1,000 gal.

	Case A	Case B (1)	(2)	(3a)	(3b)
First cost:					
Evaporator and accessories	\$900	\$900	\$3,300	\$4,300	\$2,400
Power unit and accessories	8,500	9,500	8,500	19,000	19,000
Blower or nozzle	....	....	500	14,000	16,000
Total	\$9,400	\$10,400	\$12,300	\$37,300	\$37,400

	Case A	Case B (1)	(2)	(3a)	(3b)
Cost per day:					
Overhead	\$6.30	\$6.90	\$8.20	\$24.90	\$24.90
Water	30.00	48.00	48.00	26.40	34.80
	\$36.30	\$54.90	\$56.20	\$51.30	\$59.70
Excess cost over Case A exclusive of steam	......	18.60	19.90	15.00	23.40
Steam saved over Case A, tons per day	......	(Uses more than A)	12	29	0

Case *B*(3*a*) is the ideal case, and will seldom occur; but if the conditions here represented exist, and if steam costs over 50c. per ton, this calculation shows a saving. Actual operating conditions will come much nearer *B*(3*b*), and here there is no saving in steam and an increased cost of \$23.40 per day. In other words, in the case apt to occur in practice, the turbo-blower saves nothing in steam and may be much more expensive to operate than an ordinary evaporator. This reasoning leaves out of account the more expensive labor to operate the turbo-blower evaporators, differences in piping and distribution, etc. If the solution has an elevation of boiling point, the case against the thermo-compressor is still worse.

Multiple Effect Operation

Suppose the plant could not use 250 kw. of power, but that 80 kw. could be disposed of. This power, generated in a non-condensing prime mover, would give about 3,300 lb. exhaust per hour for Case *A*. This is about a third of that available in the previous illustration; but our 1,000 gal. of evaporation per hour could be now accomplished with this steam in triple effect. This case is rather abnormal, as the sizes of all equipment will come out small. Steam consumption and cost of equipment will be figured on the basis of commercially practical units, reduced to the conditions of the problem in proportion to the amounts handled (thus eliminating the excess costs of small units per unit capacity). The results will then be strictly comparable among themselves and with the case of single effect operation above. The triple used in Cases *A* and *B*(1) is to work with a 20 deg. temperature drop in the first effect, and evaporate equal amounts in each effect. The single (used in the other cases) is to work on the same coefficient as the first effect of the triple.

As before, case *B*(2) is a nozzle compressor with an 18 deg. drop, case *B*(3*a*) a turbo-blower on a 14 deg. drop, and case *B*(3*b*) a turbo-blower on a 25 deg. drop. The efficiencies are also the same as before.

MULTIPLE EFFECT OPERATION

	Case A Triple	Case B (1) Triple	(2) Single	(3a) Single	(3b) Single
Steam raised:					
Power	40 lb.	20 lb.	20 lb.	20 lb.	20 lb.
Evaporation		20 lb.	20 lb.	20 lb.	20 lb.
Power units and accessories	1 kw. non-condensing	1 kw. condensing	1 kw. condensing 1 nozzle	1 kw. condensing 1 kw. condensing and blower	1 kw. condensing 1 kw. condensing and blower
Steam for evaporation:					
Exhaust	40 lb.	20 lb.	20 lb.	None	None
Compressed	......	......	24 lb.	70–80	40
Total	40	20	44	70–80	40
Evaporation	135 lb.	68 lb.	37 lb.	60–67	34

135 LB. EVAPORATION AND 1 KW. POWER

	Case A	Case B (1)	(2)	(3a)	(3b)
Steam:					
Power	...	20	20	20	20
Evaporation	40	40	73	40–45	80
Total	40	60	93	60–65	100
H_2O for condensers:					
Power, lb.	...	500	500	500	500
Evaporation, lb.	850	850	3,400	1,000–1,100	2,000
Total	850	1,350	3,900	1,500–1.600	2,500
Heating surface	$3x$	$3x$	$3.3x$	$4.3x$	$2.4x$

Then for a total evaporation of 1,000 gal. per hour as discussed under single effect operation, we would have:

	Case A	Case B (1)	(2)	(3a)	(3b)
Total steam needed, lb. per hr. for					
Power	3,300	1,650	1,650	1,650	1,650
Evaporation	.....	3,300	6,000	3,500	6,800
Total	3,300	4,950	7,650	5,150	8,450
Total water used per hr., gal.	6,300	10,000	29,000	11,500	18,500
Total heating surface, sq.ft.	1,050	1,050	1,150	1,500	840

	Case A	Case B (1)	(2)	(3a)	(3b)
First Cost:					
Evaporators	$2,600	$2,600	$2,900	$3,800	$2,100
Power units	3,300	3,450	3,450	3,450	3,450
Blower or nozzle	.....	......	500	17,000	14,000
Total	$5,900	$6,050	$6,850	$24,250	$19,550
Operating costs per day:					
Fixed charges (20%) per yr., 300 days per year)	$3.90	$4 00	$4 60	$16.20	$13 00
Water at 5c. per 1,000 gal	7.50	12 00	34 80	13 80	22.20
	$11.40	$16 00	$39 40	$30 00	$35 20
Excess cost over Case A per day, exclusive of steam	.....	$4 60	$18 00	$17 60	$13 80
Excess steam used over Case A, tons per day	.....	20	56	22	62

Thus, on the assumption of power demands by the plant so large that exhaust enough is furnished to do all the evaporation in single effect, there is a possibility of so combining condensing power units and thermocompression evaporators to show a saving over the usual arrangement. This will be the case only when there is no scaling, no elevation of boiling point, no hot thick liquor withdrawn to the next step, etc. In the ordinary circumstances, thermocompression offers no saving as compared to a single effect, and will be still more expensive if compared to a multiple effect. In general, then, if the power demands of a plant are reasonably in proportion to its demands for steam for evaporation, thermocompression is out of the question except where there is some unusual special condition.

Plants Using Purchased Power

The above discussion is based on the idea that the plant generates its own power. In case the plant generates no power, and central station or hydro-electric power is available, the comparison is different if the price of purchased power is low. Even with moderately expensive power, if the factory has no steam plant and supplies all its power demands with purchased power, it might be more convenient to put in a turbo-blower than to put in a steam plant. On a strict cost basis, however, power would have to be available at a figure very much under the cost of generation in the plant to make the thermocompressor arrangement economical.

Plants With Small Power Demands

The case which is most favorable to the thermocompressor is that of a plant whose evaporation problems call for the use of very much more steam than can be supplied as exhaust from their power units. Here we have four possibilities (after all the exhaust from non-condensing power units has been used): (1) Raise additional low-pressure steam for ordinary evaporators, (2) raise additional high-pressure steam and reduce it for the evaporators with a reducing valve, (3) raise additional high-pressure steam and send it to a condensing turbine driving a turbo-blower, and (4) raise additional steam, send it to a non-condensing turbine driving a turbo-blower, and use the turbine exhaust (along with the compressed vapor) in the evaporator.

Case 1 is evidently out of the question, as it takes very little more heat to raise high-pressure steam than it would to raise 5 to 10 lb. steam. Further, the chance of future needs for high-pressure steam would in any case warrant the slightly greater first cost of the boiler plant designed for high pressures. Let us then assume that the non-condensing turbine takes 40 lb. per kilowatt-hour, the condensing turbine 20 lb., that the turbo-blower will evaporate (a) 70-80 lb. per kilowatt-hour and (b) 40 lb. and that 1 lb. of steam will evaporate 0.85 lb. of H_2O per effect. Let us assume also that the amount of evaporation is such that a triple or quadruple effect evaporator would be used if case 4 were adopted. Obviously then, in case 4 the first effect would be enlarged. The evaporator may be looked on as a combination of a triple run on exhaust steam and a single with a thermocompressor. The single and the first effect of the triple happen to be combined in one shell, but it is simpler to think of them separately. Let us base our comparison first on 40 lb. of boiler steam, which gives us the following figures:

	Case 2	Case 3	Case 4a	Case 4b
Steam raised, lb.	40	40	40	Same as 4a
Power units	None	2 kw. condensing turbine and blower	1 kw. non-condensing turbine and turbo-blower	Same as 4a
5 lb. steam available for evaporators—exhaust	40	None	40	40
Compressed	None	140–160	70–80	40
Total	40	140–160	110–120	80
Lb. evaporated in single (from compressor)	None	140–160	70–80	40
In triple (from exhaust)	102	None	102	102
Total	102	140–160	170–180	142
Evaporator bodies	3 of x sq.ft. each	1 of $4.5x$ sq.ft.	1 of $3x$, 2 of x sq.ft. each	1 of $2x$, 2 of x sq.ft. each
Total surface	$3x$	$4.5x$	$5x$	$4.2x$
Lb. evaporated per lb. steam	2.55	3 5–4	4 2–4.5	3.7
Condensing water Turbines, lb.	None	1,000	None	None
Evaps., lb.	850	None	850	850

If a quadruple be assumed in cases 2 and 4:

	Case 2	Case 3	Case 4a	Case 4b
Lb. evaporated By compressor	None	140–160	70–80	40
By evaporator	135	None	135	135
Total	135	140–160	205–215	175
Condensing water Turbines, lb.	None	1,000	None	None
Evaporators, lb.	850	None	850	850
Heating surface	$4x$	$4.5x$	$6x$	$5.2x$
Lb. evapd. per lb. steam	3.4	3.5-4	5.1-5.4	4.4

Assume an evaporator to remove 30,000 lb. of water per hour in quadruple effect. This would call for about 1,300 sq.ft. per effect, and a steam consumption of 9,000 lb. steam per hour. If the data from the preceding table be converted to equal amounts evaporated, we shall have:

	Case 2	Case 3	Case 4a	Case 4b
Steam, raised, lb. per hour	9,000	8,100	5,800	7,000
Water used, gal. per hour	23,000	24,500	14,500	17,500
Heating surface sq ft. total	4,200	4,200	4,200	4,200
Hp. of blower turbine	.....	250	150	125
First cost of evaporator	$10,500	$10,500	$10,500	$10,500
First cost of blower and motor	...	17,000	14,000	12,000
	$10,500	$27,500	$24,500	$22,500
Fixed charges per day (at 20 per cent, 300 working days)	$7.00	$18.30	$16.30	$15.00
Water at 5 cents per 1,000 gal	27.60	29.40	17.40	21.00
	$34 60	$47.70	$33.70	$36.00
Difference in cost from case 2 (excluding steam)	....	+13 10	—0.90	+1.40
Steam saved over case 2, tons per day	......	11	38	24

Hence, in the case where steam cannot be supplied to the evaporators as exhaust from power units, but must be furnished from the boilers, it may be most economically supplied through a turbo-blower driven by a non-condensing turbine. This is in line with the general principle that the most economical method of using steam to produce both power and evaporation is a non-condensing prime mover sending its exhaust to the evaporating device.

Bibliography

In the bibliography which follows every article to which a reference could be found is included, even though the original was not available. Some references were obtained from footnotes where the author did not cite his references accurately. This accounts for the incomplete citations in some cases.

Patents are arranged in numerical order except in the case of the English patents. These are arranged by years and numerically in each year. Where the same

subject is covered by identical patents in different countries, full reference is made and subject given under the first entry, and succeeding notices refer back to that one. Foreign patents have not been examined other than by the literature references. All U. S. patents have been examined in the specifications themselves.

An asterisk indicates mention by title only, or an abstract so brief as to be useless.

The author wishes to express his indebtedness to L. A. Pridgeon of the department of chemical engineering, University of Michigan, for much assistance in collecting the data on which this paper is based.

LIST OF ARTICLE REFERENCES ON VAPOR, RECOMPRESSION EVAPORATION

No.	Author	Reference	Subject
1	Anon.	*Centr. Zuckerind.*, vol. 17, pp. 1193-5, 1220-1. *Chem. Abs.*, vol 3, p. 2395 (1909).*	
2	Anon.	*J. Soc. Chem Ind.*, vol. 36, pp. 70-2 (1917).	Description of Soderlund and Boberg and Prache evaporators.
3	Anon.	*Z. Bayer Revisionsver.*, 1918, p. 176. *Chem. App.*, vol 6, p. 12 (1919).	
4	Anon.	*Eng.*, vol. 102, pp. 637-40, 642 (1916). *Chem. Abs.*, vol. 11, p. 691 (1917).	Description of Prache and Bouillon evaporators with illustration.
5	Anon.	*Am. Sug r Ind.*, vol. 13, p. 538 (1911).	Abstract of No. 17.
6	Balsberg	*Oesterr.-Z. Berg.-Hüttenwesen*, 1878.	Piccard-Weibel system in salt plant.
7	Bue	*Bull. Assoc Chim. Sucr. Dist.*, vol 39, pp. 38-40 (1921). *Chem. Abs.*, vol. 16, p. 1023 (1922)*.	
8	Carlsson	*Chem. & Met.*, vol 24, p. 645 (1921). *Chem. Abs*, vol 15, p. 202 (1921).	Description of a Kummler-Matter installation and theoretical discussion.
9	Claassen	*Z. Ver. deut Zuckerind.*, vol. 52, pp. 781-9 (1902).	Use of steam jets on evaporators.
10	Claassen	*Z. Ver. deut. Zuckerind.*, vol 71, pp. 440-451 (1921). *Chem. Abs*, vol 15, p. 3699 (1921).	Use of turbo-blowers on sugar evaporators.
11	Cunse	*Z. Ver. deut. Zuckerind.*, vol. 32, pp. 541-2 (1882).	The Piccard-Weibel process.
12	Dahme	*Z. Dampfkessel Masch.*, 1920, p. 153.	The "Heat Pump."
13	de Baufre	*J. Am. Soc. Mech. Eng.*, vol 40, p. 746 (1918). *Chem. Abs.*, vol. 12, p. 2666 (1918).	Abbreviated discussion of No. 39.
14	Deerr	"Cane Sugar," 2nd Ed. 1921, pp. 354-6.	General review.
15	Degener	*Z. Ver. deut. Zuckerind.*, vol 32, p. 539 (1882)	Piccard-Weibel process.
16	Deinlein	*Z. Bayer Revisions er.*, 1919, No. 24.	The "Heat Pump."
17	Eslancher	*J. Fabr. Sucr*, 1911, Sept 13.	Tests of Prache & Bouillon nozzle and sugar installation. See No. 5.
18	Flügel	*Z. Ver. deut Ing*, vol. 64, pp. 954-8, 986-9 (1920).	General theoretical comparison of various systems.
19	Fürer	*Salzbergbau u. Salinenkunde*, 1900, p. 897.	
20	Holmes	*Paper Maker & Paper Trade J.*, 1922, pp. 610-8. *Chem. Trade J.*, vol 70, pp. 1-3, 1922 *Chem. Abs*, vol 16, p. 1505 (1922)*	General discussion.
21	Hottinger	*Schw. Techn.-Ztschr*, 1920, p. 53.	The "Heat Pump."
22	Ihlee	*Z. Ver. deut. Zuckerind.*, vol. 33, p 618 (1886).	The Piccard-Weibel system.
23	Josse	*Z. Bayer Revis ons er*, 1911, p. 11.	
24	Josse	*Z. für des ges. Turbinenwesen*, 1920, p 327.	
25	Koerting	*Z. Ver. deut. Zuckerind.*, vol. 24, p. 527 (1874).	Use of nozzles on evaporators.
26	Lubkef	*Z. Ver. deut Zuckerind.*, vol. 32, pp. 540-1 (1882).	The Piccard-Weibel process.
27	Müller	*Z. Ver. deut Zuckerind.*, vol. 31, p. 612 (1881).	The Piccard-Weibel process.
28	Nagel	*Z Ver. deut. Zuckerind.*, vol. 31, p. 600 (1881).	Home-made steam jet compressor.
29	Ombeck	*Z Ver deut Ing.*, vol. 65, pp. 64-6 (1921). *Chem. Abs*, vol. 15, p. 1770 (1921).	Tests on a distilled water plant.
30	Schaeffer & Budenberg	*Z. Ver. deut Zuckerind.*, vol. 29, pp. 1015-31 (1879).	Theory of Piccard-Weibel system.
31	Schaeffer & Budenberg	*Z Ver. deut Zuckerind.*, vol. 33, pp. 131-7 (1883).	Results from Piccard-Weibel system. (Tests of No. 42).
32	Schreber	*Kali*, vol 25, pp. 252-6 (1920). *Chem. Abs*, vol 14, p. 2841 (1920)*.	
33	Schreber	*Chem. Ztg*, vol 44, pp. 469-70 (1920). *Chem App*, vol. 8, p. 158 (1921).	
34	Schreber	*Z. Dampfkessel Masch.*, 1920, pp. 45-52.	
35	Schroeder	*Z. Dampfkessel Masch.*, 1917, p. 25.	Use of thermo-compressor for make-up in power plants.
36	Schroeder	*Chem. App*, vol 2, pp. 187-9 (1915).	Early history, Prache & Bouillon evaporators.
37	Schroeder	*Chem App*, vol 2, pp. 199-202 (1915).	Prache & Bouillon evaporators.
38	Schroeder	*Chem. App*, vol. 2, pp. 210-13 (1915).	Soderlund & Boberg, general theory.
39	Stuart	*J. Am. Soc Nav. Eng*, vol. 30, pp. 41-59 (1918).	Tests of de Baufre nozzle.
40	Svoroik	*J. Zuck. Boh*, vol. 7, p. 187 (1882).	
41	Tuss chen	*Chem. App*, vol. 6, pp. 25-6 (1919). *Chem. Abs*, vol. 12, p. 1957 (1919).	Tests of Kummler & Matter evaporator on caustic.
42	Urban	*Z Ver. deut. Zuckerind.*, vol. 33, pp. 296-300 (1883).	Test of Piccard-Weibel system.
43	Weibel	*Z. Ver. deut. Zuckerind.* vol 33, pp. 41-3 (1883).	Summary of data on Piccard-Weibel system.
44	Whitehead	*Sugar Cane*, vol. 12, p. 424 (1880).	
45	Wirth	*Bull. Schw Elektrotech. Vereins*, 1919, p. 12.	Kummler & Matter evaporators.
46	Wirth	*Z. Ver. deut. Ing*, vol. 65, p. 1183 (1921); vol. 66, p. 160 (1922). *Chem Abs*, vol 16, p. 1822 (1922).	Important collection of operating data.
47	Zs. oeye	*Z. Ver. deut. Zuckerind*, vol. 56, pp. 568-9 (1906).	Review and discussion.

LIST OF AMERICAN, GERMAN, FRENCH AND ENGLISH PATENTS ON VAPOR RECOMPRESSION SYSTEMS FOR EVAPORATORS

U. S. Patents

No.	Patent No.	Patentee	Date	Other Patent References	Lit. References	Subject
101	896,460	Prache	Aug. 18, 1908	Fr. 364,408 German 180,115 English 26,065-1905	*J. Soc. Chem. Ind.*, vol. 27, p. 929 (1908)*.	Vertical evaporator with compartments.
102	904,276	Prache & Bouillon	Aug. 18, 1908			Nozzle.
103	1,020,659	Prache & Bouillon	Aug. 18, 1908	Fr. 485,851 English 14,492-1911 German 258,010		Crystallizing evaporator.
104	1,071,341	Prache	Aug. 26, 1913	German 267,270 Fr. 450,135 Eng. 25,458-1902	*J. Soc. Chem. Ind.*, vol. 32, p. 900 (1913)*. *Sugar*, vol. 16, March, p. 61 (1914).	Inclined evaporator with superimposed compartments.
105	1,150,713	Soderlund	Aug. 17, 1915	Fr. 444,109 Eng. 12,462-1911	*J. Soc. Chem. Ind.*, vol. 34, p. 947 (1915)*. *Z. Ver. deut. Zuckerind.*, vol. 66, p. 117 (1916).	Horizontal tube film evaporator in stages.
106	1,200,996	Soderlund	Oct. 10, 1916	Fr. 449,399 Eng. 22,670-1911	*J. Soc. Chem. Ind.*, vol. 35, p. 1145 (1916)*. *Z. Ver. deut. Zuckerind.*, vol. 67, p. 171 (1917)*	Film type evaporator.
107	1,213,596	deBaufre	Jan. 23, 1917	Eng. 114,164	*J. Soc. Chem. Ind.*, vol. 36, p. 376 (1917).	Application of nozzle to evaporator.
108	1,252,962	Soderlund & Boberg	Jan. 8, 1918			Vertical tube film evaporator
109	1,361,834	deBaufre	Dec. 14, 1920			Application of multiple nozzles to evaporator.
110	1,390,676	deBaufre	Sept. 13, 1921			Application of nozzles to multiple effect evaporator.
111	1,390,677	deBaufre	Sept. 13, 1921			Similar to preceding.
112	1,391,811	Weil	Sept. 27, 1921			Application of nozzles in series to evaporator.

German Patents

No.	Patent No.	Patentee	Date	Other Patent References	Lit. References	Subject
113	167,422	Theisen	Nov. 10, 1904	Fr. 356,752 Eng. 19,385-1905	*Z. Ver. deut. Zuckerind.*, vol. 56, p. 286 (1906).	Fans in vapor lines in evaporators.
114	180,115	Prache & Bouillon	Mar. 25, 1905	U. S. 896,460	*Chem. Abs.*, vol. 1, p. 1805 (1907).	
115	185,829	Bergmans	June 26, 1906		*J. Soc. Chem. Ind.*, vol. 26, p. 1248 (1907).	Uses a superheater to regenerate vapors.
116	258,010	Prache	June 9, 1911	U. S. 1,020,659	*Chem. Abs.*, vol. 1, p. 2500 (1913)*.	
117	267,270	Prache	Nov. 19, 1911	U. S. 1,071,341	*Z. Ver. deut. Zuckerind.*, vol. 63, p. 1086 (1913).	
118	268,841	Prache & Bouillon	May 15, 1912		*Chem. Abs.*, vol. 8, p. 597 (1914)*.	
119	270,471	Prache	Feb. 22, 1913	Fr. 453,095	*Chem. Abs.*, vol. 8, p. 2941 (1914)*. *Z. Ver. deut. Zuckerind.*, vol. 64, p. 487 (1914).	Use of gas engine to compress vapors.

					French Patents	
120	339,177	Montupet & Jannin	Dec. 19, 1904		*J. Soc. Chem. Ind.*, vol. 24, p. 144 (1905). *Z. Ver. deut. Zuckerind.* vol. 55, p. 267 (1905).	Use of nozzle.
121	339,177	Montupet & Jannin	July 27, 1906	Addition to preceding	*J. Soc. Chem. Ind.*, vol. 25, p. 840 (1906). *Z. Ver. deut. Zuckerind.*, vol. 56, p. 972 (1906).	Regulation of nozzles.
122	350,409	Sautter, Harle, & Cie.	Feb. 1, 1906		*Z. Ver. deut. Zuckerind.*, vol. 56, p. 374 (1906).	Use of turbo-blower.
123	364,408	Prache & Bouillon	Mar. 19, 1906	U S 896,460	*J. Soc. Chem. Ind.*, vol. 25, p. 874 (1906). *Z. Ver. deut. Zuckerind.*, vol. 56, p. 1118 (1906).	
124	356,752	Theisen	Aug. 8, 1905	Ger. 167,422	*Z. Ver. deut. Zuckerind.*, vol. 56, p. 169 (1906). *J. Soc. Chem. Ind*, vol. 25, p. 8 (1906).	
125	379,292	Chambost	Oct 31, 1907		*Z. Ver. deut. Zuckerind.*, vol. 58, p. 53 (1908).	Nozzle with ring-shaped orifice.
126	428,851	Prache	June 30, 1910	U.S 1,020,659	*J. Soc. Chem. Ind.*, vol. 30, p 1240 (1911)*.	
127	444,109	Techno-Chem. Lab.	May 22, 1918	U S 1,150,713	*J. Soc. Chem. Ind.*, vol 31, p. 1070 (1912)*.	
128	449,399	Techno-Chem. Lab.	Oct. 14, 1912	U S 1,200,996	*J. Soc. Chem. Ind.*, vol 32, p. 476 (1913)*. *Chem. Abs.*, vol. 7, p. 3051 (1913)*.	
129	450,135	Prache	Nov. 4, 1912	U S 1,071,341	*J. Soc. Chem. Ind.*, vol. 32, p. 476 (1913)* *Chem. Abs.*, vol. 7, p. 3051 (1913)*. *Z. Ver deut. Zuckerind.*, vol. 63, p. 439 (1913).	
130	453,995	Prache	Feb 5, 1913	Ger 270,471	*J. Soc. Chem. Ind.*, vol 32, p. 858 (1913). *Chem Abs*, vol. 8, p 407 (1914)*.	
					English Patents	
131	3,080	Simpson	Feb 16, 1900		*J. Soc Chem. Ind*, vol. 20, p. 233 (1901)	Use of nozzle on evaporators.
132	19,385	Theisen	Sept 25, 1905	Ger 167,422	*J. Soc Chem Ind*, vol 25, p. 524 (1906).	
133	26,065	Prache & Bouillon	Dec 14, 1905	U S 896,460	*J. Soc. Chem Ind*, vol 26, p. 39 (1907).	
134	9,276	Prache	Apr. 19, 1909		*J. Soc. Chem Ind.*, vol 29, p. 677 (1910).	Inclined horizontal evaporator.
135	12,462	Soderlund & Testrup	May 23, 1911	U S 1,150,713	*J Soc. Chem Ind*, vol 31, p. 971 (1912). *Chem Abs*, vol. 6, p 3039 (1912).	
136	14,492	Prache	June 19, 1911	U S 1,020,659	*J. Soc. Chem. Ind*, vol. 31, p 112 (1912)*. *Chem Abs*, vol 7, p. 4 (1913)*.	
137	22,670	Soderlund	Oct 14, 1911	U S 1,200,996	*J Soc. Chem Ind.*, vol 32, p 183 (1913). *Chem. Abs*, vol 7, p 1119 (1913)*.	
138	24,590	Vincent	Oct 28, 1912		*J Soc Chem Ind*, vol 33, p. 13 (1914).	Use of nozzle
139	25,711	Sudfeldt und Co	Nov 8, 1912		*J Soc Chem Ind*, vol 32, p 408 (1913).	Use of nozzle and superheated steam.
140	4,515	Prache	Feb 21, 1913		*Chem Abs*, vol 8, p 2641 (1914)*.	
141	13,607	Boberg, Soderlund & Testrup	June 12, 1913		*J. Soc Chem Ind*, vol 33, p. 906 (1914)	Use of gas engine for power for compressor
142	3,456	Soderlund, & Boberg	Feb. 10, 1914		*J Soc. Chem Ind*, vol 34, p. 295 (1915) *Z. Ver deut. Zuckerind*, vol. 66, p. 438 (1916). *Chem. Abs*, vol. 8 p 2160(1915).	Use of gas engine for power for compressor.
143	138,871	Metallbank und Metallurgische Co	Feb. 9, 1920		*Chem. Abs*, vol 14, p. 1877 (1920)	Use of turbo-blower and spray evaporator.
144	25,458	Prache	Nov. 6, 1912	U S 1,071,341	*J. Soc. Chem Ind*, vol. 32, p. 275 (1913). *Chem. Abs*, vol 8, p. 1361 (1914)*.	
145	114,164	deBaufre	Oct 24, 1916	U S 1,213,596	*J. Soc. Chem Ind*, vol 37, p. 231A (1918)*.	
146	124,732	Matter	Mar 17, 1919		*J. Soc. Chem. Ind.*, vol. 38, p. 750A (1919).	Use of several bodies and one compressor.
147	123,716	Kummler & Matter	Oct 24, 1918		*J Soc Chem Ind*, vol 39, p. 287A (1920).	Using part of compressed vapor in open steam jet.

Growth of Canadian Paper Industry

After the depression of 1921 the present year has seen a remarkable expansion in the Canadian pulp and paper industry. For the year ended April 1, 1922, pulp and paper exports had a total value of over $180,-000,000, a figure exceeded only by exports of wheat and agricultural products. The Canadian newsprint mills now have a rated capacity of about 5,520 tons per day, equivalent to an output of 1,250,000 tons per year, which is double the output of any year prior to 1917. In addition, Canadian mills are equipped to produce 2,500 tons of pulp daily. The combined output represents a daily cut of 6,000 acres of forest land.

The Canadian pulp and paper industry is, in fact, accomplishing so much that it is a difficult matter to keep accurate trace of it, and statistics which apply today may be entirely incorrect tomorrow. According to government figures for 1920, the industry employed an invested capital of over $347,000,000, of which slightly more than half was in the Province of Quebec. In the first 6 months of 1922 Canadian mills produced over 516,000 tons of newsprint, as compared with 612,-000 produced by the United States mills. The Canadian newsprint output during this 6 months period is stated to have been 93.6 per cent of mill capacity.

While the volume of United States newsprint production has remained practically stationary at around 1,300,000 tons since 1913, Canadian production has increased from 350,000 tons to 812,000 tons in the same time. Exports to the United States have increased from 219,602 tons to 791,[illegible] tons. The United States has, in fact, come to depend on Canada for 85 per cent of the newsprint in addition to huge quantities of pulp. There is also an extensive trade being built up, and increasing rapidly, with the antipodes and the Orient, and in this regard the Pacific coast as a pulp and paper area is fast developing in importance. Total pulp and paper exports for the month of June this year amounted in value to $10,534,896, and for July $9,738,-252. Production in the latter month was nearly double that of the corresponding month in 1921, though, due to lower prices, the value was only slightly increased.

Bauxite in 1922

The domestic production of bauxite in 1922 was at least twice as large as in 1921 and may reach a total of not less than 300,000 long tons, according to the Geological Survey. This quantity is about half of that normally consumed.

During the first 6 months of 1922 the imports of bauxite averaged about 1,500 long tons a month, but since June they have been more than 3,000 tons a month. The prices of domestic dried bauxite ranged from $6 to $10 a ton, but were lower in the last half of the year. The prices of pulverized and dried bauxite have ranged from $12 to $15 a ton, and of calcined from $20 to $25 a ton. The effect of a shortage of coal is reflected in an increase in the price of calcined bauxite during the latter part of 1922. Under the new tariff the duty on bauxite is $1 a ton, whereas under the old tariff it was on the free list.

Materials for Furnaces and Ovens

Safe Temperature Ranges, and Data on Ability to Transmit Heat

DESIGNERS and constructors of ovens and furnaces, especially those operated by electric current, will find a great deal to interest them in a paper read by E. F. Collins, of the General Electric Co., before the Montreal meeting of the American Electrochemical Society, entitled "Electric Heat, Its Generation, Propagation and Application to Industrial Processes." The author calls attention to the fact that heat, light and electricity are only different manifestations of energy, and their phenomena follow identical laws. He then goes on to show how equations for the flow of electricity are analogous to those for the flow of heat. A number of tabulations of physical constants are given, so that a person familiar with the mathematical development can apply the theoretical expressions to given combinations of furnace materials.

We reproduce two of the simpler diagrams in Figs. 1 and 2. They chart in a very clear manner the capabilities and limitations of various materials of construction, and the duty demanded of different kinds of ovens or furnaces.

Another chart shows the limitations of the materials of construction when used in electrically heated equipment. These data are contained in Table I.

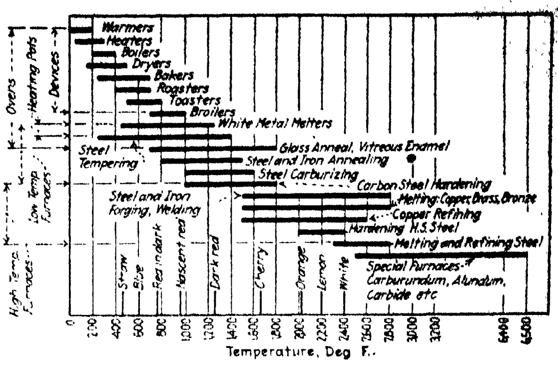

FIG. 1—TEMPERATURE RANGE IN INDUSTRIAL PROCESSES

TABLE I—LIMITATIONS OF MATERIALS

Material	Maximum Operating Temp., Deg. F.	Melting Temp., Deg. F.	
Resistors			
Tungsten	3,400		Oxidizes rapidly
Molybdenum	3,400		Oxidizes rapidly
Carbon	3,400		Oxidizes rapidly
Silundum	3,400		
Platinum	3,000		
Nickel-chromium alloy	2,200		
Aluminum steel	1,600		
Nickel	1,400		
Iron	600		
Refractories			
Firebrick	2,900	2,900	
Silica brick	3,100	3,100	
Chromite brick	3,400	3,950	
Magnesite brick	3,400	4,000	
Carborundum and alundum	3,400	4,060	
Heat insulators			
Magnesia	1,200		
Asbestos	800		
Kieselguhr	1,000		
Red brick	400		
Air cells	700		
Electrical insulators			
Porcelain	200		
Mica	800		
Fire clay	1,000		
Magnesium oxide	1,400		
Asbestos	1,000		
Alundum	2,400		
Containers and Carriers			
Cast iron	1,000		
Malleable iron	800		
Steel	600		
Nickel chromium alloy	2,200		
Monel metal	1,000		
Non-metallic refractories	2,800		
Calorized steel	1,600		

Hardening of Duralumin

"An Investigation of Duralumin" has been undertaken by S. Konno, under the direction of K. Honda, and the results of his findings are published in the *Science Reports* of the Tôhoku Imperial University, vol. 11, p. 269. He finds that the heating, quenching and aging phenomena are exactly similar to those when heating, severely quenching and tempering carbon steels. Hardening is due to the presence of the several elements and their possible compounds, present either by design or as impurities; but the aging effect is due principally to the dissolution of Mg_2Si in aluminum. Al_2Cu acts similarly, but to a very minor extent. Additions of Cu and Mn (duralumin) increase the hardness of Al:Mg alloys, but not the aging effect.

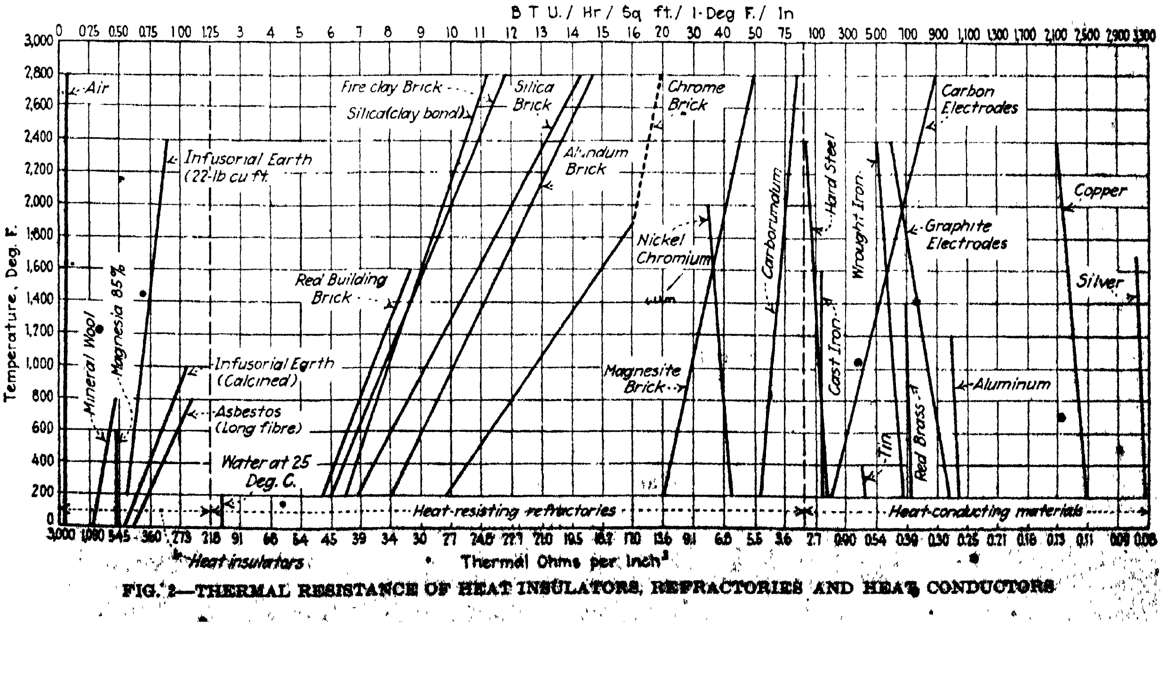

FIG. 2—THERMAL RESISTANCE OF HEAT INSULATORS, REFRACTORIES AND HEAT CONDUCTORS

Synopsis of Recent Chemical & Metallurgical Literature

Freezing or Galling of Threaded Pipe Joints

Couplings for heavy welded pipe of steel—such as oil well casings—have ordinarily been made of wrought iron. It is the usual experience that when coupling and pipe of the same metal are screwed together with considerable force, the joint will oftentimes seize or "gall" before many turns. This is really nothing but a low-temperature welding at excessive pressure. In a recent paper[1] before the American Petroleum Institute, F. N. Speller finds that steel couplings and pipe having die-cut threads can be driven three or four turns further than ordinarily if the coupling threads have previously been electroplated with zinc. Nearly as good results may be had by mixing a grease with 50 per cent by weight of zinc dust, and using this as lubricant.

Nickel and Chromium in Cast Iron

Richard Moldenke presented a paper on this subject before the San Francisco meeting of the Mining Engineers (September, 1922). It contains a summary of extended tests on standard bars made of various mixtures of cast irons containing up to 20 per cent of Bethlehem Steel Co.'s Mayari pig. He points out that this pig iron contains high carbon (4.25 per cent total) 1.2 per cent Ni, 2.4 Cr and 0.2 Ti, and is smelted with a large slag volume and heavy coke charges. All these are indications of a well-made iron, free of oxide, even approaching the general excellence of the older "charcoal irons"; and should produce castings of fine uniform grain.

When introduced into a cupola, about half the Cr is slagged; Ni persists, however. Chromium decreases the amount of graphic carbon in the resulting castings; nickel increases the strength. Large proportions of low-silicon Mayari pig will produce excellent white iron rolls, car wheels and crusher liners. Castings containing considerable Ni and Cr will also prove superior for heat- and acid-resisting purposes.

In all about 245 heats were poured, the compositions varying systematically, as follows:

Phosphorus	0.10; 0.40; 0.80
Total carbon	2.75; 3.25; 3.75
Silicon	0.75 to 2.75 by 0.25 steps
Mayari pig additions	0, 10, 15 and 20 per cent

Melting was done in a crucible furnace, and standard transverse test-bars poured. Breaking strength and deflection, Brinell hardness, tensile strength and chemical composition were determined for each heat. Results are tabulated in the paper, and a series of graphs drawn showing the effect of composition on these properties.

In general it was found that the Brinell hardness decreases as the total carbon increases, and is independent of the silicon content. Hardness and transverse strength also seem to be independent properties.

Silicon seems to weaken the transverse bars, as does also high total carbon and high phosphorus. On the other hand, nickel and chromium increase the strength, especially in low percentages. The strongest bars broke at about 4,900 lb. with a deflection of about 0.11 in. They contained total carbon about 3.25, Si 1.75 per cent, P less than 0.40 and Ni and Cr about 0.15 per cent each. This strength is about 600 lb. greater than similar analysis containing no Ni and Cr, although low-phosphorus irons containing no alloy showed superior ductility.

[1] "Physical and Chemical Properties of Oil Country Tubular Material."

Book Reviews

OUTLINES OF THEORETICAL CHEMISTRY. By *Frederick H. Getman.* Third edition, thoroughly revised. xi + 625 pp., illustrated. John Wiley & Sons, New York. Price, $3.75.

The broad field of physical chemistry is completely covered—the properties of the different physical states of matter, equilibrium, thermochemistry, photochemistry, electrochemistry and radioactivity. The arrangement is logical and clear so that one sees that physical chemistry is an organized integral science and not, as in Walker's Physical Chemistry, a series of independent topics. Perhaps the author might well have made his classification still more rigid and obvious.

The subject matter in general has been brought thoroughly up to date (e.g., isotopes). However, no mention is made of the Bingham viscosimeter and other important types of viscosimeter; nor of the Menzies b.p. apparatus, nor of plasticity, nor of the science of microchemistry as developed by Chamot. One misses the periodic arrangement of elements according to their atomic numbers. In the description of the determination of atomic weights the author omitted to show the contribution of physical chemistry in the avoidance, decrease, compensation and correction of errors in precision measurements. On page 85 the author persists in speaking of molecular aggregates within a solid crystal and he ascribes to them a sort of Brownian movement. Like most texts upon physical chemistry, this book does not show explicitly how to use Van der Waal's equation and how to calculate the constants, and no problems upon this important and practical equation are given. The chapters upon electrical conductance and electromotive force have been, to a large extent, abstracted from LeBlanc's Electrochemistry, which is a book that has long needed revision. Electrometric titration and the concentration of hydrogen ions and pyrometry have been cursorily treated.

The book is convenient in form, the printing is clear and the paper is good. The diagrams and curves are abundant (148 figures), well selected and clear.

The text is adapted (and intended) for those who are beginning the study of physical chemistry. The student who has already received, according to modern practice, some instruction in physical chemistry in his courses in general chemistry, qualitative analysis and quantitative analysis will not be too advanced to use this book. It should serve very well as a text to teach from, as well as a book for self-study or for a review. Probably it is one of our best three texts of introductory physical chemistry.

RESTON STEVENSON.

STANDARD SPECIFICATIONS FOR LABORATORY APPARATUS ADOPTED BY THE MANUFACTURING CHEMISTS ASSOCIATION OF THE UNITED STATES

These pamphlets are on sale at the office of the Manufacturing Chemists' Association in the Woodward Building, Washington, D. C. The price is not given, but is probably moderate. A committee of the Manufacturing Chemists Association, of which E. C. Lathrop of the du Pont company was chairman, has worked out, together with the manufacturers of laboratory apparatus, the committee on laboratory apparatus of the American Chemical Society and the Official Association of the Apparatus Manufacturers, a set of specifications covering the more usual types of apparatus. It will scarcely pay to go into the details of these specifications. Suffice it to say that the work is in line with modern ideas of diminishing the cost of manufacture by standardizing equipment, and also gives a happy combination of the ideas of the consumer and producer. The Manufacturing Chemists Association seems to have borrowed a leaf from Mr. Hoover's notebook, and the laboratory apparatus becomes thus Hooverized. After a casual glance through the catalog, in which are shown detailed drawings of many of the pieces of apparatus, it is evident that a good deal of thought has been given to the choice of specifications, and the convenience of the operator has been the primary slogan of the committee.

CHARLES WADSWORTH.

Recent Chemical & Metallurgical Patents

American Patents Issued Dec. 26, 1922

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,439,683—Manufacture of Gasoline. R. F. Bacon and B. T. Brooks, Pittsburgh; assigned to Gulf Refining Co., Pittsburgh.

1,439,685—Production of Light-Colored Fatty Acids. J. W. Bodman, Western Springs, Iowa; assigned to William Garrigue & Co., Inc., New York City.

1,439,781—Crusher. M. F. Williams, St. Louis; assigned to Williams Patent Crusher & Pulverizer Co. of Missouri

1,439,865—Nickel Alloy. Leon Cammen, New York City; assigned to International Nickel Co. of New Jersey.

1,439,887—Vehicle for Paint Pigments. William G. Hall, California, Pa.

1,439,909—Production of Alkali Metal Cyanides. F. J. Metzger, New York City; assigned to Air Reduction Co., New York City.

1,439,921—Recovery of Gasoline From Natural Gas. E. A. Starke, Berkeley, Calif.

1,439,939—Low Percentage Manganese Steel. J. M. Blake, Chicago Heights, Chicago, Ill.; assigned to American Manganese Steel Co., Chicago, Ill.

1,439,960—Purification of Hydrofluoric Acid. Henry Howard, Cleveland; assigned to Grasselli Chemical Co., Cleveland, Ohio.

1,439,976—Conversion of Aromatic Ring Compounds Into Motor Spirit. A. S. Ramage, Detroit, Mich.; assigned to Chemical Research Syndicate, Ltd., Detroit.

1,440,006—Cellulose Acetate Composition. H. Dreyfus, London, England.

1,440,026—Evaporator for Acid Generating Liquids. H. A. E. Nilson, Sweden.

1,440,056—Making Urea Phosphate. F. Clarkson and J. M. Braham, Washington, D. C.

1,440,063—Guanidine Nitrate. T. L. Davis, Somerville, Mass.

1,440,018—Recovery of Phenol Vapors by Tar Oils. W. Runge, Orange, and H. A. Curtis, Maplewood; assigned to Bregeat Corp. of America, Wilmington, Del.

1,440,176—Vulcanizing Rubber. Eloi Ricard, Melle, France, assigned to Société Ricard, Allenet & Cie., Melle (Deux Sèvres), France.

1,440,194—Drying, Burning and Recovering of Finely Divided Material. Abraham Wijnberg, Amsterdam, Netherlands.

1,440,195—Same title as 1,440,194

1,440,211—Continuous Process for Manufacture of Caustic Soda and Caustic Potash. Camille DeGuide, Enghien, France.

1,440,256—Treatment of Hydrocarbons. G. F. Forwood, London, England; assigned to the United Kingdom Oil Co., Ltd., London.

1,440,352—Treatment of Oil Containing Water. O. C. Gatrell, El Dorado, Kan.

1,440,355 and 1,440,356—Suspension and Emulsion and Process for Making Same. J. C. Morrell, New York City.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Diolefine Polymerization Products—It has been known that by passing a mixture of acetylene and propylene through red hot tubes it is possible to obtain small quantities of 1.3 butadiene together with other hydrocarbons. Furthermore, the formation of diolefine is increased by use of contact agents and is probably influenced by the catalytic activity of other substances. Hermann Plauson, however, claims to have produced increased yields of these condensation products by gradually increasing the pressure and the temperature, or increasing the time of reaction. He submits a mixture of equal volumes of acetylene and ethylene to a pressure of from 3 to 15 atmospheres by forcing them into a long thick-walled spiral or zigzag steel tube. This is heated from the outside to 350-450 deg. C. By a special arrangement of the valves at the ends of the tube, the gases are permitted to escape as any desired pressure is obtained. The gases which escape are passed into a distillation apparatus and are first cooled with water and then in a freezing machine to 20 deg. C. The 1.3 butadiene and the higher boiling hydrocarbons are thus condensed from the unchanged gases, which are forced back into the tube by means of the compressor.

A second example cited by this patent involves the use of molecular proportions of allylene and ethylene, from which is obtained a diolefine hydrocarbon of the formula C_5H_8. When treated with metallic sodium, this compound is polymerized to yield a rubber-like product. A yield of 8 to 12 per cent is said to be obtained by a single passage of the gaseous mixture through the apparatus, and the total yield with continuous operation is about 75 to 78 per cent. Other examples cite the use of mixtures of acetylene and propylene and of ethylene, acetylene and benzene. The polymerized products obtained from each of these mixtures are said to be of use in oil varnishes and as turpentine substitutes. (1,436,819. Nov. 28, 1922.)

Varnish Compositions—An applica- of the Plauson colloid mill in the manufacture of varnish and similar paintable compositions is claimed in a recent patent granted to the mill's inventor, Hermann Plauson, of Hamburg, Germany. In general, the process consists of subjecting a mixture of a varnish base, a liquid dispersion medium and some sort of a dispersion accelerator to intensive mechanical disintegration, such as that obtained in the colloid mill which reaches a peripheral speed of about 2,000 meters per minute. According to one of the examples cited, 100 parts of benzene is mixed with 5 to 10 parts of acetone-soluble condensation products of the phenol-formaldehyde type, which have previously been treated with small quantities of acetone, in the presence of 1 to 5 per cent of a fossil resin. The mixture is disintegrated in the colloid mill. The suspension gradually begins at a peripheral speed of about 300 meters per minute, but is carried out satisfactorily only at a speed of about 1,500 to 2,500 meters per minute. This treatment is to be continued for 3 hours at a temperature not over 70 deg. C. The result is a homogeneous lacquer which is not a true solution of the base in benzene, but is a suspensoid colloidal dispersion. Varnishes similar to shellac can be obtained from other artificial resins, such as the oxidized pitches, cumarone resins, vinyl polymerization products, etc., or from natural resins, such as copal, asphalt colophony, etc.

The products described in this patent differ from ordinary varnishes in that the particles are so finely divided that they possess the power of remaining in permanent colloidal suspension. Although in practice they may be considered as ordinary solutions, they are in reality suspensoid colloids. (1,436,820. Nov. 28, 1922.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Oils, etc.—Mineral and other oils and fats are increased in consistency by the addition of a saponifying agent and a product obtained by partly splitting two or more fats or oils with sulpho-aromatic acids. These fats or oils are preferably split to an extent of not more than 50 per cent, the resulting mixture of substances being used without any separation. Only one of the oils may be split by means of sulpho-aromatic acids, the other one being split by any other reagent. One of the two oils is preferably castor oil. In an example, 5.75 kg. of castor oil is split to the extent of 43½ per cent by means of Twitchell reagent and 1.75 kg. of fish oil are added. The mixture is added to 100 kg. of a light mineral oil together with 8 kg. of 40 per cent soda lye. (Br. Pat. 185,782. Meyer zu Eissen and P. Kiederich, Berlin. Nov. 8, 1922.)

Motor Fuel—Naphthene acid, preferably purified, is added as a diluent to hydrocarbons in amounts of at least 5 per cent and up to 40 per cent by volume to form a motor fuel; or the acid is used in the form of its neutral or acid soaps to form fuels of the type described in specification 12325/14 in which water is incorporated as an emulsion. Cresol or carbolic acid or other phenols, preferably in proportions of 1 to 3 per cent by volume, or amyl or ethyl alcohol may also be added to the

water-containing fuels to render the mixtures stable. Examples specify the use of potash and ammonia soaps of naphthene acid, and of benzol with gas oil or kerosene oil. Preferably, the naphthene acid is added to the oil, the mixture treated with alkali, and the water added subsequently. (Br. Pat. 185,796. H. Kleinschmidt, Berlin. Nov. 8, 1922.)

Tin Electrolysis—An electrolyte for refining tin consists of an acid, preferably hydrofluosilicic acid, in which tin is dissolved and to which a relatively small proportion of phosphoric acid is added to render insoluble any lead contaminating the tin. The electrolyte is prepared by intermittently immersing baskets made of impure tin or hard rubber containing impure shot tin in oxidizing tanks containing a 15.5 per cent solution of hydrofluosilicic acid until the solution has taken up 4.5 per cent of its weight of tin; the baskets are then suspended above the tanks until it is necessary to regenerate the solution. The solution is continuously circulated between the oxidizing and the electrolytic tanks by a pump. Phosphoric acid is added before solution and from time to time during electrolysis; the proportion may be from 0.1 to 0.3 per cent; about 0.1 per cent of cresylic acid, and from 0.05 to 0.1 per cent of glue may also be added. Slabs of impure tin are used as anodes and sheets of pure tin as cathodes. Both sets of tanks are lined with asphaltum paint. (Br. Pat. 185,808. W. P. Thompson, Liverpool. Nov. 8, 1922.)

Treating Copper-Nickel Solutions—A process for the precipitation of copper by means of finely divided nickel from solutions containing copper and nickel is carried out at a temperature below that of exhaustion of the nickel. Bessemerized copper-nickel matte may be ground, roasted and leached with sulphuric acid; part of the leached residue is reduced to metal and is used in excess as a precipitant for the solution obtained from the remainder of the leached residue, the precipitation being carried out at normal temperatures, and preferably on the counter-current principle. The copper-nickel powder with the copper cemented thereon is roasted, preferably in admixture with roasted or unroasted matte. The process may be applied to the removal of copper from any nickel sulphate solutions and electrolytes—for example, in cyclic processes—so that heating and subsequent cooling are avoided. In the separation of nickel and copper by electrolysis, the nickel sulphate electrolyte containing sulphuric acid may be supplied to the cathode compartment and passed through a filtering diaphragm to the anode compartment, the impure nickel-copper solution formed being drawn off, purified as described above, and returned to the cathode compartment. (Br. Pat. 185,859. H. G. C. Fairweather, London. Nov. 8, 1922.)

Pyrazolone Dyes—Direct dyeing cotton dyestuffs of the tartrazine type are obtained (*a*) by condensing two molecular proportions of an aryl-benzthiazole hydrazine with one molecular proportion of dioxytartaric acid, (*b*) by coupling a diazo aryl-benzthiazole with a pyrazolone derived from an aryl-benzthiazole and acetoacetic or oxalacetic ester. An example of each method is given using (1) dehydrothiotoluidine monosulphonic acid and dioxytartaric acid, (2) diazotized dehydrothiotoluidine monosulphonic acid and the pyrazolone obtained by condensing the hydrazine from dehydrothiotoluidine monosulphonic acid with acetoacetic or oxalacetic ester; the products dye cotton orange shades fast to light and washing. (Br. Pat. 185,880. J. Baddiley, J. B. Payman and E. G. Bainbridge; assignors to British Dyestuffs, Ltd. Nov. 8, 1922.)

Leuco Vat Dyes—Reduction products of vat dyes (indigo, thioindigo, indanthrene, etc.) are converted into enolic ethereal salts which are stable in air, by the reaction of acids with the hydroxyl groups of the said reduction products. The conversion may be effected by general methods—for example, by action of an acid chloride on the leuco dyestuff in the presence of a tertiary base. The ethereal salts of sulphuric acid are obtained by the use of chlorsulphonic acid in the presence of a tertiary base, the product being then converted into a stable salt. In an example, dihydro-indigo is added to a pyridine solution of chlorsulphonic acid in an atmosphere of carbon dioxide and the mass diluted with water and crystallized; the pyridine salt so obtained is converted into an alkali or other salt.

Animal or vegetable fibers are dyed or printed with the above described compounds which are converted on the fiber into the dyestuffs by hydrolysis and oxidation, or by treatment with an oxidizing agent only; the latter method is available particularly in the case of sulphuric acid derivatives of dihydroindigo and dihydro-thioindigo, which are hydrolyzed and oxidized simultaneously by ferric chloride, bromine, chloride of lime, or the like, even in neutral solution. (Br. Pat. 186,057; not yet accepted. Durand et Huguenin, Soc. Anon., Basel. Nov. 8, 1922.)

Oil Emulsions—Oils, particularly mineral and tar oils, are subjected to high-speed disintegration in a colloid mill, such as that described in specification 155,836, in presence of water and of an insoluble mineral solid—for example colloidal graphite, calcined magnesia or magnesium carbonate. Talc or graphite may be added to increase the consistency of the product. Pastes are obtained when not more than 6 parts of water to 1 part of oil are employed; liquid emulsions when the water exceeds this proportion. The products are suitable for use as lubricants. Four typical compositions are as follows: (1) 1 part of viscous hydrocarbon oil, 1 part of colloidal graphite, 1 to 2 parts of water, and 1 to 3 per cent of coco-butter or like fat; (2) 1 part of low-temperature tar oil, 3 to 4 parts of water, and ½ to 2 per cent of magnesium carbonate, with or without 1 to 2 parts of graphite or talc; (3) 1 part of tar oil from Saxon brown coal, 3 to 5 parts of water, 1 to 2 parts of talc and 1 to 5 per cent of glycerine or glycol; (4) 1 part of fish oil, 5 to 8 parts of water and ½ to 1 per cent of calcined magnesia. Sulphonated castor oil may be used as a protective colloid. The provisional specification also states that the insoluble mineral solid may be dispensed with, and gives further examples. (Br. Pat. 185,779. Plauson's, Ltd., London. Nov. 8, 1922.)

Formaldehyde Condensation Products—Turbid materials, resembling meerschaum and porcelain, are produced by condensing urea with not more than 120 per cent of formaldehyde in the presence of at least 3 per cent of acid, the proportions being calculated on the pure anhydrous material in each case. The products are easily worked, and being porous, may be impregnated with coloring solutions, oils, resins, salt solutions, etc. Examples are given in which urea is dissolved in formaldehyde solution, the solution heated to effervescence, nitric, sulphuric or hydrochloric acid then added, and the whole finally emptied into molds. (Br. Pat. 187,605; not yet accepted. H. Goldschmidt and O. Neuss, Berlin. Dec. 13, 1922.)

German Patents

For complete specifications of any German patent apply to the German Patent Office, 97 Gitschinerstrasse, Berlin, Germany.

Recovery of Sulphur—Hot inert gases, such as the products of combustion of producer gas, are passed through a mass containing S—e.g., spent gas-purifying material—and the issuing stream of gas is cooled to a point above the melting point of sulphur, whereby liquid sulphur is deposited. A portion of the gas is subsequently withdrawn and the remainder is mixed with a fresh supply of hot gas and again passed through the material, or a portion of the gas may be circulated repeatedly through the mass before it is cooled. (Ger. Pat. 357,033. Badische Anilin u. Soda Fabrik.)

Solution for Use in Drawing Iron and Steel Wire—(*A*) A slightly acid solution of $CuSO_4$ is mixed with one or more chlorides—e.g., NaCl or $FeCl_3$. The iron or steel wire is coated with copper by immersion in this solution, and after drawing, the copper coating is removed by treatment with an ammoniacal solution of copper sulphate. By using the mixture of salts copper separates more easily than from copper sulphate alone, and the copper adheres better to the wire, so that a thinner coating can be used than hitherto.

(*B*) The medium consists of two or more suitable chlorides, including preferably $FeCl_3$, with the addition of sufficient ammonia to produce a certain quantity of colloidal $Fe_2(OH)_6$. By the addition of ammonia the solution adheres better to the wire and its lubricating action is increased. The composition of the solution remains unchanged and the wire keeps clean till the end. When the solution is to be used for pickling the ammonia is omitted. (Ger. Pats. 299,031 (*A*) and 299,032 (*B*). O. Vogel.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

American Association for Advancement of Science Holds Annual Meeting in Boston

The Chemistry Section Holds Symposiums on Photosynthesis, Ionization and Separation of Isotopes

ABOUT twenty-five hundred registered at the various conferences at the seventy-sixth meeting of the American Association for the Advancement of Science at Boston during the week Dec. 26 to 30. The meeting was noteworthy in several respects. In the first place, it showed an increasing disposition on the part of research men to pause in their labors and take account of stock. Many of the papers presented indicated a growing feeling that an investigator who gives the best that is in him to the search for truth can no longer content himself with the publication of his results and then rest secure in the conviction that the world will make a suitable use of his findings.

The recent outcroppings of medieval intolerance in various parts of the country, which have found their most prominent spokesman in William J. Bryan, are not to be lightly dismissed. They represent a well-financed and well-organized conspiracy to poison the spring of free scientific inquiry at its source and to dictate to students of science what shall be "truth" for educational purposes. The association as a whole therefore went on record in the most unequivocal way as to the scientific position of the biological theory of evolution in particular and the necessity of each man's drawing "the thing as he sees it, for the good of things as they are."

Proper Publicity Needed

It is recognized, however, that mere reaffirmation of fundamental truisms by a body of scientific men can have little effect as long as the message, spirit and content of science never reach a public which is constantly assailed by the clamor of fools and rogues. Science as it is must somehow "get across" to the great majority, and not remain buried in the dust of technicalities or appear travestied by the marvel mongers of the Sunday supplements.

There is needed a new and more

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Sections Concerned With Engineering and Social Sciences Stress Place of Engineer in Civilization

ENGINEERING was represented at the meeting of the American Association for the Advancement of Science in two of the sections, Section K (Social and Economic Sciences), of which Dr. Henry S. Graves, of the Yale Forestry School, Yale University, is vice-president and chairman, and Section M (Engineering), F. M. Feiker, of the McGraw-Hill Co., Inc., New York, vice-president and chairman.

The keynote of the joint session between Section M and Section K was "The Relation of the Engineer to Conservation." John T. Black, State Health Commissioner, Hartford, Conn., presented a paper on conservation and industrial waste; William S. Murray, of New York City, spoke on the conservation of power.

Place of the Engineer

The keynote of the afternoon meeting of Section M was "The Place of the Engineer in Civilization," the principal paper being presented by Ira N. Hollis, president of the Worcester Polytechnic Institute. Dr. Hollis pointed out that from the dawn of history the emphasis has been placed upon the man who produces and the root names for producer in several of the earlier languages are synonymous with our definition of the term engineer. One phase or another of engineering activity enters into practically all the other arts and sciences. Dr. Hollis instanced the factor of transportation and communication as one vitally touching life and activities of men in all walks of life, and pointed out the engineer's place in the further development of transportation and communication systems in the world. Dr. J. B. Tyrrell, retiring vice-president of the section, in an address on "The Growth of the Mining Industry in Canada," pointed out the part that steam railway transportation played in the development of the mining industry as a practical illustration of the engineer's place in utilizing our natural resources.

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Metric Association Marks Progress at Boston Meeting

Wider Adoption of Metric System Reported—Opposition Is Expressed From Army and Navy

Substantial progress toward the wider adoption of the metric system in America was emphasized Dec. 30 at the annual meeting of the American Metric Association, held in connection with the convention in the same city of the American Association for the Advancement of Science. Well-attended sessions at the Massachusetts Institute of Technology and a dinner at the Copley-Plaza Hotel featured the program. Dr. George S. Kunz of New York presided, and interest was increased at the meeting by the appearance of opponents, who spoke on behalf of the Secretary of War, the United States Navy and industrial organizations.

During its convention, the American Association for the Advancement of Science reaffirmed its belief in the metric system, and passed a resolution recommending the use of metric units by scientific men in all papers of a professional character, with non-metric units in parentheses. This expression of opinion was most gratifying to advocates of the metric system. The association voted to shorten its name to the Metric Association; approved the adoption of the liter as the measure of capacity between the British Commonwealth and the United States, and passed a resolution favoring the compulsory metric system bill now before the Senate.

Advantages of Adoption Stressed

Among the speakers who carried out the advantages of the universal adoption of the metric system were A. E. Kennelly, of Cambridge, Mass., who emphasized the value of common units in applied science in an address upon "The Metric System in Electrical Engineering." B. L. Newkirk, of the General Electric Co., in a paper on "The Metric System in the Electrical Industry," reviewed the growth of metric measurements in the past century and pointed out that there is no hope of getting the non-English speaking world to adopt non-metric units. "If the world is to get together at all, it must be on a metric basis," he said.

Captain Elliott Snow, of the Con-

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Harding Approves the Three-Shift Day

President Pleased That Engineers Agree With Social Workers in Working Hour Program

The 12-hour day and the type of worker it produces have outlived their usefulness in American life, President Harding declares, commenting on the report of the committee on work-periods in continuous industry of the Federated American Engineering Societies.

This committee, after 2 years of investigation of more than forty continuous industries, including steel and iron, found that the 12-hour day was not an economic necessity. These findings, President Harding says, represent his "social viewpoint."

The President's statement, which will be embodied in the report now being compiled by the engineers, was given out in New York by the chairman of the committee, H. E. Howe of the National Research Council, Washington. It follows:

> It is a matter of very much gratification to me that the Federated American Engineering Societies, our foremost organization of American industrial skill, should have given 2 years of diligent inquiry, under competent experts, to a subject which is of very deep interest to me and important to the country.
>
> I rejoice to note the conclusions of this great body of experts are identical with those which I have reached from a purely social viewpoint. It has seemed to me a long time that the 12-hour day and the type of worker it produces have outlived their usefulness and their part in American life in the interests of good citizenship, of good business and of economic stability. The old order of the 12-hour day must give way to a better and wiser form of organization of the productive forces of the nation, so that proper family life and citizenship may be enjoyed suitably by all of our people.
>
> This clear and convincing report of the engineers must prove exceedingly helpful in showing that this much-to-be-desired result can be achieved without either economic or financial disturbance to the progress of American industry.

Members of the committee on work-periods, in addition to Chairman Howe, were J. Parke Channing, L. P. Alford, Fred J. Miller and Dwight T. Farnham of New York; Morris L. Cooke of Philadelphia, and L. W. Wallace of Washington. The field work was directed by Horace B. Drury of Washington, former member of the faculty of Ohio State University, and Bradley Stoughton of New York, chairman of the iron and steel committee of the American Institute of Mining and Metallurgical Engineers.

President Harding's declaration follows that of John D. Rockefeller, Jr., who in a recent statement favored the 8-hour day.

Standard Oil Co. Will Offer Technical Training to Employees

The Standard Oil Co. of California will soon inaugurate a correspondence course of instruction for employees in all parts of the state, designed to fit the students for better positions of technical character. The taking of the course is optional with the employees.

Nine Standard Formulas for Fertilizers Adopted by New England States

Reduction of the variety of mixed fertilizers which are to be offered for sale in the New England states to nine high analyses was agreed upon at a conference in Boston, Dec. 30, between agronomists representing the six states and representatives of manufacturers.

Analyses agreed upon as standard for New England are: 0-12-6, 2-12-4, 3-10-4, 3-10-6, 4-8-4, 4-8-6, 5-4-5, 5-8-7, 8-6-6.

The soil officials of the state colleges and experiment stations present agreed to recommend these analyses to the farmers of their states and the manufacturers agreed to push them, through their salesmen, above other analyses, although any of the present grades now being sold will be supplied upon request.

The New England meeting was the second at which state officials and fertilizer manufacturers have reached agreements to push high-analysis mixed fertilizers to the exclusion of a multiplicity of poorer grades, the first agreement having been reached at Chicago and affecting five of the Middle Western states. The present average tonnage of mixed fertilizer consumed annually in New England is about 130,000. Manufacturers representing 98 per cent of the tonnage sold in that section attended the Boston meeting, as did representatives of the soil improvement committee of the National Fertilizer Association.

A similar meeting is being arranged for the Middle Atlantic states, which are heavy consumers of fertilizer, to be held at an early date.

Large New Laboratory Dedicated at Stockholm College

New buildings and laboratories, constituting a department for chemical instruction which in size and equipment is second only to that of the largest American institutions, have just been opened by the Technical College in Stockholm, the ceremony of dedication being performed by the King of Sweden in the presence of a large assembly of prominent educators and men of affairs.

The chemical department at the Technical College now includes four laboraries, devoted respectively to research and instruction in organic chemistry, inorganic chemistry, technical chemistry, and electrochemical processes. There is also a laboratory for the study of fermentation. "The electrochemical industry is now of tremendous importance," said Prof. W. Palmaer, head of the department, in a speech at the opening exercises, "utilizing, as it does, the vast amount of power generated by the Swedish hydro-electric stations in the commercial production of a great variety of chemical and metallurgical products."

Memorials and congratulation were received from many educational institutions in neighboring countries.

Labor Shortage Discussed by A.I.M.E.

Desirability of Modification of Immigration Laws Discussed at New York Meeting

Establishment of a federal commission to study the nation's labor needs and recommend necessary changes in the present 3 per cent immigration law as a means of meeting the problem of a labor shortage was urged by Daniel Bloomfield, an industrial engineer of Boston, in an address before the Metropolitan section of the American Institute of Mining and Metallurgical Engineers at Rumford Hall, Jan. 3.

Mr. Bloomfield said that "taking down the bars of immigration without some definite, carefully devised program will not do."

"We must have a sound program," he said, "based on facts and dealing with the immigration on the basis of needs in order to help the situation." Mr. Bloomfield suggested that employees could help the situation by reducing the labor turnover, to make employment more regular in seasonal industries.

Federal Commission Suggested

"The next step in meeting the problem if labor shortage is likely to become acute," he continued, "might be a federal commission made up of a representative of the Department of Labor, Department of Commerce, representatives of employers, employees and the public groups to make a thorough study of the facts in the situaaion. If the facts then warrant action, Congress might modify the contract labor clause of the immigration law so as to permit this commission to bring in the type of laborers where work for them is guaranteed and for the period guaranteed by the concerns that need such labor. Such a commission, working with the immigration department, would act as a clearing house for labor and could so allocate labor that it would meet our needs. The per centum law might remain, but this commission could be given certain leeway in opening up or shutting down on the labor supply from abroad."

W. R. Ingalls, consulting engineer, said that he was not convinced that there was need of modifying the present immigration laws.

Countervailing Duties on Canadian Products Rescinded

The Treasury Department has revoked its orders directing imposition of customs duties on chloride of lime, calcium nitrate and cyanamide when imported from Canada. After the orders had been issued, close examination of the new tariff act disclosed that the retaliatory proviso of the calcium paragraph of the free list specifies only calcium acetate. The countervailing duty ordered on imports of this product from Canada stands and the others are rescinded.

New York Chemists Honor Pasteur

Joint Meeting of Metropolitan Sections Hears History of Great Scientist's Work and Modern Achievements That Grew from It

CHEMISTS of the metropolitan district gathered in Rumford Hall on Jan. 5, at a joint meeting of the New York Section of the American Chemical Society and of the Société de Chimie Industrielle, to commemorate the centenary of the birth of Louis Pasteur. Prof. Gary N. Calkins, of Columbia University, read a splendid paper on "Pasteur and the Science of Fermentation," and Prof. John N. Nelson, of Columbia University, spoke on "Pasteur and Chemical Asymmetry."

"No one science can claim Pasteur's genius," said Professor Calkins. Today the greatest expression of his genius is seen in his mastery of the method of science, particularly in medicine. Although he was not a physician or a biologist, by sheer ability to apply scientific methods he came to be recognized as a master in both sciences. Wherever he went, Pasteur was an initiator.

His Work on Fermentation

Pasteur's revolutionary work on fermentation was initiated by a Lille manufacturer of alcohol who came to Pasteur for advice on his process. At that time the ideas on fermentation were confused and hazy. The ordinary conception of the mechanism of fermentation as advanced by Liebig was entirely physical and did not recognize the essential part played in the process by living organisms. Pasteur first showed definitely that different activities of similar natures are brought about by living organisms and that different kinds of actions are caused by different species of bacteria. He saw the part played by micro-organisms in putrefaction. And he first conceived the life cycle and the part played by micro-organisms in putrefaction, the decay of living matter to ammonia, carbon dioxide, etc., in which form it is observed on plants by photosynthesis and again assimilated as food by living animals. The question naturally arose, Whence come these organisms? Up until the seventeenth century there was a very general belief in spontaneous generation. It was commonly accepted that lizards, flies, salamanders, etc., were generated spontaneously. Pasteur, with his characteristic, scientific thoroughness, experimented with sterile mediums instead of containers in contact with sterile air, and found that under such conditions no bacterial action was possible. His experiments demonstrated that the micro-organisms exist in the air, although for some time this theory was scoffed at and one of the proponents of the theory of spontaneous generation even went so far as to scout Pasteur's theory with the statement, "The air thus peopled would have the density of iron."

In 1865 Pasteur was called upon to study an epidemic which was causing havoc among the silk worms in the southern part of France, where the silk industry had already become a very flourishing business. In the six years that he was studying this problem he came to the conclusion that human diseases are caused by micro-organisms, in the same way that the disease was carried by the silk worm. This was really the beginning of Pasteur's far-reaching experiments on human diseases and the modern science of bacteriology.

Early Work on Chemical Asymmetry

Professor Nelson described Pasteur's early work on chemical asymmetry, which was done while he was a student at the Ecole Normale. At this time the first glimpse of chemical asymmetry had been obtained by Sir John Hershel, who pointed out that there are two varieties of quartz, one variety being, as it is called today, dextro-rotatory and the other laevo-rotatory. Certain organic substances were also known to be optically active. Pasteur conducted a number of experiments on tartaric acid and its salts. He came to the conclusion that the optical activity of tartrates was due to hemihedral crystals and that the difference between tartaric and racemic acids which had the same composition, properties, number of atoms and identical arrangement was simply in the different action on polarized light, which was due to the asymmetric arrangement of the crystal with the two substances. He also came to the conclusion that chemical asymmetry is caused solely by life forces. This conclusion has since been discredited, but nevertheless it was important because it was the origin of the present-day conception of fermentation. He also concluded that the asymmetry of two reactive bodies affects the properties of the resulting substance, a conclusion which is still tenable in the light of present knowledge.

This work extended from the year 1844 to 1860. It was important and far reaching enough in its consequences to constitute a commendable life work for the average man, but at its conclusion Pasteur stood only at the threshold of his career.

Selective Bacteriostatic Properties of Certain Dyes

The most interesting paper of the evening was delivered by Dr. John W. Churchman, of Cornell University Medical School, who spoke on "The Selective Bacteriostatic Properties of Certain Dyes." This was an especially timely subject in view of the fact that it represents a modern achievement in the field in which Pasteur was a pioneer. Chemical selection is one of the most interesting and one of the most mysterious phenomena of science. Some diseases affect only one race of human beings. Some diseases affect only one organ of the body. Lead palsy paralyzes all the numerous muscles in the wrist except one, which is apparently unaffected. Cocaine affects only the sensory nerves.

Ehrlich discovered that methylene blue injected in the blood stream picked out the nerve cells and maimed them, whereas it did not affect any other cells of the body.

A Scandanavian bacteriologist, Gramm, described the system of classification of bacteria which depends upon the staining action of gentian violet. The bacteria are stained with this dye, fixed with iodine, and then washed with alcohol. Some species of bacteria give up the color on this treatment and they are known as Gramm negative. Those which retain the stain are called Gramm positive. It has been found that the Gramm positive organisms are killed by stains, whereas the Gramm negative bacteria are not.

Dr. Churchman exhibited a number of flies which showed very conclusively that gentian violet exhibits highly selective properties in inhibiting the growth of certain species of bacteria. By the application of this principle it is possible to develop two strains of bacteria—those upon which gentian violet has a bacteriostatic action, and those which it does not affect. Sulphanilic acid, acid fuchsin, ethyl sulphonic acid also act selectively, but in exactly the opposite way.

Chemical Salesmen's Association Begins Lecture Course

Forty-six members of the Salesmen's Association of the American Chemical Industry turned out for the first lecture in Dr. F. E. Breithut's course in chemistry for salesmen at the City College of New York, Jan. 4. Dr. Breithut spoke on the subject of "How the Chemist Works" and it was a most interesting and comprehensive lecture. He explained, in non-technical terms, the functions of common laboratory equipment and gave a good idea of the chemist's technique.

Fifty-three members of the association have enrolled for the course, and others are expected to sign up before the next lecture. The members of the course include representatives of the following firms: American Cyanamid, Noil Chemical Co., Industrial Chemical Co., Marietta Refining Co., Peerless Color Co., Mathieson Alkali, Dow Chemical Co., Warner Chemical Co., B. J. Seydel Manufacturing Co., Edward Hill's Son Co., Roessler & Hasslacher, Marx & Rawolle, E. Fougera & Co., and the Mallinkrodt Chemical Co. Lectures will be given every Friday evening at C.C.N.Y. for 12 weeks.

Cash prizes have been offered by Williams Haynes for the three best essays by members of the course, on "The Value of Chemical Knowledge to Salesmen." The essays will be judged by a committee composed of F. E. Breithut, J. W. Boyer and D. H. Killeffer.

American Association for Advancement of Science

Chemistry Section Symposium

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effective mechanism of publicity; a means by which the scientific temper of the progressive thought of the world today may somehow be made a part of the working mental equipment of the "average newspaper reader." A great beginning in this respect has been made by the establishment of "Science Service," a sort of Associated News for science, with offices at Washington, D. C., under the experienced guidance of Dr. E. E. Slosson, sometime editor of the *Independent* and author, among other things, of "Creative Chemistry."

Symposium on Photosynthesis

Not content with his publicity work alone, Dr. Slosson gave one of the most interesting of the general papers presented, speaking at the symposium on photosynthesis. This was an attempt at an exhaustive inventory of possible sources of mechanical power. Besides the usual indirect utilization of solar energy by means of winds, tides, waves, water power and the storage of rainfall, the exploitation of fuels, etc., Dr. Slosson spoke of the possibilities of tapping the internal heat of the earth, the internal energy of atoms, dodging the second law of thermodynamics by sorting out fast molecules from slow ones, the use of photoelectric cells, and the exploitation of differences of temperature whether spatial (on the surface of the earth) or temporal, as between summer and winter. These and many other possibilities were passed in rapid review and formed an interesting introduction to the other papers on photosynthesis.

Dr. Spoehr, of the Carnegie Institution, was erudite and exhaustive. He left the listener crushed with the complexity of the photosynthetic problem and reported the failure of a long series of attempts to duplicate E. C. C. Baly's reported synthesis of formaldehyde from CO_2 and H_2O in ultraviolet light. Dr. Bovie, of the Haward Medical School, gave an entertaining but somewhat sketchy account of his own speculations in the field, enlivened by slides of hypothetical atomic structures and intersecting force fields, ending with a diagram showing the "hungry" amino-acid molecules inside a chloroplastid, attaching their polar groups to wandering molecules of H_2CO_3 in the plastid membrane. The carbonic complexes then rolled themselves up into rings and formed sugars.

S. E. Shepperd, of the Eastman Kodak Co., ended the discussion in a somewhat more hopeful vein. He first pointed out that interest in photochemistry is on the increase, due to the recent technical development of powerful sources of ultra-violet light, such as mercury vapor arcs in fused quartz, white flame carbon arcs and condensed spark discharges. These have enabled the efficiencies of many commercially promising processes to be studied in a comparative way and the validity of Einstein's law of photochemical equivalence has been confirmed in general, when the case is not complicated by side reactions. The outstanding commercial problem is to find new photochemical catalysts which, like chlorophyl, will take the relatively long wave length radiation in sunlight and hand it over to the chemical system in the form of the shorter wave length the system needs in order to become reactive.

Electrolytic Dissociation

Besides this session, many others contained papers of chemical interest. The discussion was most active in the session on ionization, in which D. A. McInness of M.I.T. ably presented the case for the complete dissociation of strong electrolytes which is based on the undoubted chance in the mobilities of the ions with concentration as shown by transference experiments. C. A. Kraus of Clark University and E. W. Washburn defended the opposite viewpoint and it seemed clear that the case is not fully settled, although the naïve view that the degree of dissociation of an electrolyte is always given by the ratio of the conductivity to the conductivity at infinite dilution must certainly be relinquished.

F. G. Cottrell showed slides of the Fixed Nitrogen Research Laboratory and outlined its work. Dr. Washburn described the new International Critical Tables of Physical Constants which are in preparation. These will be more complete than anything of the kind previously done and will include commercial materials as well as pure substances.

Separation of Isotopes

Much interest was aroused by W. D. Harkins, of the University of Chicago, who gave a résumé of his publications of the last 6 years dealing with the isotopic complexity of the elements, the structure of atomic nuclei, etc. He also described the recent progress of his students in separating the elements into their isotopes on a large scale, showing some fair-sized samples of mercury which differed by as much as a tenth of a unit of an atomic weight.

S. A. Mulliken, also of Chicago, described his own success in separating mercury to about the same extent by evaporation and diffusion through filter paper.

T. W. Richards, of Harvard, brought forward a new and very plausible method of calculating the diameters of the ions in crystals based upon compressibility data and his theory of compressible atoms. Professor Kraus emphasized the importance of his view that typical metals and typical electrolytes are really fundamentally similar, the negative electrons of the metal taking the place of the negative ion of the salt.

Jacques Loeb, of the Rockefeller Institute, presented his interesting view that proteins are not colloids in the sense of being molecular aggregates, but merely large single amphoteric molecules that are essentially like ordinary acids and bases. Enthusiasm for this idea was widely expressed, but on the other hand, many opposing views were mentioned, so that discussion on the subject promises to continue for some time.

The chemists concluded the session with a smoker at the American House. Santa Claus distributed presents, the *Pathetic Weakly* showed movies of chemical events and Dr. Slosson gave one of his brilliant talks. J. F. Norris of M.I.T. was the presiding officer.

Election of Officers

Dr. Charles D. Walcott, secretary of the Smithsonian Institution of Washington, was elected president for the year 1923 at a meeting of the council. Dr. Walcott has been secretary of the Smithsonian Institution since 1907. From 1894 to 1907 he was director of the United States Geological Survey, and from 1902 to 1907 he was the first director of the Reclamation Service. He is president of the National Academy of Sciences, a member of the National Research Council and chairman of the National Advisory Committee for Aeronautics.

Vice-Presidents Selected

Ten vice-presidents were elected, each representing a section of the association:

For the Chemical Section, Prof. E. W. Washburn of the University of Illinois and vice-chairman of the National Research Council.

For the Botanical Section, Prof. C. J. Chamberlain of the University of Chicago.

For the Anthropological Section, Assistant Prof. E. A. Hooton of Harvard.

For the Section on Social and Economic Sciences, John F. Crowell, director of the World Market Institute of New York.

For the Mathematical Section, Prof. Harris Hancock of the University of Cincinnati.

For the Physical Section, Prof. W. F. G. Swann of the University of Minnesota.

For the Geological and Geographical Section, Dr. Nevin M. Fenneman of the United States Geological Survey.

For the Zoölogical Section, Prof. Edward L. Rice of Ohio Wesleyan University.

For the Psychological Section, Prof. Raymond Dodge of Wesleyan University, Middletown, Conn.

For the Agricultural Section, President Raymond A. Pearson of Iowa State College of Agricultural and Mechanical Arts.

Section Secretaries Chosen

Two secretaries of sections were elected; Prof. W. D. Harkins of the University of Chicago being chosen for the Chemical Section and Prof. R. J. Terry of Washington University, St. Louis, for the Anthropological Section.

American Association for Advancement of Science

Engineering and Social Science Sections

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Dr. Hollis, as well as Harrington Emerson, another speaker of the afternoon, pointed out the need of the engineer's analytical study of facts for the solution of present-day problems, and both emphasized the idea that indirectly the engineer, because of his control of the instruments of production, is deeply concerned with present-day civilization. The paper by Prof. C. F. Scott, of Yale University, president of the Society for the Promotion of Engineering Education, on "New Phases of Engineering Education," was presented in Dr. Scott's absence by Dr. Dugald C. Jackson. Professor Scott in his paper indicated that because engineering was coming to take such a large place in our modern life it was essential that the training of engineers be approached with a new viewpoint of the engineer's place in the community.

The several contributions emphasized that the next step in engineering is to relate the problems of the material advance in civilization to the human problems of civilization, and that the engineer has an opportunity for leadership in approaching these human problems which have grown out of his own contributions in increasing the perplexity of life if he will apply the logic of his thinking with the understanding that human problems are problems of emotion as well as of logic.

PAN-AMERICAN RELATIONS

In the evening Calvin W. Rice, secretary of the American Society of Mechanical Engineers, presented an illustrated address on the engineering and scientific developments of South America. Mr. Rice pointed out three definite opportunities for the immediate association of engineers between North and South America: First, the development of a common understanding of standards, the start of which was made very definitely at the international engineering congress held at Rio de Janiero; second, the development of an English-Spanish dictionary and glossary of engineering terminology, and third, the development of an interchange of thought between engineering societies of North and South America. In this connection, Mr. Rice stated, Verne L. Havens, editor of *Ingeniería Internacional*, had been made permanent secretary of the International Engineering Congress. He also recounted the personal contacts that had been established in the various government and engineering societies to bring about this more intimate engineering understanding between the two continents. Mr. Rice's lecture was illustrated with lantern slides showing engineering developments in South America.

Largest Memorial Fund to Honor Ramsay

The largest sum ever raised to honor a man of science has been contributed to the memorial for Sir William Ramsay. The amount of the fund is more than $500,000.

Former Premier Asquith of England was president of a committee which, in 1917, made an appeal for £100,000 to be devoted to a Ramsay memorial. Later the Prince of Wales became patron of the fund. The sum collected in cash is £57,645. It has been augmented by research fellowships instituted by various dominion and foreign governments, to the value of about £60,000.

The cash sum includes subscriptions from Great Britain and Ireland, America, Australia, Canada, Chile, China, Denmark, Spain, Holland, India, Italy, Japan, New Zealand, Norway, Straits Sett'ements, France, Greece, Switzerland and Portugal.

The money, according to a report in *Science*, will be devoted to the erection of a chemical laboratory at University College, London, and to founding the Ramsay memorial fellowships in chemical science for British students. Each fellowship is of the value £300.

Feldspar Colloquium Planned by American Ceramic Society

At the meeting of the American Ceramic Society in St. Louis, there was started a discussion on feldspars which aroused much interest; this discussion was focussed chiefly on milling problems, with only incidental reference to questions of quality and methods of determining quality. Judging from prevailing sentiment, the time is ripe to move on toward the formulation of specifications, and at the request of the officers of the whitewares division, the organization of a colloquium on the subject is being undertaken.

The purpose of specifications such as it is hoped to evolve is not to enable the consumer to get more for less money, but to establish and define various grades of feldspar. It is a problem of classification rather than specification. Classification may be made on the basis of the intended use, the chemical composition, mineralogical origin, physical properties, or any combination of these. The classification according to use is derived from the properties of the material, and the latter are the important values to define. Some of these properties are fixed by nature; thus the fusion point depends on the chemical composition and apparently also on the mineralogical origin of the rock. It is believed that the members of the society are in possession of the data needed, and they are urgently requested to contribute to the program to be presented at the forthcoming meeting.

All communications on this subject should be addressed to Edward Schramm, of the Onondaga Pottery Co., Syracuse, N. Y.

Metric Association Marks Progress

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struction Corps of the United States Navy, opposed the general adoption of the metric system in industry, emphasizing the difficulties which shipbuilding would face in such an event. Major L. A. Nicholson, of the U. S. Army, presented a letter from Secretary of War Weeks, which opposed the passage of a compulsory metric bill by Congress, chiefly on the ground that it would cost about $3,500,000 to change existing war material in linear dimensions, and the same amount to change angular dimensions to a metric basis. Secretary Weeks declared that the forced adoption of the metric system would adversely affect both the supply of material and the industrial draft for war purposes.

E. A. Marsh, consulting superintendent of the Waltham Watch Co., and T. H. Miller, of the DeLaval Separator Co., reviewed the successful use of the metric system in their plants. Edward Richards, of New York, discussed the advantages of the metric system in forestry and lumber measurements, claiming that with the metric system more accurate sizing of lumber to meet future computations of strength of material in houses and other building would result.

F. H. Chase, of Boston, gave a talk upon the literature of weights and measures at the Boston Public Library during the afternoon, and this was followed by an inspection trip. The dinner at the Copley-Plaza was informal, and among the speakers were Dr. A. E. Kennelly, Dr. Hoffman, of the Babson Organization; Prof. R. A. Fessenden, of Boston; Captain Snow; Robert Spurr Weston, of Boston; Walter Wood, of Philadelphia; F. L. Roberts and B. L. Newkirk.

ELECTION OF OFFICERS

Dr. Kunz was re-elected president of the association, the vice-presidents being A. E. Kennelly, T. H. Miller and W. J. Schiefflin. Howard Richards was re-elected secretary, and F. L. Roberts treasurer, with headquarters at 156 Fifth Ave., New York City. The publication of a monthly bulletin and the formation of a Metric League were proposed at the dinner, and will probably be carried forward soon.

Canadian Paper Mills Increase Operations

The announcement is made of a new pulp and paper mill to be erected at Kaslo, B. C., Canada, by Howland & Waltz of Minneapolis, who at present operate a sawmill at Kaslo and have big timber limits there. In addition to the large body of standing timber which they control, there is plenty of water power available for hydro-electric purposes.

Preparations are also being made to reopen the Whalen Pulp & Paper Co.'s pulp mill at Swanson Bay.

Difficult to Find Successor to Stratton at Bureau of Standards

No progress has been made in the search for a director for the Bureau of Standards to succeed S. W. Stratton, who retired from the government service to accept the presidency of the Massachusetts Institute of Technology. Due to the fact that industry is making much more extensive use of research laboratories, physicists, according to Commerce Secretary Hoover, are very scarce. As a result the level of salaries has risen greatly. Where physicists formerly commanded salaries ranging from $3,500 to $5,000, many of them now are being paid from $10,000 to $20,000, Secretary Hoover says. This, he declares, makes it very difficult for the government to find an ideal man for this place when it requires a physicist in the front rank of his profession, willing to work for $6,000.

Exhaustive Study of Carboy Problems Concluded by Trade Association

A final report has been submitted by the carboy test committee to the executive committee of the Manufacturing Chemists' Association. The recommendations, which will not be made public until after the report has been considered by the executive committee, probably will be embodied in the regulations governing the shipment of carboys.

Under the direction of Guy E. Carleton, the committee has made by far the most exhaustive tests of carboys ever attempted. They cover the physical properties of the container, the closures, the package surrounding the carboy and the recovery of broken and chipped carboys. Drop, swing and concussion tests were pursued exhaustively. Shocks were carefully calculated. Observers traveled in box cars loaded with carboys to note their behavior under the conditions of actual transportation.

Physical Chemistry Symposium Planned Under Svedberg

The Rochester section of the American Chemical Society has been very fortunate in securing Prof. Thé Svedberg, University of Upsala, Sweden, to act as presiding officer of a symposium on physical chemistry which will be held in Rochester on Friday and Saturday, Jan. 19 and 20.

Papers will be presented at this symposium by prominent physical chemists from Schenectady, Cornell, Syracuse, Buffalo and Rochester. Practically every phase of physical chemistry will be considered, with the exception of colloids. On this phase there will be no papers, since a colloid symposium will be held at the University of Wisconsin later in the year.

The Rochester section extends a personal invitation to anyone interested in this physical chemistry symposium to be present and take part either in the presentation of papers or in the discussion which will follow the papers.

Department of Commerce Hopes to Collect Dye Import Figures

Itemization of dye imports is under active consideration at the Department of Commerce. If money can be found with which to undertake this work, these figures will be made available to all interested through the usual publicity channels of the department.

Chilean Nitrate for Sale

Bids for 28,000 short tons of sodium nitrate will be received by the Ordnance Salvage Board, Army Building, 35 Whitehall St., New York, until noon, Jan. 30. The material is in storage at the Old Hickory Powder plant at Jacksonville, Tenn. Purchases of 100 tons or more may be made.

Personal

Dr. M. S. BENJAMIN, professor of agricultural chemistry in the Hawkesbury Argricultural College, Richmond, New South Wales, Australia, recently paid a visit to the chemical laboratories maintained by the government in Washington.

Captain J. L. BROWN, who during the war was ordnance inspector of the powder plant of the Hercules Co. at Dover, N. J., is now representative of the New Jersey State Department of Sanitary Engineering, with headquarters at Newark.

Dr. CALVIN ADAM BUEHLER of the Ohio State University has been appointed assistant professor of chemistry in the University of Tennessee, Knoxville, Tenn.

CURTIS R. BURNETT, an official of the American Oil & Supply Co., Newark, N. J., has been re-elected president of the Ironbound Manufacturers' Association, composed of industrial interests in the Ironbound section of the city.

Dr. GUSTAV EGLOFF, director of research at the Universal Oil Products Co. of Chicago, is spending a week in New York and Philadelphia in connection with that company's business.

W. R. INGALLS of New York, DANIEL BLOOMFIELD of Bloomfield & Bloomfield, Boston, and B. F. TILLSON of the New Jersey Zinc Co. were the principal speakers at a discussion of the general subject of immigration at a meeting of the New York Section of the A.I.M.E. held at the Chemists' Club, Jan. 3, 1923.

ARTHUR LAZARUS has resigned as chief of the cost accounting bureau of the Chamber of Commerce of the United States, to resume professional practice, with offices in Washington and New York.

Dr. JUAN DE LA CRUZ POSADO, an engineer of Colombia, is spending several weeks in New York City and vicinity in the interest of a number of South American industrial enterprises. He expects to return to Colombia late in January.

OLIVER C. RALSTON, superintendent of the Pacific Experiment Station of the U. S. Bureau of Mines, at Berkeley, Calif., recently addressed the California Section of the American Chemical Society. His subject was "Aluminum Chloride, Its Manufacture and Uses."

E. E. THUM, associate editor of *Chem. & Met.*, recently addressed chapters of the American Society for Steel Treating at Worcester, Springfield, Hartford and Philadelphia, speaking on the subject, "Educating the Metallurgist and the Management." During February he will speak before other chapters at Pittsburgh, Cincinnati and South Bend on a similar topic.

Prof. WALTER G. WHITMAN, formerly assistant professor of chemical engineering, has been appointed assistant director of the Research Laboratory of Applied Chemistry of the Massachusetts Institute of Technology.

Obituary

WILLIAM R. WALKER died on Dec. 20. According to the *Iron Age* he was born at LaPorte, Ind., Nov. 26, 1857, and his career was closely identified with the iron and steel industry. His first employment was with the North Chicago Rolling Mill Co., Chicago; then he was appointed chemist for the Crown Point Iron Co., Crown Point, N. Y., and later he was with Spang, Chalfant & Co., Pittsburgh, as works superintendent. He was early associated with Robert Forsyth, the well-known steel works engineer, who constructed the South Chicago works of the North Chicago Rolling Mill Co. in the '80s. Prior to 1890 Mr. Walker was works manager of the Union works of the Illinois Steel Co., Chicago, and later became general manager of the South Chicago works for the same company.

At the time of the formation of the United States Steel Corporation in 1901 Mr. Walker was appointed assistant to the president, a position which he held at the time of his death. He gave special attention to metallurgical research and to improvements in operation and production. In the words of President James A. Farrell, "Mr. Walker was a man of keen mental attainments and possessed an exceptional knowledge of the iron and steel industry from both scientific and practical standpoints." Mr. Walker was a member of many technical associations and took a leading part in their activities. He was highly esteemed by his associates in the United States Steel Corporation and in the iron and steel industry.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

Recent Trend of Prices

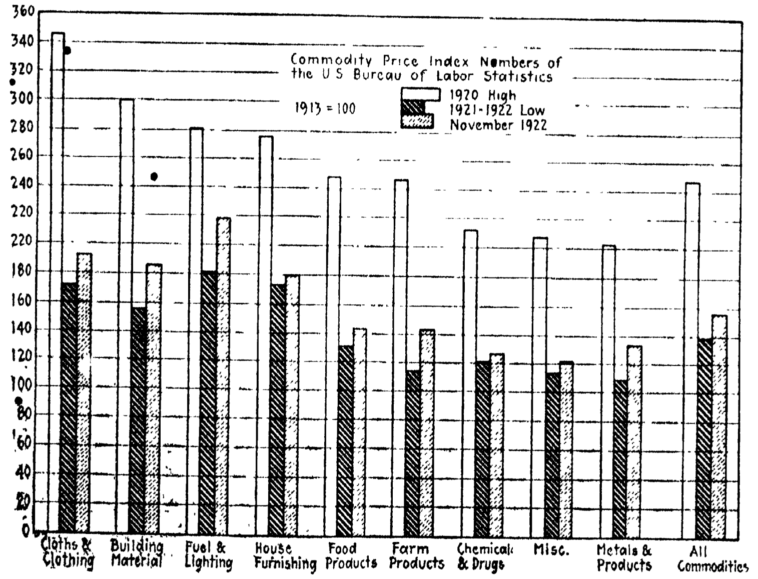
Uneven Recovery During 1922 Has Not Completely Corrected Past Disparities

A year ago it was complained that there was a maladjustment of prices, that disparities among the great groups of commodities seriously curtailed buying power, particularly of the farmer and the producer of certain raw materials. Today these conditions have been corrected to a certain extent, but there is still considerable evidence of distortion. The pronounced recovery of farm products has been beneficial, but the strikes in the mines and on the railroads have caused an altogether disproportionate rise in fuel prices. Furthermore, the record building boom of the past year has been accompanied by a marked stiffening of the prices for building materials.

TABLE I. CHANGES IN WHOLESALE PRICES IN 1922

Group	January, 1922	November, 1922	Net Gain
Building materials	157	185	28
Fuel and lighting	195	218	23
Metal and metal products	112	133	21
Farm products	122	143	21
Cloths and clothing	176	192	16
Food products	131	143	12
Miscellaneous	117	122	5
Chemicals and drugs	124	127	3
Housefurnishings	178	179	1
All commodities	138	156	18

Table I and the accompanying figure show the net changes that occurred during the first 11 months of 1922. In both, prices in 1913 are taken as a basis of 100.



A COMPARISON OF WHOLESALE PRICES SINCE 1920

The Government Indexes

The "all commodities" index of the United States Bureau of Labor Statistics rose from 138 in January, 1922, to 156 in November, 1922, a gain of 18 points. During this period the index for building materials showed a net change of 28 points, fuel and lighting 23 points, and farm products 21 points. On the other hand, the groups headed Miscellaneous, Chemical and Drugs; and Housefurnishings showed much lower gains—namely, 5, 3 and 1, respectively.

Record Buying by the Railroads

Railroad purchasing is often regarded as an important index of general buying, and certainly it bears a very vital relationship to activity in the steel industry. It is significant, therefore, that in 1921 only 239 locomotives and 23,346 freight cars were bought by the railroads, while in the first 11 months of 1922 ten times as many locomotives and six times as many cars were purchased. The figures for 1922 are 2,175 locomotives and 139,257 freight cars, according to a recent compilation made in connection with a general survey by the Harvard Economic Service.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	173.79
Last week	171.30
January, 1922	144
January, 1921	181
January, 1920	242
April, 1918 (high)	286
April, 1921 (low)	140

The continued strength of the cottonseed oil market was sufficient to offset slightly lower prices on ammonium sulphate and linseed oil. This index has shown a gain of almost 30 points during the past year.

Healthy Business Prospects in Heavy Chemicals

1923 Contracts Will Tax Capacity of Productive Equipment in Many Branches of the Industry

In general there are but few better indexes of business condition than is the heavy chemical industry. Products such as caustic soda, sulphuric acid and soda ash enter into practically every line of industrial activity. When it is stated, therefore, that 1923 holds prospects for "good, steady, healthy business" in heavy chemicals, it is safe to draw the inference that the nation's entire industrial life is in for a healthy improvement.

The president of the Mathieson Alkali Works, Inc., in an article appearing in the special chemical section of the *Journal of Commerce* (New York), is authority for the following statement:

> The heavy chemical industry has continued its work of eliminating speculative middlemen who became so prominent during the war period, with the result that violent fluctuations in heavy chemical prices have become almost a thing of the past.
>
> In the face of the increasing costs that began last fall, due to fuel, labor and freight rates, the larger companies of this industry apparently were willing to contribute their part toward the deflation of the industrial and commercial life of the country; consequently, when 1923 contracts were taken up, the larger manufacturers seemed to have attempted to maintain the prices of 1922 with few exceptions, where advances were absolutely necessary. It remains to be seen whether or not the purpose aimed at will work out in practice.
>
> The year 1923 should hold out a very encouraging outlook for a good steady, healthy business, provided business is not interfered with by attempted class legislation at Washington and attempts of certain classes to maintain their war wages, while wanting everything else reduced. Furthermore, it is our belief that the limit of the country's heavy chemical activities will not be that of plant capacities, but will be that measured by the supply of labor, which incidentally will probably be the experience of the entire industrial life of the country.

Chemical Prices at Higher Levels as Business Expands

Arsenic and Its Derivatives, Bleaching Powder and Copper Sulphate Feature Chemical Market—Acetate of Soda Makers Reduce Prices

MOST chemical prices in the New York market during the past week were well maintained and manufacturers were inclined to believe that expanding industrial activity during the year would serve to keep figures at fairly high levels. Arsenic still continued to head the list and material on spot remained in exceedingly light supply. Lead arsenate and calcium arsenate remained quite steady in sympathy with the arsenic situation. Trading in formaldehyde slackened considerably during the interval, but producers intimated the possibility of a new price advance, due to the steady rise in producing costs. Manufacturers of acetate of soda announced a reduction of ¾c. per lb. on material at the works, presumably in order to stimulate consuming interest. Producers of bleach reported a completely sold up market, with the demand far exceeding the supply.

Copper sulphate prices have remained very firm in producing quarters, in view of the fact that the metal has advanced considerably during the past few weeks, and there has been a steady demand by agricultural interests for contracts over the coming season. The alkali market for export remained quiet, although the domestic demand continued very strong. Prussiate of soda and barium chloride were somewhat easier in a very quiet market. Producers of salammoniac reported a steady contract call from the domestic trade. Oxalic acid remained practically unchanged at recent levels.

Principal Price Changes

Acetate of Soda—Leading producers announced a reduction, due to the weakened demand from the consumer. The general range is around 6¾@7c. per lb, f.o.b works.

Alcohol — Producers continued to quote former levels, but intimated an early increase on methanol. The 95 per cent grade is quoted at $1.23 per gal. and 97 per cent at $1.25.

Arsenic—Manufacturers are completely sold up at the works and are not eager to accept future orders. Export shipments have been coming in at a very slow rate from Japan and Germany and it is very doubtful if any recovery will be accomplished within the first quarter. Spot stocks were quoted at 16c. per lb., with future held at 15½c.

Barium Chloride—Importers reduced spot goods to $90@$95 per ton, depending upon quantity. Domestic producers reported a fair call from consumers and quoted carload lots at $95 per ton, f.o.b. works.

Bleaching Powder—This product is fast becoming one of the leading features of the market. It is quite certain that prices will be materially higher before the spring season, since manufacturers are completely sold up. In some instances deliveries cannot be made until the latter part of February. Contracts for carload lots, f.o.b. works, were heard around $2 per 100 lb., with odd spot at $2.30@$2.50 per 100 lb.

Formaldehyde — The demand has eased up somewhat, but prices were well sustained. Leading producers intimated another increase for the near future. Spot material was quoted at 16c. per lb., carload basis.

Lead Arsenate—Producers were very firm due to the scarcity of arsenic. Prices for limited stocks were heard around 21c. per lb.

Sal Ammoniac—Manufacturers were quite satisfied with the volume of contract business. Quotations among first hands ranged around 7½c. per lb. for the white granular and 7¾c. for the gray. Resale goods of imported quality were held at 6½c. per lb. for white and 8c. per lb. for gray.

Caustic Soda — Consuming interest continued along fairly active lines and prices ex-store were quoted at $3.75@$4 per 100 lb. Export demand was rather quiet at $3.50@$3.60 per 100 lb. f.a.s., for standard brands.

Prussiate of Soda—Importers have again reduced prices, owing to the lack of consuming interest. Spot material was quoted down to 18½c. per lb., with shipments around 18c.

Vegetable Oils

Linseed Oil—Demand has slackened somewhat and prices reflected this condition. Spot oil was quoted by leading refiners at 87c. per gal., carload basis, in barrels. January shipments held around 85c., with January-February at 84c. per gal. April shipments were quoted at 80c. per gal.

Cottonseed Oil—Prices continued to advance on the crude oil and during the next week 9¾c. per lb. for crude oil, f.o.b. mills, Southeast, was considered an inside price.

Chinawood Oil—The market during the past week was quite active. Quotations ranged around 14@14½c.

St. Louis Market Reflects Better Business Conditions

Chemical Prices Are Advanced and There Are Prospects for Further Increases in Many Lines

St. Louis, Mo., Jan. 1, 1923.

Prices have not weakened, but on the contrary have stiffened materially since our last report. Further important advances would not prove surprising, for the costs of production are advancing steadily. Prospects for the year are very bright and a feeling of optimism is prominent in all lines.

A slight firming up in the alkali market has been noticeable in this market during the last 2 weeks. No price changes of any note have taken place, but price shading and the mad scramble for business have been conspicuously absent. *Caustic soda* is being quoted at $4.25 per 100 lb. for the flake in 5-drum lots and $3.90 for the solid in like quantities. *Soda ash* is firm at $2.30 in bags and $2.40 in barrels in lots of five. *Sodium bicarbonate* has not changed in price for some time, and about the best that is being done is $2.40 per 100 lb. in 3- to 5-bbl. lots. *Sal soda* is firm at $1.65 per 100 lb. in 5-bbl. lots and has been holding this level for sometime.

Unusual Sulphuric Acid Demand

The heavy *mineral acid* market is in sound shape, surplus stocks having been diminished and the demand being unusually good. *Sulphuric acid* is leading the group and the demand this fall has been extraordinary. The *white arsenic* situation remains unchanged. There is still a very great scarcity of this material, and the only goods that seem to be available are the imported. The demand from the insecticide manufacturers is unusually heavy. There has been very little doing in *citric acid* during the past 2 weeks. *Carbon bisulphide, technical*, is rather slow, as this is the off season. The demand for *carbon tetrachloride* has been steady with a very firm market. The production of *copperas* has increased, but the demand has kept abreast so that there is practically no surplus. Prices remain firm and unchanged. Price quotations on *glycerine* remain the same as of our previous report—that is, 18½c. in drums. The market is not strong and dealers are expecting a decline in the near future. Contracts are being made on 3 months basis and 6 months basis with protection against decline, and in one or two instances a flat price of 18c. has been done on a 6-month contract without protection. *Sulphur* is slightly weaker and can be had at $1.90 per 100 lb. for commercial in bags. There is still a very broad movement in *zinc sulphate*, prices ruling at 3⅝c. in carload lots and 3⅞c.@4c. in less than carload lots, f.o.b. St. Louis.

Oils and Paint Materials

Linseed oil is holding very firm at $1@$1.02 per gal. in 1- to 4-bbl. lots, and 90@92c. in 5-bbl. lots or over. Future prices are firm due to unfavorable reports from the Argentine flaxseed fields. Not much contract business is being done at present. *Castor oil* is still holding at 13½c. in drums, with little prospect for any decline in the near future. *Turpentine* has slipped off slightly and is being quoted at 14c. in single barrels, $1.37 in 5-bbl. lots.

So far the expected rise in the *zinc oxide* price has not materialized, and the material is on a firm basis. A good volume of business is being done. No changes are reported for *whiting, blanc fixe* or *barytes*, but business is on the increase and manufacturers in this section report a waiting market.

A Seasonal Lull in the Chicago Market

A Good Outlook for the Year, However, Has Kept Prices at Fairly High Levels

CHICAGO, Ill., Jan. 5, 1923.

The chemical market has been very quiet for the past 2 weeks, with the industry reporting little business. Prices held firm, as it was obvious that it was not a question of price that was keeping the buyers out of the market. The outlook for this year is exceptionally fine, however, and all factors are expecting a prosperous year.

ALKALIS SELLING BELOW COST

The alkali market continued firm, with rumors of an advance to take place in the near future. Actual business was very light and spot quotations on *caustic soda* were unchanged at $3.50 per 100 lb. for the solid 76 per cent and $4.25 for the ground or flake. *Soda ash* was quiet and unchanged at $2.25 per 100 lb. for material in cooperage. *Caustic potash* moved only in a very small way at 7¼@7½c. per lb. for the 88-92 per cent material. Dealers claim that this price is lower than the present replacement cost.

Alums continued quiet and were unchanged in price. *Potash alum* in lump form was quoted at 4½@5c. per lb. and in powdered form at 5½@6c. *Sal ammoniac* was in a firm position, with spot supplies held at 8c. per lb. for the white granular. *Barium chloride* was unchanged in price, with the demand rather quiet. Prime white material was offered at $110 per ton. *Barium hydrate* was dull and supplies were available at 6¼c. per lb. in large casks. *White arsenic* continued very firm and was so scarce that a holder could get his own price. One or two small lots were offered at 17c. per lb. *Carbon tetrachloride* moved in a fair way and was very firm at 10½c. per lb. *Carbon bisulphide* was quoted in small or moderate lots for delivery from spot stock at 7½c. per lb.

OTHER PRICES WELL MAINTAINED

Copper sulphate was in rather limited request, but the price of 6c. per lb. was well maintained. *Formaldehyde* was firm at 17c. per lb. and supplies were reported as scanty. *Hexamethylenetetramine* was in fair request and supplies of foreign material were offered at 82@85c. per lb. *Furfural* was quoted at 25c. per lb. in thousand-pound lots. *Glycerine* was more or less unsteady and while the quoted price for the c.p. material in drums was 18½c., it was possible that good-sized business would have been taken at 18c.

LINSEED OIL AND TURPENTINE

Linseed oil was not moving in a large way, but the price was well maintained. The boiled oil in single-barrel lots was quoted today at 92c. per gal.

Turpentine was still considered high priced and dealers reported very little moving. The pure spirits was quoted at the close of today's market at $1.54 per gal. in single-drum lots.

Steel Market Enters Year With Better Prospects

Most Mills Comfortably Booked Ahead at Fairly Satisfactory Prices

PITTSBURGH, Jan. 5, 1923.

The complexion of the steel market changed decidedly during December and the outlook for a continuance of good business in the steel industry improved materially. December may be said to have made an unusual record in one respect, in that the turnover, in actual orders, was greater in the second half of the month than in the first half.

Thus the steel market has entered the new year with considerable momentum and naturally the prospect is that the buying will continue in very fair volume. Mill order books are in such shape, however, that a decided lull for a month would make no particular difference in the general situation. A number of mills had at the beginning of December not enough business to carry their operations fully through the month. Now these same mills are fully booked for more than a month. Not a few are comfortably booked for the whole quarter, while the Steel Corporation is almost wholly sold up for a longer period.

OUTPUT AT 75 PER CENT CAPACITY

Steel production continues at approximately the rate of the last 3 months of the old year, ingots being made at about 40,000,000 gross tons a year, or at about 75 per cent of capacity, finished rolled steel production being at about 30,000,000 tons a year. Production seems likely to increase rather than decrease in the next 2 or 3 months. The 40,000,000-ton rate compares with actual production in the whole of 1922 of about 34,000,000 tons, 19,000,000 tons in 1921 and 30,000,000 tons in both 1912 and 1913, the two greatest tonnage years before the war.

COKE AND PIG IRON

The Connellsville coke market has eased off a trifle in the past week, due to a practical cessation of buying by Eastern distributors for domestic consumption. Furnace coke is quotable at $8.50 @$9 against $9@$9.50 a week ago. Foundry coke remains at $9@$9.50 and there is somewhat more buying, although the market is still rather sluggish. Prices mentioned are for spot or prompt shipment.

Pig iron has been quiet in the past week. Foundry iron remains at $27 valley, to which it advanced after furnaces had made good sales, early in December, at $25 for first quarter. Basic, which went in several cases recently at $24.25 valley, cannot be bought at under $25 now and $26 might have to be paid. The stiffening is due not to increased inquiry but to the fact that steel interests that were offering basic iron have less inclination to part with it as their own consumption prospects are improved. Bessemer remains quiet at $27.50 valley.

Billets, sheet bars and slabs are quotable at $36.50, Pittsburgh or Youngstown. Very little has been done in billets and slabs, but there has been a very fair volume of covering in sheet bars as sales of sheets have been made.

Bars, shapes and plates are practically firm at 2c., concessions from this level being much less common than a month or two ago. Some large consumers of bars, expecting a concession on first quarter supplies, are now forced to pay the full price. Mills are best booked in bars, shapes coming next, while plates are a poor third.

Hoops are quoted at a general level of 2.90c., but orders that are at all attractive seem to be going at 2.75c., except for the lighter gages. Hot-rolled strips are at substantially the same level as hoops. Cold-rolled strips are firm at 4.50c. There is a very fair demand for both hot- and cold-rolled strips, attributable largely to activity in the automobile industry.

PIPE MILLS ACTIVE

Pipe mills are under about as much pressure as formerly for deliveries of butt weld pipe. Jobbers' stocks are practically exhausted and mills have no stocks. It is not unusual for mills to have a stock equal to a month's production, and normal jobbers' stocks would probably represent a larger tonnage still. The continued heavy pressure for deliveries is due to the open winter. Should consumption decrease for a time on account of weather, the slack would easily be taken up by partial replenishment of stocks. The outlook is for heavy consumption this season in oil country goods, as it is practically certain there will be a fair amount of drilling, and there is occasion for laying quite a good deal of pipe line, particularly from the Wyoming field. Tubular goods prices are very firmly maintained, merchant steel pipe being at 66 per cent basing discount.

The market for sheets is firm at 2.50c. for blue annealed, 3.35c. for black, 4.35c. for galvanized and 4.70@5c. for automobile sheets, depending chiefly on time of delivery.

Tin plate buying has been rather brisk in the past few weeks, the business being chiefly in definite orders, with specifications, for January and February delivery or for delivery over the quarter. There has not been much contracting for the half year. The market is very firm, on the basis of $4.75 per base box for 100-lb. cokes. Predictions are practically universal that this year will break all records in domestic consumption of tin plate.

Bookings in wire products, particularly nails, have been increasing and all producers are sold up for comfortable distances ahead. The majority of independents have advanced their prices $2 a ton, not so much with the idea of obtaining higher prices at once, but of protecting their order books from getting too full and enabling them later to get the higher prices by way of a delivery premium. The leading interest is not expected to modify its prices which are at 2.45c. for plain wire, $2.70 for wire nails and $2.20 for cement coated nails.

Current Prices in the New York Market

FOR CHEMICALS, OILS AND ALLIED PRODUCTS

Although these prices are for the spot market in New York City, a special effort has been made to report the America manufacturer's quotations whenever available. In many instances these are for material f.o.b. works or on a contract basi and these prices are so designated. Quotations on imported and resale stocks are reported when of sufficient importanc to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages

General Chemicals

Acetic anhydride, 85%, drums	lb.	$0.39 –	$0 41
Acetone, drums	lb.	.21 –	21½
Acid, acetic, 28%, bbl	100 lb.	3.50 –	3 60
Acetic, 56%, bbl	100 lb.	7.00 –	7 15
Glacial, 99½%, carboys	100 lb.	12.80 –	13 25
Boric, crystals, bbl	lb.	.11½–	11½
Boric, powder, bbl.	lb.	.11 –	11½
Citric, kegs	lb.	.49 –	50
Formic, 85%	lb.	.18 –	19
Gallic, tech.	lb.	.45 –	50
Hydrochloric, 18° tanks, 100	lb.	.80 –	1 00
Hydrofluoric, 52%, carboys	lb.	.11 –	11½
Lactic, 44%, tech., light, bbl.	lb.	.11 –	11½
22% tech., light, bbl.	lb.	05 –	05½
Muriatic, 20°, tanks, 100	lb.	1.00 –	1 10
Nitric, 36°, carboys	lb.	.04½–	05
Nitric, 42°, carboys	lb.	.06 –	06¼
Oleum, 20%, tanks	ton	17.00 –	18 00
Oxalic, crystals, bbl.	lb.	.13 –	13½
Phosphoric, 50% carboys	lb.	.07½–	08
Pyrogallic, resublimed	lb.	1 50 –	1 60
Sulphuric, 60°, tanks.	ton	9.00 –	10 00
Sulphuric, 60°, drums	ton	12 00 –	14 00
Sulphuric, 66°, tanks	ton	14.50 –	15 00
Sulphuric, 66° drums.	ton	19.00 –	20 00
Tannic, U.S.P., bbl	lb.	.65 –	70
Tannic, tech., bbl	lb.	40 –	45
Tartaric, imp. crys., bbl	lb.	.30½–	31
Tartaric, imp., powd., bbl	lb.	.31 –	32
Tartaric, domestic, bbl	lb.	–	32
Tungstic, per lb. of WO	lb	1 00 –	1 20
Alcohol, butyl, drums	gal.	18 –	23
Alcohol ethyl (Cologne spirit), bbl.	gal.	4.75 –	4.95
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 188 proof No. 1	gal.	.39 –	.41
Alum, ammonia, lump, bbl	lb.	.03½–	03¾
Potash, lump, bbl.	lb.	.03½–	03¾
Chrome, lump, potash, bbl	lb.	.05 –	05½
Aluminum sulphate, com., bags	100 lb.	1.50 –	1 65
Iron free bags	lb.	.02½–	02¾
Aqua ammonia, 26°, drums	lb.	.06½–	07½
Ammonia, anhydrous, cyl.	lb.	.30 –	30½
Ammonium carbonate, powd. casks	lb.	.09 –	.09½
Ammonium nitrate, tech., casks	lb.	.07½–	07¾
Amylacetate tech., drums	gal.	2.80 –	3 05
Arsenic, white, powd., bbl.	lb	.15½–	16
Arsenic, red, powd., kegs	lb.	13½ –	14
Barium carbonate, bbl.	ton	75 00 –	77 00
Barium chloride, bbl.	ton	94.00	100 00
Barium dioxide, drums	lb	.18 –	18½
Barium nitrate, casks		08½ –	08¾
Barium sulphate, bbl.	lb.	.04 –	04½
Blanc fixe, dry, bbl.	lb.	04 –	04½
Blanc fixe, pulp, bbl	ton	45 00 –	55 00
Bleaching powder, f.o.b. wks., drums	100 lb	2 00 –	2 50
Resale drums	100 lb.	2 25 –	2 50
Borax, bbl.	lb	05½–	05¾
Bromine, cases	lb.	.27 –	28
Calcium acetate, bags	100 lb.	3.50 –	3 60
Calcium carbide, drums	lb	.04½–	04¾
Calcium chloride, fused, drums	ton	22.00 –	23 00
Gran. drums.	lb.	01½–	01¾
Calcium phosphate, mono, bbl.	lb.	.06½–	07
Camphor, cases	lb.	.95 –	.96
Carbon bisulphide, drums	lb.	.07 –	07½
Carbon tetrachloride, drums.	lb.	.10 –	.10½
Chalk, precip.—domestic, light, bbl	lb.	.04½–	.04¾
Domestic, heavy, bbl	lb.	.03½–	.03¾
Imported, light, bbl	lb.	.04½–	.05
Chlorine, liquid, cylinders	lb.	.06 –	.06½
Chloroform, tech., drums.	lb.	.35 –	.38
Cobalt oxide, bbl.	lb.	2.10 –	2 25
Copperas, bulk, f.o.b wks	ton	20 00 –	22.00
Copper carbonate, bbl	lb.	.20 –	.20½
Copper cyanide, drums	lb.	.50 –	.55
Coppersulphate, crys., bbl., 100	lb.	6.00 –	6.25
Cream of tartar, bbl.	lb.	.25 –	.26
Dextrine, corn, bags	100 lb.	3.25 –	3.50
Epsom salt, dom., tech., bbl.	100 lb.	2.10 –	2.25
Epsom salt, imp., tech., bags	100 lb.	1.10 –	1.25
Epsom salt, U.S.P., dom., bbl.	100 lb.	2.50 –	2.75
Ether, U.S.P., drums	lb.	.13 –	.15
Ethyl acetate, com., 85%, drums	gal.	.80 –	.85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 –	1.00
Formaldehyde, 40%, bbl.	lb.	.16 –	.16½

Fullers earth, f.o.b mines	net ton	$16 00 –	$17 00
Fullers earth—imp., powd.	net ton	30 00 –	32 00
Fusel oil, ref., drums	gal.	3 55 –	4 05
Fusel oil, crude, drums	gal	2 30 –	2 40
Glaubers salt, wks., bags	100 lb.	1 20 –	1 40
Glaubers salt, imp., bags	100 lb.	1.00 –	1.25
Glycerine, c p., drums extra	lb.	.18½–	19
Glycerine, dynamite, drums	lb.	16 –	17
Iodine, resublimed	lb.	4 50 –	4 60
Iron oxide, red, casks	lb.	.12 –	.18
Lead:			
White, basic carbonate, dry, casks	lb.	.08 –	.08¼
White, in oil, kegs	lb.	.10½–	.12
Red, dry, casks	lb.	10½–	10¾
Red, in oil, kegs	lb.	12 –	14
Lead acetate, white crys., bbl	lb.	12 –	12½
Lead arsenate, powd., bbl	lb.	21 –	.22
Litharge, comm., casks	lb.	.09½–	10
Lithophone, bbl	lb	06½–	06¾
Magnesium carb., tech., bags	lb	07 –	07½
Methanol, 95%, bbl	gal	1.23 –	1 25
Methanol, 97%, bbl	gal.	1.25 –	1 27
Nickel salt, double, bbl.	lb.	.10 –	.10½
Nickel salts, single, bbl	lb.	.11 –	.11½
Phosgene		.60 –	75
Phosphorus, red, cases	lb.	.35 –	40
Phosphorus, yellow, cases	lb.	.30 –	35
Potassium bichromate, casks	lb.	.09½–	.10
Potassium bromide, gran., bbl	lb.	.18 –	.25
Potassium carbonate, 80-85%, calcined, casks	lb.	.05½–	05¾
Potassium chlorate, powd	lb.	07½–	08
Potassium cyanide, drums	lb	.47 –	.80
Potassium hydroxide (caustic potash) drums	100 lb.	6.50 –	6 75
Potassium iodide, cases	lb.	3.55 –	3 65
Potassium nitrate, bbl	lb.	.06½–	07
Potassium permanganate, drums	lb.	.16 –	16½
Potassium prussiate, red, casks	lb.	.90 –	95
Potassium prussiate, yellow, casks	lb.	.38 –	39
Salammoniac, white, gran., casks	lb	06½–	06¾
Gray, gran., casks	lb.	.08 –	08½
Salsoda, bbl	100 lb.	1.20 –	1 40
Salt cake (bulk)	ton	25.00 –	27 00
Soda ash, light, 58%, flat, bags, contract	100 lb.	1.60 –	1 67
Soda ash, light, basis, 48%, bags, contract, f o b wks.	100 lb.	1.20 –	1 30
Soda ash, light, 58%, flat, bags, resale	100 lb	1.75 –	1 80
Soda ash, dense, bags, contract, basis 48%	100 lb.	1.17½ –	1.20
Soda ash, dense, in bags, resale	100 lb.	1.85 –	1 90
Soda, caustic, 76%, solid, drums, f.a.s.	100 lb.	3.50 –	3.75
Soda, caustic, 76%, solid, drums, contract	100 lb.	3.35	3.40
Soda, caustic, basis 60%, wks., contract	100 lb.	2.50 –	2 60
Soda, caustic, ground and flake, contracts	100 lb.	3.80 –	3.90
Soda, caustic, ground and flake, resale	100 lb.	4.00 –	4.15
Sodium acetate, works, bags	lb.	.06½–	07¼
Sodium bicarbonate, bbl	100 lb.	1 75 –	1.85
Sodium bichromate, casks	lb	07½–	.07¾
Sodium bisulphate (niter cake)	ton	6.00 –	7.00
Sodium bisulphite, powd., U S P, bbl	lb.	.04½–	.04¾
Sodium chlorate, kegs	lb.	06 –	.07
Sodium chloride	long ton	12.00 –	13.00
Sodium cyanide, cases	lb.	.19 –	.23
Sodium fluoride, bbl.	lb.	.09 –	.09½
Sodium hyposulphite, bbl	lb.	.03 –	.03¼
Sodium nitrite, casks	lb.	.08½–	.09
Sodium peroxide, powd., cases	lb.	.28 –	.30
Sodium phosphate, dibasic, bbl.	lb.	.03½–	.04
Sodium prussiate, yel. drums	lb.	.18½–	.20
Sodium silicate (40°, drums)	100 lb.	1.25 –	1.30
Sodium silicate (60°, drums)	100 lb.	2.25 –	2.40
Sodium sulphide, fused, 60-62% drums	lb.	.04½–	.04¾
Sodium sulphite, crys., bbl	lb.	.03½–	.03¾
Strontium nitrate, powd., bbl.	lb.	.09½–	.10
Sulphur chloride, yel drums	lb.	.04½–	.05
Sulphur, crude	ton	18.00 –	20.00
Sulphur dioxide, liquid, cyl.	lb.	.08 –	.08
Sulphur, flour, bbl	100 lb.	2.50 –	3.15
Sulphur, roll, bbl	100 lb.	2.15 –	2.20
Talc—imported, bags	ton	30.00 –	40.00
Talc—domestic powd., bags	ton	18.00 –	25.00

Tin bichloride, bbl	lb.	$.10½–	$.10
Tin oxide, bbl	lb.	.45 –	.47
Zinc carbonate, bags	lb.	14 –	.14
Zinc chloride, gran, bbl	lb.	.07 –	.07
Zinc cyanide, drums	lb.	.42 –	.44
Zinc oxide, XX, bbl.	lb.	.07½–	.08
Zinc sulphate, bbl.	100 lb.	2.75 –	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl	lb.	$ .95 –	$1.00
Alpha-naphthol, ref., bbl.	lb.	1.05 –	1.10
Alpha-naphthylamine, bbl.	lb.	.28 –	.30
Aniline oil, drums	lb.	.16½–	.17
Aniline salts, bbl	lb	.24 –	.25
Anthracene, 80%, drums	lb.	.75 –	1.00
Anthracene, 80%, imp., drums, duty paid	lb.	65 –	.70
Anthraquinone, 25%, paste, drums	lb.	.70 –	.75
Benzaldehyde U.S.P., carboys	lb.	1.35 –	1.40
Benzene, pure, water-white drums	gal.	.30 –	.35
Benzene, 90%, drums	gal.	.28 –	.32
Benzene, 90%, drums, resale.	gal.	.37 –	.40
Benzidine base, bbl	lb.	.85 –	.90
Benzidine sulphate, bbl	lb.	.75 –	.80
Benzoic acid, U S P., kegs	lb.	70 –	.75
Benzoate of soda, U S P., bbl.	lb.	.57 –	.65
Benzyl chloride, 95-97%, ref., drums	lb.	.25 –	.27
Benzyl chloride, tech., drums	lb.	.20 –	.23
Beta-naphthol, subl., bbl	lb.	.55 –	.60
Beta-naphthol, tech., bbl	lb.	.25 –	.26
Beta-naphthylamine, tech.	lb.	1.00 –	1.25
Carbazol, bbl.	lb.	.75 –	.90
Cresol, U.S P., drums	lb.	.14 –	.20
Ortho-cresol, drums	lb	.18 –	.22
Cresylic acid, 97-99%, drums.	gal.	.60 –	.65
95-97%, drums	gal.	.55 –	.58
97%, resale, drums	gal.	1.00 –	1.05
Dichlorbenzene, drums	lb.	.07 –	.09
Diethylaniline, drums	lb.	.50 –	.60
Dimethylaniline, drums	lb.	.39 –	.41
Dinitrobenzene, bbl	lb.	.20 –	.22
Dinitroclorbenzene, bbl	lb.	.22 –	.23
Dinitronaphthalene, bbl.	lb.	.30 –	.32
Dinitrophenol, bbl	lb.	.34 –	.36
Dinitrotoluene, bbl	lb	22 –	.24
Dip oil, 25%, drums	gal.	.25 –	.30
Diphenylamine, bbl	lb.	.54 –	.56
H-acid, bbl.	lb.	.75 –	.80
Meta-phenylenediamine, bbl.	lb.	.95 –	1.00
Michlers ketone, bbl	lb.	3 75 –	3.85
Monochlorbenzene, drums	lb.	.08 –	.10
Monoethylaniline, drums	lb.	.95 –	1.10
Naphthalene, crushed, bbl.	lb.	.05½–	.06
Naphthalene, flake, bbl.	lb.	.06 –	.06½
Naphthalene, balls, bbl.	lb.	.06½–	.07
Naphthionate of soda, bbl	lb.	.58 –	.65
Naphthionic acid, crude, bbl	lb.	.60 –	.65
Nitrobenzene, drums	lb.	.10 –	.12
Nitro-naphthalene, bbl	lb.	.30 –	.35
Nitro-toluene, drums	lb.	.15 –	.17
N-W acid, bbl.	lb.	1.20 –	1.30
Ortho-amidophenol, kegs	lb.	2.25 –	2.30
Ortho-dichlorbenzene, drums	lb.	.17 –	.20
Ortho-nitrophenol, bbl	lb.	.85 –	.90
Ortho-nitrotoluene, drums	lb.	.12½–	.14
Ortho-toluidine, bbl	lb.	.14 –	.16
Para-amidophenol, base, kegs	lb.	1.15 –	1.20
Para-amidophenol, HCl, kegs	lb.	1.20 –	1.25
Para-dichlorbenzene, bbl.	lb.	.17 –	.20
Paranitraniline, bbl	lb.	.75 –	.80
Para-nitrotoluene, bbl.	lb.	.55 –	.65
Para-phenylenediamine, bbl.	lb.	1.50 –	1.55
Para-toluidine, bbl.	lb.	.85 –	.90
Phthalic anhydride, bbl.	lb.	.40 –	.50
Phenol, U.S.P., drums	lb.	.34 –	.35
Picric acid, bbl.	lb.	.20 –	.22
Pyridine, dom., drums	gal.	1.60 –	1.75
Pyridine, imp., drums	gal.	1.40 –	1.60
Resorcinol, tech., kegs	lb.	1.50 –	1.55
Resorcinol, pure, kegs	lb.	2.00 –	2.10
R-salt, bbl.	lb.	.55 –	.60
Salicylic acid, tech., bbl	lb.	.35 –	.37
Salicylic acid, U.S.P., bbl	lb.	.40 –	.42
Solvent naphtha, water-white, drums	gal.	.37 –	.40
Crude, drums	gal.	.22 –	.24
Sulphanilic acid, crude, bbl	lb.	.20 –	.22
Thiocarbanilide, kegs	lb.	.35 –	.38
Toluidine, kegs	lb.	1.20 –	1.30
Toluidine, mixed, kegs	lb.	.30 –	.35
Toluene, tank cars	gal.	.35 –	.37
Toluene, drums	gal.	.40 –	.43
Xylidines, drums	lb.	.40 –	.45
Xylene, pure, drums	gal.	.45 –	.50
Xylene, pure tanks	gal.	.45 –	
Xylene, com., drums	gal.	.40 –	.42
Xylene, com., tanks	gal.	.38 –	

Naval Stores

Rosin B-D, bbl.	280 lb.	$6.25 –	....
Rosin E-I, bbl.	280 lb.	6.40 –	....
Rosin K-N, bbl.	280 lb.	6.60 –	$6.85
Rosin W.G.-W.W., bbl.	280 lb.	7.75 –	8.25
Wood rosin, bbl.	280 lb.	6.25 –	
Turpentine, spirits of, bbl.	gal.	1.54 –	1.55
Wood, steam dist., bbl.	gal.	1.35 –	
Wood, dest. dist., bbl.	gal.	1.25 –	
Pine tar pitch, bbl.	200 lb.	.... –	6.00
Tar, kiln burned, bbl.	500 lb.	.... –	12.50
Retort tar, bbl.	500 lb.	.... –	11.00
Rosin oil, first run, bbl.	gal.	.43 –	
Rosin oil, second run, bbl.	gal.	.47 –	
Rosin oil, third run, bbl.	gal.	.53 –	....
Pine oil, steam dist.	gal.	.... –	.90
Pine oil, pure, dest. dist.	gal.	.... –	.85
Pine tar oil, ref.	gal.	.... –	.46
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal.	.... –	.35
Pine tar oil, double ref., bbl.	gal.	.... –	.75
Pine tar, ref., thin, bbl.	gal.	.... –	.25
Pinewood creosote, ref., bbl.	gal.	.... –	.52

Vegetable Oils

Castor oil, No. 3, bbl.	lb.	$.11¾ –	$.12¼
Castor oil, AA, bbl.	lb.	.12¼ –	.12¾
Chinawood oil, bbl.	lb.	.14 –	.14½
Coconut oil, Ceylon, bbl.	lb.	.09¼ –	.09½
Coconut oil, Cochin, bbl.	lb.	.09½ –	.09¾
Corn oil, crude, bbl.	lb.	.11 –	.11½
Cottonseed oil, crude (f.o.b. mill), tanks.	lb.	.09¼ –	
Summer yellow, bbl.	lb.	.11 –	.11¼
Winter yellow, bbl.	lb.	.11½ –	.12
Linseed oil, raw, car lots, bbl.	gal.	.87 –	.88
Raw, tank cars (dom.)	gal.	.84 –	.85
Boiled, 5-bbl. lots (dom.)	gal.	.89 –	.90
Olive oil, denatured, bbl.	gal.	1.05 –	1.12
Palm, Lagos, casks	lb.	.07¾ –	.08
Palm kernel, bbl.	lb.	.08¼ –	.08½
Peanut oil, crude, tanks (mill)	lb.	.12½ –	.12¾
Peanut oil, refined, bbl.	lb.	.15½ –	.16
Rapeseed oil, refined, bbl.	gal.	.85 –	.86
Rapeseed oil, blown, bbl.	gal.	.90 –	.91
Soya bean (Manchurian), bbl.	lb.	.11½ –	
Tank, f.o.b. Pacific coast	lb.	.09¼ –	.09½

Fish Oils

Menhaden, light pressed, bbl.	gal.	$0.60 –	
White bleached, bbl.	gal.	.64 –	.65
Blown, bbl.	gal.	.68 –	.69
Whale No. 1 crude, tanks, coast	lb.	.06 –	.06½

Dye & Tanning Materials

Divi-divi, bags	ton	$38.00 –	$39.00
Fustic, sticks	ton	30.00 –	35.00
Fustic, chips, bags	lb.	.04	.05
Logwood, sticks	ton	28.00 –	30.00
Logwood, chips, bags	lb.	.02½ –	.03½
Sumac, leaves, Sicily, bags	ton	65.00 –	
Sumac, ground, bags	ton	55.00 –	60.00
Sumac, domestic, bags	ton	35.00 –	
Tapioca flour, bags	lb.	.03½ –	.05

EXTRACTS

Archil, conc., bbl.	lb.	$0.18 –	$0.20
Chestnut, 25% tannin, tanks	lb.	.02 –	.03
Divi-divi, 25% tannin, bbl.	lb.	.04 –	.05
Fustic, crystals, bbl.	lb.	.20 –	.22
Fustic, liquid, 42°, bbl.	lb.	.08 –	.09
Gambier, liq., 25% tannin, bbl.	lb.	.08 –	.09
Hematine crys., bbl.	lb.	.14 –	.18
Hemlock, 25% tannin, bbl.	lb.	.04 –	.05
Hypernic, solid, drums	lb.	.24 –	.26
Hypernic, liquid, 51°, bbl.	lb.	.14 –	.17
Logwood, crys., bbl.	lb.	.19 –	.20
Logwood, liq., 51°, bbl.	lb.	.09 –	.10
Quebracho, solid, 65% tannin, bbl.	lb.	.04½ –	.05
Sumac, dom., 51°, bbl.	lb.	.06½ –	.07

Waxes

Bayberry, bbl.	lb.	$0.29 –	$0.30
Beeswax, refined, dark, bags	lb.	.30 –	.32
Beeswax, refined, light, bags	lb.	.34 –	.35
Beeswax, pure white, cases	lb.	.39 –	.40
Candelilla, bags	lb.	.34	.35
Carnauba, No. 1, bags	lb.	.38 –	.40
No. 2, North Country, bags	lb.	.23 –	.24
No. 3, North Country, bags	lb.	.17 –	.17½
Japan, cases	lb.	.15 –	.15½
Montan, crude, bags	lb.	.03½ –	.04
Paraffine, crude, match, 105-110 m.p.	lb.	.04 –	.04½
Crude, scale 124-126 m.p., bags	lb.	.02½ –	.02¾
Ref., 118-120 m.p., bags	lb.	.03¼ –	.03½
Ref., 125 m.p., bags	lb.	.03½ –	.03¾
Ref., 128-130 m.p., bags	lb.	.04 –	.04¼
Ref., 133-135 m.p., bags	lb.	.04½ –	.04¾
Ref., 135-137 m.p., bags	lb.	.05 –	.05¼
Stearic acid, sgle pressed, bags	lb.	.10 –	.10¼
Double pressed, bags	lb.	.10½ –	.10¾
Triple pressed, bags	lb.	.11 –	.11½

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb.	$3.20 –	$3.25
F.a.s. double bags	100 lb.	3.60 –	3.75
Blood, dried, bulk	unit	4.60 –	....
Bone, raw, 3 and 50, ground	ton	30.00 –	35.00
Fish scrap, dom., dried, wks.	unit	5.00 –	5.10
Nitrate of soda, bags	100 lb.	2.60 –	2.65
Tankage, high grade, f.o.b. Chicago	unit	4.60 –	4.65

Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$3.50 –	$4.00
Tennessee, 78-80%	ton	7.00 –	8.00
Potassium muriate, 80%, bags	ton	35.55 –	38.25
Potassium sulphate, bags	unit	1.00 –	....

Crude Rubber

Para—Upriver fine	lb.	$0.25½ –	$0.25¾
Upriver coarse	lb.	.18¼ –	.18½
Upriver caucho ball	lb.	.20½ –	.20¾
Plantation—First latex crepe	lb.	.28½ –	.29
Ribbed smoked sheets	lb.	.28½ –	.29
Brown crepe, thin, clean	lb.	.23 –	.23½
Amber crepe No. 1	lb.	.23 –	.23½

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh. ton	$450.00 –	$550.00
Asbestos, shingle, f.o.b., Quebec	sh. ton	60.00 –	80.00
Asbestos, cement, f.o.b., Quebec	sh. ton	15.00 –	17.00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	16.00 –	20.00
Barytes, grd., off-color, f.o.b. mills bulk	net ton	13.00 –	21.00
Barytes, floated, f.o.b. St. Louis, bbl.	net ton	24.00 –	28.00
Barytes, crude f.o.b. mines, bulk	net ton	8.00 –	9.00
Casein, bbl., tech.	lb.	.12 –	.14
China clay (kaolin) crude, f.o.b. Ga.	net ton	7.00 –	9.00
Washed, f.o.b. Ga.	net ton	8.00 –	9.00
Powd., f.o.b. Ga.	net ton	14.00	20.00
Crude f.o.b. Va.	net ton	8.00 –	12.00
Ground, f.o.b. Va.	net ton	13.00 –	20.00
Imp., lump, bulk	net ton	14.00 –	20.00
Imp., powd.	net ton	40.00 –	45.00
Feldspar, No. 1 pottery	long ton	6.00 –	7.00
No. 2 pottery	long ton	5.00 –	5.50
No. 1 soap	long ton	7.00 –	7.50
No. 1 Canadian, f.o.b. mill	long ton	20.00 –	21.00
Graphite, Ceylon, lump, first quality, bbl.	lb.	.05 –	.05½
Ceylon, chip, bbl.	lb.	.04 –	.04½
High grade amorphous crude	ton	35.00 –	50.00
Gum arabic, amber, sorts, bags	lb.	.15 –	.16
Gum tragacanth, sorts, bags	lb.	.50 –	.60
No. 1, bags	lb.	1.75 –	1.80
Kieselguhr, f.o.b. Cal.	ton	40.00 –	42.00
F.o.b. N.Y.	ton	50.00 –	55.00
Magnesite, crude, f.o.b. Cal.	ton	14.00 –	15.00
Pumice stone, imp., casks	lb.	.03 –	.05½
Dom., lump, bbl.	lb.	.05 –	.05½
Dom., ground, bbl.	lb.	.06 –	.07
Shellac, orange fine, bags	lb.	.74 –	.75
Orange superfine, bags	lb.	.76 –	.77
A. C. garnet, bags	lb.	.75 –	.77
T. N., bags	lb.	.72 –	.73
Silica, glass sand, f.o.b. Ind.	ton	2.00 –	2.50
Silica, sand blast, f.o.b. Ind.	ton	2.50	5.00
Silica, amorphous, 250-mesh, f.o.b. Ill.	ton	17.00 –	17.50
Silica, bldg. sand, f.o.b. Pa.	ton	2.00 –	2.75
Soapstone, coarse, f.o.b. Vt., bags	ton	7.00 –	8.00
Talc, 200 mesh, f.o.b., Vt., bags	ton	6.50 –	9.00
Talc, 200 mesh, f.o.b. Ga., bags	ton	7.00 –	9.00
Talc, 200 mesh, f.o.b. Los Angeles, bags	ton	16.00 –	20.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	ton	$45–50
Chrome brick, f.o.b. Eastern shipping points	ton	50–52
Chrome cement, 40-50% Cr_2O_3	ton	23–27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	40–46
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	36–41
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65–68
9-in. arches, wedges and keys	ton	80–85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	48–50
F.o.b. Mt. Union, Pa.	1,000	42–44
Silicon carbide refract. brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N.Y.	ton	$200.00 –	$225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11 –	.11½
4-6% C	lb.	.11½ –	.12
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	100.00 –	105.00
Spiegeleisen, 19-21% Mn.	gr. ton	35.00 –	37.00
Ferromolybdenum, 50-60% Mo, per lb. Mo.	lb.	1.90 –	2.15
Ferrosilicon, 10-15%	gr. ton	40.00 –	45.00
50%	gr. ton	75.00 –	80.00
75%	gr. ton	115.00 –	120.00
Ferrotungsten, 70-80%, per lb. of W	lb.	$0.90 –	$0.95
Ferro-uranium, 35-50% of U, per lb. of U	lb.	6.00 –	....
Ferrovanadium, 30-40%, per lb. of V	lb.	3.50 –	4.00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$6.00 –	$9.00
Chrome ore, Calif. concentrates, 50% min Cr_2O_3	ton	22.00 –	23.00
C.i.f. Atlantic seaboard	ton	18.50 –	19.00
Coke, fdry, f.o.b. ovens	ton	9.00 –	9.50
Coke, furnace, f.o.b. ovens	ton	9.00 –	9.50
Fluorspar, gravel, f.o.b. mines, New Mexico	ton	17.50 –	....
Fluorspar, std., dom. washed gravel Ky. & Ill. mines	ton	21.50 –	22.00
Ilmenite, 52% TiO_2	lb.	.01½ –	.01¾
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.45 –	....
Manganese ore, chemical (MnO_2)	ton	75.00 –	80.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N.Y.	lb.	.80 –	.85
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb.	.06 –	.08
Pyrites, Span., fines, c.i.f. Atl. seaport	unit	.11½ –	.12
Pyrites, Span., furnace size, c.i.f. Atl. seaport	unit	.11½ –	.12
Pyrites, dom. fines, f.o.b. mines, Ga.	unit	Nominal	
Rutile, 95% TiO_2	lb.	.12	
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.00 –	8.50
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	7.50 –	8.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 –	3.75
Uranium oxide, 96% per lb. U_3O_8	lb.	2.25 –	2.50
Vanadium pentoxide, 99%	lb.	12.00 –	14.00
Vanadium ore, per lb. V_2O_5	lb.	1.00 –	....
Zircon, washed, iron free, f.o.b. Pablo, Fla.	lb.	.04½ –	.13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	14.75
Aluminum, 98 to 99%	22.00–23.00
Antimony, wholesale, Chinese and Japanese	6.35
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	36.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	38.625
Lead, New York, spot	7.25
Lead, E. St. Louis, spot	7.125
Zinc, spot, New York	7.25
Zinc, spot, E. St. Louis	6.90–7.00

OTHER METALS

Silver (commercial)	oz.	$0.64½
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.45
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99%	lb.	1.00@1.05
Platinum	oz.	118.00
Iridium	oz.	240.00@275.00
Palladium	oz.	65.00
Mercury	75 lb.	74.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.00
Copper bottoms	30.00
Copper rods	19.75
High brass wire	18.75
High brass rods	15.75
Low brass wire	1[illegible].60
Low brass rods	2[illegible].25
Brazed brass tubing	2[illegible].00
Brazed bronze tubing	2[illegible].00
Seamless copper tubing	24.75
Seamless high brass tubing	22.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.00@11.25
Copper, heavy and wire	10.[illegible]@10.75
Copper, light and bottoms	[illegible]
Lead, heavy	4.50@4.75
Lead, tea	3.25@[illegible]
Brass, heavy	[illegible]
Brass, light	[illegible]
No. 1 yellow brass turnings	[illegible]
Zinc	2.25@2.50

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$2.90	[illegible]
Soft steel bars	2.80	[illegible]
Soft steel bar shapes	2.80	[illegible]
Soft steel bands	3.40	[illegible]
Plates, ¼ to 1 in. thick	2.90	[illegible]

Industrial

Financial. Construction and Manufacturers' News

Construction and Operation

Alabama

SYLACAUGA—The Sylacauga Fertilizer Co has completed plans for the immediate erection of a new 1-story plant, 30x100 ft., for the production of commercial fertilizer. Another unit of like size will be constructed as soon as the first building has been completed.

HOLT—The Central Foundry Co has commenced enlargements in its local plant, including remodeling work. It is proposed to convert the structure into a hand-molding shop for the manufacture of pipe and fittings. It has been closed for about a year past. Headquarters of the company are at 41 East 42nd St., New York.

California

SAN FRANCISCO—The Los Angeles Soap Co., 633 East 1st St., Los Angeles, manufacturer of soaps, washing powders, refined cottonseed oils, etc., will soon take bids for the erection of its proposed 2-story and basement plant at 2nd and Brannan Sts., San Francisco, estimated to cost $80,000, including equipment. W. H. Crim, Jr., 425 Kearny St., San Francisco, is architect.

LOS ANGELES—The California Enameling Co. will soon break ground for the construction of a new 1-story plant at 51st St. and Santa Fe Ave., 300x600 ft., for the manufacture of enameled products. Hamm & Grant, Ferguson Bldg., are architects.

SEBASTOPOL—The Western Apple Vinegar Co., McKinley St., has acquired property adjoining its plant and plans for the erection of a new dehydrator works. Bids will be asked at an early date.

LOS ANGELES—The Pacific Coast Borax Co., Kohl Bldg., San Francisco, has increased the size of its proposed new refinery at Los Angeles Harbor from 2- to 3-story, of size 250x305 ft. A general contract for erection will soon be let. The complete plant will cost in excess of $1,200,000, including machinery. Albert C. Martin, Higgins Bldg., Los Angeles, is architect.

LOS ANGELES—The Shell Oil Co., 313 Sansome St., San Francisco, has leased a tract of land totaling about 5 acres on Mormon Island, San Pedro, as a site for the construction of a new storage and distributing plant. Plans will be prepared at an early date. The estimated cost is reported in excess of $90,000, with equipment.

Connecticut

HARTFORD—The Lotz Asbestos Co., 60 Prospect St., manufacturer of special cements, asbestos specialties, etc., has acquired a 2-story factory on site 100x130 ft., at 479 Windsor St., for a new plant for increased production. The structure will be improved and enlarged with the construction of two additional stories. Early occupancy is planned.

BERLIN—The Hall-Spiers Brick Co., recently organized with a capital of $75,000, will succeed the company of the same name operating a local plant. Extensions are planned, including the installation of equipment for oil-burning for kiln service. F. M. Hall is president, and Paul H. Spiers, vice-president and secretary.

Florida

OCALA—The Loncala Phosphate Co., P.O. Box 471, is planning for the installation of brick-manufacturing equipment at its plant. Inquiries are being made for hand-power or gasoline engine-operated apparatus.

Georgia

ATLANTA—The United Paper Co., manufacturer of fruit-wrapping and other paper products, has tentative plans under consideration for the erection of a new 5-story building on local site, to cost about $200,000.

Illinois

CHICAGO—The Enamel Steel Sign Co., 190 North State St., has completed plans and is taking bids for the erection of a 1- and 2-story plant on West Ravenswood Ave., 100x160 ft. Arthur H. Knox, 7 West Madison St., is architect. Manly Simmons is president.

CHICAGO—Gutman & Co., Webster Ave. and Dominick St., leather tanners, have plans nearing completion for the erection of additions to their plant, including a main 1-story extension, 40x160 ft., for general production; 1- to 3-story beam house, 37x115 ft.; and carpenter and woodworking shop, 40x66 ft. The structures are estimated to cost $50,000.

CHICAGO—The Patterson-Sargent Co., 2025 Lumber St., manufacturer of varnishes, paints, etc., with headquarters at Cleveland, O., has completed foundations and will proceed the superstructure for its new branch plant at Seward and Lumber Sts., estimated to cost about $175,000. A. E. Fenn is local manager.

Indiana

EAST CHICAGO—The Pressed Steel Mfg. Co., 20 West Jackson Blvd., Chicago, Ill., has plans nearing completion for the erection of a new plant at East Chicago, to be 2-story, estimated to cost in excess of $100,000. Frank D. Chase, Inc., 645 North Michigan Ave., Chicago, is architect and engineer. Walter P. Murphy is president.

Kentucky

SCOTTSVILLE—The Massey Oil & Refining Co., recently organized, will succeed to the plant and business of the Massey Refining Co. Extensions and improvements are planned in the present refinery. W. E. Massey, Louisville, is president.

Louisiana

NEW ORLEANS—The Prest-O-Lite Co., Indianapolis, Ind., manufacturer of acetylene apparatus, has awarded a contract to J. V. and R. T. Burkes, New Orleans, for the erection of the initial buildings for its proposed new local plant. A group of ten structures will be erected, estimated to cost in excess of $150,000 with equipment. The company is operated by the Union Carbide Co., 30 East 42nd St., New York, N. Y.

MONROE—The Monroe-Louisiana Carbon Co., DeKalb and Zepp Sts., St. Louis, Mo., has commissioned Chauncey Matlock, 949 Broadway, New York, consulting engineer, to prepare plans for its proposed new plant at Ladel, near Monroe, to have an initial daily output of about 5,000 lb. of carbon black. The majority of equipment will be electrically operated. The buildings to be erected at the present time will cost about $100,000, and this appropriation will be increased at a later date.

Maryland

BALTIMORE—The Crown Oil & Wax Co., Pratt and 8th Sts., has filed plans for the erection of a 1-story addition, 45x88 ft. The contract for construction has been let to Charles E. Ehrman & Sons, Baltimore.

DUNKIRK—The Dashiell Mining & Refining Co. is planning for extensive developments on local rare earth deposits. A plant will be installed with conveyor system and other mechanical apparatus. B. J. Dashiell, Baltimore, is consulting engineer for the company.

Michigan

MONROE—The Monroe Paper Products Co. has commenced the erection of a new addition to its plant, 75x225 ft., to be equipped for the employment of about 50 operatives.

GRAND LODGE—The Briggs Clay & Mfg. Co., has tentative plans under consideration for the rebuilding of the portion of its plant, destroyed by fire, Dec. 20, with loss reported at $17,000.

CALUMET—The Calumet & Hecla Co., operating copper mining and smelting properties, has work under way on a plant for the treatment of Tamarack conglomerate sands for local service.

CHEBOYGAN—Fire, Dec. 22, destroyed a portion of the foundry of the Cheboygan Brass Foundry Co., with loss estimated at about $12,000. It is planned to rebuild.

PONTIAC—The Pontiac Varnish Co., has plans under way for the erection of a new plant addition to cost about $25,000. C. H. Hutchins is president.

NEW BALTIMORE—Charles Reimold and R. A. Waterbury, Mt. Clemens, Mich., are organizing a company to construct and operate a local plant for the manufacture of brick and other burned clay products. Options have been secured on a tract of clay property for the plant site.

DETROIT—Robert Finn, 622 McKeachey Bldg., architect, has plans in progress for a new foundry, 1-story, 50x140 ft., estimated to cost about $15,000, to be erected on local site. The name of the owner is temporarily withheld.

ST. JOSEPH—The local plant of the Mullen Brothers Paper Co. has been acquired at a sale in bankruptcy by Francis Hughes, Chicago, Ill., and associates, for a consideration of about $70,000. The new owners are said to be planning for a reorganization of the company and the operation of the mill, including proposed extensions and improvements.

Minnesota

HIBBING—The Water & Light Department, D. D. Haley, secretary, has awarded a general contract to the Phelps Brake Co., Hibbing, for the erection of a 1-story and basement addition to the municipal artificial gas plant, 35x66 ft., estimated to cost about $90,000. Charles Foster, Sellwood Bldg., Duluth, Minn., is engineer.

Mississippi

MOSS POINT—The Southern Paper Co. has plans nearing completion for the erection of a new pulp and paper mill at its local plant, with daily output of about 120 tons, equally divided between pulp and paper. It is expected to call for bids at an early date. George F. Hardy, 309 Broadway, New York, N. Y., is engineer. J. L. Dantzler is president.

Missouri

KANSAS CITY—The Schreiber Flour & Cereal Co. has tentative plans under consideration for the rebuilding of the portion of its 5-story mill, destroyed by fire, Dec. 15, with loss approximating $125,000, including equipment.

New Jersey

NEWARK—The Department of Streets and Public Improvements will install a complete chemical laboratory in the new building to be constructed for the Bureau of Water at Cedar Grove. It will cost about $20,000.

NEWARK—The Board of Education, City Hall, is considering the installation of additional equipment in the chemistry department at the new Seymour Vocational School, Sussex Ave. It is also planned to install foundry apparatus and other equipment in the different departments.

Ohio

UTICA—The Licking Window Glass Co. has completed plans and will soon break ground for the construction of a 1-story addition, 148x160 ft., estimated to cost about $35,000. It will be equipped for the production of plate glass. The Truscon Engineering Co., Ferris Bldg., Columbus, O., is engineer in charge. H. H. S. McCann is secretary.

SHELBY—The Ohio Seamless Tube Co. will soon commence the construction of a plant addition, 100x280 ft., to be used primarily for the production of cold drawn tubing. Other plant extensions are contemplated. The work is estimated to cost approximately $200,000, including machinery.

Oklahoma

CHICKASHA—The Chamber of Commerce, J. W. Comer, secretary, is perfecting plans for the construction and operation of a local plant for the manufacture of glass products. It is proposed to organize a company to carry out the project. Plans are also being discussed for the establishment of a local mill for the manufacture of corrugated paper products.

PERRY—The Garber Oil Refining Co. is said to have plans under way for the construction of an addition to its local refinery. E. A. Hutcheson is general manager.

Pennsylvania

JEANNETTE—The American Window Glass Co., Farmers' Bank Bldg., Pittsburgh, has arranged an appropriation of approximately $250,000, for the proposed addition to its local plant, on which work has been commenced. A general contract has been awarded to the Bollinger-Andrews Co., Empire Bldg., Pittsburgh. William L. Monroe is president.

CHESTER—The Stauffer Chemical Co., 624 California Ave., San Francisco, Calif., has awarded a contract to the Chester Construction & Contracting Co., Chester, for the erection of the first unit of its proposed new plant on Front St., Trainer, near Chester, estimated to cost approximately $165,000.

WEST READING—The A. Wilhem Co., manufacturer of enamels, paints, etc., has tentative plans under consideration for the rebuilding of its local plant, destroyed by fire Dec. 24, with loss reported at $14,000.

PITTSBURGH—The Vitro Mfg. Co., Bessemer Bldg., manufacturer of enamels and kindred products, has filed plans for the construction of its proposed 1-story plant on Oliffe St., and will commence immediate erection. It is estimated to cost about $10,000.

PHILADELPHIA—The Quaker City Japanning & Enameling Co. has leased a floor in the building at Buttonwood and 10th Sts., for the establishment of a local plant.

CREIGHTON—The Pittsburgh Plate Glass Co., Frick Bldg., Pittsburgh, is perfecting plans for the construction of a local plant, to be equipped primarily for the manufacture of plate glass products for automobile service. It will have a capacity of more than 15,000,000 ft. per year, and is estimated to cost in excess of $200,000

LOWER GWYNEDD—The American Chemical Paint Co., 1126 South 11th St., Philadelphia, is completing plans and will take bids during January for the construction of a new plant here, on Brookside Ave J. Harvey Gravell is president.

PHILADELPHIA—A. Waxman & Co, 121 North 3rd St, glass products, has acquired adjoining property, and a 4-story factory in the immediate vicinity at 417-21 North Orianna St., 50x78 ft., for a consideration of about $[illegible]5,000, for proposed expansion

Tennessee

KNOXVILLE—The Cherokee Brick Co, recently organized, has acquired a tract of property in the Chestnut Ridge section, comprising about 20 acres of land, as a site for a new plant for the manufacture of face brick and other burned clay products. The initial works will have a capacity of about 40,000 bricks per day, and is estimated to cost in excess of $125,000 J. Albert Robbins is president, and E C. Wright, secretary.

MEMPHIS—The Board of Public Works will commence the immediate installation of a filtration plant in connection with extensions and improvements in the municipal waterworks, to cost close to $1,500,000.

Texas

FERRIS—The Globe Pressed Brick Co is planning for the rebuilding of the portion of its plant, destroyed by fire Dec. 19. An official estimate of loss has not been made.

Virginia

HOPEWELL—The Stamsocott Co. Inc, manufacturer of pulp and paper products, has work under way on enlargements in its plant, for considerable increase in capacity. The present working force of 350 men will be materially increased in the near future.

HOPEWELL—The Hummel-Ross Fibre Corp. is completing the erection of a new mill for the production of kraft paper, with daily capacity of about 50 tons, and plans to place the unit in service at an early date. The output at the pulp mill, on adjoining site, will be increased from 50 to 100 tons in the near future.

Washington

SEATTLE—The Concrete Pipe Co. is planning for the installation of a testing laboratory in a new 1-story and basement building, for which plans are now being prepared. A. H. Albertson, Henry Bldg., is architect.

TACOMA—Fire recently destroyed a portion of the plant of the Continental Pipe Co., 1612 Center St., with loss estimated at approximately $75,000. The plant has been operated under lease by the Washington Wood Products Co. It is planned to rebuild.

West Virginia

WHEELING—The B. & M. Metal Rolling Mill, 36th and McCulloch Sts., has perfected plans for the operation of a local plant for the manufacture of bronze rods and kindred specialties. It is proposed to develop a daily output of about 25 tons. W. J. Broddock is president.

Wisconsin

MILWAUKEE—The Rickertron Mineral Paint Co., South Bay St., has preliminary plans in preparation for the construction of a new 1-story and basement plant, 63x70 ft., on Wilcox St., to cost approximately $25,000. The Birkholz Engineering Co., 290 3rd St., is architect and engineer.

Industrial Developments

GLASS—The American Window Glass Co, Pittsburgh, Pa, is advancing production at its plants, with employment of additional workers. During 4 weeks near the close of last year, 567 carloads of window glass were shipped, establishing a new high record.

The Republic Glass Co., Monroe, Mich., is arranging for the immediate operation of its new local plant, recently completed at a cost of about $100,000, and will specialize in the manufacture of lenses and kindred high-grade glassware A full working force will be employed. M. M. Llera is president, and W. N. Mathews, vice-president and general manager.

CERAMIC The Hopewell China Corp. is planning for increased production at its pottery, including the installation of 2 new decorating kilns. The present equipment comprises 7 general ware and 6 decorating kilns, with total output of approximately 12,000 doz pieces per week The working force of 225 employees will be increased at an early date.

Practically all of the general ware potteries at East Liverpool, O, have resumed production, following the close of the operatives' strike, under full capacity schedule. It is said that orders received have booked a number of plants for the entire year to come

Brick-manufacturing plants in the Birmingham, Ala., district are all running on a full time schedule, with regular working forces, and a record production is expected during 1923.

The Metropolitan Paving Brick Co, Canton, O., is operating at full capacity at all of its plants, and it is expected to maintain this schedule for a number of weeks to come

The Chelsea China Co., New Cumberland, W Va., has resumed operations at its plant after a shut down of a number of weeks, and plans to develop maximum output in the line of hotel ware. A number of improvements are planned to facilitate operations.

The Corning Brick, Terra Cotta & Tile Works, Corning, N. Y., is increasing production of brick and terra cotta Employment is being given to close to 45 per cent more men than at this time a year ago, with early extensions contemplated in the working force

The Canton Brick & Fireproofing Co., Canton, O., is advancing operations at its plant and expects to develop capacity, with full working force.

The Alton Brick Co, Alton, Ill., is arranging for the early resumption of production at the former plant of the Banner Clay Works, Edwardsville, Ill., recently acquired. Extensions and improvements will be made, including the installation of additional equipment.

The What Cheer Clay Products Co., What Cheer, Ia., will operate under maximum output, following the completion of additions and improvements. It is expected to develop a capacity of close to 35,000 tons of material per annum.

IRON AND STEEL—The Marietta Furnace, Marietta, Pa., has resumed operations after a shut down of about 2 years, giving employment to about 100 men. It is expected to maintain production for an indefinite period.

The Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., has resumed production at its finishing mills, following a brief curtailment during the holidays. The plant will run on a double turn under maximum operating schedule. The Fairfield plate mill of the company is running full, and has orders on hand to insure full capacity for a number of weeks to come. The third blast furnace at Bessemer, Ala., has been blown in on foundry iron, and a fourth unit will be placed in service at an early date. All six furnaces of the company at Ensley are in blast.

The Thomas Iron Co., Hokendauqua, Pa., is planning to blow in its local blast furnace about Jan. 15. A full working force will be employed under a capacity schedule.

The Gulf States Steel Co., Birmingham, Ala., is arranging to place its finishing mills on a double turn at an early date.

The Glasgow Iron Co., Pottstown, Pa., has placed its puddle mill in operation after an idle period dating back to 1918. A number of improvements have been made in the plant. It is expected to maintain production for an indefinite period. The universal mill and plate mill of the company are now in service on full turn.

The Interstate Iron & Steel Co., Chicago, Ill., is maintaining production at its alloy steel mills at close to capacity, with employment of regular working force.

The United States Steel Corp., Pittsburgh, Pa., is operating at its different plants at about 83 per cent of normal, the highest rate of production throughout 1922.

The Reading Iron Co., Reading, Pa., is running full at its plate mill and one of its puddle mills, and plans to maintain this basis for some time to come. The 8 plants of the company in neighboring sections are also on full turn.

Steel mills in the Chicago, Ill., district are operating on a basis of 75 to 80 per cent of normal, with prospects for early increase.

The Carpenter Steel Co., Reading, Pa., is maintaining full operations at its plant and is said to have advance orders to insure this basis for some time to come.

METALS—The Hoover Steel Ball Co., Chelsea, Mich, is planning for the early resumption of operations at its local plant, which has been closed down since late in 1920.

The Utah Copper Co., Salt Lake City, Utah, has placed another unit in operation at its new Magna mill, making 8 sections now in service. Other units are in the course of construction and will be placed in operation as soon as completed, or on the basis of 2 units a month. The mill will consist of 12 units.

The Chino Copper Co, Santa Rita, N. M., is maintaining close to normal operations at its local properties and an average of 600 tons of concentrates are being sent to the mill daily. The mill is running on a similar production schedule of 600 tons per day.

Pipe foundries in the vicinity of Birmingham, Ala., are running at capacity and a number of plants are arranging for immediate expansion. The Birmingham Machine & Foundry Co proposes to construct a new foundry addition for the production of sanitary pipe. The National Cast Iron Pipe Co. will soon commence the erection of an extension to its pipe foundry at Tarrant City, and the McWane Cast Iron Pipe Co has broken ground for its proposed new plant in the East Birmingham district.

The Tonopah Extension Mining Co., Tonopah, Nev., is arranging for capacity production at the local McNamara mill, recently secured under lease. Operations will be on a basis of about 100 tons per day.

The Consolidated Cortez Mining Co., Cortez, Nev., is completing the construction of a new mill and plans to place the unit in service at an early date. Initial production will be on the basis of 100 to 150 tons of handled ore per day.

The National Tin Co., Hill City, S. D., is arranging for increased production at its plant, and proposes to develop an output that will produce about 125 tons of metal at the smelter per month.

MISCELLANEOUS—The Widen-Lord Tanning Co., Danvers, Mass., is maintaining full production at its local tannery, specializing in the production of elk leathers.

H. B. Johnston & Co., Toronto, Ont., are running full at their local tannery for the production of calf leathers. A full working force is being employed.

The Owosso Sugar Co., Owosso, Mich., is operating at full capacity at its local mill. Plans are being considered for the reopening of the Lansing, Mich., plant of the company, which has been inactive since last June.

The Mt. Clemens Sugar Co., Mt. Clemens, Mich., is running full at its local mill, which has been in active service since Oct. It is expected to maintain the present schedule for a number of weeks.

E. I. du Pont de Nemours & Co., Wilmington, Del., are discontinuing operations at their plant in Wayne Township, near Paterson, N. J., heretofore devoted to the production of black powder. The machin-

ery will be removed to a works at Hillsdale Junction, near Scranton, Pa.

The Producers' & Refiners' Co., Fort Steele, Wyo., has completed the construction of the first unit of its new local refinery, and plans to place the plant in operation early in February. It will operate on a basis of 5,000 bbl. per day.

The Electro-Chemical Co. of Canada, Niagara Falls, Ont., is planning to operate a local plant for the production of nitric acid for general commercial use. A department will also be operated for the manufacture of calcium nitrate fertilizers. Existing plant facilities will be arranged for the new production with continuance of operations for present products.

The Calera Lime Works, Inc., Birmingham, Ala., is maintaining capacity production at its plant, and owing to heavy orders eliminated the annual shut-down during the holidays. A new kiln has been installed and other plant extensions will be made. A full working force is employed.

The Union Bag & Paper Co., Cheboygan, Mich., is increasing production at its plant, and machinery idle for some time past has been placed in service. Present operations are on a basis of about 70 tons of paper per day, and this will be increased to more than 100 tons daily at an early date.

The Michigan Sugar Co. has full-time production in force at its Caro, Mich., mill with employment of regular working quota. It is proposed to maintain capacity ouput for some time to come.

New Companies

THE CAVALIER CHEMICAL Co., Winston-Salem, N. C., has been incorporated with a capital of $50,000, to manufacture chemicals and chemical byproducts. The incorporators are E. M. Spivey and Wesley Taylor, both of Winston-Salem.

THE PENINSULA RUBBER Co, Boston, Mass., has been incorporated with a capital of $90,000, to manufacture rubber products. Andrew P. Keegan is president, and Lawrence F. Keegan, 505 East 6th St., South Boston, treasurer. The last noted represents the company.

THE PREFERRED CHEMICAL CORP., New York, N. Y., care of Isador Leifer, 110 West 40th St., New York, representative, has been incorporated with a capital of $20,000, to manufacture chemicals and chemical byproducts. The incorporators are S. D. Silverman, A. Siegel and E. M. Neilson.

THE ATLAS PULVERIZING Co., 136 West Lake St., Chicago, Ill., has been incorporated with a capital of 100 shares of stock, no par value, to manufacture paints, pigments, etc. The incorporators are Samuel E. Hirsch, Eugene I. Kalmuk and H. V. Gressang.

THE ESSEX ANALYTICAL LABORATORIES, INC., Newark, N. J., has been incorporated with a capital of $100,000, to manufacture chemicals and affiliated products. The incorporators are Paul C. Schotte, William A. Tries and Charles B. Clancy, 810 Broad St., Newark. The last noted represents the company.

THE COATES BRICK & TILE Co., Kansas City, Mo., has been incorporated with a capital of $15,000, to manufacture brick, tile and other burned clay products. The incorporators are W. W. Coates, A. O. Kickel and A. J. Moorhead, all of Kansas City.

JOSEPH A. MAGILO, INC., New York, N. Y., care of J. A. O'Rourke, 299 Broadway, representative, has been incorporated with a capital of $10,000, to manufacture chemical specialties. The incorporators are J. A. Magilo and S. S. Bemstein.

THE MOORE OIL & REFINING Co., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $500,000, to manufacture refined oil products.

THE CALIFORNIA PRODUCTS Co., Houston, Tex., has been incorporated with a capital of $25,000, to manufacture extracts, vinegar, etc. The incorporators are G. A. MacFarland, A. D. Baker and O. E. Gilleland, all of Houston.

THE SANFORD MFG Co., 846 West Congress St., Chicago, Ill., has been incorporated with a capital of $250,000, to manufacture inks, pastes, sealing wax and kindred specialties. The company is operating a plant at Congress and Peoria Sts. The incorporators are William K. Otis, Roy P. Kelley and William C. Boyden, Jr.

THE NATIONAL CHEMICAL PRODUCTS Co., Union Hill, N. J., care of Edward Hollander, 8 Bergenline Ave., Union Hill, representative, has been incorporated with a capital of $125,000, to manufacture chemicals and chemical byproducts. The incorporators are Richard D. Zucker and Joseph C. Bender.

THE SMITH-ALSOP SOUTH BEND PAINT Co., South Bend, Ind., has been incorporated with a capital of $25,000, to manufacture paints, varnishes, oils, etc. The incorporators are Edward A. White, Guy W. Frederick and Floyd E. Dix, all of South Bend.

THE MOAVA PRODUCTS CORP., Rochester, N. Y., Care of Reed, Shutt, Downs & Shutt, Wilder Bldg., Rochester, representatives, has been incorporated with a capital of $650,000, to manufacture chemicals and chemical byproducts. The incorporators are E. W. Hinman, F. W. Clements and F. W. Townsend.

THE SOUTHERN BRICK Co., Knoxville, Tenn., has been incorporated with a capital of $25,000, to manufacture brick, tile and other burned clay products. The incorporators are Reed P. Black, Leo I. Fanz, and Charles H. Smith, all of Knoxville.

THE GOLDEN WEST PETROLEUM CORP., Los Angeles, Calif., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws, with capital of $10,000,000, to manufacture refined petroleum products. The incorporators are Sherman S. Clark, James E. Kelby and King C. Gillette, all of Los Angeles.

THE GARDINER FOIL Co., 1356 West Lake St., Chicago, Ill., has been incorporated with a capital of $100,000, to manufacture tin foil and other composition foils. The incorporators are Robert A. and Harry J. Gardiner and F. W. Murray.

THE HALL-SPIERS BRICK Co., Berlin, Conn., has been incorporated with a capital of $75,000, to manufacture brick, sewer pipe, tile and other burned clay products. The incorporators are Wilson and Paul H. Spiers, Cambridge, Mass.; and Frederick M. Hall, 77 Wallace St., New Britain, Conn. The last noted represents the company.

THE VALE CHEMICAL Co., care of the Capital Trust Co. of Delaware, Dover, Del., representative, has been incorporated under Delaware laws, with a capital of $100,000, to manufacture chemicals and chemical byproducts.

THE CITY CHEMICAL Co., Jersey City, N. J., has been incorporated with a capital of $125,000, to manufacture chemicals and chemical byproducts. The incorporators are Henry, Jerome and Max Wolpert, 67 Van Winkle Ave., Jersey City. The last noted represents the company.

THE KEYSTONE CARBON Co., Huntington, W. Va., has been incorporated with a capital of $2,000,000, to manufacture carbon and oil products. The incorporators are T. W. Scott, H. Blaidell and H. T. Lovett, all of Huntington.

THE ILLINOIS GLASS Co., 402 West Randolph St., Chicago, Ill., has been incorporated with a capital of $11,100,000, to manufacture bottles and other hollowware. The company is now operating plants at Alton, Ill., Bridgeton, N. J., and other points. The incorporators are John M. Levis, E. M. Ashcroft, Jr., and C. J. Lord.

THE CAPITOL BRICK Co., Newark, N. J., care of Gifford & Miller, 763 Broad St., Newark, representatives, has been incorporated with a capital of 20,000 shares of stock, no par value, to manufacture brick, tile and other burned clay products. The incorporators are Arthur H. Wolfe, Clarence S. Dame, and C. G. Towne.

THE HANSEN RUBBER PRODUCTS Co., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws, with a capital of $250,000, to manufacture rubber products.

THE BELL LEATHER CORP., Peabody, Mass., has been incorporated with a capital of $10,000, to manufacture leather products. Rogers M. Crehore, 20 Chase St., Danvers, Mass., is president and treasurer, and represents the company.

THE FLORIDA HUMUS Co., Zellwood, Fla., has been incorporated with a capital of $200,000, to manufacture fertilizer products. John A. Hayes is president; Robert J. Rosenthal, vice-president; and Michael J. Perez, secretary, all of Zellwood. The same officials have also organized the ALPHA Co., with similar capital of $200,000, and location, to manufacture like products.

THE PHYMOS CHEMICAL LABORATORIES, INC., Pensacola, Fla., has been incorporated with a capital of $45,000, to manufacture chemicals and chemical byproducts. The incorporators are V. J. and John J. MacIntire, both of Pensacola.

THE GENERAL PLATING WORKS, INC., 2600 Prairie Ave., Chicago, Ill., has been incorporated with a capital of $10,000, to operate a metal-plating plant. The principal incorporator is Lee J. Howard.

Capital Increases, Etc.

THE AMERICAN OIL & SUPPLY Co., 288 Wilson Ave., Newark, N. J., has filed notice of increase in capital from $100,000 to $500,000.

THE HENDERSON TIRE & RUBBER Co., Buffalo, N. Y., has filed notice of increase in capital from $550,000 to $650,000 for proposed expansion.

THE DIAMOND GLUE Co., Robinson St., Chicago, Ill., has filed notice of increase in capital from $500,000 to $2,000,000 for general expansion.

THE DAMON OIL Co., Tulsa, Okla., has filed notice of increase in capital from $50,000 to $1,000,000 for proposed expansion.

THE CAMDEN POTTERY Co., Camden, N. J., manufacturer of sanitary earthenware products, has arranged for an increase in capital from $200,000 to $500,000.

THE EASTERN TANNERS' GLUE Co., River St., Gowanda, N. Y., has arranged for an increase in capital from $1,500,000 to $2,500,000 for general expansion.

THE DUNLOP TIRE & RUBBER CORP. OF AMERICA, River Road, Buffalo, N. Y., has disposed of a bond issue of $15,866,700, a portion of the proceeds to be used for expansion.

THE OAKLAND CHEMICAL Co., 59 4th Ave., New York, N. Y., has filed notice of increase in capital from $10,000 to $750,000 for general expansion.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York City.

AMERICAN ENGINEERING COUNCIL, executive organ of the Federated American Engineering Societies, will meet in Washington, D. C., Jan. 11 and 12, 1923.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its annual meeting in New York City during the week of Feb. 19, 1923.

AMERICAN SOCIETY FOR STEEL TREATING will hold its winter sectional meeting in the City Club, Chicago, Feb. 8 and 9, 1923.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL FOREIGN TRADE COUNCIL will hold its annual conference April 25, 26 and 27, 1923, in New Orleans, La.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

A PAPER INDUSTRIES EXPOSITION will be held in Grand Central Palace, New York City, during the week of April 9, 1923, by the International Exposition Co.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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Benjamin Franklin And National Thrift

THE date of this issue is the 217th anniversary of the birth of BENJAMIN FRANKLIN. There is probably no American living who will remain so eminent. He was a printer and publisher, which we of today count an abundant calling. He addressed himself for the short period of six years to science, and who can match the signal importance of his discovery? Having completed his work in respect to electricity, he regarded the matter as a closed book and hardly even referred to it again. He signed the Declaration of Independence, and those of us who can boast of any ancestor who was a "signer" are disposed to be rather cocky about it. He organized the U. S. Post Office. He was a philosopher and contributed richly to the thought of the eighteenth century. In his old age he was a great and successful ambassador; proving himself a master of statecraft. And he had a great and glorious time in living.

Throughout his days he preached and practiced the gospel of thrift. He kept the thought alive in his mind that material progress is dependent on savings. We know this just as well as FRANKLIN did, but we don't hold fast to the idea. We let it slip away unremembered. We know that every railroad, every telegraph and telephone line, every business undertaking, is established and organized and brought into being and into function by means of dollars that have not been spent on living. Whatever we earn and do not spend is in the bank, or in life insurance, or in investments. Few of us keep it in stockings. The capital of a nation is the reserve of that nation; the reserve that has not been spent on living. We may not make loans on investments ourselves, but if we do not, then our banks do. Whatever we set aside becomes busy money. The reason why we do not make the loans and investments is because we do not save enough. As soon as we have enough, then we buy bonds and stocks, or real estate, or let out our money on bond and mortgage. If we do not save, but spend whatever we earn on living, we do not participate in the wealth of the nation. We are out of it as contributors. We may make wealth by what we do, but the direct contributors are the owners of the shops where we spend our earnings. As between the improvident man who adds by his thought to human welfare and the publican with whom he spends his substance, the source of value is with the former, but the credit and the rewards go to the latter. FRANKLIN knew this and sensed it; hence his constant preaching to save pennies. We all know it too, but many of us do not sense it well enough to remember it when pay day comes around. So the week following FRANKLIN'S birthday has been selected and established by a large number of organizations as Thrift Week. Thrift is to be preached and sounded and rung out and declared by all the arts of advertising and suggestion and applied psychology.

It's curious, but when we consider the contributions of America to the philosophy of life, the first American philosopher who was not at once a theologian and a dogmatist urged thrift upon everybody. And yet of all the civilized nations of the earth our thrift index is certainly the lowest in proportion to our earnings. It is absurd to declare that, so long as money is in circulation, it adds to wealth. It doesn't. Let's take a concrete example. Suppose you have a farm on stony ground. You employ ten men at $3 a day to pick up the stones from one field and throw them into another. Then you employ the same ten men to pick up stones from the second field and throw them back again into the first. They have been employed, and have had their wages, but nothing has been accomplished by you. That is an example of luxury. But suppose you employ the same men to throw the stones from the first field upon a pile and then to plough and sow the field, the while you sell the stones for road-making. That is an example of thrift, and you have a good farm and some extra capital to operate it, while the community has a good road.

It takes head-work to save. The lower orders of people, the inferior persons, can't sense this. They can't compute consequences. But intelligent people look ahead and adjust expenditures to income. They set aside what they do not use. They are wise, like the thoughtful men who made our country for us.

M. C. Whitaker, Perkin Medalist

ADDED to the roster of those distinguished industrial chemists who have been awarded the Perkin medal is the name of MILTON C. WHITAKER. In his selection the representatives of the Society of Chemical Industry and the affiliated chemical and electrochemical societies have indeed made a happy choice, for measured in the wholesome esteem of his fellow chemists WHITAKER is without a peer. And in his industry his position is equally unique. Many of us have acquired the habit of referring to him with some little pride as the sort of executive that is sorely needed by many of our chemical industries. Our respect for him is not solely prompted by the fact that he is a technical man in charge of a great technical organization, but al- because, as a man of vision, he has guided that organ zation with a full sense of the fundamental value of th science on which it rests. At a time when many shor sighted industrial leaders were abandoning researc and scrapping their investigational department, scie tific inquiry under Dr. WHITAKER'S direction was bein prosecuted with increasing zeal. The result was th great and fundamental accomplishment came from h laboratory and research plant. Development work w

continued even during the worst of the business depression. Several products once regarded only as laboratory curiosities were brought out on a large commercial scale. The marketing of absolute alcohol in tank car quantities is but one of the signal accomplishments destined to have almost revolutionary effect on many industrial processes and materials.

To learn of Dr. WHITAKER'S early life and environment is to account for much that he is today. Even as a student he was able to go out in charge of Western lumber camps. This indicated at an early age his leadership of men and his ability to get things accomplished with the least waste of time and money. His native gift and later development of mechanical skill has stood him in good stead. One of his old professors says of him, "He could always do anything with his hands." His unusual power to grasp details in plant construction and to sense and remedy operating defects give credence to the statement. Insights such as these characterize ARTHUR D. LITTLE'S excellent appreciation of the life and human qualities of the medalist.

But it is primarily as an organizer that Dr. WHITAKER has been honored. He has built up organizations that stand as monuments to his record of constructive achievements. In his address of acceptance, we believe our readers will find an unusual exposition of the basic principles that underlie all industrial organizations. He sounds the keynote for success, not alone for chemical production, but in all lines in which science is applied to industry.

Get Out Of the Red

IN what follows we should like to talk to the men responsible for technical control, to the men in charge of the testing department, to the men who are interested in putting quality into the product.

It is seldom realized that the total volume of production of a manufacturing organization is attained through two main groups of influences. First, there are what might be called positive factors—a great number of circumstances such as labor-saving equipment, proper routing, low turnover of workmen, all together swelling the production. It is upon these favorable factors which the "efficiency expert" and production manager spend the most time. Every success is properly bulletined, and appears in the most favorable light in the daily reports going over the manager's desk, and in turn are passed on to the board of directors. None of the latter are so obtuse as to doubt that men who can increase the production of a certain machine by 10 per cent are valuable employees.

But not all the working conditions are favorable. There are a number—often a surprisingly large number—which may be grouped as negative factors, influences which tend to decrease production. In a plant manufacturing articles of metal many of these factors have to do with the quality of metal entering the plant, and of the tools used in its fabrication. And the activities of the metallurgist and the testing department are to a great extent confined to the removal of these drag anchors. Their work is not spectacular, it does not advertise itself, and unfortunately those men actually doing the work do not see to it that the manager gets news of their successes. Nobody makes much of a fuss about the rejection of a certain shipment of metal, practically certain to produce 10 per cent faulty pieces—nobody perhaps except the purchasing agent who thought he was getting a bargain in raw material. But it requires no argument to prove that the man who can prevent a large percentage of rejections (or dissatisfaction by customers) is as important as he who can get ten completed units where nine only came before.

In short, total production is the difference between positive factors and negative. The metallurgist often is intent on cutting away the latter, and rightly, but unfortunately his successes never are segregated in the reports, and he seldom can point to a certain positive thing as his achievement. What is more natural, then, than that he should be regarded merely as a salary expense to be lopped off at the first demand for economy?

Metallurgists, to come into their own, must therefore get off the debit side and into the credit side of the ledger. Cultivate the auditor, and have him start an account for the testing department, as he has already done for the warehouse. These people usually do business like a department store—they buy and stock all manner of things used about the plant, and sell them upon demand, charging a sufficient margin to cover the cost of handling, purchasing and bookkeeping. At the end of the year, they show a certain small profit on the books. Is this service fundamentally different from that rendered by the testing department? If the purchasing agent were to have a shipment inspected and analyzed by an independent laboratory he certainly would expect to pay for the report, and the expense would be loaded on the selling price when the material left the warehouse. Or, if the grinding department was having troubles with "alligator cracks" and secured the advice of a consultant, they would not balk at the fee.

Just because a plant has a testing department, metallurgist and chemist is no reason why that department or those men should be called upon to do all these jobs for everybody gratis. The surest way to get on the right side of the ledger is to have a departmental account started. Then charge a fair fee for the services rendered, and insist upon a credit whenever large savings result from an independent investigation. You'll be surprised how quickly you get out of the "red ink."

Lime Manufacture A Chemical Industry

"OUR aim has been to place the lime industry on the same footing as any other chemical industry. In the past it has, in this country [England], been treated more like the manufacture of bricks for example; and even in America it is only in recent years it has risen to its proper place as the industry concerned in the manufacture of one of the most important chemical reagents."

The compliment which is so gracefully expressed by our British friend quoted above is well deserved by some of the American producers; but there are others who still lag far behind in their progress toward a better understanding of what chemical lime really is, what standards of composition and performance can be expected of it, and how most economically to produce the optimum quality. The statement really indicates only an important trend in this important industry. It is a trend that might be speeded up by greater chemical activity in lime manufacture without any detriment either to manufacturers or users.

The making of high-grade chemical lime at the lowest cost demands no little chemical engineering skill. He who neglects to recognize this fact will shortly find himself outdistanced by more progressive competitors.

What's Behind The Stock Dividend?

THE EPIDEMIC of stock dividends which broke out so virulently during the closing months of the old year continues to excite public discussion. Opinions continue to differ widely as to their purpose and effect. In view of the leading part played by the Standard Oil group in the distribution of such dividends, particular interest attaches to the vigorous defense of the policy advanced by A. C. BEDFORD in his recent address before the American Petroleum Institute at St. Louis.

Mr. BEDFORD flatly denies that stock dividends result in any tax evasion. Further he makes a strong plea for the essential soundness of the process of building up a surplus from current earnings, plowing it back into the business and capitalizing it through the issuance of new shares to old stockholders. The issuance of the stock dividend, he insists, means merely "changing a dollar into four quarters." It creates no new wealth.

Economists and accountants generally will agree that the simple act of declaring a stock dividend creates no new wealth. They will also agree that the increase of the capital fund is essential to the progress of business and the country generally. Finally, they will admit that the stock dividend does not offer a method of tax evasion in any legal sense. However, having conceded all of these points, an honest, inquiring mind may still hunger for a deeper analysis than Mr. BEDFORD has made. Is there nothing more than this to the stock dividend epidemic? Is there no rational explanation for the conviction so generally prevalent that the stock dividend is significant of some condition which needs correction?

Mr. BEDFORD apparently accepts the orthodox definitions of wealth and income, for he argues that the stock dividend is not income because it creates no "new wealth." One has income when his wealth—his economic strength, in the sense of command over goods and services—has increased. This is the general conception of income which underlies our federal income tax law. With this definition in mind, let us raise a few queries which may serve to clarify the issues.

Suppose you were to invest twenty-five cents in the Standard Oil Company of New Jersey. Suppose the company prospers and builds up a large surplus, your share of which amounts to the value of seventy-five cents, so that your interest in the company is now worth a dollar. Suppose the company declares a stock dividend "changing the dollar into four quarters." Has anything of significance happened? Has your economic strength increased? Have you received any income?

Clearly the stock dividend simply recognizes an existing situation. It recognizes that the quarter has expanded into a dollar and makes the convenient "change." But the significant thing is that you are ahead to the extent of seventy-five cents in value—not merely because of the stock dividend—but as the result of the whole process. At the beginning you had a quarter invested in productive enterprise. Now you have an investment worth, by assumption, a dollar.

The real nub of the matter from the tax point of view is this: The process described in the above example is about the only way you can make seventy-five cents and reinvest it in productive enterprise without subjecting the three new quarters to the heavy surtaxes of the federal income tax. The corporation pays the normal tax (slightly higher, it is true, than the individual normal rate) when it adds the new quarters to surplus, but you are asked to account for them only *if* and *when* the corporation distributes them to you as a cash dividend or *if* and *when* you sell your stock at the enhanced value due to the surplus which has been built up. Thus, this "if and when" is of considerable importance.

If you had invested your original quarter in an equally prosperous individual enterprise or partnership you would have been asked not only to pay the normal tax as the new quarters were earned and reinvested, but would also have been compelled to pay the surtaxes on them *when earned* rather than "if and when" distributed or "if and when" the stock was sold at an advance.

Clearly the corporate form of business organization has an advantage under the tax law because of this situation and the stock dividends are advertising this advantage in a most striking manner. It is this advantage which is really the shining mark at which the "agitators" are aiming. Is it not an advantage which must in some manner be equalized if the "sturdy qualities" of individual initiative and resourcefulness, which Mr. BEDFORD so properly praises, are to be given full play?

How to accomplish this is, indeed, perhaps the most puzzling tax problem which the federal government is facing. It cannot be solved by refusing to recognize its existence or by approaching it from the point of view of one industry, one form of business organization, or one economic class. The differential in favor of the corporation may conceivably be removed by increasing the burden on the corporations or by decreasing the burden on the other forms of business enterprise. The "agitators" suggest a new tax on the undistributed surplus of corporations as closely equivalent as possible to the present surtax burden on reinvested earnings of other forms of business enterprise—a suggestion which Mr. BEDFORD labels "a proposal of sabotage by legislation." The fear of such a tax is probably a contributing cause, although not the sole or perhaps not the most important cause of the stock dividend epidemic. The alternative plan for eliminating the corporations' differential would be to reduce the present burden upon reinvested profits of partnerships and individuals. But he who proposes this must be prepared to convince the public that a dollar of wages should be more heavily taxed than the dollar of reinvested profit. This is the dilemma!

Co-operating With The Customs Authorities

MORE than usual significance attaches to the important series of conferences now under way for the purpose of considering the proposed rules and regulations which will govern the Treasury Department in administering the new tariff law. For the first time in history manufacturer as well as importer is being given a chance to participate in the discussion. He is expected to contribute valuable basic information on prices and commodities, particularly as regards coal-tar products. The tariff act of 1922 contains many snarls of construction and definition which are yet to be untangled and the net result of these conferences will often determine whether or not certain of the protective provisions will actually become effective. Later, it is our intention to give more detailed consideration to some of these administrative difficulties, but in the meantime we believe that the customs authorities should receive the fullest co-operation from the chemical industry.

Milton C. Whitaker, Perkin Medalist, 1923

Sixteenth Award for Meritorious Accomplishments in Applied Chemistry Goes to Industrial Leader Characterized as "Investigator, Organizer and Doer"—Addresses of Appreciation by Associates—Presentation by Charles F. Chandler

IT IS particularly significant that this year the Perkin medal should have been awarded to an outstanding industrial leader who has actively sponsored fundamental research and through it has built up a great and lasting chemical industry. These were the "meritorious accomplishments in applied chemistry" that prompted the joint committee of the chemical societies to award this coveted medal to Milton C. Whitaker, president of the U. S. Industrial Chemical Co. and vice-president and director of the U. S. Industrial Alcohol Co. The presentation took place under auspicious circumstances at the meeting of the American Section of the Society of Chemical Industry, held in Rumford Hall, New York City, Jan. 12, 1923.

In his introductory remarks, Prof. Ralph H. McKee, chairman of the section, referred briefly to the founding of the medal in 1906 and to the list of illustrious chemists, beginning with Sir William H. Perkin himself, who have since received the award. At this point a little leaven was added to the otherwise heavy program by the reading of a number of congratulatory telegrams, not the least significant of which came from the Anti-Saloon League of America and the Kelly-Pool Gang of the Chemists' Club.

The first of the speakers was Arthur A. Backhaus, introduced by Chairman McKee as "one of that large group of young men who have worked under and with Dr. Whitaker and have helped him to bring to successful accomplishment several significant commercial enterprises." Mr. Backhaus, with an apology that "a close-up on so large a subject is likely to be very much out of focus" proceeded to share with the audience his "Impressions of the Medalist." His views in part were as follows:

Some Impressionistic Views of Whitaker

By Arthur A. Backhaus

During the summer of 1914 Dr. Whitaker, then head of the chemical engineering department at Columbia University, was seeking an assistant. Professor Chambers, with whom I had done my undergraduate work recommended me for the job, which in turn was offered me and I accepted it. The entire negotiation consisted of but two letters, one in which the position was offered, the other in which it was accepted, although neither of us knew the other. I arrived in New York on the morning of September 16, and in the afternoon I reported to Havemeyer Hall, Columbia University, wondering what my new boss was going to look like. Dr. Whitaker was in his office, seated at his desk, completely filling a roomy chair. He had his coat off, sleeves rolled up, hair ruffled, hard at work as one usually finds him. I was impressed, not only by the size of the man but also by his speed, "his velocity coefficient," for before I knew it I had been hustled into the laboratory and put to work. From that day until now I have been honored in calling Dr. Whitaker my boss.

Some Personal Characteristics

Dr. Whitaker has an unusually keen insight into chemical processes and chemical plants. He can size up a plant operation, see the weak spots and suggest remedies or improvements. He invariably turns the spot light on jokers in proposed new processes. His mind not only grasps broad features and general principles, but also takes in minute details.

Dr. Whitaker has said on several occasions, that the successful plant or works superintendent must have the faculty of instinctively "happening on the spot" at the psychological moment.

I have often been impressed with the fact that Dr. Whitaker can make a little chemistry go farther than any man I know. This applies not only to chemistry but to other information. His ability to apply knowledge or practice from an unrelated field to a problem at hand comes up again and again.

It is probably not necessary to dwell upon the ability of Dr. Whitaker to express himself in clear and forcible English. His clearness in expression is due to his extensive vocabulary and his apt choice of similes and metaphors. Many here have probably heard him speak of research chemists as "prima-donnas who must be handled with kid gloves." Unfortunately his most picturesque expressions would not appear well in print.

Dr. Whitaker differs from many other executives in that he thinks his problems out clearly and completely. He not only fixes a definite goal, but also works out, in his own mind, at least one good way of reaching it. In all his dealings with his men he plays the game with all his cards on the table.

Conferring the Medal

Following the delivery by Arthur D. Little of his inspiring appreciation of the medalist, Dr. Charles F. Chandler, senior past president of the Society of Chemical Industry in America, was called upon to make the actual presentation of the medal. The venerable dean of American chemistry read portions of his prepared address which reviewed the life of Dr. Whitaker and listed references to all of his patents and published articles. "It gives me the greatest pleasure," he said, "as the representative of the Society of Chemical Industry and the affiliated chemical and electrochemical societies of America, to place in your hands this beautiful Perkin medal, as a token of the appreciation and affection of your fellow chemists."

In expressing his deep appreciation of the honor thus conferred upon him, Dr. Whitaker said:

> It has been my good fortune to be an organization man rather than an individual worker. Achievements which have resulted in the award of the Perkin medal to me are necessarily therefore achievements of the men with whom I have worked. It would be a pleasure to catalog the names and individual accomplishments of these men, but the list would be so long and involved that it is probably better at this time to generalize. Accordingly the medal is accepted by me, in a representative capacity, as a distinguished honor conferred by the American chemical profession on these men with whom I have been associated in the 30 years devoted to study and practice in the field of applied chemistry.

Dr. Whitaker's address of acceptance, a remarkable exposition of the principles of organization, will be found on pp. 104 to 109.

Chem. & Met., Jan. 17, 1923.

Whitaker and His Work

BY ARTHUR D. LITTLE

MEN are sometimes distinguished for what they do and sometimes for what they are. More rarely are we permitted to honor them for both. Milton C. Whitaker is a chemist who has earned distinction by his works, but he is first, last and all the time a man.

The realm of Chemistry is not a single and isolated state, nor are its workers unionized. It is, instead, a Commonwealth of Federated Nations, each rich in resources of its own which require special aptitudes for their development.

So it happens that Chemistry can only realize the potentialities of her estate through the co-ordinated efforts of workers of many types and diversified endowment. Some must be patient and persistent garnerers of facts and gleaners of detail; others, highly skilled manipulators to divide that which we have called the indivisible. Some must be students and thinkers, whose thinking leads to generalizations. There must be teachers and expounders, to spread the truth, and doubters and disputants, lest error pass for truth. Finally, that mankind may derive material benefits from these accumulations of knowledge, there must come the organizer and doer, whose bottles are tank steamers, whose test tubes are digesters, and his beakers 50,000-gallon tanks. As student, teacher, editor, Milton C. Whitaker has won high place in our esteem, but tonight it is primarily for his position and achievement as the organizer and the doer that we are met to honor him.

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MILTON C. WHITAKER

Those of us whose professional activities center in the study, the class room or the laboratory are commonly inclined to award a disproportionate meed of merit to that one whose discovery of fact, material or reaction supplies the basis for a great industrial development. They seldom recognize or appreciate the obstacles and difficulties along the steep and rocky road which leads from the laboratory to the plant. They do not see the caulkers on the first Burton still closing the leaking seams between hot boiler plates in an atmosphere of gasoline. They do not know how it feels to work sixty-four hours at a stretch to push along repairs or how Saturday looks on Friday with no money in the bank to meet the pay roll. It is a wise invention that knows its own father. Countless examples can be adduced to show that the organizer, the adapter, the engineer plays a part in the development of industry that is often vastly more constructive than that of the discoverer. We commonly and properly attribute the telephone to Bell, but the instrument as we know and use it is the child of many minds and the godchild of the organizer. Barconnot, in 1918, effected in a laboratory operation the conversion of cellulose to sugars and through them to alcohol. It required thereafter nearly a century of effort to transform that relatively simple laboratory procedure into a commercially operative process. The vast and intricate coal-tar industries, which have so greatly stimulated chemical science, owe their many-sided development as certainly to the organizer and administrator as to the laboratory worker, even though that worker be Perkin himself. It is, therefore, peculiarly fitting that the medal, which commemorates Perkin's great contribution to our science and to industry, should this year be bestowed on one who has shown superlative ability in the application of chemistry to industry on the grand scale; who has the faculty of sensing fundamental principles and necessities in their broad commercial and economic relationships and of building on them great producing agencies.

Milton C. Whitaker was born in Frazeysburg, Ohio, December 16, 1870. Doubtless there were boys in Frazeysburg who tried to lick him, but history records none who did. Later, his family moved to Colorado, and during the four years beginning with 1890 young Whitaker worked in the various lumber mills of Stubbs and Jakway, cherishing always the ambition for a college education and a degree in chemistry. The youth showed the quality of the man, and concerning his work the testimony of his employer may be thus summarized. Ability as a mechanic was evident from the first and with it a natural and unusual power to grasp details and detect and remedy defects in plant and operation. He soon became master-mechanic and when a little later, owing to the exhaustion of the local supply of timber, it became necessary to dismantle the mill, transport the equipment and re-erect and house it on a new site, the task was assigned to Whitaker. So well did the youth repay the confidence that the new mill proved the most successful that the company had operated. In 1896 the company decided to build another mill and for this Whitaker, though then at college, prepared the working plans and during his summer vacation supervised construction. It was a good mill, of which its owners said years afterward, "It has not lost a single day because of faulty construction."

So Whitaker earned and saved and studied until in 1897 he was graduated from the Universty of Colorado with the coveted B.S. degree. Degrees have this in common with olives in a bottle and the kisses of a girl:

The first one is hard to get, but the others come more easily. An M.S. from Colorado followed in 1900 and an LL.D. in 1913, and to these the University of Pittsburgh added Doctor of Chemical Engineering in 1915.

Following his graduation Whitaker became instructor in chemistry at Colorado and in 1898 tutor in chemistry at Columbia. Here he came under the benign and stimulating influence of that honored and beloved dean of applied chemistry in America, Dr. Charles F. Chandler, whom he was privileged to serve as private assistant for nearly four years. That in itself was a liberal education.

His Impress of the Mantle Industry

Whitaker's intimate contact with chemical industry and his constructive influence thereon began in 1902, when he went to the Welsbach Co. as chemist, on the recommendation of Dr. Chandler, who had for years been its consultant. From Whitaker's associates in this new connection one learns that his impress on the organization was almost immediate and ultimately profound. He was at first engaged upon work of a purely chemical character in the laboratory under the direction of Dr. H. S. Miner, but through the laboratory he was gradually brought into general touch with the operations of the plant. Whitaker had been with the company only five or six months when Dr. Miner came down with typhoid fever, and the responsibility for production fell upon the shoulders of his assistant. As we should now expect, Whitaker handled affairs in the plant in a masterly way, going at once to fundamentals, and as troubles arose finding the means and methods for the prevention of their recurrence. Collodion was the bugbear of the industry. Its viscosity with the same solvent and concentration varied over wide and confusing range. As with most colloids at that time, little was known concerning methods of controlling this disturbing factor. Whitaker promptly secured a man experienced in the manufacture, installed a small plant, and worked out the problem of control with large resultant savings and the elimination of many difficulties elsewhere in the factory.

In 1903 he went to Shelby, North Carolina, to inspect the company's monazite mines and there became terrifically ill with a digestive trouble, from which he nearly died. It is reported, though difficult of credence, that "he returned a shadow." Happily, the substance is now restored to us.

With renewed health came his appointment as general manager of the company, and Whitaker initiated a general campaign for the improvement of the hidebound methods of the mantle industry. He worked out a new flow-sheet and rearranged the factory. He enunciated the principle that "a man is as good as his boss," and with this sense of responsibility for their performance he picked leaders with a wise discretion and developed them into departmental heads. His ambition was to evolve a self-contained plant and an organization he could leave. He fixed responsibilities and demanded results, organized weekly conferences, established systems of reports that stimulated healthy rivalries, wrote historical and educational bulletins for the sales department, developed a research laboratory and a system of control throughout the plant, built a club house for girl employees, installed a hospital, invented testing machines. He put in a print shop to obviate delays, a lamp shop to broaden sales, a development shop for the incubation of new mechanical ideas. By standardizing the process of collodion dipping he saved twenty per cent of the collodion used. He substituted the electric drive for rope transmission, developed machines to replace hand labor, invented the present system of packing the fragile mantles, improved the equipment and methods of the bleaching room. In short, he was responsible for betterments in practically every stage of the manufacture in the company's plants at Gloucester, New Jersey, Chicago, and Columbus, Ohio, and he left his impress on the industry from the time the order was received until the goods went out on the platform. It is an achievement to handle material efficiently. Whitaker did far more. He developed *esprit de corps* in men and women, created an organization from human beings, and secured and held their warm affection. Small wonder is it that during his connection with the Welsbach Co. costs of production went down steadily and its business more than doubled.

The Return to Columbia

It was with such a background of achievement and experience that Whitaker returned to Columbia in 1910 as professor of chemical engineering. Of his work and influence while there we cannot do better than record the impressions of a student whom he inspired, of a close associate who worked with him in understanding sympathy, and of Dr. Nicholas Murray Butler, his administrative chief.

The student says:

"It was heretical to cut one of Dr. Whitaker's lectures, and there were never heretics. A class convening for a quiz on multiple-effect evaporation would find, after the bell had rung, that the subject of discussion was the longshoremen's strike just declared that day in New York City. The quiz on evaporation would be given at the following session. In the meantime, wages, living conditions, labor policies and legislation were moved down stage for closer inspection. A chance remark by someone in the class would cause the interruption of the order for the day while some principle of professional ethics, industrial justice or downright decency was explained in a manner that left an indelible impression on the minds of young men. The verbiage of technical texts was never heard in Dr. Whitaker's classes. Even in the routine of teaching fundamentals, things sounded different, more tangible, more homely. And when those fundamentals were brought forth for application to practical problems the pedagogic atmosphere was dispersed completely. Dr. Whitaker's students have perhaps forgotten where they first learned how to select the right type of filter press, but they will always remember who taught them to think like engineers and to behave like men."

The estimate of the associate is this:

"Nothing but a long talk could possibly cover the subject of Whitaker and his work. I suppose his outstanding characteristic might be called moral and professional courage, with a very high order of sales ability. He loved a problem, he loved to dig out its solution even more, but most of all he loved to put his solution across, to sell it against opposition. At Columbia he made Chemical Engineering. Without him it would never by any feature of identity have been distinguishable from Industrial Chemistry. This is history that went beyond Columbia."

Dr. Butler writes:

"I rejoice at the good news that Dr. Whitaker is to receive the Perkin medal. He certainly has earned it. He showed while with us marked initiative, administrative capacity and single-minded devotion to science. He realized to the full the close interrelations between what is sometimes called pure science and what is sometimes called applied science and he labored effectively to promote and to develop these relations. So vigorous was his work and so large his influence that a Department of Chemical Engineering was in fact, even earlier

than in form, set off from the Department of Chemistry and put under his direction. We look upon him as one of our own and follow his career with pride and satisfaction."

Combining Chemistry and Finance

Dr. Whitaker had always maintained that the effective teaching of chemical engineering required of the teacher close and continuing contacts with industry. In developing such contacts for himself, he soon established relations with those who stand within the circle of opportunity. His executive ability, soundness of judgment and technical attainments were quickly recognized. He gained the confidence of capital and effected that difficult synthesis which involves the combination of chemistry and finance. As a result, he was called in 1916 to become manager and in 1917 president of the Curtis Bay Chemical Co. and, following reorganizations, president of the U. S. Industrial Chemical Co. and vice-president and director of the U. S. Industrial Alcohol Co. In this latter capacity his position is, in one respect, undoubtedly anomalous. Most manufacturers strive to pass on to their customers the best they can produce. Whitaker turns out a product of surpassing purity, for which the demand is well-nigh universal, and he then deliberately, if not indeed maliciously, adds to it objectionable and insalubrious compounds which remove it from our sphere of non-professional interest.

The technical operations for which Whitaker is ultimately responsible in these two great companies are conducted on a scale of amazing magnitude. They afford convincing evidence of the fundamental importance of alcohol as an industrial raw material and justify the demand of our profession for less burdensome and more intelligent regulation of its industrial use.

The basic activity of these plants is, of course, the manufacture of alcohol from molasses, which in the sugar-producing countries was formerly thrown away in vast amounts. Obviously, however, when alcohol is made on the grand scale fermentation byproducts, though of small percentage value, assume a large significance. Here aldehydes, as well as alcohol, are utilized in vinegar making, fusel oil is split into its component alcohols, the carbonic acid, carefully purified, is compressed in cylinders, sulphate of ammonia and potash are recovered from the distillery slop by evaporation in multiple effect and furnacing.

The alcohol itself is marketed in many forms, each involving special operations. It may go out as tax-paid alcohol, 95 per cent or absolute, or as spirit denatured to meet the requirements of special industries or uses. Much is converted to the familiar solid alcohol and such amounts to tincture of iodine as to require a separate plant for the purification of the element by steam-distillation. Many thousands of gallons of anhydrous alcohol are daily mixed with gasoline to produce the motor fuel Alcogas. To those who, like ourselves, have regarded absolute alcohol as a laboratory luxury and who are familiar with the refinements required for its preparation, its production on this scale and at a cost permitting such use stands forth as a conspicuous technical achievement.

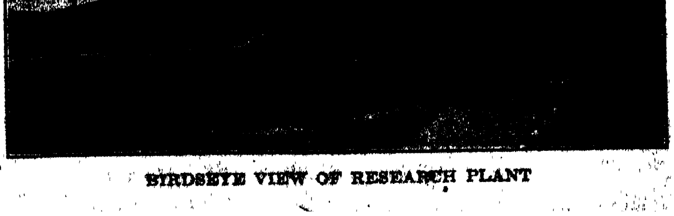
The range of Whitaker's professional work is further demonstrated by the varied subject matter of the twenty-two patents granted him as sole or joint inventor. Of these fourteen are in the former class. Among the inventions covered are containers for fragile gas mantles and those for gases and volatile liquids; processes of gas manufacture, distillation, pulping resinous woods, recovering catalysts, and making ethylene; apparatus of varied types and motor fuels. With it all he has found time to publish important papers to the number of twenty-five, dealing with such diversity of topics as the rare earths and their place in industry, water gas and oil gas, the war supply of nitrogen, the cracking of hydrocarbons, the carbonization of coal, and many others.

Professional Appointments and Offices

As members of the American Chemical Society, we gratefully acknowledge our own signal indebtedness to Whitaker for his upbuilding of the *Journal of Industrial and Engineering Chemistry* and for the stimulus of his editorials during the six years ending with 1916. If you would know Whitaker himself and his professional and business attitude, go back to his famous editorial of September, 1912, on "Fussy Administration." If you are an executive, or if you hope to be one, it will give you something to think about.

To the profession generally Whitaker has given generously of his time and effort. In 1911 he served as chairman of the New York Section of the Society of Chemical Industry and in 1914 as president of the American Institute of Chemical Engineers. He was for several years a member of the latter's committee on chemical engineering education and in December, 1910, presented clean-cut, constructive suggestions in a paper on "The Training of Chemical Engineers." From 1915 to 1917 he was president of the Chemists' Club, and that honorable office is no sinecure. While carrying his great responsibilities for the production of war materials at the plant of the U. S. Industrial Chemical Co. at Curtis Bay, he served for two years as advisor to the War Industries Board.

Such, in brief outline and under dim illumination, is the career of the man whom we are proud to honor tonight. We award the Perkin Medal to him because he has shown himself to be a great constructive force in the field of applied chemistry, but it is his intensely human quality for which, after all, we value him most dearly. His corpuscular count is high. He knows men and handles them with consummate skill. He can call a spade a spade and if necessary, he can call it something a whole lot worse.



BIRDSEYE VIEW OF RESEARCH PLANT

ORGANIZATION
The Keynote of Successful Chemical Production

by
Milton C. Whitaker

Address of Acceptance on Being Awarded the Perkin Medal by the American Section of the Society of Chemical Industry and Affiliated Chemical and Electrochemical Societies

ORGANIZATION for this or that purpose is a venerated topic for speech makers—especially efficiency experts and others with more or less amateur standing. Organization for chemical development and production has been spared much of this limelight, probably because of the new elements introduced and the greater difficulty in understanding the problem or even the language of chemical industry.

Nevertheless the fact must be recognized that no program of chemical production can be carried through without an adequate organization, any more than mechanical production can be accomplished without operators, or railroads run without men. While research chemists and physicists are laying the foundation for products, processes and plants, it is incumbent upon somebody to develop, study and perfect, concurrently, a suitable organization to carry their research results through the various stages of development and finally to profitable production. Furthermore, organized effort is obviously more rapid, efficient and thorough than single handed work, and this applies to every step from research to sales.

Accordingly, it seems appropriate, in spite of the overworked character of the subject of organization, to outline some of the methods which my associates and I apply to chemical development in order to arrive at the results which the committee of the Society of Chemical Industry has accepted as collectively justifying the great honor of the Perkin medal.

Eight Elements of Organization

Arthur Little once said "There is great danger in an organization chart—someone might mistake it for *an organization*." After this apt, if somewhat blunt, awakening, we would not venture even to submit an organization chart. For the purposes of developing and coordinating the work of organization, the problems requiring individual treatment and timing may be arranged under the following general heads:

1. Objective.
1. Direction and Policy.
3. Research and Engineering.
4. Construction.
5. Operation.
6. Office and Accounting.
7. Sales and Promotion.
8. General Seasoning.

Time will not permit a detailed analysis of the methods of development for each of these organization headings, but the system which we have followed may be illustrated by selected examples.

The objective of an organization requires the most careful analysis. This applies to all organizations, whether old or new. What is it supposed to do and for where is it headed? Obviously the scope and extent of an organization should be adjusted to the facts developed by such an analysis. Overorganization seems to be the most general fault. We saw many cases during the war where there was so much organization that there was no one left to do the work. Frequently we still find organizations "all dressed up and no place to go."

The direction and policy of an organization for chemical production is obviously, on account of its basic position, the most important element of the whole program. An organization without proper and carefully defined policy is like a ship without a rudder. It may gyrate around without going anywhere in particular,

or it may, in close quarters, do a great deal of damage, both to itself and to its neighbors. Furthermore, a policy should be carefully worked out in the beginning and must "stay put." Missteps in the formulation or execution of policy may be of little consequence at the time, but may at some future date loom up like a rock in the channel. In any project of development, therefore, direction and policy deserve and must receive, far in advance, the most profound and intelligent consideration.

Organizing Research

Research and engineering are the logical preliminaries to the development of any new program of chemical production, and we believe are equally necessary to improvement in the efficiency of established operations. Volumes have been written on the subject of organization for research. We claim no originality for the systems which we have adopted, but take this occasion to record some typical schemes followed in our work, in the hope that they may serve as guides to others in what to do or what not to do according to their desires or tastes.

The overhead set-up for research must be analyzed as a preliminary to any plan to develop a research organization. The objective, interest and resources available to the directors and executives are of primary importance in any research program. Their ability to understand the scope of our activities, their confidence in our abilities, their determination to see the thing through, and their capacity to stand disappointments, are qualities which must be measured and will form the foundation on which the program may be built. In short, ambitious researchers must exercise care in the selection of their bosses.

Many research projects are doomed to failure before they start, because of the lack of interest or understanding on the part of the overhead. If research is to be a part of an organization at all, it is entitled to the full benefits of co-operative support of every man in that organization from overhead to office boy. Research men are liable to be sensitive and sometimes temperamental. They respond to encouragement and wholehearted support, while on the other hand, a single knocker may wreck the works.

Sympathetic Direction and Support

The greater portion of our organized research effort has been with the Welsbach Co., Columbia University, the U. S. Industrial Alcohol Co. and the U. S. Industrial Chemical Co. The confidence and undivided support which we have received from the directors and officers of these organizations, and the mistakes they have stood for and paid for, form the basis on which we have been able to build recent organizations.

We always see to it that officers and directors understand what we are trying to do and how we are trying to do it. We discuss our projects and policies and program with them. We do not even deny them the privilege of sharing our disappointments and understanding our failures. We have received in return encouragement, confidence, support.

A president of a corporation or a chairman of a board who reads and understands the research reports, knows and follows the progress of the work of every chemist and engineer in the organization, who champions the fellow who is down and encourages the fellow who is up, and who interprets these results and conditions to his directors, may be a rarity in some programs for the development of chemical production, but in our cases he has been the inspiration. We attribute these conditions to the care we have exercised in the selection and training of our bosses. They doubtless will ascribe it to other reasons.

Our research organizations consist of personnel, equipment, problems. Diversifications of all three of these elements, within the scope of the project, is both necessary and desirable.

Picking Men for Team Work

We have no formula for the selection of the men. We do not believe any one can pick a winner every time from a group of available chemists. Our best guess, based on training, experience and temperament as disclosed by the candidate, is given a trial in the organization and the candidate is given reasonable time to adjust or eliminate himself by a process of natural selection. Many chemists who think they are research men are not qualified either by training, ability or temperament to handle research problems. Yet these same men may be or may develop into excellent plant men. It likewise follows that many chemists who think they are qualified by nature to handle plant problems are essentially research men. Some men are not fitted for either research, plant or sales and would probably do better in insurance or music. A man who is essentially a plant man is liable to be a nuisance in a research laboratory, and on the other hand, a man with research inclinations is a hazard to any production process.

Diversification of training and experience among the members of a research organization is of the utmost value when the organization works as a group. While each investigator may have his particular problem, team work is a necessary element in order to achieve the greatest results.

The man who is inclined or prefers to play a lone hand, who is selfish or secretive, is out of place in any organization. Individual effort is limited to the capacity of a single person, whereas the advantages of an organization should be capitalized by producing results which represent the combined effort and experience and knowledge of a number of men participating. Thus it is that many successful developments come from the laboratory for which it is difficult to award the credit to any individual.

Equipment for industrial research is selected according to the number and scope of our problems, and the amount available is made or acquired in accordance with our needs and the progress of our work. A laboratory for the development of new processes and products should contain all necessary physical and chemical apparatus for the investigation of each fundamental principle involved in the projects under study. Every theory and fact contained in the literature and bearing directly on the problem or related problems is made available to the investigator before work is actually undertaken. We regard this as much a part of our research equipment as the apparatus and desks. Most of these chemical and physical facts and theories have to be checked and confirmed, and the laboratory equipment should be ample to meet these requirements.

Organizing the Experimental Unit

As the results of the laboratory work are completed checked, plotted and discussed, plans are considered for an elaboration of these principles into a small labora

tory apparatus. Confirmation of theories and reasoning at the laboratory desk and further consideration and discussion of results bring us to the point where co-operation is required between the chemists and the engineers.

We believe that the place to start and finish a real chemical engineering problem is in the research laboratory. For this reason our engineers work with and rank with our research chemists. Personal contact and discussion during the laboratory development and close co-operation in the planning of a semi-commercial unit have avoided many misunderstandings and failures.

Our experimental units have for their purpose much more than the checking of the laboratory results obtained by the research chemist. These units are scaled to a size that will permit of a continuous operation over a considerable period in order definitely to establish engineering data for use in the design of commercial units, and to determine capacity, quality of product and materials of construction. It must also produce a sufficient quantity of the product to enable it to be sold and finally to determine if it meets the supreme commercial test, that is, to *stay sold*.

We operate these experimental units from six months to two years, depending upon conditions, changes re-

FIG. 1—CHEMICAL LABORATORY OF RESEARCH PLANT

quired, market tests, etc. During this period, the operation is under the close observation of the research chemists who established the basic data for the process, the engineers who co-operated and designed, and if possible, the mechanics who built the apparatus. Even the plant organization which may ultimately be expected to erect and operate the commercial units, and the sales department which has to sell the product and make it stay sold, are kept in contact with the work.

Incidental to this experimental operation, all questions of quality, specifications, market requirements, containers and natural sales units are determined. The purchasing office becomes familiar with the problems involved in locating, specifying and buying raw materials, the apparent hopelessness of the problem of costs and accounting in the operation becomes clarified for the auditors. And finally the clerks, stenographers and office boys add the new names to their vocabulary and discuss the prospects of the new process with assurance.

Innumerable other elements such as I. C. C. regulations, insurance risk, workman hazards, keeping qualities, etc., are determined so that when commercial units are finally undertaken, all of the elements from design to sale of products are settled and behind us.

Concentration on research problems, based on the needs and requirements of the organization and its policy for development, requires courage and persistence, but it must be regarded as necessary in industrial work. An industrial research laboratory has a different objective from that of the academic institution. We endeavor to achieve constructive results within a limited field, and in a reasonable time, which aim at the building of a plant and the production of a product at a profit. The academic investigator, on the other hand, may choose his problem from the unlimited field and for the purpose of making a contribution to science or of qualifying for a degree. The objective of the industrial investigator is a process and a plant to which he can point with the pride of achievement, whereas the objective of the academic investigator is a contribution to science and publications to which he can with equal fairness point with the pride of authorship. The former measures his success by the amount of factory noise and smoke his work creates, while the latter may modestly acknowledge the cheers of his peers, or may measure his success by the amount of printer's ink he has caused to be consumed.

THE BEGINNINGS AT BALTIMORE

Such a research organization as outlined was established in the fall of 1916 in the industrial outskirts of Baltimore. We selected as a building site a large potato patch and surrounded it with a high fence enclosing several acres. Here we developed what might be called a "research plant." We are inflicted with neither neighbors nor architects. The lighting, heating, ventilation and drainage were planned by and for chemists with the result that we have an abundance of each. Architecturally, as may be observed from Fig. 1, the chemical laboratory is below par, but it is what it was built for.

By the beginning of the year this plant was in full operation, manned by chemists specially qualified by analytical, organic, physical or biochemical training, and brought together from Maine to California with a liberal allowance for intermediate points. The chemists were reinforced with engineers, assistants, mechanics and bottle washers. The specific problem placed before this organization was the development of uses of alcohol and the utilization of the byproducts of the alcohol industry.

The work of the laboratory was soon interrupted by war problems and the entire time of the organization was devoted for over a year to the development and improvement of processes for the production of acetic acid, acetone, methyl acetate, ethylene and solvents for airplane dopes. The acetone process, which at one time supplied 60 per cent of the war requirements for acetone, was discontinued at the signing of the armistice. Methyl acetate and solvents for airplane dopes were no longer in demand and the process for the direct production of acetic acid was abandoned in favor of the byproduct acid. Ethylene has since achieved considerable commercial development as a gas for cutting and welding and as a standard chemical.

Thus at the end of 1918 we were like many other research organizations—going strong, but not in the right direction.

While the surveyors were staking out the site for the laboratory, a competent group of chemists were building up our equipment on the "state of the art." Every literature or patent reference, directly or indirectly related to our problems, in every country and

language was studied, translated if necessary, abstracted, classified, indexed and made available to the laboratory staff. This file now includes over forty thousand references kept strictly up to date. These searchers are in constant contact with the laboratory, supplying them with advance information, helping over the humps and bringing up the rear on patents. The department has since been expanded into a general information service for the entire business, including contemporary progress, commercial development, statistics, foreign relations, etc.

QUALIFICATIONS OF THE GOOD OPERATOR

Good operating chemists and engineers are in a class by themselves. Patience, caution and conservatism are not natural to a chemist who has been trained to visualize the invisible, to theorize and experiment. Too much imagination and inventiveness are qualities which if applied to a production operation will eventually wreck it. We prefer men who are hard headed, poker faced, unimaginative citizens, possessed of an obsession to make the wheels go round.

A good operating man will study every detail of his operation with a view to increasing its efficiency and output. This includes the efficiency and dependability of his operators. Each man, woman or boy in his subunits is studied to determine his or her fitness for the job. They must be made to fit the job or the job made to fit them. This leaves no room on the inside for misfits.

The operating chemist's problems are production, incessant production, quality and costs, including the costs of his losses of equipment, materials and time. If he has a burning desire to investigate something about a going process, let him take his problem to the research laboratory and keep it there till he gets the answer. Let him remember that the business of the plant is to produce and the business of the research laboratory is to experiment and develop, but that it takes a wiser man than he is to make the two function together and avoid the clutches of the sheriff.

PLANT AND OFFICE PERSONNEL

Plant offices are often neglected in spite of the fact that they are capable of being made one of the most necessary and important elements in a plant organization. They should be the connecting link between all internal units of the organization and between the organization as a whole and the public. Some office organizations, if allowed to drift, seem to have a genius for developing a high nuisance value and getting themselves disliked both inside and outside the plant. The exercise of a little common sense and some of the same care on the office personnel and its functions as that used on the development of research or operation will make an office staff what it should be—the pivotal point around which the whole finished organization will smoothly and noiselessly rotate. We believe that accountants, in addition to holding post-mortems on past performances, should supply *live* figures and facts designed to assist, direct and control going operations; that their costs need *not* be a blind assemblage of figures, but that they should reflect a working knowledge of the operation and what the costs ought to be—at least enough knowledge to enable them to get the decimal point in the right place. This policy means that the office becomes a working part of our research engineering construction operating organization and not the "short hour aristocrats" of the plant. Orders, billing and correspondence come in for their share of systematic attention and the "foreign relations" of the organization are handled with a minimum of "alibi building" and "buck passing."

Purchasing agents, in addition to their usual prerogatives of browbeating salesmen, are expected to function as advance agents for research and engineering, to know the stocks of materials and supplies in the

FIG 2—EXPERIMENTAL DISTILLING TOWER AND FERMENTATION LABORATORY

plant and to anticipate balance and look forward. Their job does not end with writing an order and dropping it in the mail, but they are expected to know when and where the goods will be delivered, see to it that they are delivered, that the stuff delivered is what was purchased and, more important, what it wanted, and finally, to see that the man who wants the stuff knows it is in and where it is to be found. This may look like a big contract, but it can be done and is being done wherever purchasing offices function according to our plan.

Having achieved the development of new products and processes and reached the point of production, the largest problem of all is sales. Unless proper attention has been given to the development of sales, which includes the promotion and introduction of the products to the trade, disaster awaits a budding chemical industry.

Sales development is a long and tedious process. It takes time and talent for a new producer to butt into an old market and it takes more time and more talent to introduce new products. New products must be guided through the introductory stages by the research laboratory and especially by those men most responsible for the development. This knowledge and paternal interest must be capitalized in order to furnish salesmen, even those with technical training, with the proper sales points and the necessary enthusiasm.

THE SEASONING PROCESS

General seasoning of a new organization is the most elusive and, therefore, the most interesting problem of them all. It has many discouraging and some mysterious features. Experience and patient hammering seems to be the solution if one can live through it. General plant sense, mechanical horse sense, legal liabilities as applied to purchase, sales and employment contracts, insurance, fire risks, employees, risks and safeguards, do not fall within the training and experience of the young plant chemist or engineer, yet it is

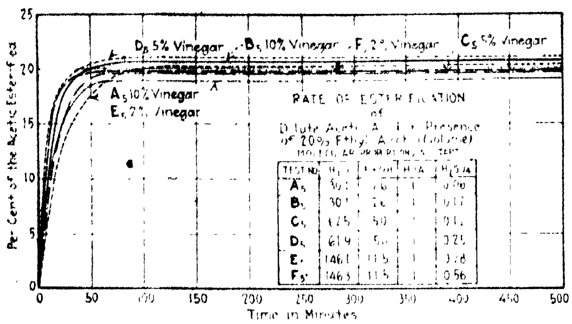


FIG. 3—RATE OF ESTERIFICATION OF DILUTE ACETIC ACID IN PRESENCE OF 20 PER CENT ALCOHOL

incumbent upon the organization as a whole to understand and handle these and many similar problems.

The element of mystery is involved in such things as running a suction pipe 65 ft. into a well, trying to push a loaded conveyor belt, installation of pipe sizes which add 100 per cent to 200 per cent of friction load to the normal head load of a pump, connecting operating units directly to underground sewers, omitting safety valves from steam jacketed equipment and trusting labor to function 100 per cent perfect. To the seasoned factory man, such things are hard to account for. Whatever may be the cause of these apparent lapses, continued hammering, an occasional steam roller and frequently some sad experiences seem slowly to wear down the list. In time men will learn to apply their physics, to think things through, to develop the "high points" in supervision so as to "just happen around" at a critical time, and finally to leave nothing to chance—to hold your aces at all times. No organization will ever be free from seasoning problems so long as we have the human element to deal with, but the "rate of frequency" may be used as a measure of perfection.

Ethyl Acetate

An Example of Organized Production

The foregoing general outline of the methods followed in organizing and preparing for chemical production would seem to require a specific illustration to show how the machinery works. This is probably best furnished by selecting a few steps followed in the development of our process for the continuous production of anhydrous, chemically pure, ethyl acetate directly from dilute solutions of acetic acid and alcohol.

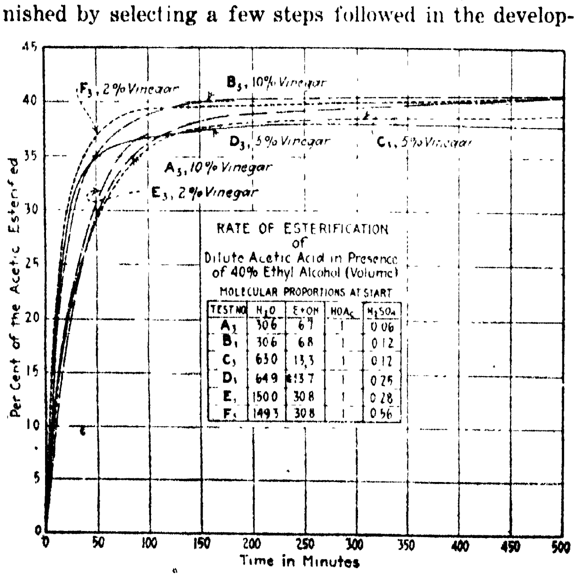


FIG. 4—RATE OF ESTERIFICATION OF DILUTE ACETIC ACID IN PRESENCE OF 40 PER CENT ALCOHOL

The production of ethyl acetate is not new and the literature is full of descriptions of the methods by which it is produced. All of these methods are based upon the theory that high concentration is required to bring about esterification and that in addition to the high concentration, a dehydrating agent, such as sulphuric acid, is necessary. The usual process, as you will recall, is the addition of high proof alcohol and sulphuric acid to dry calcium acetate, usually followed by prolonged refluxing of the mixture. Finally the ethyl acetate formed in the reaction, together with alcohol and acetic acid, is allowed to distill over and

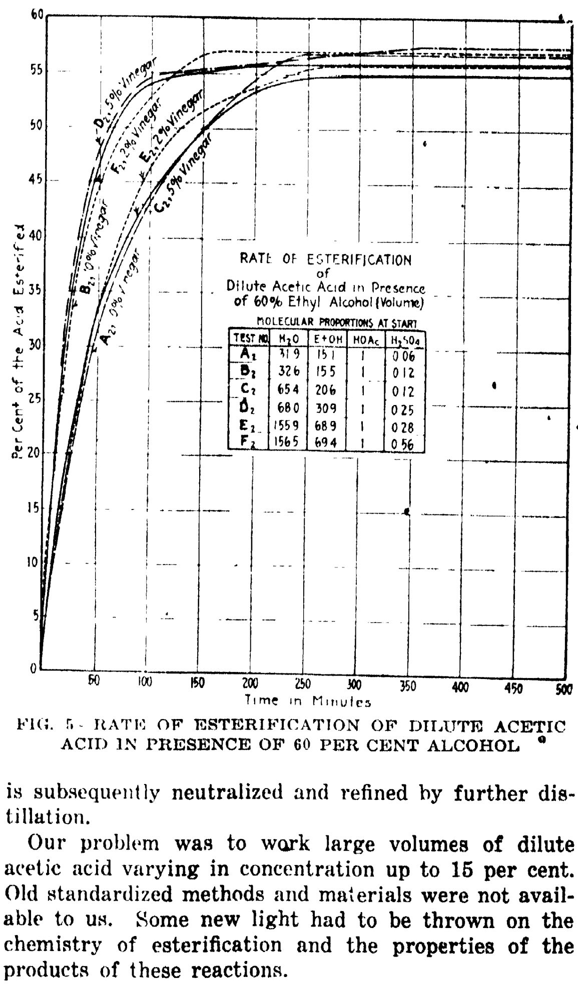


FIG. 5—RATE OF ESTERIFICATION OF DILUTE ACETIC ACID IN PRESENCE OF 60 PER CENT ALCOHOL

is subsequently neutralized and refined by further distillation.

Our problem was to work large volumes of dilute acetic acid varying in concentration up to 15 per cent. Old standardized methods and materials were not available to us. Some new light had to be thrown on the chemistry of esterification and the properties of the products of these reactions.

Following the usual research practice and our abundant references to the state of the art, we made a few cut-and-try experiments on esterification. We played a few "hunches" as it were. These, as usual, resulted in nothing except to exert a sort of gyroscopic effect and to steady the boat. We determined, therefore, to make a basic study of the reactions between alcohol and acetic acid. This study included a careful investigation of the rates of reaction between alcohol and acid, equilibrium conditions, concentration of catalyzers, and various ratios of acetic acid and alcohol. Months were required to complete these investigations, but the facts once established presented an entirely new view of the problem, saved months of time in mistakes, or perhaps avoided final failure.

New Data on Alcohol-Acetic Acid Reaction

The results of these observations were carefully plotted and the following definite conclusions drawn from the facts disclosed:

(1) That there is a very definite reaction between acetic acid and alcohol in dilute solutions.
(2) That sulphuric acid in very low concentrations is an excellent and effective catalyzer for this esterification reaction.
(3) That the rate of reaction is comparatively high and is materially influenced by the concentration of the catalyzer.
(4) That the reaction is in general more than half completed in the first thirty minutes and has reached equilibrium in 150 minutes.
(5) That the equilibrium percentage of acid esterified for all conditions under consideration is determined solely by the concentration of the alcohol in the reacting mixture.
(6) That the old ideas, involving high concentration of the reacting materials, a dehydrator, refluxing, etc., in the ethyl acetate reaction, are a joke.

It is also an easy matter to draw some important deductions from the facts disclosed in these cases:

(1) That if the ester can be removed from the reacting mixture at the rate formed, without disturbing to a material extent the established conditions, it would be possible completely to exhaust the acetic acid in the form of ester.
(2) That having exhausted the acetic acid from the reacting mixture in the form of ester, the alcohol could be recovered by the usual exhausting process and the water residue, having no value, thrown away.
(3) That, assuming the physical facts would permit the removal of the ester from the reacting mixture without altering the conditions favoring the reaction, the operation could be carried on as a batch or as a continuous process.

The answer to the one open question brought out by the second deduction is found in the property of ethyl acetate to form constant boiling mixtures, as might be expected from its kinship to ethyl alcohol—an old offender in this respect. Little note is taken of these constant boiling mixtures in the literature on ethyl acetate processes, but Table I will show their importance to our line of reasoning.

TABLE 1—CONSTANT BOILING MIXTURES OF ETHYL ACETATE—ALCOHOL—WATER

Components	Boiling Point Deg. C	Ester per Cent	Alcohol per Cent	Water per Cent
Ester, Alcohol, Water	70.3	83.2	9.0	7.8
Ester, Water	70.5	91.4	.	8.6
Ester, Alcohol	71.8	69.4	30.6	
Ester	77.2	100.0	.	

All of the curve deductions (see Figs. 3, 4 and 5), including the use of the properties of the constant boiling mixtures, and the relations of these to the solubility mixtures, were promptly put to the test of laboratory apparatus and confirmed.

We then turned to the design of a large scale experimental unit, utilizing some war equipment which was delivered months after the armistice, and junk. It had many misfit elements which did not meet even the calculated requirements of the basic data. It was far from mechanically perfect, and it leaked.

The Semi-Commercial Unit

Nevertheless, this experimental unit served a very valuable purpose. It operated for several months and produced a product at a profit. It gave the engineers an opportunity to study the materials of construction, and the design. It gave the chemists a chance to find out some things about continuous operations of this character, which they had not heretofore known, for example: They expected to produce ester of high quality and free from aldehydes. They were unsuccessful in this until they discovered that a small amount of aldehyde was formed in the operation and carried into the finished product. The experimental unit gave opportunity to introduce a minor change which resulted in the accumulation of the aldehyde and its complete separation from the final product.

The experimental apparatus had a capacity of 300 to 400 gallons per day and was operated on a 24-hr. basis continuously for months at a time. During this period, the engineers had every opportunity to study the performance of the apparatus and to design a new machine embodying the ideal requirements as developed in the original investigations, and at the same time meeting the operating requirements as developed in the large scale experimental apparatus. In the meatnime, the market test showed the product of this process to be

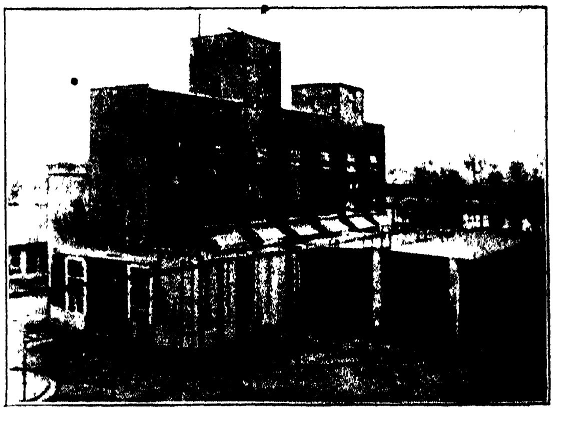


FIG. 6—ETHYL ACETATE PLANT

exceptionally good. There was no difficulty in selling it or making it stay sold, and the demand for larger production was constantly increasing. We had reached this point in our work when one of our former associates, for whose opinions we had the greatest respect, but who had not kept up to date on our work, advised us that in his opinion we were "trying to drive a pile, a railroad spike and a tack with the same hammer in one operation."

The large scale designs were finally completed, put in the shops, erected and put into operation. (Fig. 6 shows plant.) This machine was kept under continuous observation by the research laboratory and the engineers for a period of over a year; daily reports in the form of operating logs were kept, not only for the guidance of the plant operating men, but also for the research chemists and engineers. These reports formed the basis of a subsequent complete re-analysis of the process and plant by the research laboratory for the purpose of establishing all facts and data that had developed in subsequent construction and operation, with a view to improving the design, materials of construction, operating features, etc.

The changes found necessary as a result of this re-investigation were very minor, and a second unit is now ready for operation which is almost an exact duplicate of the first. The monthly production of anhydrous chemically pure ethyl acetate by the continuous esterification of dilute acetic acid by this process is now over 150,000 gallons.

Research Bureau Laboratory Standard Steel Car Co.

BY RICHARD RIMBACH

THE Research Bureau Laboratory, located on the ground floor of the recently completed Cafeteria Building at the plant at Butler, Pa., embodies some of the best features of a number of laboratories visited by the metallurgist. Much of the apparatus, furniture and other equipment was specially constructed to his designs and specifications. In most cases this equipment was built in our own shops.

The laboratory has five units: A physical testing laboratory, a heat-treating laboratory, an experimental machine shop, a metallographic laboratory and a chemical laboratory. The disposition and character of the equipment as planned and installed insure the execution of all work with due economy of time and effort.

The physical testing laboratory, the heat-treating laboratory and the machine shop were combined, because this arrangement promises facility of operation.

The physical laboratory is equipped for all kinds of physical tests. It contains the following testing machines: A 200,000-ft. automatic and autographic universal testing machine; a 60,000-in.-lb. automatic and autographic torsion machine; a cold bend machine; a repeated impact machine; a vibratory machine; a slip abrasion machine; a 120-ft.-lb. combined impact tension and cantilever notched bar bar-testing machine.

The heat-treating equipment is modern in every respect. The arrangement is excellent for research work, such as case-hardening and other heat-treating experiments. The equipment consists of two electric muffle furnaces and an electric carbon resistance high-speed furnace. A high-resistance double-scale wall mounting indicating pyrometer with an eight-point switch is used for reading the temperatures of the furnaces. The quenching is done in four tanks, each 2x3x25 ft. Two of the tanks are for oil, one for brine and the other for water. These are provided with wire baskets so that the specimens may be dropped as soon as they have been quenched. Water, air and steam jets are also arranged for hardening. A hood for taking away the fumes and heat is over all furnaces. A Brinell machine is used for checking the heat-treatments, as is also a scleroscope.

The machine shop is equipped with the machines necessary for the sampling and preparation of tests for physical testing, chemical and microscopic analysis.

METALLOGRAPHIC AND CHEMICAL LABORATORIES

The metallographic laboratory also serves as the balance room. It is equipped with thoroughly up-to-date apparatus, including an optical bench. The microscope is an important feature of the modern laboratory and no pains have been spared to make this one complete in every respect. The optical bench is mounted on a stand of drawers in which the photographic plates are filed. Experiments in pyrometry can be carried on in this room. For this purpose a work bench runs along one wall. The critical point machine is set up at one end of this work bench. The balance table is placed so as to be most convenient to the adjoining chemical laboratory.

The chemical laboratory has the equipment of a first-class analytical laboratory. The work tables are composed of alberene stone mounted on drawer and cupboard units. A hood unit 12 ft. long and 3 ft. wide is provided, the working table of which is covered with alberene stone. The hoods have not only the customary upper draft into the stack but also a lower draft. This draft is sufficient to pull out heavy fumes, which otherwise get into the room. It is supplied by an acid fume-resistant exhaust blower. The hood unit is divided into four compartments. One compartment is used for sulphur determination apparatus, one for phosphorus, one for dissolving samples and the last for testing fuels, oils and gases. Nearly all hot acid solutions are cooled under the hoods, and in a large measure the atmosphere of the laboratory is quite free from acid fumes. A large cabinet is placed at one end of the laboratory, for storing chemicals and glassware which are not used daily.

A shower bath head is placed in the chemical laboratory for extinguishing burning clothing or for diluting corrosive liquid splashes. It is provided with a chain fastened to a quarter turn valve so that the water may be released without difficulty in time of accidents. No drain is provided in the floor, as the use of this shower should be infrequent.

The service is piped above the tables and in the hoods. The tables and hoods are provided with numerous electric power plugs for the operation of motors, ovens and the like. The piping system comprises drains, oxygen, hot and cold water, compressed air, vacuum, gas, distilled water and high- and low-pressure steam. The pipes and fittings are painted with distinctive colors denoting their use, which makes it an easy matter to locate trouble. The color scheme used is given below:

Service	Color of Pipe	Color of Fittings
Acetylene	Black	Black
Compressed air	Yellow	Black
Electricity, 110 v., d.c.	Black	Red
Electricity, 220 v., d.c.	Black	Yellow
Electricity, 440 v., a.c.	Black	Green
Gas	Blue	Gray
Hydrogen	Blue	Blue
Oxygen	Yellow	Yellow
Pyrometers	Black	Gray
Vacuum	Green	Green
Water, cold	White	White
Water, hot	White	Black
Water, distilled	Glass	Rubber
Waste and sewage	Gray	Gray

The vacuum is furnished by a small vacuum pump, which starts and stops automatically.

There is also a storeroom for heavy chemicals, apparatus and miscellaneous supplies. This storeroom has a card system which is kept up to date, making it possible to tell the amount of material on hand at any time.

New Uses for Grain Sorghums

The grain sorghums, a comparatively new crop in the United States raised largely only for the feeding of farm animals, are now being used in increasing quantities for human food and various industrial purposes, according to the United States Department of Agriculture, and are receiving attention from the manufacturers of alcohol and starch. Feterita and milo, which contain on an average 65 per cent of starch, seem to be especially suitable as raw material for the manufacture of high-grade starch by commercial processes.

The results of a study on the physical characteristics and the chemical composition of milo and feterita have just been published in Department Bulletin 1129, by George L. Bidwell, Leslie E. Bopst, and John D. Bowling, Bureau of Chemistry. This study was made to provide a basis for the utilization of grain sorghums in the manufacture of starch and feeding stuffs, and to furnish data for engineers who may be called upon to design machinery for milling, all of which data are included in this bulletin.

Effect of Temperature On the Mechanical and Microscopic Properties of Steel

By George C. Priester and Oscar E. Harder

Assistant Professor Mathematics and Mechanics, and Associate Professor Metallography, University of Minnesota.

Properties of a Low-Carbon Steel in the Blue Heat Range Are Inherent to That Temperature and Are Not Duplicated When Same Metal Is Tested at Room Temperature After a Corresponding Tempering

THIS investigation was instituted early in 1920, and had for its purpose a study of the mechanical properties of steels at elevated temperatures, the properties of these same steels at ordinary temperature after having been heated to various drawing temperatures, and, finally, the correlation, in so far as possible, of these properties with the microstructure of the steels.

Previous Investigations

Recently published investigations on this subject include those by French,[1] MacPherran,[2] Spooner[3] and D'Arcambal.[4] French first investigated boiler plate of firebox and marine grades with carbon contents of 0.19 and 0.25 per cent respectively.

As a means of comparing these results Table I has been prepared. In it a ratio has been figured between the properties of these steels at room temperature and at that temperature which showed the maximum tensile strength. Some calculations are only approximate, because the values had to be taken from the published curves.

TABLE I RELATION OF MECHANICAL PROPERTIES AT HIGH AND ROOM TEMPERATURE

Investigator	Carbon, Per Cent	Tensile Strength	Propor Limit	Yield Point	Red of Area	Elongation
H. J. French	0 19	1 13	0 66		0 80	0 68
	0 25	1 09	0 72		0 75	0 56
	0 38	1 10	0 73	0 54	0 54	0 74
Authors	0 16	0 98	0 89	0 98	0 92	0 96
R. S. MacPherran	0 19	1 22			0 83	0 57
	0 09	1 33		0 67	0 81	0 58
	0 41	1 03			0 85	0 53
	0 53	1 14		0 90	0 70	0 70
A. P. Spooner	0 10	1 25		0 78	0 85	0 66

It will be observed that the present authors have obtained a lower ratio for the tensile strength, but higher ratios for the other values. This can probably be attributed to the different heat-treatments, since we have tested the steel at room temperature in the hardened conditions, whereas other investigators have used annealed or drawn steels for their tests at room temperature.

Scope of the Investigation

The present investigation has included the following: Development of apparatus for determining the mechanical properties of steel at elevated temperatures; tests on hardened 0.16 per cent carbon steel to determine the maximum stress, proportional limit, yield point, reduction of area, and elongation at temperatures from 20 to 600 deg. C.; determination of these same properties on specimens which had been hardened, drawn at various temperatures from 100 to 600 deg. C. and tested at ordinary temperature; and the impact properties of specimens tested at ordinary temperature after hardening and subsequently drawing at various temperatures. There is also included the Brinell and scleroscope hardness values on the drawn specimens and the microscopic examination.

Hot-rolled steel ¾-in. diameter was used of the following chemical composition: C 0.16, Mn 0.46, S 0.034, P 0.009. All specimens were annealed after machining and before hardening in order to give a uniform structure. The various heat-treatments are discussed under the particular test to which they apply.

Tests at Elevated Temperatures

In order to make tests at elevated temperatures, a special apparatus was developed, a sketch of which is shown in Fig. 1. The temperature of the specimen was measured by a carefully calibrated thermocouple, the hot junction of which was clamped in contact with the lower shoulder of the specimen. The specimen was gradually heated to the desired temperature by means of the electric furnace and was held at that temperature for 30 minutes to establish thermal equilibrium. Under these conditions it is believed that any heat changes which took place during the testing of the specimen are negligible. It is believed that there can be no

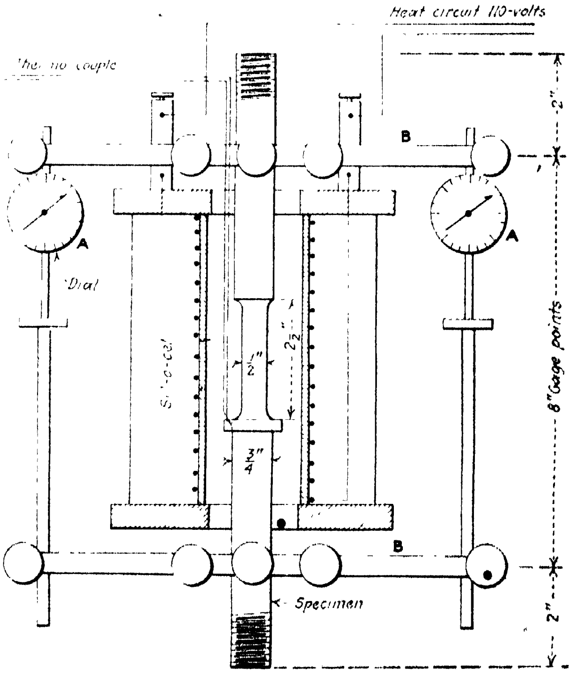


FIG. 1—SKETCH OF APPARATUS FOR MECHANICAL TESTS AT ELEVATED TEMPERATURE

[1] "Tensile Properties of Boiler Plate at Elevated Temperatures," *Mining & Met.*, February, 1920, No. 158, Sec. 15. Also in *Chem. & Met.*, 1922, vol. 26, p. 1207. Discussion of MacPherran's paper "Comparative Tests of Steels at High Temperatures," *Proc.* A.S.T.M., vol. 21, pp. 861-3 (1921).

[2] "Comparative Tests of Steels at High Temperatures," *Proc.*, A.S.T.M., vol. 21, pp. 852-860 (1921). Also in *Chem. & Met.*, 1921, vol. 24, pp. 1153-55.

[3] Discussion of MacPherran's paper, *ibid.*, pp. 863-8.

[4] September meeting American Society for Steel Treating (1921). These results apply to tool steels, rather than material of low-carbon content.

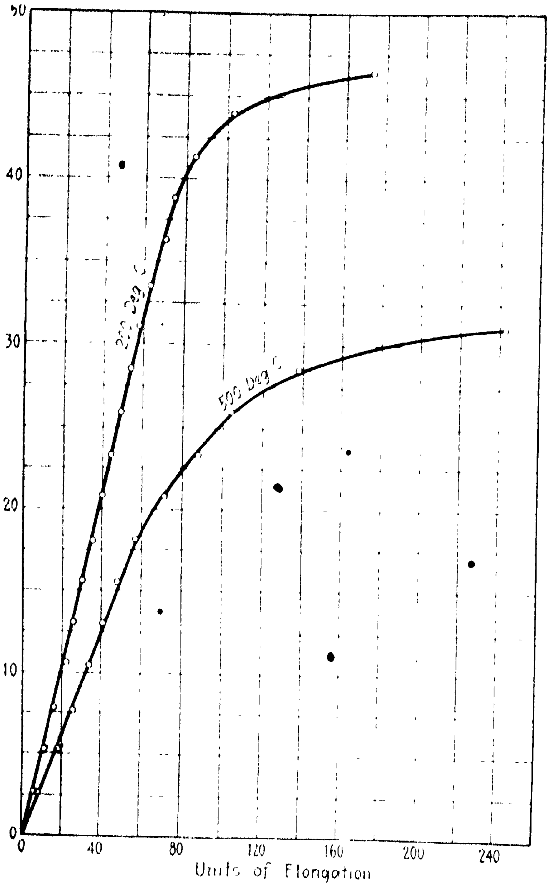


FIG. 2—TYPICAL STRESS-STRAIN CURVES, SPECIMENS QUENCHED FROM 910 DEG. C. AND THEN TESTED AT THE TEMPERATURES NOTED

question about the accuracy of the temperature measurements for these tests.

It will be observed from the figure that the extension was measured by means of two Ames dials on opposite sides of the specimen. The character of the stress-strain diagram and incidentally the care with which this work has been done are shown in two typical curves in Fig. 2. The specimen used in making tests at elevated temperatures is also shown in Fig. 1. The extensions, as measured, doubtless are for a longer gage length than 2 in., but this condition would only change the slope of the stress-strain curve, thus making it impossible to calculate accurately the modulus of elasticity, but would not affect any of the data herein reported.

Data in Table II show the results of the tests made on this steel at temperatures from 20 to 600 deg. C. The heat-treatments which these steels received before testing should be noted,* because some investigators have tested steels without any heat-treatment, and usually they have annealed or drawn the specimen at a temperature above that at which it was to be tested before heating it for the test at elevated temperature. Our steel had been given an anneal and then hardened before heating for the test at elevated temeprature. It had not been drawn before testing. This probably accounts for the fact that maximum stress, yield point

TABLE II—EFFECT OF TEMPERATURE ON THE MECHANICAL PROPERTIES OF STEEL

Spec. No	Temp., Deg C	Propor. Limit, Lb./Sq In.	Yield Point, Lb./Sq.In	Maximum Stress Lb. Sq In.	Red of Area, Per Cent	Elongation, Per Cent
3B	20	44,000	54,300	73,700	77 4	24 0
3A	20	46,400	54,000	74,200	77 2	31.5
5A	100	41,400	51,900	69,600	78 7	27.0
4B	200	39,000	52,000	69,700	75 7	32 0
4A	200	38,800	51,800	68,800	77 0	25 0
9A	250	38,300	51,000	70,000	75 0	25 5
1B	300	39,000	51,900	72,700	71 9	26.5
1A	300	41,400	54,300	72,700	69 7	27 0
8B	350	32,900	48,000	68,200	74 8	31.0
8A	350	35,200	50,300	70,300	74 2	29 0
2A	400	28,500	44,000	59,300	88 8	37.0
6A	500	18 100	31,100	42,700	93 6	38 0
7A	600	10 300	19,300	23,200	96 3	38.0

or proportional limit never exceeds the values obtained at ordinary temperature. However, there is a well-marked maximum in these curves clearly shown in Fig. 3 which is in good agreement with results found in previous investigations. The character of the fracture of these test specimens seems to be rather significant and these fractures are shown arranged in order of the increase in temperature from left to right in Fig. 4. The marked decrease in the maximum stress, yield point and proportional limit begins at about 350 deg. C., and this seems to be in general agreement with the breakdown in the microstructure (Figs. 6 to 13.)

Quenched and Tempered Steels

Specimens used for testing this steel after tempering correspond to the A.S.T.M. standard. Heat-treatment of the machined bar consisted in annealing 1 hour at 910 deg. C., furnace cooling; hardening in ice water after 30 minutes' soaking at 910 deg. C., then heating to the various drawing temperatures, holding at that temperature for ½ hour and then cooling in air to room temperature. Results of these tests are shown in Fig. 5.

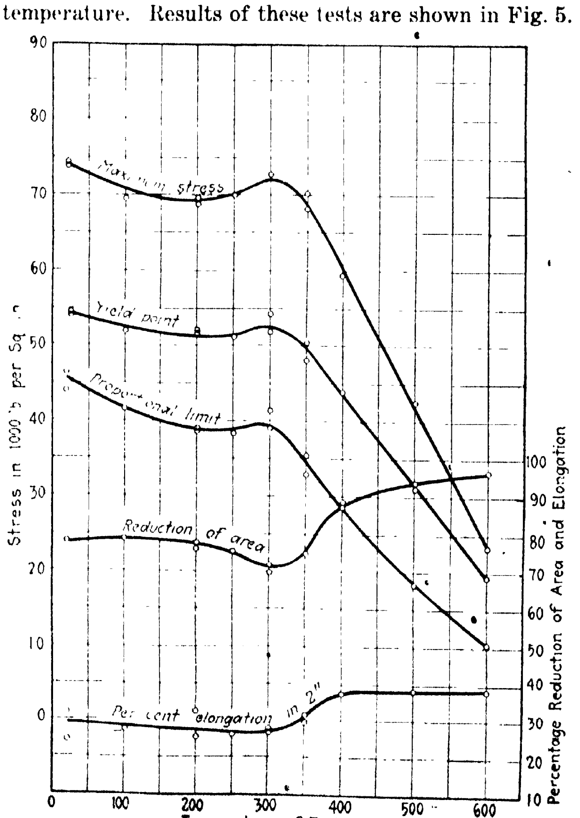


FIG. 3—MECHANICAL PROPERTIES OF QUENCHED 0.16 C. STEEL AT HIGH TEMPERATURES

*The test pieces were machined, heated to 910 deg. C., held for 1 hour, cooled slowly in the furnace, reheated to 910 deg. C., held for 30 minutes, then quenched in ice water. The specimens were then placed in a testing machine as shown in Fig. 1, heated to the temperature shown, held at that temperature ½ hour and tested at that temperature.

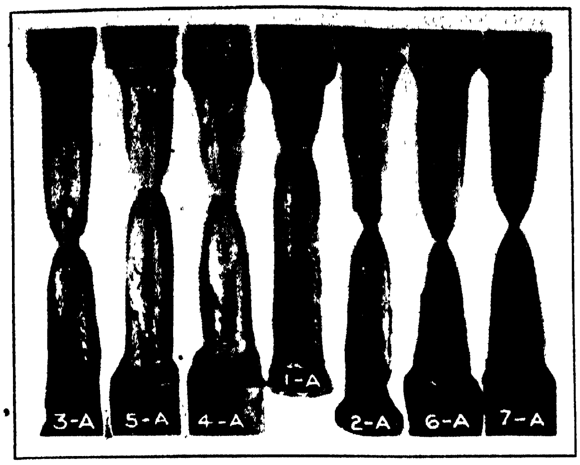


FIG. 4—FRACTURE OF SPECIMENS BROKEN AT HIGH TEMPERATURE (ABOUT HALF SIZE)

The mechanical properties—maximum stress, yield point, proportional limit, reduction of area and elongation—are approximately straight line functions of the drawing temperature. There are no maximum and minimum points which result from the steel having been drawn at 300 deg. C. This leads to the conclusion that the maxima and minima observed when the tests are made at elevated temperatures are due to the temperature at which the tests are made and not to the fact that the steel has been drawn at certain temperatures.

Impact Properties—The impact test data are shown in Table III. Tensile test specimens were turned down to 0.236 in diameter between gage marks; the specimen

TABLE III—EFFECT OF DRAWING TEMPERATURE ON THE IMPACT PROPERTIES OF STEEL

	Impact Tensile Test				Notched Bar Impact Test	
Spec. No.	R. A. Per Cent	Elong. Per Cent	M.-Kg. Sq. Cm.	Ft.-Lb. Sq. In.	M.-Kg. Sq. Cm.	Ft.-Lb. Sq. In.
Annealed					15.4	716
Annealed (a)					14.2	658
20	57.8	8.0	33.6	1,560	14.4	671
20A	62.2	12.5	45.4	2,120	13.9	645
100	48.9	5.5	26.0	1,220	14.7	684
100A					15.4	716
200	53.8	10.5	45.4	2,120	17.2	800
200A	55.3	6.0	32.5	1,520	16.7	781
300	66.7	13.5	45.2	2,090	17.6	819
300A	62.9	15.5	57.8	2,970	17.4	800
400	67.6	11.5	39.0	1,810	18.4	858
400A	70.0	13.5	48.0	2,230	18.0	839
500	72.8	22.0	71.5	3,330	19.2	890
500A	74.1	22.0	65.1	3,030	19.8	923
600	73.2	21.0	64.7	3,000	20.4	948
600A	74.3	23.5	67.0	3,240	20.3	942

was 4 in. long and the $\frac{3}{8}$-in. shoulders at each end were threaded clear up to the fillet. The results are erratic, but seem to indicate that the impact tensile, reduction of area and elongation show a minimum after a draw at 100 deg. C. There is then an increase in these properties up to about 500 deg. C. with possibly a little falling off after a draw at 600 deg. C.

Notched bar tests show a gradual increase with the increase in drawing temperature. The test pieces were notched before hardening (which is not the usual practice). They were 10 mm. square, 55 mm. long, notched at the center half way through. The notch was 1 mm. wide and had a round bottom.

Brinell and Scleroscope Hardness — Brinell and scleroscope hardness tests were made on the specimens which had been tested at elevated temperatures for

TABLE IV—EFFECT OF DRAWING TEMPERATURE ON THE HARDNESS OF STEEL

Drawing Temperature..	20	100	200	250	300	350	400	500	600
Brinell	148	143	146		143	...	142	137	131
	147	146	149		145	.	140	134	128
Average	148	144	148		144		141	136	130
Scleroscope	41.0	40.0	38.0	38.4	41.6	41.4	37.3	33.1	30.1
	38.5		39.5		39.6	41.7		...	...
					38.6	40.3		...	...
Average......	39.8	40.0	38.8	38.4	39.9	41.1	37.3	33.1	30.1

their tensile properties. They had not only been drawn at the various temperatures shown but had also been stressed in tension at those temperatures. The data from the hardness tests are given in Table IV and are shown graphically in Fig. 5. The results are averages of at least five tests on the individual specimen. The effects of drawing temperatures on these values are in general agreement with the effects on the tensile properties of these specimens at high temperatures (shown in Fig. 3) rather than when tested in tension after a draw. However, there are observed peaks in the curves for the Brinell and scleroscope hardness curves at draws of 200 and 350 deg. C. respectively. No explanation is offered for this phenomenon.

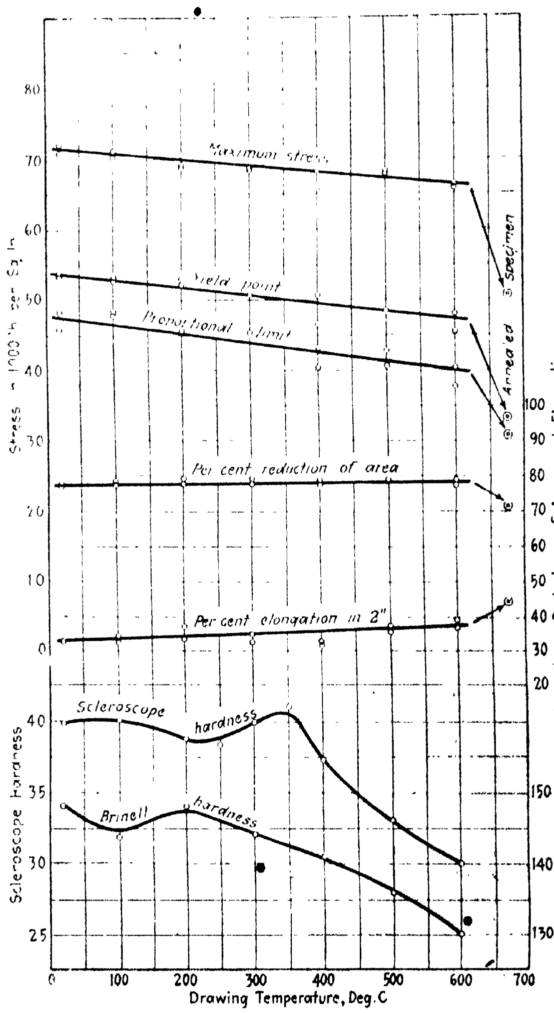
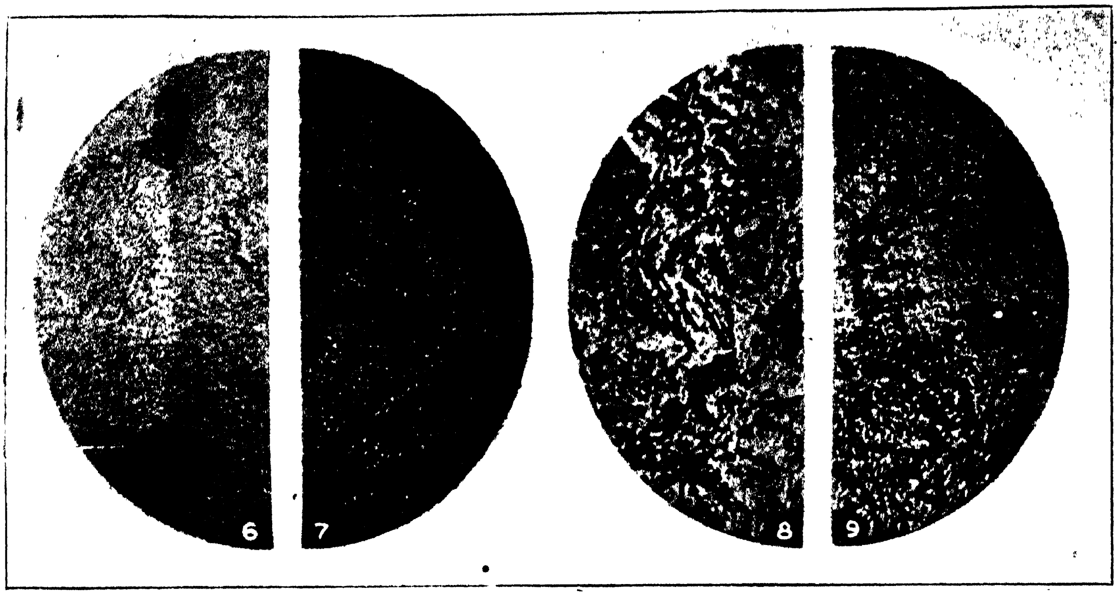


FIG. 5—PROPERTIES OF QUENCHED AND TEMPERED 0.16 C. STEEL



FIGS. 6 TO 9—STRUCTURE OF STEEL. ETCHED WITH PICRIC ACID. × 1,000
Fig. 6—Annealed. Fig. 7—Quenched from 910 deg. C. Fig. 8—Drawn at 100 deg. C. Fig. 9—Drawn at 200 deg. C.

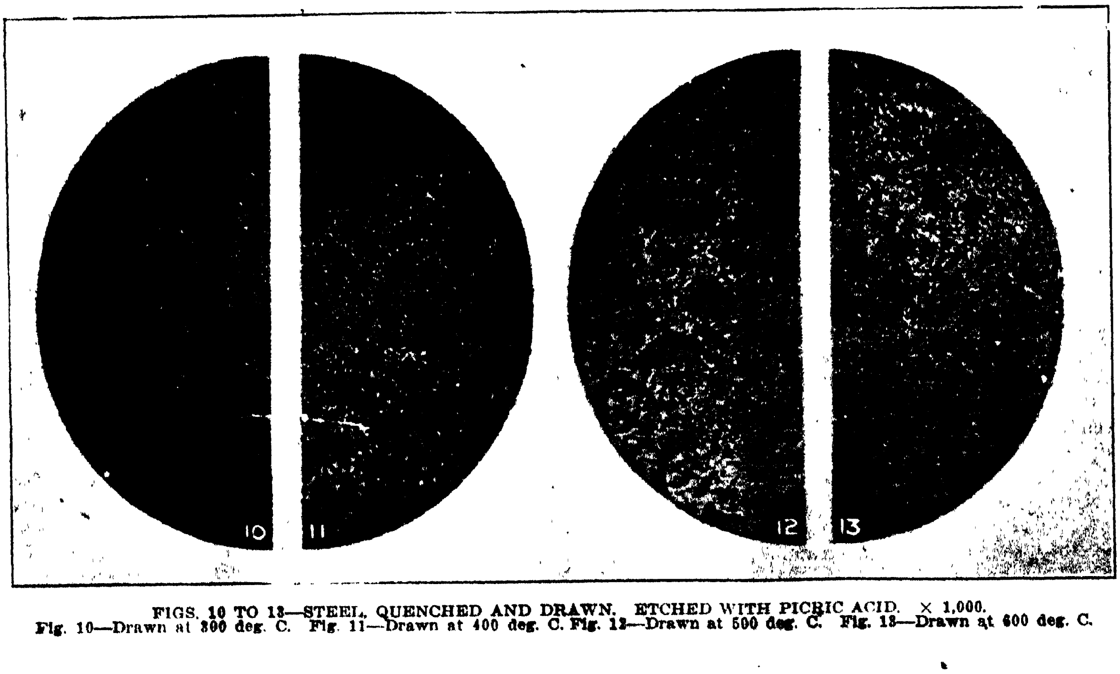
Microscopic Examination—Microscopic examinations of the specimens which had been drawn at various temperatures show first of all that the hardened specimens still contained some free ferrite and are reproduced in Figs. 6 to 14 inclusive. The amount and distribution of ferrite seems to be fairly uniform in the different specimens. There is an indication of a breakdown in the hardened areas at the higher draw, particularly at 400 to 600 deg. C. It is difficult to get satisfactory etches on hardened steel of this low carbon content.

CONCLUSIONS

(1) Plain carbon steel containing 0.16 per cent carbon, when tested at temperatures ranging from 20 to 600 deg. C., shows a maximum in the maximum stress, yield point and proportional limit curves at about 300 deg. C.; however, these values do not exceed the corresponding values at 20 deg. C. It shows a minimum in the reduction of area curve at approximately this same temperature, with a less pronounced minimum in the elongation curve.

(2) These changes in the physical properties are due to the temperature at which the test is made and are not the result of the steel having been drawn or tempered at a certain temperature. This is shown by the fact that when this steel is drawn, then cooled to ordinary temperature and tested, there is no maximum or minimum observed in the curves.

(3) Above about 300 deg. C. the minimum stress, yield point and proportional limit decrease almost as a straight line function of the temperature at which



FIGS. 10 TO 13—STEEL, QUENCHED AND DRAWN. ETCHED WITH PICRIC ACID. × 1,000.
Fig. 10—Drawn at 300 deg. C. Fig. 11—Drawn at 400 deg. C. Fig. 12—Drawn at 500 deg. C. Fig. 13—Drawn at 600 deg. C.

the test is made, and the effect on the maximum stress is the most pronounced. There is a corresponding increase in the reduction of area and elongation, but the elongation is approximately constant above 400 deg. C.

(4) The impact toughness increases with the drawing temperature and appears to be nearly a straight line function of the drawing temperature.

The results of the impact tensile tests show a slight decrease in the tensile strength, reduction of area and elongation for specimens drawn at 100 deg. C. At higher drawing temperatures these values increase with increase in the drawing temperature.

(5) Microscopic examination shows changes in the microstructure which correspond to the changes in the mechanical properties at the higher temperatures (400 to 600 deg. C.), but do not seem to throw any light on maximum and minimum points in the curves for tests at 300 deg. C.

Recent Work on the Separation of Isotopes*

THE SEPARATION of isotopes is of timely interest, inasmuch as Dr. Aston and Professor Soddy have just been awarded the Nobel prize for their work in this connection. It was Soddy who gave the name to isotopes and who began his work in 1914. Aston's work is later, and has to do with those of common elements.

It would be as difficult to answer the question "what is an isotope?" as it would be to expound the problem "what is a scissor?" or "what is a trouser?" They are indeed atomic twins, triplets, quadruplets and even sextuplets and octuplets. Isotopes of an element have substantially all properties in common except atomic weight. Isotopes of chlorine have, for example, masses respectively of 35 and 37. Six have been found of mercury and eight of tin. On the other hand, oxygen nitrogen, carbon and hydrogen appear to be homogeneous, and have only one atomic weight; to be, therefore, without isotopes.

The whole thing is revolutionary, in that it attacks the chemist in his most sensitive spot, where his most painstaking work has been carried on—his table of atomic weights. It makes his meticulous fractions mere averages of mixtures of isotopes of which the mass of each is indicated by a whole number. On the other hand, it connects up and coincides in a remarkable manner with the Lewis-Langmuir theory of atomic and molecular structures. Aston's deductions, like Langmuir's, may be wrong, but it is hard to deny them in the face of such an overwhelming flood of coincidences as is found in support of them.

Aston's Process of Separation

The Aston method of procedure consists, first in obtaining the positive rays of a given material by the adoption of a modification of Sir J. J. Thomson's method of positive ray analysis. The material is first ionized by X-rays and passed through a fine slit, giving a narrow ribbon of rays. These are then passed between positive and negative poles which deflect the positive rays in the direction of the negative pole. Passing now through a diaphragm the positive rays are again deflected by a magnet, so that they strike a photographic plate. If, then, all rays have the same mass they should strike the plate at the same spot. Aston's experiments show this to be the case with elements which have atomic masses of whole numbers based on oxygen as 16. An oxygen gives only a single mark. Those having fractional atomic weights give more than one line, as, for instance, chlorine which gives one line at exactly 35 and another at 37, the line at 35 being three times as strong as that at 37. Neon shows a line at 20 and one at 22, but that at 20 is ten times brighter than the one at 22. He tested out carbon monoxide in the same way, and got bands at 28, at 12 and at 16. Carbon and oxygen show no isotopes, but the undissociated positively charged CO went just where it belonged, to 28. He made a great number of tests and reached the conclusion already given, that with oxygen as 16 every element that shows a fractional atomic weight consists of isotopes having masses of whole numbers, while every element with a whole number for its atomic weight with oxygen as 16, is homogeneous, i.e., it has no isotopes.

The Ionic Migration Method

The principle of the moving boundary is here being utilized. An agar-agar gel containing a chloride is inserted as a short middle section in a long horizontal tube, being preceded by a gel containing a faster anion (hydroxide ion) and followed by a gel containing a slower anion (acetate ion). When a current is passed, the boundaries between the solutions remain perfectly sharp, and the chloride moves slowly toward the anode. Now tubes of hydroxide gel are inserted before it reaches its goal, and after it has traveled, say, 100 ft., the chloride gel is sectioned and analyzed. If Cl(35 and Cl(37) possess different mobilities, the front section should contain only the one isotope, the second section only the other.

The Discharge Potential Method

Although the free energy charges involved in the separation of an electron from isotopic ions such as Cl(35) and Cl(37) are not necessarily identical, owing to the different constitutions of their nuclei, it is unlikely that the discharge potentials of the reaction: $2\,Cl^- \rightarrow Cl_2 + 2$ minus will be *appreciably* different in the two cases, when expressed in volts. What is more important than any possible *intrinsic* difference is the fact that in the natural isotopic mixture the concentration of $Cl^-(35)$ is more than 3 times that of $Cl^-(37)$. Provided the familiar Nernst E.M.F. equation applies, therefore, the discharge potentials of the two ions *in any solution* should differ by about 0.03 volts. If now we can adjust our current so that it is just above the decomposition potential of one ion, and just below that of the other, and if we can withdraw the discharged products immediately, then a perfect separation should be possible. Possibly the utmost that will be obtainable in practice, will be an "electrolytic fractionation."

The experimental details are now being developed and perfected, before actual runs are made. Mercury, magnesium and lithium are under investigation in the connection, as well as chlorine.

The Freezing Point Method

Although attempts to separate other isotopes by analogous methods have not succeeded in the past, it is possible that in an extreme case such as Li(6) and Li(7), where the atomic masses vary by 16 per cent, an appreciable difference in the points of fusion of the pure isotopes will exist, and so permit a separation by fractional crystallization. This method is being tested out at the present time, with lithium and potassium.

*Résumé of a talk by Dr. James Kendall, of Columbia University, before the New York Section of the American Chemical Society Dec. 8, 1922.

Ethylene as a Source of Alcohol

A Study of the Distillation Gases Yielded by Trent Amalgams, With Special Reference to Their Unsaturated Constituents*

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Research Chemist, Pittsburgh Experiment Station
U. S. Bureau of Mines

SIXTY years ago M. Berthelot found that ethylene could be selectively absorbed from gaseous mixtures by concentrated sulphuric acid and that the compound formed by the chemical union of the gas and acid was readily decomposed by heating with water, yielding ethyl alcohol. Only within the last few years has there been any attempt to make use of this discovery technically. Bury[1] working in England at the Skinningrove Iron Works and on a commercial scale, developed a technical method for converting the ethylene of coke oven gas into alcohol. With a gas containing less than 3 per cent of ethylene, he obtained a yield of 1.6 gal of alcohol per ton of coal carbonized.

De Loisy[2] perfected a technical method for treatment of coke-oven gas for alcohol. Evidently this work was carried out on a semi-commercial scale. His method is based on the use of catalytic agents for hastening the absorption of ethylene by sulphuric acid. He uses part of the spent acid for drying the gases and part for the manufacture of ammonium sulphate. Excess acid is reconcentrated by waste heat. Others have worked on the problem, but so far there has been no large recovery of ethylene from coke-oven gases. The chief difficulty seems to lie in the low efficiency (about 50 per cent) of methods and the relatively low concentrations of ethylene in the gases treated. Gas from Trent amalgam[3] contains much larger percentages of ethylene than does coke-oven gas, as will presently be shown, and if it should ever prove practical to treat industrial gas for alcohol, this gas would offer attractive possibilities.

Carbonizing Trent Amalgams

The method used here to carbonize the amalgams differs from any now used for the commercial carbonization of coal. In ordinary practice, coal charges are distilled at all temperatures from the decomposition point of the coal to the highest retort temperature, and no definite temperature can be fixed on as the temperature of distillation. With the method here used, the distillation range was made narrow. This was effected by feeding the charge regularly into a retort kept at constant temperature—that is, the predetermined distillation temperature. Distillations were conducted at temperatures 400, 500, 600, 700 and 800 deg. C., and the gases evolved were measured and analyzed. Samples of the coal and oil used to prepare the amalgams were distilled under the same conditions as were the amalgams for purposes of comparison.

*Report of Investigations, Serial No. 2112

[1] Bury, Ernest, "Ethylene as Alcohol From Coke Oven Gas," *Gas Journal* vol 148, Dec 30, 1919, p. 518.

[2] De Loisy, M. E., "Sur un procédé industriel de fabrication synthétique de l'alcool et de l'ether a partir des gaz de distillation de la houille," *Comp. rend.*, vol 170, January 1920, pp. 50-3.

[3] A paste consisting of approximately 2 parts finely pulverized coal and 1 part oil such as that obtained as a final product in the Trent process for cleaning coal. See Perrott, G. St.J. and Kinney, S.P., "The Use of Oil in Cleaning Coal, *Chem. & Met.*, vol. 25, Aug. 3, 1921, p. 182.

TABLE I—CHARACTER OF MATERIALS USED

Big Muddy Coal

	Per Cent
Moisture	5.78
Volatile matter	31.87
Fixed carbon	52.42
Ash	9.93
Total	100.00
Sulphur	1.28

Fractionation of the Navy Fuel Oil

Temperature Range Deg. C.	Per Cent Distilling
130	First drop
130 to 225	1.1
225 to 250	4.83
250 to 275	14.25
275 to 300	20.10
300 to 325	21.70
325 to 350	30.90
Residue	5.82
Loss	1.31
Specific gravity of the oil at 20 deg. C.	0.868

Experimental Results

The materials used in the experiments were Illinois coal obtained from the Big Muddy Coal & Iron Co., Herrin, Ill., and an asphaltic base fuel oil. An analysis of the coal is given in Table I, which also shows the fractionation results for the oil. Table II gives the analyses of gases evolved from amalgam, coal and oil at temperatures 400, 500, 600, 700 and 800 deg. C., together with total yields of gas and light oils scrubbed from the gas. Results for the 700 deg. amalgam run are not reported, owing to the fact that precipitated carbon clogged the mains and rendered the gas samples taken of doubtful value.

In general, the oils give higher yields and richer gases; the amalgams give somewhat less gas of poorer quality; and the coals give the lowest yields and the poorest gas. It is an interesting fact that the run at 800 deg. C., (with continuous feed) gave almost as much gas for the amalgam as for the oil, and gave a gas of slightly better quality. It thus appears that at

TABLE II—ANALYSES OF GASES FROM TRENT AMALGAMS, COAL, AND OIL

Charge	Temp. Deg. C.	CO_2	C_2H_4	O_2	CO	CH_4	C_2H_6	H_2	N	B.t.u. Per Cu.Ft.	Yield, Cu.Ft. Per Ton	Oil From Gas, Gal. Per Ton	Remarks
Amalgam	400	9.8	23.4	0.6	4.0	29.1	17.3	8.9	6.9	1,000	750	0.38	
Coal	400	17.9	0.5	0.4	11.7	46.7	0.0	17.4	5.4	550	980	1.5	
Oil	400	15.5	16.6	0.0	1.0	23.2	39.1	4.6	0.0	1,182	600	0.0	
Amalgam	500	5.0	17.0	0.0	5.3	37.4	12.0	25.0	0.3	937	4,470	3.0	
Coal	500	10.2	1.2	0.6	19.7	38.4	8.5	12.2	8.6	779	2,970	0.1	
Oil	500	0.6	39.6	0.4	0.5	29.3	24.1	2.9	2.6	1,353	5,300	2.6	
Amalgam	600	3.0	8.8	0.6	8.5	50.8	0.0	25.3	2.8	730	10,650	8.4	Continuous feed
Amalgam	600	3.3	13.6	0.6	7.5	49.4	0.0	23.9	1.7	794	5,650	3.6	Batch distillation
Coal	600	4.7	3.3	0.5	11.4	30.6	0.0	46.2	3.3	525	6,430	4.5	
Oil	600	1.8	31.0	0.5	1.8	46.3	10.8	5.0	2.8	1,167	16,900	11.1	
Amalgam	700												Gas samples uncertain
Coal	700	6.4	0.6	0.5	28.1	13.0	0.0	46.9	4.5	370	10,750	2.1	
Oil	700	0.4	23.2	0.5	0.5	63.6	2.0	8.3	1.5	1,056	19,320	7.0	
Amalgam	800	4.9	8.9	0.7	6.7	35.3	8.1	31.5	3.9	757	19,800	4.1	Continuous feed
Amalgam	800	4.7	6.1	0.0	7.9	32.9	5.4	36.9	3.4	654	3,400	20.2	Batch distillation
Coal	800	4.2	3.0	0.4	16.5	26.6	0.0	45.4	3.9	496	10,000	0.55	
Oil	800	2.1	2.2	0.0	1.6	63.7	0.0	28.2	2.3	710	20,050	2.1	

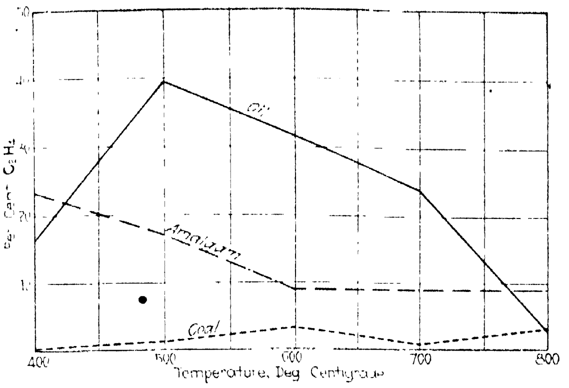


FIG. 1—PER CENT OF ETHYLENE IN GASES FROM OIL, AMALGAM AND COAL

this temperature Trent amalgam is just as good material for making commercial oil gas as the oil itself. The amalgam would of course be the cheaper, and further, it will be noted that under these conditions more oil was scrubbed from the amalgam gas than from the oil gas. Of course if a rich oil gas is wanted, the best procedure is to crack the straight oil at a lower temperature.

The percentages of oxygen-containing gases for the coals and amalgams are considered somewhat high. This is due partly to the method of feeding the retort and partly to the fact that the coal used was of high oxygen content. As for the first cause, the charge fed was finely divided, and must have carried into the retort a fair amount of adsorbed air.

Unsaturated Gases The percentages of unsaturated gases are uniformly higher for the oil except with the run at 800 deg. C., where the amalgam gives the highest percentages. The coals give the lowest percentages of unsaturated gases, but slightly higher, perhaps, than would be obtained by commercial methods of carbonization The amounts of these bodies found for the amalgams are intermediate between those for the oil and coal. Unsaturated gas is reported here as ethylene (C_2H_4), and it is probable that 95 per cent of it actually was ethylene. Especially is this true when it is considered that the gas had passed a charcoal scrubber, which would have a tendency to remove heavier gases.

Yields of Unsaturated Gases From Amalgams—Table III gives the yields of unsaturated gases from amalgams at the corresponding temperatures of distillation,

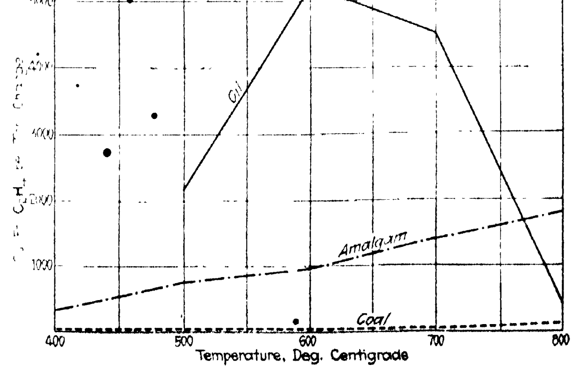


FIG. 2—YIELD OF ETHYLENE IN CU.FT. PER TON OF CHARGE

TABLE III—YIELDS AND ALCOHOL EQUIVALENTS OF UNSATURATED GASES FROM AMALGAMS

Temp Deg C.	C_2H_4 Per Cent	Total Gas Cu Ft	C_2H_4 Cu Ft.	Alcohol Equivalent Gal. Per Ton
400	23 4	750	172	3.1
500	17 0	4,400	760	13.8
600	8 8	10,850	955	17 3
800	8 9	19,800	1,760	32 0

and their equivalents in alcohol, assuming complete recovery. Figs. 1 and 2 show the data graphically. As a basis of comparison of yields we may take Bury's[1] figure of 1.6 gal. of absolute alcohol per ton of coal charged in byproduct ovens. Assuming a 50 per cent recovery, this would mean a possible yield of only 3.2 gal. of absolute alcohol per ton of coal from coke-oven gas, whereas from Trent gas there is possibly from 3 to 32 gal. per ton of amalgam charged It would thus seem that Trent gas is ideal (second only to oil gas) for the application of an alcohol recovery process.

Recovery of Ethylene as Alcohol So far it has not been possible to recover from coke-oven gas more than 50 per cent of ethylene contained as alcohol, but it would undoubtedly be possible to improve this figure considerably by research. The problem offers possibilities, particularly in connection with the rich Trent gas For example, De Loisy found that he could increase considerably the speed of absorption of ethylene by sulphuric acid through the use of catalytic agents, and thereby increase the recovery of alcohol.

Loss of Heating Value Through Removal of Ethylene From Gases Table IV shows that the loss of heating value suffered by Trent amalgam gases on removal of the ethylene is not an important consideration. They are rich gases to start with, and the removal of ethylene, although that gas has a high heating value, does not bring their heating value below that of the best industrial gases.

TABLE IV—EFFECT OF REMOVAL OF ETHYLENE ON THE HEATING VALUES OF TRENT AMALGAM GASES

Distillation Temperature, Deg. C.	B.t.u. Per Cu Ft Raw Gas	B.t.u. Per Cu Ft Scrubbed Gas
400	1,000	798
500	936	795
600	726	639
800	757	671

It may be stated further that the ethylene in the composite gas has a market value much below that which it would have as pure gas. For example, (see Table III) a 600 deg. distillation will yield 10,850 cu.ft. of composite gas, 955 cu.ft. of which is ethylene. The ethylene if recovered commercially pure would be worth 1 cent per cubic foot, or \$9.55, whereas all the gas (at 50 cents per 100) would be worth about \$5.40.

Flaky Fractures in Tool Steel

In connection with an extended investigation of high-speed tool steels now under way at the Bureau of Standards a number of treatments were applied to a single heat of high tungsten, low vanadium steel to determine whether so-called fish scale or flaky fractures could be produced intentionally, irrespective of the quality of metal as has been claimed. Normal fractures were obtained, however, in all cases, but these tests will be supplemented by further work with steels of questionable quality.

The Low-Temperature Carbonization of Coal

III.—The Clinchfield Carbocoal Plant

By Harry A. Curtis and Earle E. Daughton

THE Carbocoal process, as finally developed at Irvington, N. J., consisted of the following steps:

1. Crushing the coal and carbonizing it at a relatively low temperature in primary retorts provided with means for agitating the coal and advancing it continuously through the retorts.

2. Grinding the carbon residue, fluxing it with pitch, and briquetting.

3. Carbonizing the briquets at a relatively high temperature in secondary retorts to harden them and render them smokeless. The experimental plant at Irvington grew to be a semi-commercial installation before the work there was discontinued, but the plant was never put on a purely production basis. In September, 1918, ground was broken for a commercial Carbocoal plant at Clinchfield, Va. This plant was a government war project, but after the armistice construction was completed by the International Coal Products Corporation and the plant finally put into operation late in June, 1920. Not all of the units were finished at this time, but they were completed during the next few months.

General Arrangement and Equipment of the Plant

The Clinchfield Carbocoal plant has been described in several technical journals during the past 2 years.[1] There will therefore be included in the present article only such brief mention of the general features of the plant as will contribute to an understanding of the operating problems discussed later.

The general layout of the plant is shown diagrammatically in Fig. 1. In addition to the buildings, etc., appearing in this sketch, the company owns and operates a village for its employees, the plant being located in an isolated mountain district of southwestern Virginia.

The coal to be carbonized is dumped from railroad cars into a track hopper, carried on a Link-Belt apron conveyor to a Williams No. 3 hammer mill and crushed to pass a [illegible]-in. bar screen. It is then elevated by a Link-Belt bucket elevator to the top of the primary retort house and distributed by a flight conveyor to steel coal bins supplying the retorts. The capacity of this coal-handling equipment is, roughly, 50 tons per hour.

The primary retorts are of the type described in the first paper of this series.[2] For convenience a sketch of this retort is reproduced as Fig. 2. Twenty-four such retorts are arranged in four batteries, with the feed ends of the retorts turned together so that one coal bin serves four retorts, and a 50-hp. motor drives the feed screws and paddle shafts on twelve retorts. The carbon residue from the "Vesuvius" discharge falls on rubber-covered conveyor belts and is carried to the grinding mills, one belt serving twelve retorts. The scrubber standpipe from each retort carries the foul gas into a common main leading to the byproduct house.

The carbon residue was originally ground in Williams No. 3 hammer mills, two of these being installed underneath the carbon residue storage bins. It was found, however, that the hammers on these mills would last

[1] Article by Brandeger, *The Black Diamond*, July, 1920, describes the plant in some detail.

[2] *Chem. & Met.* vol. 28, No. 1, p. 11, Jan. 3, 1923.

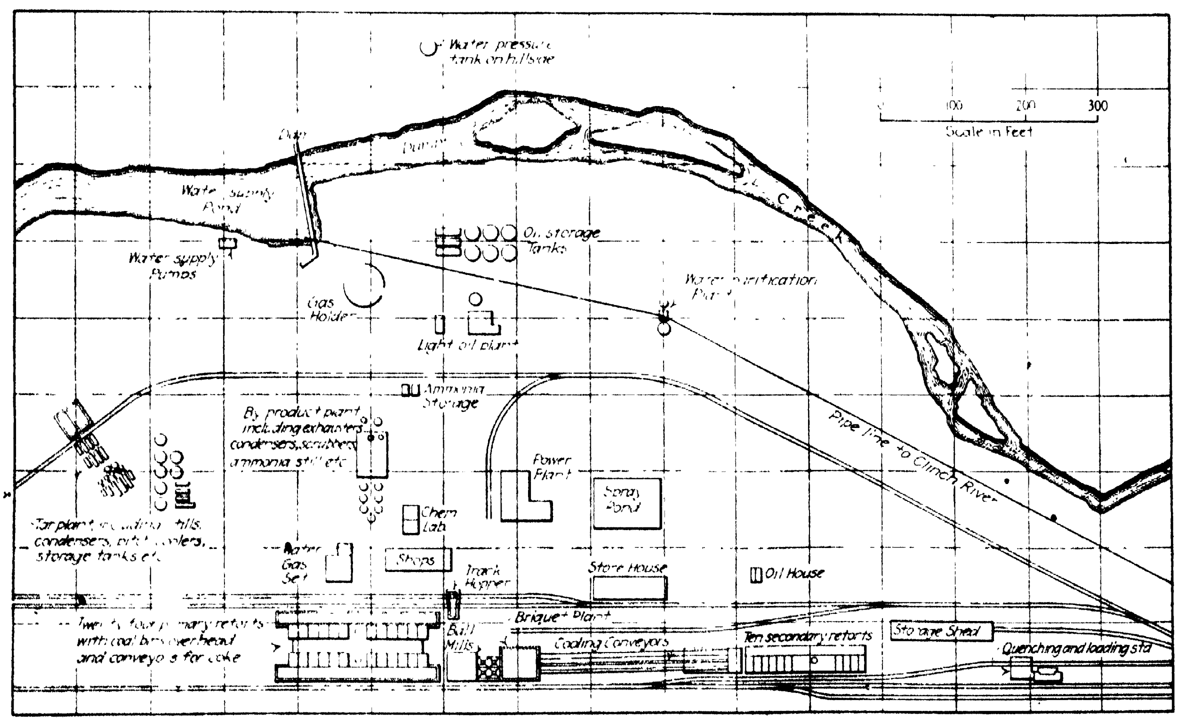


FIG. 1—GENERAL LAYOUT OF CLINCHFIELD CARBOCOAL PLANT

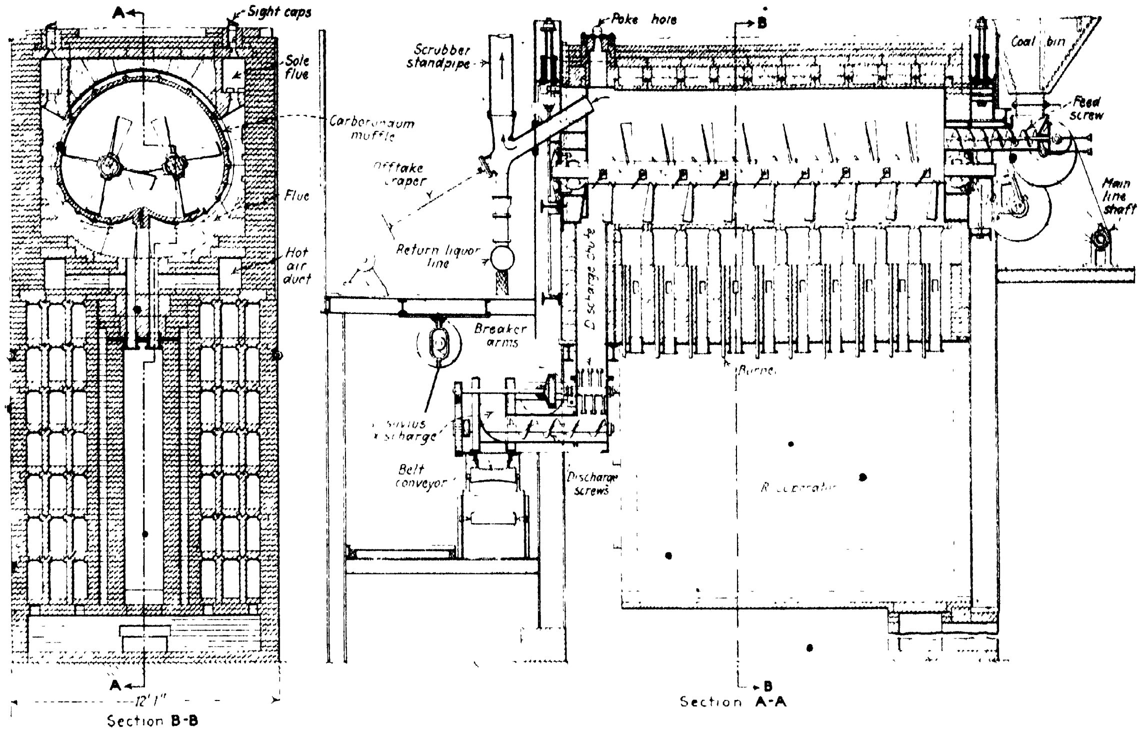


FIG. 2- CLINCHFIELD PRIMARY RETORT

ily about 24 hours. Finally the mills were abandoned nd a ball mill installed ahead of the storage bins. After rinding, the carbon residue is elevated to storage bins; om the bottom of these bins it is fed by a drag-chain roportioning conveyor to a bucket elevator, and deliv-red to a horizontal paddle mixer, where it is mixed ith molten pitch. The paddle mixer empties into a uxer, where the material is stirred and is heated with ve steam. The fluxer empties by gravity into a sec-nd paddle mixer feeding the briquet presses. All of ie grinding, elevating, mixing, fluxing and briquetting quipment is installed in duplicate units, each having apacity sufficient for the whole output of the primary etorts. The briquet presses are of the roll type with at-link chains running between the molds so as to give riquets with flattened ends.

The warm briquets from the presses fall onto long, etallic chain-belt, cooling conveyors and are carried lowly up to a raw briquet storage bin. From the bot-om of this bin the raw briquets are withdrawn over a haker screen into a steel larry car serving the sec-ndary retorts.

There are thirty secondary retorts arranged in ten enches of three retorts each. The retorts are divided nto an upper and lower chamber by a silica brick parti-ion, the chambers opening into each other at either nd Fig. 3 shows the general features of a secondary etort. The retorts are heated by vertical flues between em, with gas burners at the top of the flues. The wer ends of the flues open into a common duct passing p along the floor of the lower retort chamber and lead-ig to the recuperator.

In these secondary retorts the briquets are carbon-ed for 8 to 10 hours, at a temperature which eventually eaches about 1,800 deg. F., the byproducts from this rbonization being collected and handled along with ose from the primary retorts. At the end of the rbonizing period the discharge door at the lower end the retort is opened and the briquets permitted to run out, the charge being poked with rods from the lower end if it hangs in the retort. The red hot briquets are quenched under a water spray, screened and loaded for shipment. In Fig. 4 there is shown a diagrammatic representation of the whole Carbocoal process, indicating the individual units.

The plant includes, besides the usual byproducts equipment, a tar plant, power plant, light oil refinery,

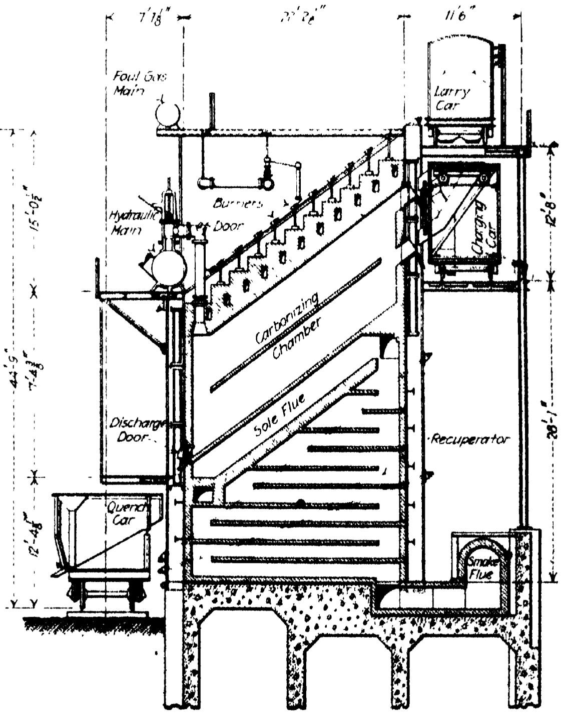


FIG. 3—CLINCHFIELD SECONDARY RETORTS

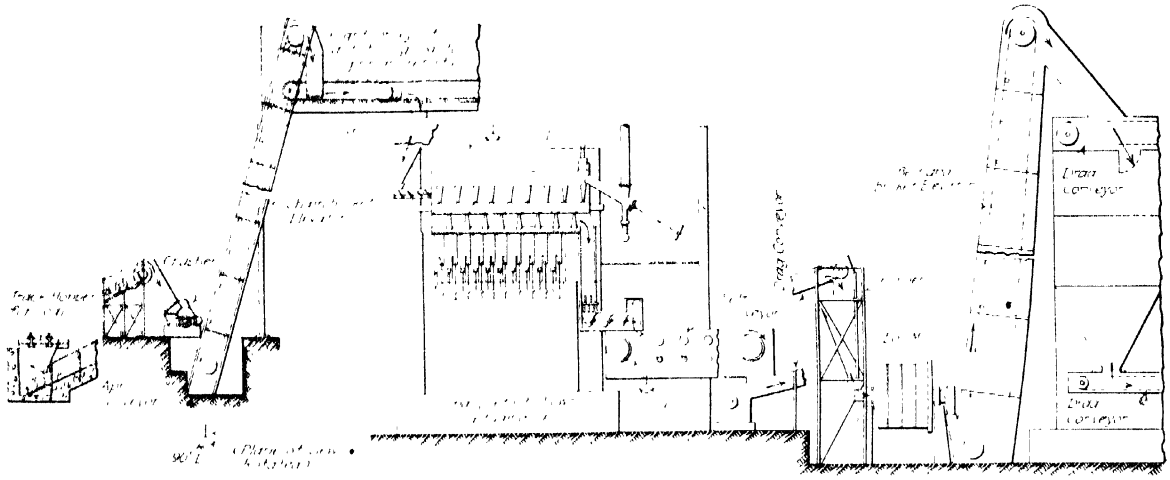
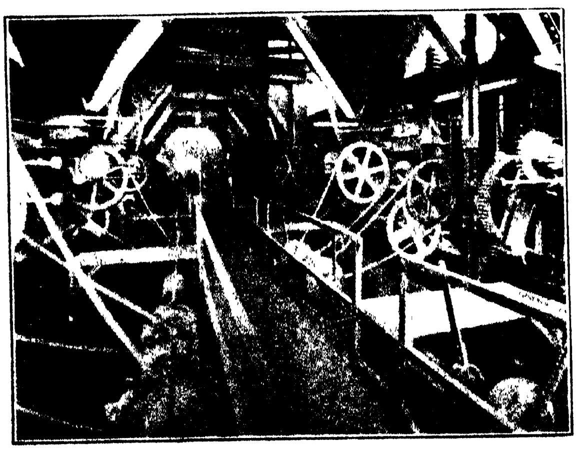


FIG. 1—EQUIPMENT FOR CARBOCOAL PRODUCTION (NOT DRAWN TO SCALE)

laboratory, shop, storehouses, etc., as shown in Fig. 1. A pair of water gas generators are provided for starting the plant and to make up any deficit in gas supply.

Errors in Plant Design

In deciding upon equipment and layout for the Clinchfield plant there was apparently poor liaison between the officers of the company who approved the designs and the operating crew at the company's Irvington plant. While in general the Clinchfield plant was designed along the lines worked out at Irvington, there were numerous cases where Irvington experience was disregarded and equipment installed which had already been found inadequate. Certain parts of the plant are poorly arranged and there is evidence of poor engineering throughout the plant. It was, of course, inevitable that in a pioneer project of this sort mistakes would be made, but the Clinchfield plant certainly included more blunders than might reasonably be expected. This was most unfortunate, for the operating difficulties connected with a new process were certain to be numerous under the best of planning. As a matter of fact, the difficulties encountered at the Clinchfield plant were so numerous and so persistent that, although the plant was kept operating, the manufacturing costs bore no relation to the actual costs of carrying out the steps of the process, and after nearly 2 years of operation it finally appeared best to shut the plant down temporarily and solve some of the mechanical problems.



PADDLE DRIVES AND FEED MECHANISMS, PRIMARY RETORTS

In the pages which follow a number of operating difficulties are discussed and the method of overcoming some of them given. It should by no means be concluded that the whole Clinchfield plant was a failure mechanically, for such was not the case. The plant was operated and many thousands of tons of Carbocoal sent to market during 1920 and 1921. Commercial operation was deliberately discontinued in March, 1922, because persistent mechanical difficulties ran up the manufacturing costs above the market value of the products. Since March, 1922, an experimental program has been followed actively and solutions have been found for several of the most serious difficulties. It is only a question of solving minor mechanical problems now. The process itself is sound, the fuel produced readily salable, and the remaining mechanical problems are well defined.

Operation Difficulties

Carbon Deposit in Primary Retorts

Referring to Fig. 2, it is noted that there are necessarily small clearances between the ends of the paddles and the retort walls. Shortly after a retort is put into operation this space fills with carbon residue baked in place. At first this layer between the ends of the paddles and the retort wall is soft, but it gradually hardens until it passes the hardness of steel. The paddles then drag heavily over this hard surface, which ever tends to grow thicker until after, say, 50 or 60 or 70 days there comes a time when the resistance offered to the motion of the paddles is great enough to break the paddles, the paddle shafts or some part of the driving train.

At the time the Clinchfield plant was built it was known that this carbon deposit in the retort would give trouble, but it was thought that cleaning the retort once in 5 or 6 months would suffice. It was found in Clinchfield operation, however, that there was danger of breaking something after about 60 days. This was serious. In fact, this was perhaps the most serious problem which developed at Clinchfield. Persistent, foolishly persistent, attempts were made to keep retorts operating longer than 60 days, regardless of breakage with results which were disastrous to the cost data at Clinchfield.

Numerous attempts had been made at Irvington and

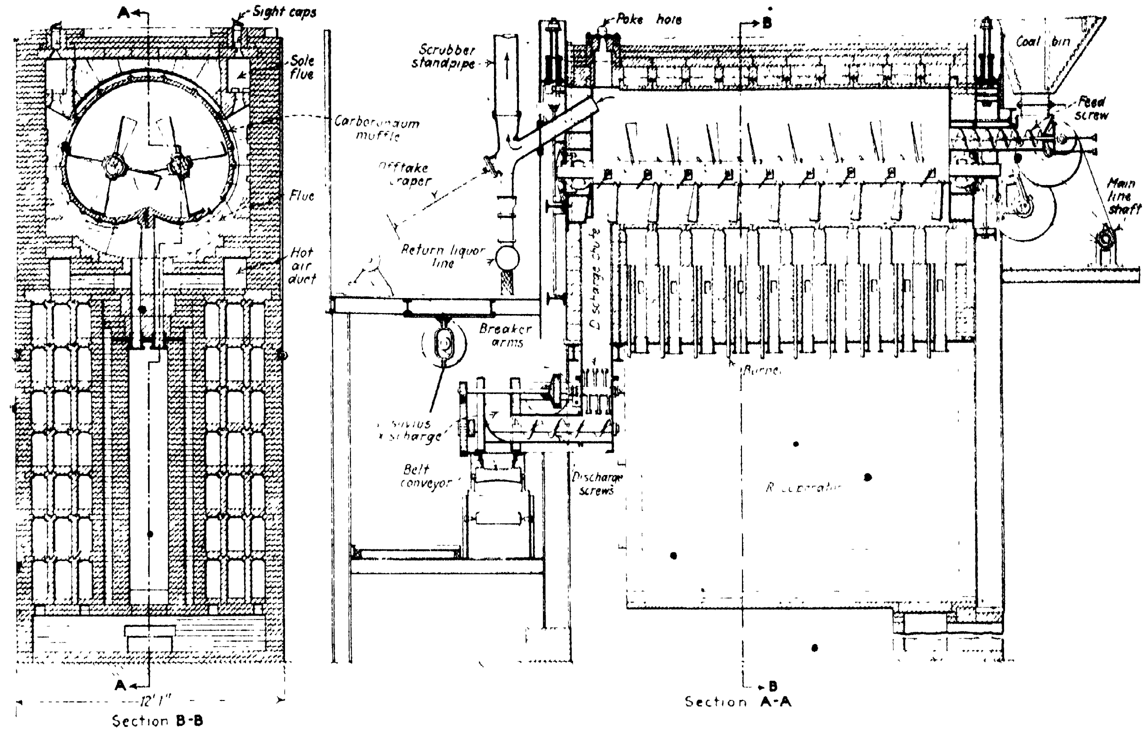


FIG. 2- CLINCHFIELD PRIMARY RETORT

nly about 24 hours. Finally the mills were abandoned nd a ball mill installed ahead of the storage bins. After rinding, the carbon residue is elevated to storage bins; om the bottom of these bins it is fed by a drag-chain roportioning conveyor to a bucket elevator, and deliv- red to a horizontal paddle mixer, where it is mixed ith molten pitch. The paddle mixer empties into a uxer, where the material is stirred and is heated with ve steam. The fluxer empties by gravity into a sec- nd paddle mixer feeding the briquet presses. All of e grinding, elevating, mixing, fluxing and briquetting quipment is installed in duplicate units, each having apacity sufficient for the whole output of the primary etorts. The briquet presses are of the roll type with at-link chains running between the molds so as to give riquets with flattened ends.

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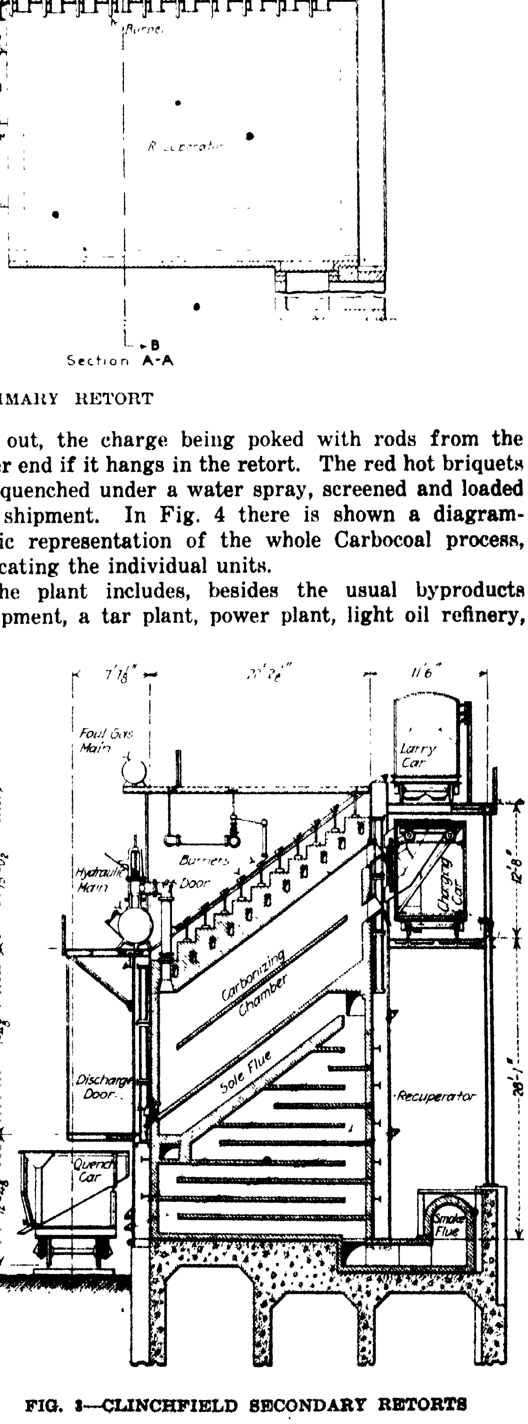
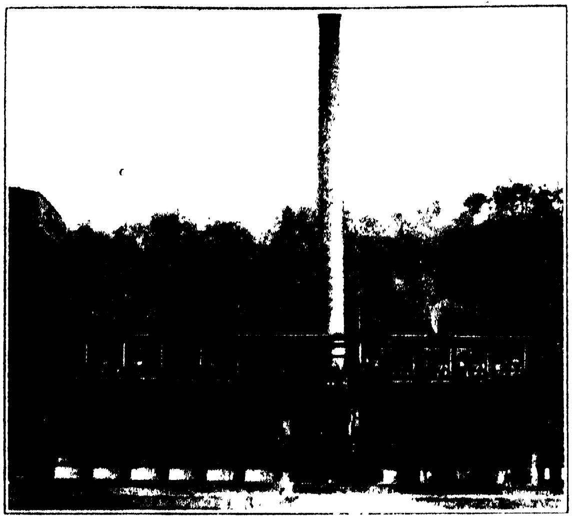


FIG. 3—CLINCHFIELD SECONDARY RETORTS



BATTERY OF SECONDARY RETORTS

of hot, carbon dioxide-bearing air into the retort. This carbon dioxide gave trouble later, of course, in the ammonia recovery equipment.

In addition to the above defect, the end-flights on the discharge screws and the driving gears on the discharge mechanism wore out rapidly due to the heavy work of pushing the carbon residue up over the dam in the "Vesuvius." Whenever the carbon residue was discharged in a plastic condition and whenever the end-flight had worn down to a certain point, the discharge would jam. It was then necessary to open relief discharge doors at the foot of the discharge chute while the hot screws were hauled out and the flights renewed.

Altogether, the discharge arrangement on the Clinchfield retort was thoroughly bad. A crew of mechanics was busy continually getting discharges back into operation, with consequent unnecessary increase in the operating costs.

Since the sealing of the retort accomplished by forcing the carbon residue up over the dam in the "Vesuvius" was so slight, it was eventually decided to cut a hole in the bottom of this casting and permit the carbon residue to fall directly from the discharge screws onto the conveyor belts. This relieved much of the load on the discharge drive mechanism and did not materially change the other conditions of operation. The discharges were in use this way at the time the plant was closed down in March, 1922 Since that time experiments with various discharge arrangements have been conducted. A successful discharge has been developed in which the carbon residue falls into an inclined cooling chamber at the end of the retort with a water-sealed door at the bottom of the chamber. From the cooling chambers to the ball mill the carbon residue will be moved in steel cars mounted on a track running around the batteries. Tests on this scheme are now in progress.

The Conveyor System for Carbon Residue

Belt conveyors were installed at Clinchfield for handling the carbon residue from the primary retorts to the ball mills. Experience has shown that the carbon residue coming from the retorts is too hot to be handled by rubber-covered conveyor belts. Replacements were required frequently, but the belts were continued in use.

As an experiment a short drag conveyor was installed just ahead of the ball mill hopper. The abrasive carbon residue caused excessive wear on the chain guides and the equipment would soon have been worn out if it had been continued in service. It is probable that a pan or an apron conveyor would be satisfactory. Our present scheme, however, is to use small hopper cars instead of a conveyor.

The Gas Offtake, Primary Retorts

In Clinchfield operation it was found difficult to keep the gas offtakes clean. As originally built each retort was provided with a hand-operated scraper in the gas offtake. The scraper would stick in the offtake frequently and its operation was irksome. For some time no scraper was used, the offtakes being poked out with a rod when they became so choked as to interfere with retort operation. Later, however, the scrapers were replaced and an electric motor for driving them mounted on an overhead track. This made a fairly satisfactory arrangement. During some recent experiments it was found that a certain arrangement of liquor sprays eliminated most of the gas offtake trouble, and these sprays will eventually be installed on all the retorts.

Grinding Equipment

It has been found at Irvington that the Williams hammer mill was unsuited for grinding material as abrasive as carbon residue. Completely disregarding this experience, two such hammer mills were installed at Clinchfield. As a result, the screen analysis on the ground carbon residue was seldom correct for getting best results, and this accounted in part for the poor quality of the Carbocoal made at first. Five months after the plant was started, a Kennedy-Van Saun ball mill was installed and during the summer of 1921 a Marcy ball mill was added. Either one of these mills will grind the total carbon residue output of the primary retorts, say 18 tons per hour. The Marcy mill is much the superior of the two mills.

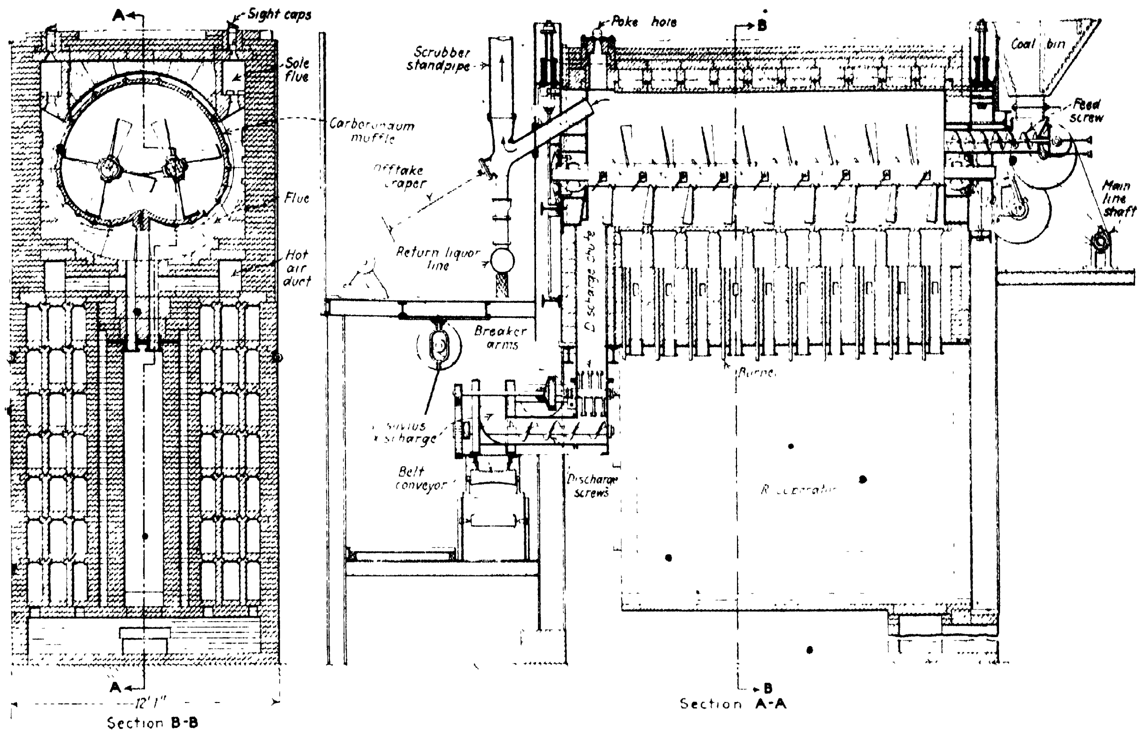
While the ball mills grind the carbon residue satisfactorily and stand up well under constant use, we feel that the grinding problem is not entirely solved. The ball mills in use now require 200- to 250-hp. drive motors. The power cost for grinding seems too high. It is possible that much smaller rod mills would do the work satisfactorily, and this experiment is on our schedule.

The Briquet Presses

The briquet presses installed at Clinchfield are roll presses with flat-link chains running between briquet dies so as to give briquets with flat ends. These presses are exceptionally well built, but, unfortunately, the wear on the chains with a material as abrasive as carbon residue is excessive, even though the chains be made of glass-hard alloy steel. When the chains wear thin, they do not fill their grooves on the rolls and briquet material is forced into these grooves, preventing the briquets from slipping in the dies as they pass beyond the point of maximum pressure. This gives briquets with one rough side and increases the percentage of fines beyond the presses. It is likely that some type of Belgian press without the chains will be installed before operations are resumed at Clinchfield.

Handling of Raw Briquets

It was known at Irvington that the raw briquets should be handled gently and that it was bad practice



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nly about 24 hours. Finally the mills were abandoned nd a ball mill installed ahead of the storage bins. After rinding, the carbon residue is elevated to storage bins; rom the bottom of these bins it is fed by a drag-chain roportioning conveyor to a bucket elevator, and deliv- red to a horizontal paddle mixer, where it is mixed ith molten pitch. The paddle mixer empties into a uxer, where the material is stirred and is heated with ve steam. The fluxer empties by gravity into a sec- nd paddle mixer feeding the briquet presses. All of e grinding, elevating, mixing, fluxing and briquetting quipment is installed in duplicate units, each having apacity sufficient for the whole output of the primary etorts. The briquet presses are of the roll type with at-link chains running between the molds so as to give riquets with flattened ends.

The warm briquets from the presses fall onto long, etallic chain-belt, cooling conveyors and are carried lowly up to a raw briquet storage bin. From the bot- om of this bin the raw briquets are withdrawn over a haker screen into a steel larry car serving the sec- ndary retorts.

There are thirty secondary retorts arranged in ten enches of three retorts each. The retorts are divided nto an upper and lower chamber by a silica brick parti- ion, the chambers opening into each other at either nd Fig. 3 shows the general features of a secondary etort. The retorts are heated by vertical flues between hem, with gas burners at the top of the flues. The wer ends of the flues open into a common duct passing p along the floor of the lower retort chamber and lead- ng to the recuperator.

In these secondary retorts the briquets are carbon- ed for 8 to 10 hours, at a temperature which eventually eaches about 1,800 deg. F., the byproducts from this rbonization being collected and handled along with ose from the primary retorts. At the end of the rbonizing period the discharge door at the lower end the retort is opened and the briquets permitted to run out, the charge being poked with rods from the lower end if it hangs in the retort. The red hot briquets are quenched under a water spray, screened and loaded for shipment. In Fig. 4 there is shown a diagrammatic representation of the whole Carbocoal process, indicating the individual units.

The plant includes, besides the usual byproducts equipment, a tar plant, power plant, light oil refinery,

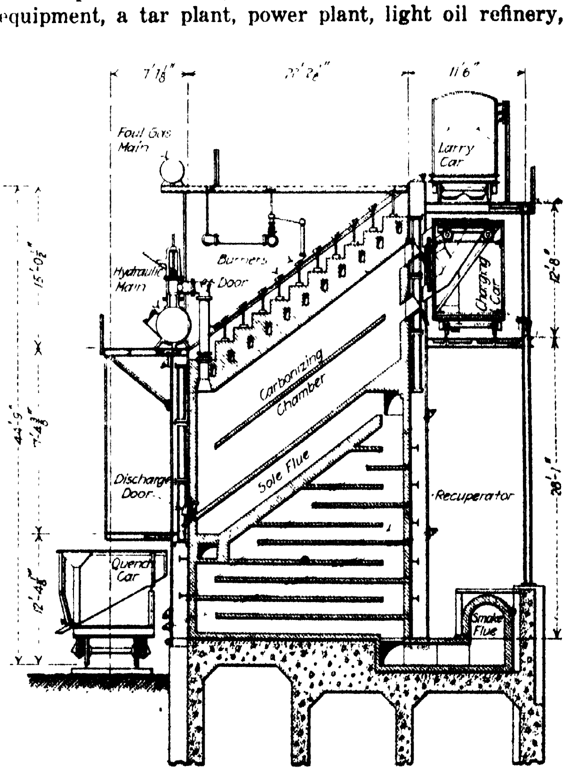


FIG. 3—CLINCHFIELD SECONDARY RETORTS

Legal Notes

By Wellington Gustin

Perkins Patent for Process and Product Covering Glue Upheld in Three Cases

The Perkins reissue patent, No. 13,434, for a wood glue and process of making same was held valid and infringed in the cases of Perkins Glue Co. vs. Hood & Wright and same vs. the West Michigan Furniture Co., 279 Fed. Rep., 454, decided by District Judge Sessions.

Suit was brought in each case for infringement of two process claims, Nos. 13 and 38, and three product claims, Nos. 28, 30 and 31, of the patent. The patent covers a vegetable glue derived from starch or starchy products, having the adhesive strength and qualities of animal glue and suitable for gluing woods, especially veneers; and also the method or process of making such glue.

Glue Base Purchased and Treated by Method of Patent

The defendants used the glue mainly for making veneers. Each bought the prepared glue base from the National Process Co., then subjected the glue base so purchased to the treatment of the final process described in the patent, and thus produces the glue of the patent ready for use.

The glue base manufactured and sold by the National and International Process companies of Indianapolis and used by the defendants is not prepared in accordance with the method or first step of the process of the patent, but is produced by mixing commercial starches of different grades and kinds, the raw, underdegenerated and overdegenerated starches being so proportioned that the mixture has the same average degeneration and the same water absorptive properties as the processed glue base of the patent.

Claims for Final Process and Resultant Product Valid

The court found the claims of the patent for the glue base as well as the process of preparing it to be invalid, but same were not involved in this action. But it did find that the claims for the finished product and for the complete process of preparing such product were valid; also it found that the claims for the glue resulting from the application of the final process to the glue base of the patent are valid, notwithstanding the fact that neither the glue base itself nor the process of making it is patentable.

For the glue base may be produced, it was admitted, without using the inventor's preferred process. And it follows, said the court, that the claims for the inventor's final process, applied to or in combination with the glue base of the patent, in whatever manner such base may have been produced, are valid. A patentable product does not result from the practice of an old, well-known and non-patentable process. The Court of Appeals had, in a former case, held the claims valid for the final process and the resultant product. Clearly, it says here, "final" process does not necessarily or presumably mean "complete" process and the patent claims were "not strictly for the second step of the process above and as such, but are for the final process, applied to or in combination with the glue base of the patent."

Now the owner of a patent is bound by the disclaimer in the patent. The sole object of the disclaimer in the patent at bar was to narrow the claims with respect to the starchy product or glue base to be subjected to the final process of the patent. Under the disclaimer the starch or starchy product to be processed must be degenerated to the extent described in the patent before being subjected to the final process of the patent. So limited, the claims are valid and infringed, said the court.

Case Where Single Starch Was Used for Base

This same court was called to pass upon the patent again in an action brought against the Holland Furniture Co. and others.

The only substantial difference between the former cases and this one was found in the method of producing a part of the base used by the defendants in the production of the glue. In this case a part of the glue base was produced by another manufacturer by selecting a single grade and quality of commercial cassava starch and merely sifting out the impurities therein contained. Manifestly the resultant glue base is the same, whether consisting of a mixture of starches of different degrees of degeneration or of a single starch of the same degree of degeneration as the mixture. Defendant's final product was obtained by subjecting the glue base to the treatment described in the patent as the second or final step of the patented process, and was identical with the glue of the patent; and the court held it did so combine product and process in the preparation of its glue as to infringe the product claims of the patent.

Standard of Comparison for Determining Profit From Infringement of Alkaline Process for Reclaiming Rubber

The standard of comparison for determining profits earned by an infringement is a point involved in a suit brought by the Philadelphia Rubber Works against the United States Rubber Reclaiming Works and others. There it was held by the Circuit Court of Appeals of the United States that a process developed by an infringer after an injunction against infringement was issued to avoid the infringement, cannot be adopted as a standard of comparison in determining the profits due to the infringement. (277 Federal, 171.)

The case was before the Court of Appeals from a decree by the District Court fixing the amount of damages for the infringement after an accounting, both sides appealing. Plaintiff had been awarded the sum of $324,597.46 as profits which were realized by the defendants during a period of 5 years of alleged infringement of plaintiff's patent. Plaintiff appealed for the reason that it contended the award was too small.

The suit involves the Marks patent, No. 635,141, owned by the plaintiff, Philadelphia Rubber Works, covering a process for devulcanizing rubber waste. The patent was held valid and infringed in the District Court, and this result was affirmed on appeal. (143 C. C. A., 426.) There the court decided that the Marks patent accomplished a new result by the application of a new process to the reclamation of rubber waste. Defendant, United States Rubber Reclaiming Works, conveyed its business and property to the United States Rubber Reclaiming Co., Inc., which later transferred its assets and business to the Madison Tire & Rubber Co., each of which were made parties defendants in this suit.

The District Court ruled that there was no standard of comparison from which to estimate the profits, and that the plaintiff was entitled to recover the entire profits made by the defendants from reclaimed rubber produced by the infringing process. It refused to allow a deduction of $179,309.24 for alleged profits on the compounds which the defendants claim that they incorporated into the reclaimed rubber sold. It further refused to allow the defendants a reduction of $75,-946.24 for alleged profits made from operations subsequent to the devulcanizing process, which operations are usual and customary in reclaiming rubber to put the product in condition for sale. To the sum agreed upon by the accountants as the basic figure of profits, $610,581.66, the court added $10,982.48, a portion of $21,507.30 which was deducted in fixing said sum as special expenses, a proportion of the sum of $21,004.18 legal expenses, and a proportion of the reorganization expenses of defendants of $3,461.71. The court held this to have been improperly charged to the cost of the operation with the infringing process.

District Court Allowed Recovery of Entire Profits

Further, the District Court reduced the profits by $122,932.57, apportioning certain expenses between the infringing and non-infringing processes—that is, it divided the general expenses equally between the defendants' two mills and allowed this as a deduction. The plaintiff claims that the court should have followed the method adopted by the accountants jointly representing the parties. Then the court allowed a reduction of $197,200.72 for interest on capital invested in the plant and business using the infringing process. Defendants claimed the court erred in making the Madison Tire & Rubber Co. a party and requiring payment of the damages by it.

Marks Process

The process of the Marks patent for devulcanizing rubber waste consists in submerging the finely ground rubber waste in a dilute alkaline solution in a sealed vessel, and in keeping the contents of the vessel at a temperature of 3.4 deg. F., and in maintaining this temperature for 20 hours, more or less. The court held that the defendants appropriated the essential elements of this process and thereby achieved the same result as the Marks patent accomplishes. The questions of validity and infringement were established against the ...nts by the previous decision of the court cited above.

The Marks process opened a new field for production of reclaimed rubber—that being from highly vulcanized scrap. This had never previously been successfully accomplished. By the acid process, the court found, rubber had been reclaimed from boots and shoes and made capable of being used for other purposes. But from the reception and use of the Marks process in the trade and the results accomplished by it, the court found this process was of great monetary and economic value, particularly in reclaiming rubber used in automobile tires.

Alkaline Process Only One Successful With Tire Scrap

It is pointed out that the devulcanized rubber must not only possess a maximum plasticity and absorptive ability but must not lose these properties with age, and the revulcanized reclaimed rubber must show high tensile strength and high elongation, and must retain these properties for a maximum period of time. Tire scrap devulcanized by the acid process does not exhibit these properties, which are observed in the stock devulcanized by the alkali process. And also because of its increased plasticity prior to vulcanization, the alkali stock exhibits a superior abrasive resistance, and is superior as to aging. Such that proof showed that the Marks patent was one of the most successful and valuable rubber patents ever issued.

It was found that the defendants' product essentially derived its marketability and value from the unlawful appropriation of the process of Marks. Therefore the court awarded the plaintiff, owner of the Marks patent, the entire profits made by defendants from the sale of reclaimed rubber produced by the Marks process.

The Court of Appeals held that the rule of damages applied by the court below was correct, and that there was no process in use or known which could be used as a standard of comparison as contended for by the defendants. Again, it says that in determining the profits of an infringer, other methods of accomplishing the results of the patented process cannot be used as standards of comparison, if such methods were covered by other patents so as not to be available to the infringer.

No Other Method Available for Defendants

In such cases, the court says, in finding the proper amount of damages the question to be determined is, What advantage did the defendant derive from using the plaintiff's invention over what he had in using other processes then open to the public and adequate to obtain an equally beneficial result? The fruits of that advantage are the profits, and these are the damages to the owner of the invention.

The standard of comparison for determining the profits earned by an infringement, to be applicable in the case, must have been known and open prior to the date of the plaintiff's patent. The field of selection of process which might be used should be, in principle, that which is open to the art at the time the invention is appropriated. Where there is a patent which forbids such use, the question is presented whether it is actually available to the infringer during the period of infringement. Where the owner of the patent declines to permit its use or grant a license, it cannot be set up as a standard of comparison, says the court.

Neither may processes which were developed after the infringement as a substitute for use by the defendants be used as a standard of comparison. In this case the court found no process which might be used as this standard. Therefore the rule applicable required the defendants to pay over to the plaintiff all the profits which they derived through unlawful infringement.

Now, where profits are made by the use of an article patented as an entirety, the infringer is liable for all the profits, unless he can show, and the burden is on him to show, that a portion of them is the result of some other things used.

Claim of Profit on Other Steps Not Allowed

The defendants argued that a small portion only of the total profits is due to the devulcanizing step and that the remainder is due to the finishing and refining steps performed subsequently. The devulcanized rubber is not immediately in condition for sale or use, but is subjected to the refining and finishing steps. Defendants argued that of the total cost of producing

reclaimed rubber, only 18 per cent of that cost is incurred in the devulcanizing step, the balance being due to subsequent steps. But the evidence showed that the value of the product is due to the devulcanizing process, the reclaimed rubber being given characteristics wholly different from the characteristics of acid reclaimed tire scrap. These characteristics result in a new product, which could be attained only by depolymerizing the waste or breaking down the rubber molecules formed during vulcanization. The particular rubber product obtained could be obtained only by the Marks process. The fact is, says the court, that defendants could not have sold the reclaimed rubber without first having imparted to that rubber the characteristics resulting from the Marks process. This cannot be separated from the finishing and refining which help to make the article marketable. The court found it impossible for the defendants, without the wrongful use of plaintiff's process, to carry on their operations as they did. It appeared that the entire commercial value of the rubber arises from the use of the patented process and the court said plaintiff was entitled to recover from the infringer the total profits derived.

Infringer Could Not Claim That Part of Profits Was Made on Compounds

Further, the defendants contended for alleged profits on compounds which were incorporated in the reclaimed rubber sold. There were about 7 per cent of various compounding ingredients used, costing defendants $57,157.72, and they claimed the right to deduct the profits which they claim to have made in these ingredients, or a total sum of $179,309.24. The court found no proof that these compounds, after being combined with the rubber, were of any greater value than when put in. But since the whole product was sold at the market price for rubber, the infringer could not claim that a portion of his profits was a profit on the compounds used, and he is entitled to deduct only the cost of the compounds according to the ruling of the court.

Again, in determining the profits earned by an infringer, special payments made by the infringer to its officers, in addition to their regular salaries, legal expenses incurred in defending the infringement suit and expenses of reorganizing the infringing corporation cannot be deducted from the gross profits. Yet interest on the capital invested in the infringing portion of defendant's business was properly allowed as a charge against the gross profits from the infringing product.

In its findings the court says this was not a willful and deliberate infringement. The District Court was upheld in its holdings by the appellate court, and the United States Supreme Court, after a hearing on a petition for a certiorari to bring it up to that court, denied the petition.

A Slide Rule for Oil Viscosities

For more than 30 years the oil industry has employed various viscosimeters, there being in common use four types—the Saybolt in the United States, the Redwood in England and the colonies, the Engler in Germany and most other countries, including France, where also the Barbey ixometer is used by the French Government.

Unfortunately all attempts to introduce or adopt one type of instrument to be used universally have failed. The scientific method for determining viscosities of oil in absolute measure as poise has not reached the stage to be adopted by the oil industry.

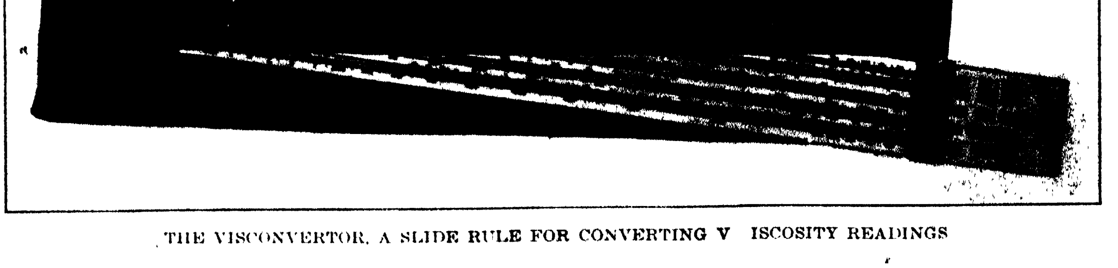
Almost every refinery and plant doing business in foreign countries is handicapped by the requirement of tests on the different instruments as before noted. This means that the actual tests must be made on the various instruments or use made of various calculated tables and plotted curves for the approximate conversion of the viscosity from one instrument to another, which is time consuming and not always accurate.

An attempt to provide the oil industry with an instrument for converting the viscosity of an oil from the value of one instrument to the value of another instrument at the same temperature, as well as at slightly different temperatures, has resulted in the designing of an instrument known as the "Visconvertor" by V. L. Chechot of the physical testing staff of the Atlantic Refining Co. of Philadelphia. Results obtained on this instrument are accurate within a reasonable degree, slight variations being expected in converting from one temperature to another according to the crude source.

The corresponding viscosities are arranged in logarithmical lines, similar to a slide rule, and the reading is made in simple manner by placing a slider over the observed instrument line and reading the corresponding value on the desired instrument line.

The arrangement of the logarithmical lines is such that it is possible to convert viscosities at the same temperature on the four instruments mentioned—viz., Saybolt, Redwood, Engler and Barbey. Also Saybolt at 100 deg. F. can be translated into Engler at 50 deg. C. or Barbey at 50 deg. C.; Saybolt at 100 deg. F. to Redwood at 140 deg. F. or Saybolt at 130 deg. F.; Saybolt at 130 deg. F. to Redwood at 140 deg. F.; Engler at 50 deg. C. to Engler at 20 deg. C. or Barbey at 50 deg. C.; Saybolt at 210 deg. F. to Engler or Barbey; Redwood at 200 deg. F. to Saybolt at 210 deg. F., etc.

The data used in preparing this instrument have been calculated theoretically by means of absolute and kinematic viscosities and then verified by actual tests on certified instruments. The reverse side of the rule contains a considerable amount of data and formulas pertaining to the oil industry.



THE VISCONVERTOR, A SLIDE RULE FOR CONVERTING VISCOSITY READINGS

The District Court ruled that there was no standard of comparison from which to estimate the profits, and that the plaintiff was entitled to recover the entire profits made by the defendants from reclaimed rubber produced by the infringing process. It refused to allow a deduction of $179,309.24 for alleged profits on the compounds which the defendants claim that they incorporated into the reclaimed rubber sold. It further refused to allow the defendants a reduction of $75,946.24 for alleged profits made from operations subsequent to the devulcanizing process, which operations are usual and customary in reclaiming rubber to put the product in condition for sale. To the sum agreed upon by the accountants as the basic figure of profits, $610,581.66, the court added $10,982.48, a portion of $21,507.30 which was deducted in fixing said sum as special expenses, a proportion of the sum of $21,004.18 legal expenses, and a proportion of the reorganization expenses of defendants of $3,461.71. The court held this to have been improperly charged to the cost of the operation with the infringing process.

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Marks Process

The process of the Marks patent for devulcanizing rubber waste consists in submerging the finely ground rubber waste in a dilute alkaline solution in a sealed vessel, and in keeping the contents of the vessel at a temperature of 344 deg. F., and in maintaining this temperature for 20 hours, more or less. The court held that the defendants appropriated the essential elements of this process and thereby achieved the same result as the Marks patent accomplishes. The questions of validity and infringement were established against the ...nts by the previous decision of the court cited above.

The Marks process opened a new field for production of reclaimed rubber—that being from highly vulcanized scrap. This had never previously been successfully accomplished. By the acid process, the court found, rubber had been reclaimed from boots and shoes and made capable of being used for other purposes. But from the reception and use of the Marks process in the trade and the results accomplished by it, the court found this process was of great monetary and economic value, particularly in reclaiming rubber used in automobile tires.

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Neither may processes which were developed after the infringement as a substitute for use by the defendants be used as a standard of comparison. In this case the court found no process which might be used as this standard. Therefore the rule applicable required the defendants to pay over to the plaintiff all the profits which they derived through unlawful infringement.

Now, where profits are made by the use of an article patented as an entirety, the infringer is liable for all the profits, unless he can show, and the burden is on him to show, that a portion of them is the result of some other things used.

Claim of Profit on Other Steps Not Allowed

The defendants argued that a small portion only of the total profits is due to the devulcanizing step and that the remainder is due to the finishing and refining steps performed subsequently. The devulcanized rubber is not immediately in condition for sale or use, but is subjected to the refining and finishing steps. Defendants argued that of the total cost of producing

Cellulose Acetate Solvent—The use of cyclobutanone as solvent for cellulose acetates in the manufacture of varnishes, artificial silk and films is covered by a patent granted to Henry Dreyfus. It is claimed that cyclobutanone is an excellent solvent for cellulose acetate, better than cyclohexanone. The cyclobutanone or side chain homologues thereof may be used in any desired quantity relative to the cellulose acetate either alone or with suitable diluents or solvents, such as methyl alcohol, acetone, etc. Any other usual or suitable substances such as camphor, fillers, coloring matter, etc., may be added in making the various products. (1,440,006. Henry Dreyfus, London, England. Dec. 26, 1922.)

Ammonia as Nitrocellulose Solvent—A patent recently issued to John Collins Clancy covers the use of liquid anhydrous ammonia as a solvent for nitrocellulose. Anhydrous ammonia is said to serve as an excellent solvent for the nitrates of cellulose generally, being capable of readily dissolving the higher nitrates which have heretofore been regarded as insoluble or soluble only in a very limited number of solvents. It is also claimed that the higher nitrates, as well as the more readily soluble lower nitrates, can be dissolved in liquid anhydrous ammonia without losing their structural aggregates.

Not only is it possible to dissolve the nitrates of cellulose in liquid anhydrous ammonia, but solutions thus formed may be transferred into other suitable menstrua and upon evaporating off the ammonia the nitrates will remain in solution in the menstrua to which they have been transferred, even though the nitrates were not initially soluble in such menstrua.

It is claimed that the same result may be accomplished by simply moistening the cellulose nitrates with liquid anhydrous ammonia, thereby changing the nitrates to a gelatinous mass, even when the ammonia is not added in sufficient quantity to form a clear solution. The cellulose nitrates thus treated when transferred to the tetrachlorethane, carbon tetrachloride, benzene, alcohol or ester, which is to constitute the final solution medium, will immediately form a clear transparent solution of any degree of viscosity desired, and when the process is carried out by this method the use of pressure may be dispensed with, as a sufficient quantity of ammonia will remain in the cellulose nitrates during the transfer to the solvent, even at atmospheric pressure, to render the nitrates soluble in the second solvent.

The advantages of such a process are pointed out in the specifications. Obviously, this extra step in the solution of nitrates of cellulose will allow a wider latitude in the choice of solvent for a nitrocellulose solution of any desired characteristics. It also would permit the use of non-flammable solvents which cannot be used ordinarily on account of their low solvent value. (1,439,293. John Collins Clancy, Providence, R. I.; assignor to the Nitrogen Corp. of Providence. Dec. 19, 1922.)

Cellulose Nitrate — The cellulose nitrate used in the manufacture of pyroxylin plastics is usually made by nitrating shredded tissue paper. It is a well known fact that during the nitration process there is a considerable amount of acid lost by chemical combination with the cellulose and by the formation of acid fumes and by the mechanical retention of acid in the nitrated fiber. R. P. Calvert has been granted a patent which is assigned to E. I. du Pont de Nemours & Co., Wilmington, Del., covering the process of compressing the paper before it is nitrated by passing it through calenders under a pressure sufficient to materially reduce its thickness. The results of experiments made to compare the acid loss on paper which was nitrated without previous compression with that which had been subjected to the extra step showed a net saving of about 0.4 of a pound of concentrated acid for each pound of nitrocellulose produced. (1,437,041. Robert P. Calvert, assignor to E. I. du Pont de Nemours & Co. Nov. 28, 1922.)

Reclaiming Nitrocellulose From Pyro Smokeless Powder—At the end of the war there existed large surplus stocks of pyro smokeless powder, originally containing about 0.5 per cent of diphenylamine. Some of this powder is not suitable for use in the arts because the powder grains are difficultly soluble in the usual pyroxylin solvents on account of their relatively large size and also because a solution of pyro has a viscosity which is too high for use in coating fabrics, etc. As is well known the decomposition products of the powder form dark colored nitroso and nitro derivatives, which react with the diphenylamine and make the powder solutions unsuitable for use except in very dark colored products. It has also been found that the presence of diphenylamine in a solution of pyroxylin causes a rapid falling in the viscosity of the solution on standing, just as a number of inorganic salts are known to do. This also militates against the use of pyro powder as a substitute for pure pyroxylin in its various applications.

A patent has been granted to Richard G. Woodbridge, assignor to E. I. du Pont de Nemours & Co., of Wilmington, Del., covering a process for the extraction of diphenylamine from pyro powder. The process comprises immersing the powder grains in a liquid which is substantially a non-solvent for the powder, such as propyl alcohol, butyl alcohol or benzene and heating the mass at a temperature near the boiling point of the solvent. It is preferable to use a liquid which is a non-solvent for the powder, but which, at a boiling temperature, is a good solvent for diphenylamine and is also a solvent for the nitroso and nitro derivatives of diphenylamine.

It is claimed that by such a treatment the viscosity of the powder solution is reduced to a point where it can be conveniently handled and that the diphenylamine content is reduced to a point where its influence is negligible. In an example of the process the patentee describes an experiment in which a sample of powder originally containing 0.45 per cent of diphenylamine was heat treated by immersing in denatured ethyl alcohol containing ½ gal. of benzene to 100 gal. of ethyl alcohol, the alcohol being boiled in a suitable still provided with a reflux condenser. The viscosity of the powder was originally 250 sec. by the so-called steel ball method, in a solvent mixture composed of benzene 50, ethyl alcohol 20, and ethyl acetate 30 parts at a temperature of 28 deg. C. After heating the powder in boiling ethyl alcohol for about 75 hours, using sufficient alcohol to keep the powder covered, the viscosity of the powder was reduced to 20 sec. and the content of the diphenylamine both converted and unconverted remaining in the powder was less than 0.02 per cent, a practically negligible amount.

The relative efficiency of various solvents for accomplishing the two objects of the treatment, namely the lowering of the viscosity of the resulting solution and the extraction of the objectionable diphenylamine are given in the patent disclosure. A modification involving the use of heating under pressure in an autoclave is also covered by the patent. (1,439,656. Dec. 19, 1922.)

Vulcanization of Rubber—Eloi Ricard, of France, has assigned to the Société Ricard, Allenet & Cie. the following patent for the vulcanization of rubber. Many accelerators, such as dimethylaniline, piperidine, anthraquinone, etc., are well known. This invention has to do with the use of furfuramide as an accelerator. From 0.5 to 2 per cent of the weight of the rubber will diminish the vulcanizing time 70 to 80 per cent and the temperature of the heating from 8 to 10 deg. C. (1,440,176. Dec. 26, 1922.)

Production of Alkali-Metal Cyanides—Present production following such processes as U. S. Pat. 1,322,195 yields a product containing 30 per cent of alkali-metal cyanide, the remainder consisting of alkali-metal carbonate and oxide, carbon, iron and sulphur. Other patents show how hydrocyanic acid may be prepared from these crude cyanides, and this is then liquefied, etc. The wide use of pure alkali-metal cyanides, however, has made it desirable to work out a method for the production of pure products from the crude material described above. The present invention has its foundation in the discovery that the reaction which is depended upon to free hydrocyanic acid from the furnace product may be reversed under suitable conditions, which are properly controlled. The hydrocyanic acid reacts with the carbonate of an alkali metal if the mass is held at a temperature of 200 to 500 deg. C. The process further deals with a new method for liberating hydrocyanic acid from the crude mass, consisting in subjecting it to a high concentration of carbon dioxide at comparatively high temperature. The carbon dioxide replaces the cyanide in the furnace mass and the hydrocyanic acid gas mixed with carbon dioxide comes off. This is then absorbed

at from 200 to 500 deg. as mentioned above in suitable converters, the carbon dioxide being returned to the process to liberate more hydrocyanic acid from another batch. (1,439,909. F. J. Metzger, assignor to the Air Reduction Co. of New York. Dec. 26, 1922.)

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Phosphate Fertilizers — Phosphoric compounds suitable for fertilizer, such as naturally occurring phosphates, bone meal and phosphoric slags, are converted into a form soluble in citric acid and partly soluble in citrates by intimate grinding with about one to one and a half parts of a suitable salt of the alkali or alkaline-earth metals, ammonium or magnesium. Double salts of the alkali metals and magnesium may also be used. The sulphates, chlorides, silicates and nitrates of these metals are mentioned as suitable salts, and either the artificially prepared compounds or the naturally occurring varieties such as kainite, schoenite, kieserite and carnallite may be employed. The process is stated to be of particular value in the treatment of Florida phosphates. (Br. Pat. 186,223. R. W. James, London, and Eisenwerk Ges. Maximilianshütte, Rosenberg. Nov. 15, 1922.)

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nickel, 1 to 3 parts of manganese, 1 to 2 parts of iron, 0.5 to 3 parts of aluminum, and less than 40 parts of zinc. The copper, nickel, manganese and iron are first melted together, the zinc then added, and finally the aluminum. (Br. Pats. 186,336 and 186,337. Allgemeines Deutsches Metallwerk Ges., Berlin. Nov. 15, 1922.)

Motor Fuel—Fuel oil for internal-combustion engines comprises an intimate mixture of mineral hydrocarbon oils, of 0.865 to 0.895 specific gravity, resin oil or oil derived from heating resin or a resinous body, and water, with or without distilled or recovered grease, fatty oils, tar distillates or cracked or polymerized mineral oil, the constituents being incorporated by ammonia or trimethylamine. The resinous and fatty constituents may be nitrated or sulphonated. The tar distillates used contain tar acids and boil between 250 and 280 deg. C. One example comprises 65 parts of kerosene, 10 to 12 parts of resin oil, or of a mixture of 20 to 30 per cent of resinous and 80 to 70 per cent of fatty oils, 2 to 5 parts of ammonia and 20 parts of water. (Br. Pat. 186,106. T. M. Hickman, Wolverhampton. Nov 15, 1922.)

Book Reviews

THE SMITHSONIAN INSTITUTION'S STUDY OF NATURAL RESOURCES APPLIED TO PENNSYLVANIA'S RESOURCES. By *Samuel S. Wyer*, consulting engineer, Columbus, Ohio. Published for and distributed by the Smithsonian Institution, Washington. 1922. 150 9x12-in. pages, including nearly 100 full-page illustrations, maps or charts.

The State of Pennsylvania has undertaken to give to the grade schools and high schools special instructions regarding the natural resources of the state and the utilization of these resources by industry. In furtherance of this idea, this volume has been prepared and is to be placed in the hands of every seventh grade geography teacher of the state, and will be distributed as well to others who will use it for instruction purposes. However, the value of the work is not by any means limited to that state nor to educational purposes.

The author has given a splendid and a detailed review of fuel, mineral, forest and agricultural resources as well as a special exposition of some of the metallurgical and mineral industrial development of the state. Mr. Wyer has been, in his many publications, exceptionally successful in graphic presentation and clear demonstration of important industrial and economic facts by maps, charts and photographs. This particular volume seems to be a superlative exhibition of this unusual skill, for the many illustrations are in themselves of such great value that without the text the book would be of great interest.

Of necessity the technical information furnished in such a book is not new, but the methods of presentation are in many cases novel and worthy of consideration by any engineer. The photographs and diagrams of industrial processes and plants are in general either diagrammatic or developed from models such as those exhibited by the Smithsonian Institution. Anyone having an industrial demonstration to make of any of the industries covered in this book will do well to consult this work both for material and for suggestions as to methods of presentation. It is to be hoped that the Smithsonian Institution will find it possible to extend its work of this sort until every state of the Union can be served by as fine a book as this one for Pennsylvania.

R. S. McBRIDE.

THE ANALYSIS OF RUBBER. By *John B. Tuttle*. 155 pp. Chemical Catalog Co., New York. Price, $2.50.

It is the author's intention that his monograph serve a two-fold purpose, namely, a guide to those chemists unfamiliar with rubber who may be called upon to analyze this type of product, and, for the benefit of the rubber technologist.

The book in general is of little, if any, value to a rubber technologist. The chapter dealing with the testing of crude rubber is entirely too limited and the methods outlined cannot be successfully used to differentiate between non-uniformity of shipments either from the standpoint of rate of cure or quality variation. The same applies to that part dealing with the sampling and testing of the various reinforcing and diluent pigments. In many cases the tests given are incapable of interpretation as far as their effects on the resultant compound is concerned, while in others some particular test of much importance is neglected.

A few instances may be mentioned, such as in the examination of oil substitutes (page 29) where the acetone extract is made for eight hours only, of mineral rubber (page 31) which determines the "acetone soluble" in four hours and makes no reference to the melting point of plasticity, of litharge (page 42) which is not examined for metallic lead and of gas black (page 48) where no reference is made to a test for grit.

Throughout, there is a tendency on the part of the author to endeavor to explain the effects and uses of the compounding pigments in rubber, which seem to indicate a lack of experience along this particular line, inasmuch as many statements conflict with present practice. He refers to magnesium carbonate (page 45) as not being as powerful an accelerator as the oxide, whereas it has no accelerating value, to aluminum flake (page 46) being used to replace zinc oxide, to mineral rubber (page 30) reducing blooming, and to air slaked lime hydroxide (page 51) as having but some accelerating effect. These are but few instances of many such statements to which exceptions may be taken.

It would have been well to have left out any reference to organic accelerators, or at least confined their mention to name only, as serious misconceptions may be formed by a close study of this particular chapter, a noticeable example of which is the statement that p-phenylene-diamine is of no importance commercially (page 40).

When the value of this monograph to the non-rubber technologist is considered it probably serves its purpose to some extent. However, it adds nothing to what has already been published along these lines, particularly by the various committees of several technical societies. It has, however, the advantage of having in compact form many data which are otherwise quite scattered as well as many references to work on rubber.

It may be well to call attention to the fact that the book does not seem to have been thoroughly proof-read. A particularly bad example is on page 25, where it states to "divide the percentage of rubber by the percentage of combined sulphur," whereas the opposite is the procedure, namely, dividing the sulphur by the rubber.

F. J. DUGAN.

THE ROMANCE OF THE GAS INDUSTRY. By *Oscar E. Norman*, librarian and superintendent of training and education, Peoples Gas, Light & Coke Co., Chicago. Privately published and for distribution by the author. 200 pages, including many illustrations. Price, $1.50.

As implied by its title this book is intended to popularize many of the historical and dramatic features of the gas industry and record in part "the romance of its achievements." "An attempt has also been made to relate entertainingly how obstacles in the way of production, distribution and uses of gas have been overcome; how gas has become the ideal fuel in the household and in the factory; and how its radiance rivals the sun."

The author has succeeded in bringing together many interesting items regarding the early history of the manufactured gas business; and he clearly sets forth some of its present day problems, quite obviously in an effort to defend the industry against some of the common misapprehensions and criticisms.

Starting as it does with the beginning of the universe and tracing some of the early stages of civilization through the worship of fire to the discovery of practical applications of gas in the household, the book attempts a most difficult task. As presented, it is doubtful whether the general reader would find a great deal of interest or value to him; but many in the gas business itself will doubtless be inspired to greater enthusiasm for the industry and may receive from the book suggestions as how diplomatically to meet public-policy problems which repeatedly tax the ability of even the most ingenious management. Particularly for the information of the young employee during his course of instruction as a cadet, this work should find general usefulness.

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Engineers Honor Caetani at Banquet

Distinguished Gathering Hears New Italian Ambassador's Message of Good Will—Engineer Needed in Public Life

POLITICS needs a larger dose of logic and practical sense, Prince Gelasio Caetani, new Italian Ambassador to the United States, declared in an address at the annual dinner of the American Engineering Council of the Federated American Engineering Societies held at the Chevy Chase Club, Washington, Thursday evening, Jan. 11. These qualities of the engineer, he said, would bring great advantages to public affairs.

The Ambassador, himself an engineer and for 13 years previous to the war a resident of the United States, said that his principal aim is to strengthen the bonds of friendship and esteem between this country and Italy. Recalling his engineering career in the West following his graduation from the Columbia University School of Mines in 1903, Prince Caetani said that he was returning not only as a diplomat but as an engineer and friend of America.

Engineering, he continued, is destined to play a powerful rôle in modern civilization. Italy he described as a nation born again. Its potentialities industrially, he said, were bound to make it a great force in world commerce. The electric industry especially was making rapid strides and all branches of engineering activity were developing constructive effort, in which Italy's greatest asset was an abundance of efficient labor and in which American capital and machinery were needed.

The Ambassador's address was heard by leading engineers and public officials from all parts of the country. Dean Mortimer E. Cooley of the University of Michigan, president of the American Engineering Council, presided. Other speakers were Calvin W. Rice of New York, secretary of the American Society of Mechanical Engineers, and John J. Tigert, United States Commissioner of Education.

Pan-American Unity

Mr. Rice, who recently returned from South America, where, accompanying Secretary Hughes and party to the Brazilian Centennial Exposition, he acted as an envoy of the American engineering profession, said that definite steps have been taken to promote Pan-American unity among engineers. Through the efforts of the Department of Commerce, Mr. Rice reported, the idea of standardization was spreading in the South American countries, all of which are contemplating legislation to establish a standardization bureau, as recommended by Secretary Hoover.

A permanent organization to carry out the resolutions of the recent International Engineering Congress at Rio de Janeiro has been effected, according to Mr. Rice, who said it was now proposed to call a meeting of the Pan-American nations to develop the dream of a transcontinental railway. He predicted that the engineer would be increasingly influential in bringing about

Photo Copyright, Underwood & Underwood
GELASIO CAETANI
Mining Engineer and Newly Appointed Italian Ambassador

Pan American solidarity and in the attainment of international peace.

Engineering in Japan

Elmer A. Sperry of New York, reporting upon his mission to Japan, told of the remarkable progress being made by the Japanese in industry and in engineering, saying that even England had come to Tokio to gain new ideas in warship construction. Mr. Sperry described the huge size of the industrial plants and machinery used in Japan as exceeding anything known in the United States. The Japanese people, he said, were keeping the disarmament compact to the letter, while the engineers of Japan were aiming to promote a better international understanding by effecting closer relations with the engineers of other nations.

Caetani's Address

The Italian Ambassador was warmly received by his fellow engineers, and his remarks were frequently applauded. Extracts from his speech follow:

"Your kind invitation to be a guest at the annual banquet of the Federation of American Engineering Societies reached me while I was preparing to leave for the United States. I read it with deep satisfaction, for it made me feel that, besides sailing for America as Italy's Ambassador, I was going home to my old stamping grounds somewhat still invested with the qualifications of an engineer.

"We pride ourselves in saying: 'Once an engineer, always an engineer.' Whatever may be the course of life followed by one of us, it will always be marked by the indelible seal of the scientific, practical and logical training to which an engineer is subjected during the early years of life.

"I judge that many of my colleagues present at this banquet have followed in life most disparate occupations which often had little to do with engineering; such has been my personal experience during the agitated years since the beginning of the war. Well, gentlemen, we can say that in each and every occupation we have felt and thought and acted chiefly as engineers.

"Some have made the remark in criticism that engineers lack political intuition and ability; I would answer that a larger dose of logic and positiveness applied to politics would bring great advantages to public affairs.

"Whatever the case may be, it is very agreeable that politics bear little weight in the relations between Italy and the United States. Between our two countries there has never existed political rivalry or serious commercial competition; our relations have been confined almost exclusively to contacts of labor, of engineering, of commerce, of science and of art.

"Italy's largest asset is the remarkable quality of its people's labor; sober, intelligent, hardworking and plastic, the Italian peasant or workman will in an incredibly short time become efficient in whatever he is called to do. While I was carrying out fortification works along our front, many officers of the allied powers expressed to me their admiration for the remarkable skill of our peasant-soldiers compared with their own.

"Of all this many Americans are perhaps not yet fully aware for the reason that the wave of Italian emigration which shortly preceded the war was so sudden that it was not utilized to best advantage. Most of our skillful laborers, insufficiently guided, agglomerated in the congested cities of the East, contenting themselves with the first job they came across, instead of taking up occupations more congenial to their nature and for which they were better prepared.

"Specialization of Italian labor will bring great advantages to the large engineering industrial and agricultural enterprises which are still to be achieved in the United States.

Italy's Natural Resources

"Much, however, is still to be done in Italy itself; its resources are far from being fully developed and there are many opportunities for American capital, machinery and technical organization to be usefully applied in Italy.

"The electric industry in our country has made rapid strides and as to percentage of utilized water power, Italy ranks, I believe, foremost in the world. Electricity is our 'white coal' and at the present day its use results in an economy of about two billion lire, otherwise necessarily spent on fuel imports.

"In 1898 the electric energy developed in Italy amounted only to 87,000 kw.; it increased to 426,000 kw. in 1908, to 1,240,000 kw. in 1918 and power plants for some other 1,000,000 kw. are planned

or under construction. About 800,000 kw. are still to be developed.

"On the Tirso in Sardegna a reservoir of 416 million cu.m. capacity is being constructed. It will be the second largest in the world, ranging immediately after the Assuan dam and will develop about 50 million kw.-hr. and irrigate 60,000 acres of land.

"My experience in the United States has been my most valuable asset in life. Before leaving Rome, at a dinner given to me by the Italian engineers, I exhorted the young engineers to get a few years of practical training in America. I hope you will do likewise by encouraging your students and graduates to spend some time in Italy, as nothing broadens the mind more than to breathe an atmosphere different from that of one's own town and country.

"Italy's atmosphere is vibrating with wonderful reflexes of a long and glorious past and full of promise for a remarkable future.

"It is a great art in life to single out and appreciate other people's good qualities and try to make them your own.

"Similar intercourse between our young students who, in a few years, will be the active men of our countries, will be a powerful factor in reaching the principal and ultimate aim I will have in view in carrying out my duty as Ambassador—that is, to strengthen the bonds of friendship and esteem between Italy and the United States."

Would Continue to Hold Foundation Patents

Department of Justice Asks Provision in Winslow Bill to Exclude Chemical Patents From Returned Alien Property

The Department of Justice is urging that a safeguarding clause be inserted in the Winslow bill, which authorizes the restoration of $10,000 trusts held by the Alien Property Custodian to their German and ex-enemy owners, specifically excluding the 4,700 patents which are now held by the Chemical Foundation. H. J. Galloway, special assistant to the Attorney-General, informed the committee last week that the government desired to have this additional protection in order that the patents, listed at nominal valuations, might not be turned back.

Present indications are that the government's motion to get back the Chemical Foundation patents will be heard in the District Court of Delaware about April 15, Mr. Galloway said. He informed the House Interstate and Foreign Commerce Committee, which had been conducting hearings on the Winslow bill, that all of the necessary preliminary legal papers had been filed and that only the fixing of the date of argument held up consideration of the case.

"If the Chemical Foundation has any title at all to the ex-German patents, it is an absolute title," Mr. Galloway said. However, he contended that the sum paid for the patents was inadequate and that Francis P. Garvan, when Alien Property Custodian, had arranged for the sale of the patents to the Chemical Foundation, so that he stood in the position of both buyer and seller.

This, Mr. Galloway said, was manifestly lacking in equity. The value of the patents, he said, had been variously estimated from $10,000,000 to $100,000,000, one patent for neosalvarsan being worth more than the total amount paid for all of the German patents.

The Department of Justice wants Congress, in passing any legislation dealing with the question of alien property, to exclude the patents held by the Chemical Foundation, but Mr. Galloway made plain that it desired to have the rights of the American industries now using them under a license plan to have ample protection. If the patents are restored it will be up to Congress to direct what is to be done with them.

Engineering Council Reviews Accomplishments

Encourages Participation of Professional Men in Public Affairs

The engineering profession is on the eve of great developments, Dean Mortimer E. Cooley of the University of Michigan declared in his address to the American Engineering Council of the Federated American Engineering Societies at the annual meeting of the Council held at the Cosmos Club in Washington, Jan. 11 and 12. Dean Cooley, who was unanimously re-elected president of the Council for 1923, struck the keynote of the gathering in saying:

"We are, I feel, entering upon a new era. The engineer, not so much in the technical as in the social sense, is about to take that part in the world which rightfully is his. I am speaking not of civil engineering, mechanical engineering, chemical engineering, electrical engineering or any other branch of engineering, but of the engineering profession as a whole."

Dean Cooley, reviewing the year's work, said that substantial results had been achieved, and that the Federation was progressing gradually and surely toward the fulfillment of its mission. His trip through eighteen states last spring, he said, inspired the conviction that the Federation was a necessary instrument of organized engineering and a source of opportunity for service both within and without the profession that exceeded the hopes even of its founders. The waste report and the report on the two-shift day in continuous industry he characterized as two outstanding accomplishments of world importance. The two-shift report is now available in printed form, and the committee which prepared it has been formally discharged by the executive board of the Council. A third undertaking of similar magnitude was likely to be set in motion in the near future, Dean Cooley announced.

The report of Executive Secretary L. W. Wallace, who was re-elected by the executive board, showed that the activities of the Federation are multiplying rapidly. Relations with government departments are becoming more extensive and more intimate and in every direction the Federation is winning increased recognition. A letter from Secretary Hoover, read at the meeting, asserted that the Federation was one of the most influential existing agencies in the promotion of public good.

Federal legislation in which the Federation through the executive secretary has taken an active interest includes the Sterling-Lehlbach bill, topographic mapping, helium, national hydraulic laboratory and revision of the mining laws. John R. Freeman was the principal witness at the hearings on the question of a national hydraulic laboratory, the need for which he pointed out in an exhaustive report. Mr. Wallace asserted that the bill for mining law revision should receive the active attention of all engineers. Adoption of an amendment increasing the appropriation for topographic mapping from $325,000 to $500,000 was called by Mr. Wallace "a distinct victory auguring well for the Temple bill." He reported a tendency to delay action on the Sterling-Lehlbach bill, and this he described as unfortunate.

Engineering Ideals

A report of the committee on engineering ideals, expressing the desire of the Federation to bring to the attention of the engineering colleges throughout the country the need of pointing engineers toward leadership in public affairs, was adopted. The committee was headed by Prof. Joseph W. Roe of New York University. The Council adopted the report of its patents committee requesting "that a joint commission be appointed by the Senate and House of Representatives to investigate the needs of the Patent Office, as to both personnel and physical equipment, and that it be requested to report at an early date, so that the present session of Congress may take appropriate action."

At the suggestion of the Spokane Engineers Club, transmitted through J. C. Ralston, the Council voted to refer to its committee on public affairs with its indorsement a proposal to recommend to President Harding the selection of "the engineering type of man" as Secretary of the Interior to succeed Mr. Fall, who has resigned. J. Parke Channing, head of the committee, supported this proposal, saying that it was in keeping with the engineering movement to establish a Department of Public Works. Eighty per cent of the activities of the Interior Department, it was asserted, concern engineering problems. The speakers made it plain that no political considerations were involved.

Vice-presidents were elected by the Council as follows: J. Parke Channing and Calvert Townley, New York; Philip N. Moore, St. Louis; Gardner S. Williams, Grand Rapids, Mich. H. E. Howe of Washington was elected treasurer.

Fertilizer Man Attacks Ford Shoals Offer

C. H. MacDowell Points Out Effect on Water Power Act in Establishing Such a Precedent

Vigorous opposition to acceptance of Henry Ford's proposal for purchase of the Muscle Shoals government project was voiced in an address before the Chicago Woman's Club in Chicago, last week, by C. H. MacDowell of the Armour Fertilizer Works.

"The Ford proposal, if accepted, nullifies the fifty-year clause of the water power act," said Mr. MacDowell. "The government builds the plants, while the Ford company pays no taxes on the costs and takes no risk of the dams holding.

"The company acquires special privileges and subsidies from the government which enable it to compete unfairly with companies putting up their own funds. It obtains a private power monopoly for 100 years or more and obtains a strangle hold on the industrial development of that section through its power control. Certainly a large block of economic power to be entrusted to the administration of a private company!"

Danger of Special Legislation

Mr. MacDowell pointed out that the Federal Trade Commission, in its second annual report, forcibly draws the attention of Congress to the danger of special legislation, the effect of which must be nullification of the national policy in respect to water power, which has been declared by Congress after investigation and study covering more than a decade.

"The commission does not mention by name Muscle Shoals or the Ford proposal," he continued, "but it could have meant nothing else in the following statement:

"'There are movements on foot in several quarters to secure for certain sites or streams special legislation which if approved would constitute a partial repeal of the federal water power act, and would eventually result in the progressive disintegration of our present national water power policy.'"

Will Attempt to Collect Literature on Cellulose

Dr. C. J. West, chairman of the committee on bibliographies of the Technical Association of the Pulp and Paper Industry, has offered to act for the cellulose division of the American Chemical Society as a receiving center for bibliographies relating to any branch of cellulose chemistry. It is hoped that all of those having such bibliographies will send a copy to Dr. West, National Research Council, 701 Massachusetts Avenue, N.W., Washington, D. C. Dr. West has kindly offered to assemble all material received and make it available to anyone interested. It is hoped that a large amount of duplication of effort can be avoided in this way.

Tear Gas Adopted by Washington Police Force for Mob Control

Police and other officials of the District of Columbia had a striking demonstration of the effectiveness of tear gas when one of the guns recently invented by Captain L. M. McBride, of the Chemical Warfare Service, was accidentally opened in the office of the chief of police. The chief himself was temporarily blinded, as were a number of employees in the District Building. The gas found its way into the halls and elevator shafts, with the result that hundreds of persons participated in this accidental demonstration of its effectiveness.

As a result of this incident, it was revealed that the Washington police department is equipping all patrol wagons, police stations and jails with this gun.

Reported Used by Burglars

Officers of the Chemical Warfare Service are impressed with the significance of the report that the theft of the Schoellkopf jewels in New York City was made possible by the use of gas. If the use of gas is found to be effective in the highly practical art of burglary, it is believed that the police and military authorities will be more ready to admit that the Chemical Warfare Service has developed an agent with the greatest potentialities in the control of mobs and other law breakers.

Agricultural Chemists Develop Poison for Barberry Bush

Intensive experiments on the part of the office of cereal investigations of the Department of Agriculture has developed two chemical methods for the eradication of the barberry bush. This bush spreads a rust to grains and grasses. A campaign is now in progress throughout New England and the Middle West looking to the eradication of this growth. More than forty chemicals were tried in the experiments. It has been found that rock salt and sodium arsenite give uniformly good results. It is anticipated that large quantities of these materials will be employed in future eradication work.

Under-Fertilization of German Farms Promises Demand for Chilean Nitrate

During 1922 Germany used some 350,000 metric tons of atmospheric nitrogen for agricultural purposes. To this may be added not more than 100,000 tons of Chilean nitrate. This indicates that German farms are being under-fertilized by 40 per cent.

Since no important expansion of atmospheric nitrogen production is expected in the near future, the general opinion in Germany is that there should be large importations of Chilean nitrate this year. Indications are that an active effort now is being made to provide for the financing of large purchases.

F. C. Brown Made Head of Bureau of Standards

Assistant Director Assigned Temporarily to Post Vacated by Stratton

Since a considerable period is likely to elapse before a director will be chosen for the U. S. Bureau of Standards, importance is attached to the designation by Secretary Hoover of Dr. Fay C. Brown as the acting director, who will direct the work of this important subdivision of the Department of Commerce during the interim.

Dr. Brown was born in Washington, Ohio, in 1881. He was graduated from the University of Indiana, in 1903. He did graduate work at the University of Illinois, at the University of Chicago and at Princeton. After taking his doctor's degree at Princeton in 1908, he did further work at that institution as an Ogden Fellow. On the completion of that work he accepted a position as instructor in physics and engineering at the University of Illinois. Later he joined the faculty of the University of Iowa. He was engaged in that work when the United States entered the war. He entered the military service and was assigned to the Ordnance Department, where he was placed in charge of the testing and ballistic work on airplane bombs. While in the military service he attained the rank of major.

At the end of the war, Dr. Brown had the opportunity to choose between the professorship of physics at the University of Iowa and the position of assistant director of the Bureau of Standards. He accepted the latter post where he has been engaged continuously since.

Accomplishments in Research

While Dr. Brown regards as his principal achievement the work that he has done in directing the Bureau which Secretary Hoover likes to refer to as "the largest physical laboratory in the world," he has done a great deal of research in addition to his administrative duties. He is proud of his work in thermionics, since that proved to be a sort of forerunner of radio amplification. He did important optical work and has made an intensive study of the electrical and mechanical properties of selenium and selenium crystals. With Joel Stebbins, the astronomer, he took an important part in starting the work on the mechanical measurement of the intensity of double stars.

Wages Cut in Austrian Chemical Industry

Wages in the Austrian chemical industry were cut 11 per cent on Dec. 1, according to advices sent the Department of Commerce from Vienna. The difficulties of the chemical trade have been increased by the action of German chemical manufacturers in declining to extend credit to Austrian firms for longer than 30 days and by their demand for partial or full payment of the order, in some cases at the time it is placed.

Federal Suit Instituted Against Butterworth-Judson Corporation

Heavy Chemical Company Called to Account for Expenditure on War-Time Picric Acid Plant

THE FIRST of a series of suits to be brought by the government to recover damages on war contracts was instituted last week in the federal court of New York. The suit was brought at the instance of Attorney-General Daugherty and Colonel William Hayward, Federal Attorney, through Victor House, Assistant United States District Attorney.

In the initial suit Mr. House directs that Henry G. Atha, James O'Grady and Thomas G. Haight, receivers in equity for the Butterworth-Judson Corporation, account for $1,151,000 expended by the corporation from a revolving fund of $1,500,000 advanced by the government.

History of Picric Acid Plant

According to Mr. House the revolving fund was advanced on a contract consummated by the government with the Butterworth-Judson Corporation in May, 1918, for the construction of a plant at New Brunswick, Ga., by the defendant corporation, for the manufacture of 72,000,000 lb. of picric acid. The construction was to cost $7,000,000. Approximately $8,500,000 was expended and the plant was about 50 per cent completed when the contract was terminated by the cessation of hostilities.

In April creditors instituted suits in New York and New Jersey for the designation of a receiver for the defendant corporation, it being alleged it was unable to satisfy maturing obligations.

Funds Were Banked

It is alleged by the government that the revolving fund advanced to the defendant was partially deposited with various banks in this city, which Mr. House contends was a wrongful conversion of trust funds, and that the banks are not entitled to retention of the deposits.

At the time of the suit for a receiver the defendant corporation had $528,009 deposited with the Chase National Bank, American Exchange National Bank, New York Trust Company and National Newark & Essex Banking Company.

Discussing the suit Mr. House said: "When the advance of $1,500,000 was made the government required a surety company bond conditioned upon an appropriate accounting of the advance. Eight surety companies joined in this bond, the American Surety Company of New York being the company through which it was written. These surety companies are joined as parties defendant, and the court is asked to direct them to pay any balance of the $1,500,000 not otherwise paid."

The main Butterworth-Judson plant is located in Newark, N. J. There has been a large depreciaiton in the value of the plant since the war ended. It is being operated by the receivers, who recently received authority from the court to enter into contracts for the coming year. It is understood that reorganization is being planned.

Company Asks Damages

The original contract provided that if it were terminated before 18,000,000 lb. of picric acid were delivered, the contractor should become entitled to liquidated damages of 3 cents a pound on the undelivered portion of such 18,000,000 lb.

No picric acid was ever manufactured or delivered under the contract, and one of the large items of dispute in this suit is whether the Butterworth-Judson Corporation is entitled to $540,000 as liquidated damages under the termination clause of the contract. The government will contend that this provision for liquidated damages was not intended to become operative unless the plant was completed and deliveries of picric acid under the contract had been begun prior to the termination of the contract.

French Consider Compulsory Use of Alcohol in Motor Fuel

France is considering the establishment of a Bureau of Alcohol in one of its Federal departments, according to advices to the Department of Commerce.

In addition, legislation practically is assured which will require the admixture of at least 10 per cent of alcohol with all motor fuel. Reports have been submitted by chemists to the Chamber of Deputies setting forth that a mixture of 45 to 55 per cent alcohol can be used in automobile engines without any change from the designs now using gasoline only.

Fiber Companies Merge

The American Vulcanized Fiber Co., the Keystone Fiber Co., both of Wilmington, Del., and the National Fiber & Insulation Co., Yorklyn, Del., have been merged under the name of the National Fiber Co. Headquarters will be maintained at Wilmington, and present plants there and at Yorklyn and Newark, Del., will be continued in operation. J. Warren Marshall, formerly head of the National Fiber & Insulation Co., has been elected president of the new organization; Claude W. Sutton, heretofore head of the American Vulcanized Fiber Co., will be vice-president of the consolidated company, in charge of sales.

Engineers Urge National Hydraulic Laboratory

Hearty support for a national hydraulic laboratory is coming from all parts of the country and from the men engaged in all branches of engineering, the Senate sub-committee was told during the course of a hearing on January 10, at which Senator Ransdell's bill providing for the establishment of a National Hydraulic Laboratory was considered. The principal testimony was given by John Lyle Harrington, of Kansas City, the president of the American Society of Mechanical Engineers; Gardiner S. Williams, of Detroit, a hydraulic engineer, and John C. Ralston, of Spokane, Wash., a civil engineer.

The sub-committee was told that all branches of engineering are coming to attach greatly increased importance to research. The hydraulic laboratory would do much to supplant rough and ready knowledge of hydraulic formulas and practice by exact knowledge, it was said. Mr. Harrington cited a number of specific cases in which there have been wide divergences of engineering opinion on fundamental problems in hydraulics. In each of these cases the completion of the work demonstrated absolutely that certain theories advanced by eminent engineers were wrong. These differences never would have arisen had accurate basic information been available. As it is, Mr Harrington told the Senators, most hydraulic problems are solved by the application of judgment rather than in a scientific manner. Were it possible to reduce the margin to provide for the unknown, great economies could be effected in the construction of flood control works, he asserted.

Accurate Formulas Lacking

Mr. Williams referred to the existing controversy among engineers over the spillway problem at New Orleans, as being typical of the great dearth of scientific data which can be applied to the control of rivers. He is at a loss to undestand, he said, why there should be opposition to a national hydraulic laboratory from the Corps of Engineers—the agency which would benefit most from its operation. The Mississippi River Commission, he declared, would benefit particularly, as he believes many of their theories could be proven absolutely if studied at such a laboratory.

The committee was told that hydraulic formulas are not of scientific character. There is need, it is stated, for research work on all the problems of water, but since such a laboratory must be confined in the start to the more pressing problems, it was predicted that its early work would be confined to the problems of river hydraulics. It was suggested that the laboratory should be made available to the engineering societies and to individual engineers for the working out of special problems, in addition to those which come before the Corps of Engineers, the Geological Survey, the Bureau of Standards, and the Reclamation Service.

Engineers Plan World Congress in 1926

Sesqui-Centennial Exposition in Philadelphia to Be Scene of International Meeting

A conference on the plans for an international engineering congress, to be held at the time of the Sesqui-Centennial celebration in Philadelphia, was held in New York City, Jan. 9. The meeting was called to order by Richard L. Humphrey, chairman, who outlined the purposes of the conference and reviewed briefly the events leading to the calling of the meeting.

The movement to hold a world congress of engineers in 1926 was initiated by the Engineers Club of Philadelphia in December, 1921, and at that time an invitation was extended to the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Society for Testing Materials. Each was requested to appoint two representatives to meet with a committee of the Engineers Club in Philadelphia to formulate a plan for such a world congress.

An outline of the plan of organization for such a congress was prepared by the secretaries of the four founder societies in May, 1922, and was subsequently approved by the presidents of these societies. This plan proposed a board of management, which was duly elected, at an organization meeting in November, 1922 George S. Webster was appointed temporary chairman and Charles E. Billin temporary secretary.

Will Promote Welfare of Profession

At the meeting last week the committee considered the advisable scope of the congress, methods of financing, relation of meetings of engineering societies to the sessions of such a congress and publicity.

It was brought out in the discussion that this meeting represents another step toward bringing the engineers of the different countries of the world closer together, taking up the threads of contact that had been broken by the war and fostering a better understanding of the relation of the engineer not only to the technical problems of the world, but to the reconstruction of our present day civilization, to which the engineer has already contributed so much in a material way.

Personal

RICHARD V. AGETON, of the Bureau of Mines staff, who has been doing examination work for the War Minerals Relief Commission, is acting as assistant chief mining engineer of the Bureau of Mines.

Dr. RAYMOND F. BACON and Dr. J. ENRICO ZANETTI have been presented with Distinguished Service Medals for their services in France. Dr. Bacon was Colonel of the Technical Division, Chemical Warfare Service, American Expeditionary Forces, and Dr. Zanetti was Lieutenant Colonel, Liaison Officer, Chemical Warfare Service, American Expeditionary Forces. Presentation was made by General Bullard, Governors Island, New York.

Dr. H. E. BARNARD, director of the American Institute of Baking, spoke before the Indiana Section of the American Chemical Society, Jan. 9, on "The Possibilities of Chemical Research in the Baking Industry."

E. L. BULLOCK of New York, formerly an official of Katzenbach & Bullock, manufacturers of chemicals, and recently connected with the Tidewater Chemical Co., New York, has resigned from the latter company.

M. R. CAMPBELL will serve as acting director of the United States Geological Survey during the absence from Washington of Philip S. Smith.

EDMUND S. DAVENPORT, formerly research metallurgist of the Eastern Malleable Iron Co., Naugatuck, Conn., is now with the Westinghouse Lamp Co., Bloomfield, N. J.

Dr. THOMAS B. DOWNEY is the present incumbent of the industrial fellowship in the Mellon Institute of Industrial Research of the University of Pittsburgh, established by the Edible Gelatine Manufacturers of America, Inc., for the purpose of ascertaining the real food value of edible gelatine in the American dietary. In addition to experimental investigations, a correlation of available facts regarding edible gelatine will be made, to be held at the disposal of all users.

Brigadier-General AMOS A. FRIES, chief of the Chemical Warfare Service, spoke before the Engineers Club, Baltimore, Jan. 9, on "Gases Used in Warfare Protection Against Them and Their Peace-Time Uses."

Dr. MORRIS S. KHARASCH, formerly national research fellow in organic chemistry at the University of Chicago, has been appointed associate professor of organic chemistry at the University of Maryland.

Dr. RICHARD C. LORD, at one time instructor at Washington and Lee University and later engaged in industrial chemistry, has been elected assistant professor of chemistry and physics at Kenyon College, Gambier, Ohio.

Dr. E. Z. LYNN of the college of pharmacy, University of Washington, Seattle, gave an interesting address at a recent meeting of the Puget Sound Section of the American Chemical Society on "The Manufacture of Zinc and Barium Products."

S. JOSEPH MCGRATH, formerly head chemist for the Obrien Varnish Co. of South Bend, Ind., has been appointed superintendent of the Phelan Varnish Co. of St. Louis, Mo.

Dr. JOSIAH H. PENNIMAN was elected provost of the University of Pennsylvania, on Dec. 27, 1922. He has been acting provost since the resignation of Dr. Edgar Fahs Smith about three years ago.

Dr. OTTO M. SMITH, formerly in charge of research for the Roseville Chemical Co., Roseville, Indiana, has been appointed assistant professor in quantitative chemistry at Iowa State College, Ames, Iowa.

Prof. O. F. STAFFORD, head of the department of chemistry of the University of Oregon, has returned to his university work at Eugene, after a leave of absence of four years' duration devoted to industrial research in the field of waste wood utilization by destructive distillation.

E. B. SWANSON has been promoted to be administrative assistant to the Director of the Bureau of Mines. As private secretary to the Director, Mr. Swanson for some time has been discharging the duties of administrative assistant, without having had the title or the salary which goes with that position. Mr. Swanson is a graduate of the University of Washington.

F. G. THOMPSON of Seattle, Wash., has been elected chairman of the Puget Sound Section of the American Chemical Society at the annual meeting held at the University of Washington. A. G. Bissell has been elected vice-chairman; R. W. Ellison, secretary; G. C. Howard, treasurer, and H. K. Benson, councillor.

L. M. TOLMAN has been appointed technical director of Wilson & Co., following a reorganization of the company's technical and laboratory activities. The work of the chemical laboratory has been divided into two divisions: The Technical Division, with E. A. SCHLESSER in charge, and the Food and Sanitary Division, with F. W. KURK in charge. Mr. Tolman will continue to supervise the work of both divisions.

F. M. TURNER, JR., was elected a councillor of the New York Section of the American Chemical Society, and not F. M. Turner, as given on page 1190 of our Dec. 13 issue.

Dr. CHARLES D. WALCOTT, secretary of the Smithsonian Institution, president of the National Academy of Sciences, and formerly director of the United States Geological Survey, has been elected president of the American Association for the Advancement of Science.

Dr. E. R. WEIDLEIN, director of the Mellon Institute of Industrial Research, addressed the Indiana Section of the American Chemical Society, Jan. 12, on "The Value of Industrial Research."

The following men have been elected to membership in the Club de Engenharia (South America), which organization corresponds to an amalgamation of the four national societies in the United States: JOSIAH E. SPURR, LOUIS J. HIRT, VERNE L. HAVENS, A. W. K. BILLINGS, EDWARD WEGMANN, SAMUEL M. VAUCLAIN and CALVIN W. RICE.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

A Year of New Records in the Petroleum Industry

Crude Oil Output Exceeds Last Year's by 81,000,000 Bbl.—Daily Production Now Over 1,750,000 Bbl.

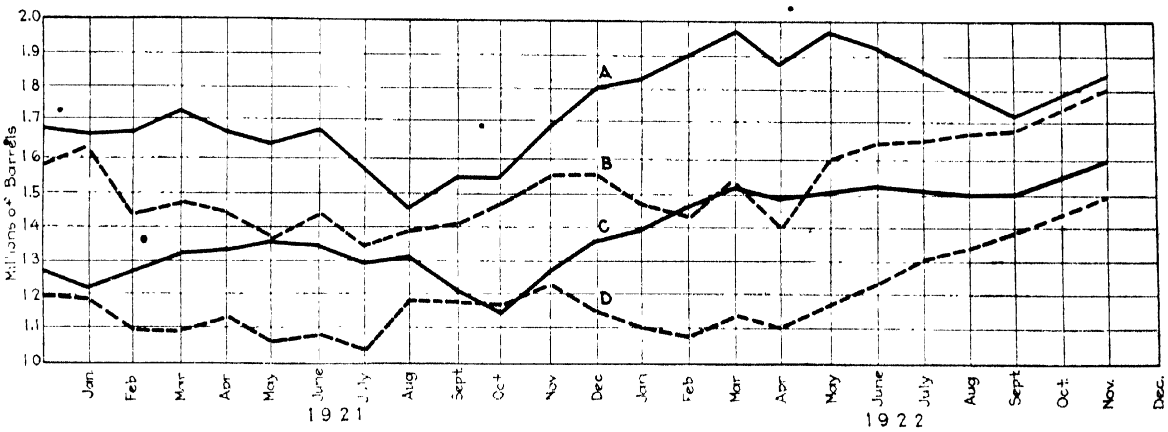
The year just closed has been a remarkable one for the oil industry. Crude oil production for 1922 probably exceeded 550,000,000 bbl.—a gain over 1921 of 17 per cent. Recently, for the first time in history the output of crude oil has reached 1,750,000 bbl. daily. The American Petroleum Institute has estimated that production for the week ended Jan. 6, 1923, averaged 1,752,000 bbl., as compared with 1,741,200 bbl. for the preceding week, an increase of 11,300 bbl.

The increase over last year, which has been explained largely by the declining production in Mexico, has come principally from Arkansas, California, Wyoming and Montana. A decrease in the central Texas field was more than offset by Oklahoma and California gains.

During the past few months the oil industry has witnessed an interesting race between domestic production and consumption. The recent demand for petroleum products has been equivalent to 1,700,000 bbl. per day. The supply has been amounting at times to over 1,900,000 bbl., the increment being due to imports from Mexico. The accumulation of stocks has brought the problem of oil storage to a very serious stage and during the coming year the industry will doubtless be forced to provide additional storage for crude oil.

The Monthly Averages

The statistics compiled by the United States Geological Survey are complete only for the first eleven months of the current year. During November the survey reports that the daily average production of petroleum (amounting to 1,596,300 barrels) increased 51,623 barrels; the daily average imports of crude and topped oil (amounting to 245,467 barrels) increased 6,499 barrels; the daily average exports of crude oil (amounting to 28,533 barrels) increased 4,630 barrels and the daily average consumption of crude petroleum (amounting to 1,781,433 barrels) increased 74,078 barrels, net results being that stocks increased 954,000 barrels. This is the smallest addition to storage that has been recorded for any month since September, 1920.



STATISTICS OF CRUDE PETROLEUM, JANUARY, 1921, TO DECEMBER, 1922

Daily Averages for—
(*A*) Domestic production of petroleum plus imports of "mineral crude oil."
(*B*) Consumption plus exports of domestic and imported petroleum.
(*C*) Domestic production (petroleum transported from producing properties).
(*D*) Consumption plus exports of domestic petroleum.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	171.71
Last week	172.79
January, 1922	144
January, 1921	181
January, 1920	242
April, 1918 (high)	286
April, 1921 (low)	140

The slightly lower price for cottonseed oil was sufficient to lower this week's index by one full point. Prices for practically all of the other commodities were well maintained.

New Corporation to Sell German Potash

Kalisyndikat Representative Announces Plans for a New Distributive Agency for North America

A potash-importing corporation to market the products of the German syndicate in the United States, Canada, Cuba and Porto Rico has been announced by A. Vogel, the American representative of the Deutsches Kalisyndikat, G.m.b.H. It is generally believed that this represents the first move in an effort to transfer the syndicate's business to an agency in this country, in order to put it on a dollar basis. Difficulties in exchange, reparations and inland taxes in Germany no doubt helped to prompt this action. It is further intimated that the move may be a part of the syndicate's plans for recapturing its pre-war monopoly, since it would be entirely possible to allow large American consuming interests to participate in the importing corporation and share in its profits.

Mr. Vogel's announcement is as follows:

> I herewith beg to announce that the Deutsches Kalisyndikat, G.m.b.H., Berlin, has entered into an agreement with the Potash Importing Corporation, 42 Broadway, New York, whereby the corporation undertakes to market and distribute the syndicate's products in the United States of America, Canada, Cuba and Porto Rico.
>
> The contract begins with the first of May, 1923, and until then the syndicate will continue the sale and the distribution of its products, through its New York office, which after the first of May, 1923, will be liquidated.

New York Chemical and Allied Markets Are Only Moderately Active

Manufacturers of Salicylates Announce New Advances — Phenol and Derivatives at Higher Levels — Ammonium Nitrate Scarce and Firmer

ALTHOUGH PRICES for most basic commodities were firmly sustained, the chemical market during the past week lacked any outstanding interest. Activity was limited and buyers seemed inclined to purchase only small quantities for immediate consumption. It is possible that the present European trouble will eventually affect the market and some manufacturers were already sitting back to await any helpful changes. Export business to Europe has dropped off considerably, but South American and Far Eastern demand continued along fairly active lines. Producers of salicylic acid announced a new increase of 5c. per lb., because of higher producing costs. Phenol has shown some material gain during the past week and holders were not disposed to offer any round lots. Quotations were considerably higher on all phenol derivatives in sympathy with this product. Ammonium nitrate has become exceedingly scarce on the spot market and traders were asking abnormally high prices for limited stocks. Producers have not been able to offer any material and seem to be heavily sold ahead at the works.

THE ARSENIC MARKET STILL FIRM

Arsenic still remained very scarce on spot and prices were firmly maintained. Lead arsenate and calcium arsenate also retained their former strength. Formaldehyde was somewhat quieter due to the present high prices, although producers seemed quite satisfied with the recent business and stated that a new increase was very probable for the near future, due to the steadily increasing costs of production. Copper sulphate producers have been shipping in fair tonnages to South America, but are somewhat disappointed at the lack of interest from Europe. Domestic consumers have not shown any desire to purchase large stocks, in view of the fact that arsenic and its compounds are so extremely hard to locate. Amyl acetate, ethyl acetate and fusel oil are exceedingly firm and producers are not anxious to book any large tonnages at present levels. Imported caustic potash is materially higher for shipment and on spot. Caustic soda and soda ash continue along moderate lines, with domestic demand covering the lack of interest from exporters.

PRINCIPAL PRICE CHANGES

Alcohol—The market continued along very steady lines and producers reported a well sold up condition at the works. Methanol 95 per cent in barrels is held at $1.21@1.23 per gal., with 97 per cent at $1.23@1.25 per gal. Denatured 188 proof No. 1 formula is moving in a fair way at 39@40c. per gallon.

Arsenic—Leading traders quote this market firm at 15½@16c. per lb. for limited stocks. Several large tonnages were reported on dock from Japan and Germany, but the increasing consuming demand seemed to overbalance these arrivals.

Ammonium nitrate—There has been extreme difficulty experienced in locating spot supplies. Here and there an odd lot was offered at 10@10½c. per lb. Producers are completely sold up at the works.

Amyl acetate—Producers report a steady demand and are finding it difficult to keep pace with deliveries. Supplies on spot are scarce with quotations ranging around $2.80@3 per gallon.

Copper sulphate—Producers report a fair business going into consuming channels, but also state that several orders were cancelled by insecticide manufacturers. Export business was reported fair to South America. Prices range around 6c. per lb. for large crystals.

Caustic soda—Export quotations for standard brands remain around $3.50@3.60 per 100 lb. Domestic material is held at $3.75 per 100 lb. ex-store New York. Contracts for standard material are offered at $2.50 per 100 lb., basis 60 per cent., f.o.b. works, carload quantities. Demand, in general, is merely of a routine nature.

Fusel oil—Spot supplies of crude material are very difficult to locate and producers report a heavily sold up condition at the works. The demand is very strong with quotations ranging around $2.30@2.40 per gal. for crude and $3.50@4.00 per gal. for refined.

Permanganate of potash—Several large sellers have advanced prices of U.S.P. to 16½c. per lb., but the general range is around 16@16½c. per lb. Demand continues fairly active.

Prussiate of potash—There has not been much activity shown in the yellow material of late and prices were held around 38c. per lb. Consumers were not anxious to purchase any round lots at the present high levels. Red prussiate was quoted much lower, with quotations around 85@90c. per pound.

Sal soda—Prices were practically unchanged among leading producers, with barrels ranging around $1.20 per 100 lb. and kegs at $1.35. Demand continues along moderate lines.

Soda ash—Several carload quantities were sold around $1.75 per 100 lb. in bags, on spot. Smaller lots were sold around $2.15@2.35 per 100 lb. Producers offer contracts at $1.20 per 100 lb., f.o.b. works, carload lots, basis 60 per cent, in bags.

Sulphuric acid—Contract business over 1923 is expected to reach very high levels. Withdrawals have already started and producers seem well satisfied with the trend. Spot business, however, is very dormant and quite irregular. Material in tank cars, 66 deg., is held at $14.50@15.00 per ton, with 60 deg. in tank cars at $9.00 a ton.

COAL-TAR PRODUCTS

Benzene—Conditions in this market for the past few months are gradually improving. Prompt shipments are now available to an appreciable degree and sellers have begun to accept new business at 35@40c. per gal. for the pure and 26@30c. for the 90 per cent material. Resale material is still held at a slight premium.

Cresylic acid—The market continued in a very tight position with extreme difficulty experienced among purchasers to locate any nearby shipments. The dark 95 per cent material is quite scarce at 95c. per gal. in drums on spot. Several small sales of 97 per cent goods were recorded as high as $1.25@1.30 per gal. Holders of available material have much firmer ideas and the general tone tends to much higher levels.

Phenol—Prices are materially higher for this material due to the urgent demand from consumers. Producers are heavily sold ahead and spot goods are bringing as high as 36c. per lb. for limited stocks.

Fewer Price Changes in Firm Market at St. Louis

Greater Activity Awaits Completion of Inventory Taking and Better Shipping Conditions

ST. LOUIS, MO., Jan. 11, 1923.

The industrial chemical market of this district since the beginning of the year has not been as lively as expected. It is presumed, however, that this is due to the fact that trade generally is still occupied with inventory matters, but just as soon as this temporary influence has been removed the market will show more activity. Large consumers are showing a more liberal attitude in covering future requirements, which is evidence of better confidence in the market. Freight conditions are somewhat better, but are still below normal. The general tone of the market is very firm and price changes have been few and mostly in the upward direction.

ALKALIS SHOW STRENGTH

Business in alkalis has shown considerable strength since the first of the year and prices are very firm. Some contract business has been reported and a general feeling of confidence seems to exist among buyers. *Caustic soda* is being quoted at $3.90 for solid, $4.30 for flake, $4.50 for the ground per 100 lb. in 1- to 5-drum lots delivered to buyer's door. *Soda ash* is in good demand and quoted at $2.20 in 5-bag lots, and at $2.40 in 5-bbl. lots delivered buyer's door. *Sodium bicarbonate* is holding firm at $2.40 per 100 lb. in 5-bbl. lots, with a good volume of business being transacted. *Sal soda* has slumped some,

and quotations on barreled goods have been reported as low as $1.55 per 100 lb.

GENERAL AND SPECIAL CHEMICALS

The heavy *mineral acid* market is pretty good and fairly firm. Inquiry and demand for *citric acid* is nil and there is only a normal movement in *oxalic acid*. *Tartaric acid* and *cream of tartar* are in very light demand, but that is to be expected at this time of the year. An improvement has been noted in the inquiry and demand for *carbon bisulphide technical*, and some fairly good-sized orders have been placed. There has been no relief for the *white arsenic* situation, as American producers are reporting sold up for some time, and imports have been very small. The future does not seem very promising. Many of the large users have been obliged to curtail their operations because of lack of supplies of this article. The market for *glycerine* is in a rather unsettled condition. No reduction in price has yet appeared except in a few isolated cases where contracts were involved, but it seems to be common knowledge among buyers that glycerine is due for a drop and they are buying in limited quantities in anticipation of a decline. The copperas market has shown no change for some time and is still quoted at $1 in bulk and $1.25 in barrels, f.o.b. mills. There has been no material increase in the production, consequently there has been no accumulation of stocks, and the demand keeping pace with the output. The market has been very firm. *Potassium ferricyanide* and *ferrocyanide* have been moving in appreciable quantities. *Sulphur* is very quiet at present, the demand not being very strong. Prices, however, have not declined. *Zinc dust* is being quoted at 10c. in carload lots, f.o.b. New York, with a very firm market. Spelter has been stationary and a good business reported, which if continued will bring about higher prices. The *zinc sulphate* market has been quiet since our last report. However, it is firm at 3¼c. f.o.b. St. Louis in carload lots.

VEGETABLE OILS AND NAVAL STORES

Castor oil is very firm at 13¼c. in drums, and a good volume of business is being transacted. *Linseed oil* is in a very firm condition and a rise in price is to be looked for. Shipping conditions, a desire on the part of flaxseed producers to hold seed for a better price and the fact that Argentine seed does not affect this market before March 15 at the earliest tend to make for a higher market. *Turpentine* is again on the upward trend and prices today are as follows: 5 bbl. lots, $1.48; single barrels, $1.54 per gal.

PAINT MATERIALS

The paint industry in this section is beginning to boom and orders are being placed that would indicate a prosperous season. There have been no price changes of note, though contracts for material are being placed in some instances for the year's requirements.

A Prediction for the Steel Market

Predictions are always more or less hazardous, but based upon what seems to be in the minds of buyers the prediction might be made that for the next three or four months there will be a very strong market for steel, with heavy deliveries and consumption, and that in the second half of the year there will be relatively light demand. This prediction leaves a leeway of two or three months as a twilight zone. The present showing may as a matter of fact be quite insufficient to base a prediction upon, but there is another factor deserving of consideration, the belief in many quarters that general business conditions, from the long range viewpoint, are hardly sufficient to sustain continuously a movement in steel measured by an ingot production at 40,000,000 tons a year, this being one-third greater than the output in either 1912 or 1913, the two largest tonnage years before the war, likewise one-third greater than the average of 1920, with its heavy output, and 1921, with its very light output. Production in 1922 was about 34,000,000 tons.

Steel Unusually Active Despite Lower Output

December Sales of Sheets More Than 150 Per Cent of Productive Capacity—Other Products Strong

PITTSBURGH, Jan. 12, 1923.

The 30 companies which make monthly returns of their steel ingot output report a production of 2,779,890 tons in December against 2,889,297 tons in November. The decrease is barely as much as the decrease in the number of working days from 26 to 25, while a little output was no doubt lost through the holiday season. Order books are in better shape than 30 days ago, labor supply is somewhat better than in October, simply on account of the curtailment in outdoor work, and pig iron and fuel supplies are sufficient for a heavier production.

Production of ingots by the steel industry as a whole was at a rate of about 40,000,000 tons a year in each of the last three months, there being no noticeable variation from month to month, and the prospect is that production will be somewhat heavier this month. The quarter as a whole may show a gain of 5 to 10 per cent over last quarter. No large increase could be expected, on account of labor supply, whatever the other factors in production might be.

All the finished steel markets are more or less active, the most sluggish item being structural shapes. In plates the activity is moderate except in car plates, which are booked far ahead.

SHEET MILLS DOUBLE THEIR SALES

The majority of independent steel producers had heavy bookings in December. Some of the independents entered December with decidedly lean order books, scarcely sufficient to carry some departments through the month, and these independents are now much better fixed. The independent sheet mills that report to the National Association of Sheet and Tin Plate Manufacturers, representing 66.5 per cent of the total capacity of the sheet industry, reported sales for December of 399,624 net tons, or 156.6 per cent of a month's capacity, almost double the business reported for any one of the preceding five months.

On the other hand, the United States Steel Corporation reported a December decrease in unfilled obligations of 94,539 tons, against a November decrease of 62,045 tons, and this despite the fact that its sheet and tin plate subsidiary opened its order books for the new period only on November 23, thus being a very light seller in November and a heavy seller in December.

Nearly all the independent wire mills have advanced their prices $2 a ton or more. The Steel Corporation seems unlikely to advance its prices on wire or other products. The greatly improved order books of independent sheet mills make relatively safe a prediction that the independent sheet mills will soon begin advancing their prices quite generally. The Wheeling pipe independent, previously one point above the general level, recently advanced another point. Nails are quotable at $2.70 to $2.80 and plain wire at 2.45c. to 2.70c.

Bars, shapes and plates are now very strong at the 2.00c. level, which was being shaded more or less in November. Hoops are 2.75c. to 2.90c., depending on gage, etc. Recently some attractive orders were booked at as low as 2.50c.

Billets, slabs and sheet bars are all quotable at $37.50 to $38.50, against a general level of $36.50 lately ruling, at which much first quarter contract tonnage was entered. There have been sales at both $37.50 and $38.50 in the past week. The $45 rod price has entirely disappeared, leaving the market at $47.50 for good orders and up to $50 for single carloads.

COKE AND PIG IRON

Connellsville coke has softened somewhat in the week, furnace coke being now easy at $8.50, with foundry at $9 to $9.25. The market is, however, much above the level existing when the sudden demand from the east for domestic coke effected a sharp advance. Furnaces seem to be well covered by contracts at $7.00 to $7.50. Production has been increasing, car supplies being materially better.

Pig iron has been dull as to actual turnover, but prices are stiffening. On small prompt lots of foundry iron valley furnaces are securing $28, furnace, against a general quotation of $27 a week ago, while first quarter contracts were made at $25 in the buying movement of about 30 days ago. Basic iron is not clearly defined. Recent transactions were at $24.25 and $24.50, valley, and since then there have been one or two sales on a basis of $25.50 or $26, but it remains to be seen whether such prices can be obtained generally. In some quarters the claim is made that basic iron cannot be bought at under $27. Bessemer remains at $27.50, with occasional small transactions.

Current Prices in the New York Market

FOR CHEMICALS, OILS AND ALLIED PRODUCTS

Although these prices are for the spot market in New York City, a special effort has been made to report the American manufacturer's quotations whenever available. In many instances these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported and resale stocks are reported when of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb	$0 39	$0 41
Acetone, drums	lb	21	21½
Acid, acetic, 28%, bbl	100 lb	3 50	3 60
Acetic, 56%, bbl	100 lb	7 00	7 15
Glacial, 99½%, carboys	100 lb	12 80	13 25
Boric, crystals, bbl	lb	11	11½
Boric, powder, bbl	lb	11	11
Citric, kegs	lb	49 -	50
Formic, 85%	lb	18	19
Gallic, tech	lb	45	50
Hydrochloric, 18° tanks, 100	lb	80	1 00
Hydrofluoric, 52%, carboys	lb	11	11½
Lactic, 44%, tech, light, bbl	lb	11	11½
22% tech, light, bbl	lb	05	05½
Muriatic, 20°, tanks, 100	lb	1 00	1 10
Nitric, 36°, carboys	lb	04½	05
Nitric, 42°, carboys	lb	06	06¼
Oleum, 20%, tanks	ton	17 00	18 00
Oxalic, crystals, bbl	lb	13	13½
Phosphoric, 50%, carboys	lb	08	09
Pyrogallic, resublimed	lb	1 50	1 60
Sulphuric, 60°, tanks	ton	9 00	10 00
Sulphuric, 60°, drums	ton	12 00	14 00
Sulphuric, 66°, tanks	ton	14 50	15 00
Sulphuric, 66° drums	ton	19 00	20 00
Tannic, U S P, bbl	lb	65 -	.70
Tannic, tech, bbl	lb	40 -	.45
Tartaric, imp crys, bbl	lb	30½ -	31
Tartaric, imp, powd, bbl	lb	31 -	32
Tartaric, domestic, bbl	lb		32
Tungstic, per lb of WO	lb	1 00 -	1 20
Alcohol, butyl, drums	gal	18 -	23
Alcohol ethyl (Cologne spirit), bbl	gal	4 75 -	4 95
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 188 proof No 1	gal	.39 -	41
Alum, ammonia, lump bbl	lb	03½	03¾
Potash, lump, bbl	lb	03¼	03½
Chrome, lump, potash, bbl	lb	05 -	05¼
Aluminum sulphate, com, bags	100 lb	1 50	1 65
Iron free bags	lb	02¼	02½
Aqua ammonia, 26°, drums	lb	06½ -	07¼
Ammonia, anhydrous, cyl	lb	30	30½
Ammonium carbonate, powd casks	lb	09	.09½
Ammonium nitrate, tech, casks	lb	10 -	11
Amyl acetate tech, drums	gal	2 80	3 05
Arsenic, white, powd, bbl	lb	15½	16
Arsenic, red, powd, kegs	lb	13½	14
Barium carbonate, bbl	ton	75 00	77 00
Barium chloride, bbl	ton	94 00	100 00
Barium dioxide, drums	lb	18	18½
Barium nitrate, casks		08½	08¾
Barium sulphate, bbl	lb	04	04¼
Blanc fixe, dry, bbl	lb	04	04½
Blanc fixe, pulp, bbl	ton	45 00 -	55 00
Bleaching powder, f o b wks, drums	100 lb	2 00	2 10
Resale drums	100 lb	2 25	2 50
Borax, bbl	lb	05 -	05½
Bromine, cases	lb	27	28
Calcium acetate, bags	100 lb	3 50	3 60
Calcium carbide, drums	lb	04	04½
Calcium chloride, fused, drums	ton	22 00 -	23 00
Gran drums	lb	01½ -	01¾
Calcium phosphate, mono, bbl	lb	06½ -	07
Camphor, cases	lb	93	95
Carbon bisulphide, drums	lb	07 -	07½
Carbon tetrachloride drums	lb	10	10½
Chalk, precip - domestic, light, bbl	lb	04¼	04½
Domestic, heavy, bbl	lb	03½	03¾
Imported, light, bbl	lb	04½	05
Chlorine, liquid, cylinders	lb	06	06½
Chloroform, tech, drums	lb	35	38
Cobalt oxide bbl	lb	2 10	2 25
Copperas, bulk, f o b wks	ton	20 00	22 00
Copper carbonate, bbl	lb	20	20
Copper cyanide, drums	lb	50	55
Coppersulphate, crys bbl	100 lb	6 00	6 25
Cream of tartar, bbl	lb	25	26
Dextrine, corn, bags	100 lb	3 25	3 50
Epsom salt, dom., tech, bbl.	100 lb	2 10 -	2 25
Epsom salt, imp, tech, bags	100 lb	1 10 -	1 25
Epsom salt, U.S.P., dom, bbl.	100 lb	2 50 -	2 75
Ether, U S.P, drums	lb	13 -	15
Ethyl acetate, com, 85%, drums	gal	80 -	85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	95 -	1 00
Formaldehyde, 40%, bbl	lb	16 -	16½

Fullers earth, f o b mines	net ton	$16 00 -	$17 00
Fullers earth—imp, powd	net ton	30 00	32 00
Fusel oil, ref, drums	gal	3 55	4 05
Fusel oil, crude, drums	gal	2 30 -	2 40
Glaubers salt, wks, bags	100 lb	1 20 -	1 40
Glaubers salt, imp, bags	100 lb	1 00	1 25
Glycerine, c p, drums extra	lb	18½	19
Glycerine, dynamite, drums	lb	17	17¼
Iodine, resublimed	lb	4 50	4 60
Iron oxide, red, casks	lb	12 -	18
Lead			
White, basic carbonate, dry, casks	lb	08	08¼
White in oil, kegs	lb	10½	12
Red, dry, casks	lb	10½	10¾
Red, in oil, kegs	lb	12	14
Lead acetate, white crys, bbl	lb	12 -	12½
Lead arsenate, powd, bbl	lb	21 -	22
Lime Hydrated, bbl	per ton	16 80 -	17 00
Lime, Lump, bbl	280 lb	3 63 -	3.65
Litharge, comm, casks	lb	09½ -	10
Lithophone, bbl	lb	06½	.07
Magnesium carb, tech, bags	lb	07 -	07½
Methanol, 95%, bbl	gal	1 23 -	1 25
Methanol, 97%, bbl	gal	1 25 -	1 27
Nickel salt, double, bbl.	lb	10 -	10½
Nickel salts, single, bbl	lb	11 -	11½
Phosgene		60 -	75
Phosphorus, red, cases	lb	.35 -	40
Phosphorus, yellow, cases	lb	.30 -	35
Potassium bichromate, casks	lb.	.10 -	.10¼
Potassium bromide, gran, bbl	lb	.18 -	.25
Potassium carbonate, 80-85%, calcined, casks	lb	05½ -	.05¾
Potassium chlorate, powd	lb	07½ -	08
Potassium cyanide, drums	lb	47 -	80
Potassium hydroxide (caustic potash) drums	100 lb	6 75 -	7 00
Potassium iodide, cases	lb	3 55	3 65
Potassium nitrate, bbl	lb	06½	07
Potassium permanganate, drums	lb	16 -	16½
Potassium prussiate, red, casks	lb	85 -	90
Potassium prussiate, yellow, casks	lb	38 -	39
Salammoniac, white, gran, casks	lb	06½ -	06¾
Gray gran, casks	lb	08	08¼
Salsoda bbl	100 lb	1 20 -	1 40
Salt cake (bulk)	ton	25 00	27 00
Soda ash, light, 58% flat, bags, contract	100 lb	1 60 -	1 67
Soda ash, light, basis, 48%, bags, contract, f o b wks	100 lb	1 20 -	1 30
Soda ash, light, 58%, flat, bags, resale	100 lb	1 75 -	1 80
Soda ash, dense, bags, contract, basis 48%	100 lb	1 17½	1 20
Soda ash, dense, in bags, resale	100 lb	1 85 -	1 90
Soda, caustic, 76%, solid, drums f a s	100 lb	3 50 -	3 75
Soda, caustic, 76%, solid, drums, contract	100 lb	3 35	3 40
Soda, caustic, basis 60%, wks contract	100 lb	2 50 -	2 60
Soda, caustic, ground and flake, contracts	100 lb	3 80 -	3 90
Soda, caustic, ground and flake, resale	100 lb	4 00 -	4 15
Sodium acetate, works, bags	lb	06½	07
Sodium bicarbonate, bbl	100 lb	1 75	1 85
Sodium bichromate, casks	lb	07½ -	08
Sodium bisulphate (niter cake)	ton	6 00 -	7 00
Sodium bisulphite, powd, U S P, bbl	lb	04½ -	04¾
Sodium chlorate, kegs	lb	06½ -	07
Sodium chloride	long ton	12 00 -	13 00
Sodium cyanide, cases	lb	19 -	.23
Sodium fluoride, bbl	lb	09¼ -	09½
Sodium hyposulphite, bbl	lb	03 -	03¼
Sodium nitrite, casks	lb	08½ -	09
Sodium peroxide, powd, cases	lb	28 -	30
Sodium phosphate, dibasic, bbl	lb	03½ -	04
Sodium prussiate, yel drums	lb	18½ -	20
Sodium silicate (40°, drums)	100 lb.	80 -	1 15
Sodium silicate (60°, drums)	100 lb	2 25 -	2.40
Sodium sulphide, fused, 60-62% drums	lb	04½ -	.04¾
Sodium sulphite, crys, bbl	lb	03½ -	.03¾
Strontium nitrate, powd., bbl.	lb.	.09½ -	.10½
Sulphur chloride, yel drums	lb.	.04½ -	.05
Sulphur, crude	ton	18 00 -	20 00½
Sulphur dioxide, liquid, cyl	lb	08 -	08
Sulphur, flour, bbl	100 lb	2 50 -	3.15
Sulphur, roll, bbl	100 lb	2 15 -	2.20

Talc—imported, bags	ton	$30 00 -	$40 00
Talc—domestic powd, bags.	ton	18 00 -	25 00
Tin bichloride, bbl	lb.	11 -	11½
Tin oxide, bbl	lb	45 -	.47
Zinc carbonate, bags	lb	14 -	14½
Zinc chloride, gran, bbl	lb	07 -	07½
Zinc cyanide, drums	lb	42 -	44
Zinc oxide, XX, bbl	lb	07½ -	08
Zinc sulphate, bbl	100 lb.	2 75 -	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl	lb	$ 95 -	$1.00
Alpha-naphthol, ref, bbl	lb	1 05 -	1.10
Alpha-naphthylamine, bbl	lb	28 -	.30
Aniline oil, drums	lb	16½ -	.17
Aniline salts, bbl	lb	24 -	25
Anthracene, 80%, drums	lb	75 -	1 00
Anthracene, 80%, imp, drums, duty paid	lb	.65 -	.70
Anthraquinone, 25%, paste, drums	lb	70 -	.75
Benzaldehyde U S P, carboys	lb.	1 35 -	1.40
Benzene, pure, water-white, tanks and drums	gal.	35 -	.40
Benzene, 90%, drums	gal.	26 -	.32
Benzene, 90%, drums, resale	gal.	34 -	.35
Benzidine base, bbl	lb.	85 -	.90
Benzidine sulphate, bbl	lb.	75 -	.80
Benzoic acid, U S P, kegs	lb	72 -	.75
Benzoate of soda, U S P, bbl	lb	.57 -	.65
Benzyl chloride, 95-97%, ref., drums	lb.	.25 -	.27
Benzyl chloride, tech, drums	lb.	20 -	.23
Beta-naphthol, subl, bbl	lb	55 -	.60
Beta-naphthol, tech, bbl	lb	.25 -	.26
Beta-naphthylamine, tech	lb.	1 00 -	1.25
Carbazol, bbl	lb.	75 -	.90
Cresol, U S P, drums	lb.	.14 -	.20
Ortho-cresol, drums	lb.	.18 -	.22
Cresylic acid, 97%, resale, drums	gal	1.25 -	1.30
95-97%, drums, resale	gal.	95 -	1 00
Dichlorbenzene, drums	lb	07 -	.09
Diethylaniline, drums	lb	50 -	.60
Dimethylaniline, drums	lb	39 -	.41
Dinitrobenzene, bbl	lb	20 -	.22
Dinitroclorbenzene, bbl	lb.	22 -	.23
Dinitronaphthalene, bbl	lb	30 -	32
Dinitrophenol, bbl	lb	35 -	.40
Dinitrotoluene, bbl	lb	22	.24
Dip oil, 25%, drums	gal.	25 -	.30
Diphenylamine, bbl	lb	54 -	.56
H-acid, bbl	lb	75 -	.80
Meta-phenylenediamine, bbl	lb	.95 -	1 00
Michlers ketone, bbl	lb.	3 50	3 75
Monochlorbenzene, drums	lb	08 -	10
Monoethylaniline, drums	lb.	.95 -	1 10
Naphthalene crushed, bbl	lb	05½ -	06
Naphthalene, flake, bbl	lb.	.06 -	.06½
Naphthalene, balls, bbl	lb	07 -	07½
Naphthionate of soda, bbl	lb.	58 -	.65
Naphthionic acid, crude, bbl	lb	60 -	.65
Nitrobenzene, drums	lb.	10 -	.12
Nitro-naphthalene, bbl	lb	30 -	35
Nitro-toluene, drums	lb	15 -	.17
N-W acid, bbl	lb.	1 20 -	1 30
Ortho-amidophenol, kegs	lb.	2 30 -	2 35
Ortho-dichlorbenzene, drums	lb.	17 -	20
Ortho-nitrophenol, bbl	lb.	90 -	92
Ortho-nitrotoluene, drums	lb.	12½ -	.14
Ortho-toluidine, bbl	lb.	14 -	16
Para-amidophenol, base, kegs	lb	1 25 -	1 30
Para amidophenol, HCl kegs	lb	1 30 -	1 35
Para-dichlorbenzene, bbl	lb	17 -	20
Paranitraniline, bbl	lb.	.75 -	80
Para-nitrotoluene, bbl	lb.	55 -	.65
Para-phenylenediamine, bbl	lb.	1 50 -	1 55
Para-toluidine, bbl	lb	85 -	90
Phthalic anhydride, bbl	lb	35	38
Phenol, U S P, drums	lb	35 -	37
Picric acid, bbl	lb	20	22
Pyridine, dom, drums	gal.	nominal	
Pyridine, imp, drums	gal.	2 80 -	3 00
Resorcinol, tech, kegs	lb.	1 50 -	1 55
Resorcinol, pure, kegs	lb	2 00 -	2 10
R-salt, bbl	lb	55 -	60
Salicylic acid, tech, bbl	lb	40 -	42
Salicylic acid, U S P, bbl	lb	45 -	47
Solvent naphtha, water-white, drums	gal.	37 -	40
Crude, drums	gal.	22 -	24
Sulphanilic acid, crude, bbl	lb.	.20 -	.22
Thiocarbanilide, kegs	lb.	35 -	.38
Toluidine, kegs	lb.	1 20 -	1 30
Toluidine, mixed, kegs	lb.	30 -	.35
Toluene, tank cars	gal.	.35 -	.37
Toluene, drums	gal.	.40 -	43
Xylidines drums	lb.	40 -	.45
Xylene, pure, drums	gal.	45 -	50
Xylene, com, drums	gal.	40 -	42
Xylene, com., tanks	gal.	.30 -	

Naval Stores

Rosin B-D, bbl	280 lb.	$6 15 –	
Rosin E-I, bbl	280 lb	6 30 –	
Rosin K-N, bbl	280 lb.	6 50 –	$6 75
Rosin W G.-W W., bbl	280 lb.	7 75 –	8 25
Wood rosin, bbl	280 lb	6 25	
Turpentine, spirits of, bbl	gal	1 51 –	1 52
Wood, steam dist., bbl	gal	1 35	
Wood, dest. dist, bbl	gal	1 25 –	
Pine tar pitch, bbl	200 lb	–	6 00
Tar, kiln burned, bbl	500 lb		12 50
Retort tar, bbl	500 lb	–	11 00
Rosin oil, first run, bbl	gal	43	
Rosin oil, second run, bbl	gal	47	
Rosin oil, third run, bbl	gal	53 –	
Pine oil, steam dist	gal.		90
Pine oil, pure, dest. dist	gal		85
Pine tar oil, ref.	gal.	–	46
Pine tar oil, crude, tanks f.o.b Jacksonville, Fla	gal	–	35
Pine tar oil, double ref, bbl.	gal	–	75
Pine tar, ref, thin, bbl	gal	–	25
Pinewood creosote, ref, bbl	gal	–	52

Vegetable Oils

Castor oil, No. 3, bbl	lb	$ 11¾ –	$ 12¼
Castor oil, AA, bbl	lb	12¼	12¾
Chinawood oil, bbl	lb	15 –	15½
Coconut oil, Ceylon, bbl	lb	09¼	09½
Coconut oil, Cochin, bbl.	lb	09¾	09¾
Corn oil, crude, bbl	lb	11	11¼
Cottonseed oil, crude (f.o.b. mill), tanks	lb	09½ –	
Summer yellow, bbl	lb	11¼	11½
Winter yellow, bbl	lb	11½ –	12
Linseed oil, raw, car lots, bbl.	gal	87 –	88
Raw, tank cars (dom.)	gal	84 –	85
Boiled, 5-bbl lots (dom.)	gal	89 –	90
Olive oil, denatured, bbl	gal	1 05 –	1 12
Palm, Lagos, casks	lb	08 –	08¼
Palm kernel, bbl	lb	08¾ –	09
Peanut oil, crude, tanks (mill)	lb	12¾ –	13
Peanut oil, refined, bbl	lb	15½ –	16
Rapeseed oil, refined, bbl	gal	83 –	84
Rapeseed oil, blown, bbl	gal	87 –	88
Soya bean (Manchurian), bbl	lb	11½ –	
Tank, f.o.b. Pacific coast	lb	09½ –	09¾

Fish Oils

Menhaden, light pressed, bbl	gal	$0 60 –	
White bleached, bbl	gal	64	65
Blown, bbl	gal	68 –	69
Whale No. 1 crude, tanks, coast	lb	06 –	06½

Dye & Tanning Materials

Divi-divi, bags	ton	$38 00	$39 00
Fustic, sticks	ton	30 00	35 00
Fustic, chips, bags	lb	04 –	05
Logwood, sticks	ton	28 00 –	30 00
Logwood, chips, bags	lb	02½	03½
Sumac, leaves, Sicily, bags	ton	65 00 –	
Sumac, ground, bags	ton	55 00	60 00
Sumac, domestic, bags	ton	35 00 –	
Tapioca flour, bags	lb	03¼	05

EXTRACTS

Archil, conc., bbl	lb	$0 18	$0 20
Chestnut, 25% tannin, tanks.	lb	02	03
Divi-divi, 25% tannin, bbl	lb	04 –	05
Fustic, crystals, bbl	lb	20 –	22
Fustic, liquid, 42°, bbl.	lb	08	09
Gambier, liq., 25% tannin, bbl.	lb	08 –	09
Hematine crys., bbl	lb	14	18
Hemlock, 25% tannin, bbl.	lb	04	05
Hypernic, solid, drums	lb	24 –	26
Hypernic, liquid, 51°, bbl.	lb	14	17
Logwood, crys., bbl	lb	19	20
Logwood, liq., 51°, bbl.	lb	09 –	10
Quebracho, solid, 65% tannin, bbl	lb	04½ –	05
Sumac, dom., 51°, bbl.	lb.	06½ –	07

Waxes

Bayberry, bbl.	lb	$0 30 –	$0 31
Beeswax, refined, dark, bags	lb	30 –	32
Beeswax, refined, light, bags	lb	34	35
Beeswax, pure white, cases.	lb.	40 –	41
Candelilla, bags	lb.	34 –	35
Carnauba, No. 1, bags	lb.	38 –	40
No. 2, North Country, bags	lb	23 –	24
No. 3, North Country, bags	lb	17 –	17½
Japan, cases	lb	15 –	15½
Montan, crude, bags	lb	03½ –	04
Paraffine, crude, match, 105-110 m.p.	lb.	04	04¼
Crude, scale 124-126 m.p., bags	lb.	02½	02¾
Ref., 118-120 m.p., bags	lb	03¼ –	03½
Ref., 125 m.p., bags	lb	03½ –	03¾
Ref., 128-130 m.p., bags	lb.	.04 –	04¼
Ref., 133-135 m.p., bags	lb	04½	04¾
Ref., 135-137 m.p., bags	lb.	05 –	05¼
Stearic acid, sgle pressed, bags	lb	10 –	.10½
Double pressed, bags	lb	10½ –	10¾
Triple pressed, bags	lb.	11	11½

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb.	$3.20 –	$3.25
F.a.s. double bags	100 lb.	3.60 –	3.75
Blood, dried, bulk	unit	4.60 –	....
Bone, raw, 3 and 50, ground	ton	30.00 –	35.00
Fish scrap, dom., dried, wks.	unit	5.00 –	5.10
Nitrate of soda, bags	100 lb.	2.60 –	2.65
Tankage, high grade, f.o.b. Chicago	unit	4.60 –	4.65

Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$3.50 –	$4.00
Tennessee, 78-80%	ton	7 00 –	8 00
Potassium muriate, 80%, bags	ton	35 55 –	38 25
Potassium sulphate, bags	unit	1 00 –	....

Crude Rubber

Para—Upriver fine	lb	$0 26½ –	$0 26¾
Upriver coarse	lb	19	19½
Upriver caucho ball	lb	21 –	21½
Plantation—First latex crepe	lb	30½	31
Ribbed smoked sheets	lb	30½ –	31
Brown crepe, thin, clean	lb	23 –	.23½
Amber crepe No. 1	lb	23 –	.23½

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh ton	$450 00	$550 00
Asbestos, shingle, f.o.b., Quebec	sh ton	60 00	80 00
Asbestos, cement, f.o.b., Quebec	sh ton	15 00	17 00
Barytes, grd., white, f.o.b. mills, bbl	net ton	16 00	20 00
Barytes, grd., off-color, f.o.b. mills bulk.	net ton	13 00	21 00
Barytes, floated, f.o.b. St. Louis, bbl	net ton	24 00	28 00
Barytes, crude f.o.b. mines, bulk	net ton	8 00	9 00
Casein, bbl., tech.	lb.	12	14
China clay (kaolin) crude, f.o.b. Ga.	net ton	7 00 –	9 00
Washed, f.o.b. Ga.	net ton	8 00 –	9 00
Powd., f.o.b. Ga	net ton	14 00 –	20 00
Crude f.o.b. Va	net ton	8 00 –	12 00
Ground, f.o.b. Va	net ton	13 00	20 00
Imp., lump, bulk	net ton	14 00 –	20 00
Imp., powd	net ton	40 00 –	45 00
Feldspar, No. 1 pottery.	long ton	6 00	7 00
No. 2 pottery	long ton	5 00 –	5 50
No. 1 soap	long ton	7 00	7 50
No. 1 Canadian, f.o.b. mill	long ton	20 00	21 00
Graphite, Ceylon, lump, first quality, bbl	lb	05	05½
Ceylon, chip, bbl	lb	04	04½
High grade amorphous crude	ton	35 00	50 00
Gum arabic, amber, sorts, bags	lb	15	16
Gum tragacanth, sorts, bags	lb	50	60
No. 1, bags	lb	1 75	1 80
Kieselguhr, f.o.b. Cal	ton	40 00	42 00
F.o.b. N.Y.	ton	50 00	55 00
Magnesite, crude, f.o.b. Cal	ton	14 00	15 00
Pumice stone, imp., casks	lb	03	05½
Dom., lump, bbl	lb	05	05½
Dom., ground, bbl	lb	06	07
Shellac, orange fine, bags	lb	76	77
Orange superfine, bags	lb	78	79
A. C. garnet, bags	lb	77	78
T. N., bags	lb	74	75
Silica, glass sand, f.o.b. Ind	ton	2 00	2 50
Silica, sand blast, f.o.b. Ind	ton	2 50	5.00
Silica, amorphous, 250-mesh, f.o.b. Ill	ton	17 00	17 50
Silica, bldg. sand, f.o.b. Pa	ton	2 00	2 75
Soapstone, coarse, f.o.b. Vt., bags	ton	7 00	8 00
Talc, 200 mesh, f.o.b., Vt., bags	ton	6 50	9 00
Talc, 200 mesh, f.o.b. Ga., bags	ton	7 00	9 00
Talc, 200 mesh, f.o.b. Los Angeles, bags	ton	16 00	20.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	ton	$45–50
Chrome brick, f.o.b. Eastern shipping points	ton	50–52
Chrome cement, 40-50% Cr_2O_3	ton	23–27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23 00
Fireclay brick, 1st quality, 9-in shapes, f.o.b. Ky. wks	1,000	40–46
2nd quality, 9-in shapes, f.o.b. wks	1,000	36–41
Magnesite brick, 9-in straight (f.o.b. wks.)	ton	65 68
9-in arches, wedges and keys	ton	80 85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9-in sizes, f.o.b. Birmingham district	1,000	48 50
F.o.b. Mt. Union, Pa	1,000	42–44
Silicon carbide refract. brick, 9-in	1,000	1,100 00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N.Y.	ton	$200 00 –	$225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	11 –	11½
4-6% C	lb.	.11½ –	12
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	100.00 –	105.00
Spiegeleisen, 19-21% Mn.	gr. ton	35.00 –	37.00
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb	1.90 –	2.15
Ferrosilicon, 10-15%	gr. ton	40.00 –	45.00
50%	gr. ton	75.00 –	80.00
75%	gr. ton	115.00 –	120.00
Ferrotungsten, 70-80%, per lb. of W.	lb.	$0.90 –	$0.95
Ferro-uranium, 35-50% of U, per lb. of U	lb.	6 00 –	....
Ferrovanadium, 30-40%, per lb. of V.	lb	3 50 –	4.00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$6 00 –	$9 00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22 00 –	23.00
C.i.f. Atlantic seaboard	ton	18 50 –	19.00
Coke, fdry., f.o.b. ovens	ton	9 00 –	9.50
Coke, furnace, f.o.b. ovens	ton	9 00 –	9.50
Fluorspar, gravel, f.o.b. mines, New Mexico	ton	17 50 –	......
Fluorspar, No. 2 Lump—Ky. & Ill. mines	ton	25 00 –	......
Ilmenite, 52% TiO_2	lb	.01½ –	.01¾
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	45 –	....
Manganese ore, chemical (MnO_2)	ton	75 00 –	80.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N.Y.	lb	.80 –	85
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb.	.06 –	.08
Pyrites, Span., fines, c.i.f. Atl. seaport	unit	.11½ –	.12
Pyrites, Span., furnace size, c.i.f. Atl. seaport	unit	11½ –	.12
Pyrites, dom. fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2	lb.	12 –	......
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8 00 –	8.50
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	7 50 –	8.00
Uranium ore (carnotite) per lb. of U_3O_8	lb	3 50 –	3.75
Uranium oxide, 96% per lb. U_3O_8	lb	2 25 –	2.50
Vanadium pentoxide, 99%	lb	12 00 –	14.00
Vanadium ore, per lb. V_2O_5	lb	1 00 –	....
Zircon, washed, iron free, f.o.b. Pablo, Fla.	lb.	.04½ –	.13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	14.75
Aluminum, 98 to 99%	22 00–23.00
Antimony, wholesale, Chinese and Japanese	6.60
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	36.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	38.75
Lead, New York, spot	7.50
Lead, E. St. Louis, spot	7.30
Zinc, spot, New York	7 15–7.25
Zinc, spot, E. St. Louis	6.80–6.90

OTHER METALS

Silver (commercial)	oz	$0.64⅛
Cadmium	lb	1.15
Bismuth (500 lb. lots)	lb	2 45
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99%	lb.	1.00@1.05
Platinum	oz.	118.00
Iridium	oz.	250 00@275.00
Palladium	oz	65.00@70.00
Mercury	75 lb.	74.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.00
Copper bottoms	30.00
Copper rods	19.75
High brass wire	18.75
High brass rods	16.75
Low brass wire	19.60
Low brass rods	20.25
Brazed brass tubing	23.00
Brazed bronze tubing	28.00
Seamless copper tubing	24.75
Seamless high brass tubing	22.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11 00@11.25
Copper, heavy and wire	10.50@10.75
Copper, light and bottoms	8.50@8.75
Lead, heavy	4.50@4.75
Lead, tea	3.25@3.50
Brass, heavy	5.50@5.75
Brass, light	5.00@5.25
No. 1 yellow brass turnings	5.50@5.75
Zinc	2.25@2.50

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$2.90	$2.90
Soft steel bars	2.80	2.80
Soft steel bar shapes	2.80	2.80
Soft steel bands	3.40	3.40
Plates ¼ to 1 in. thick	2.90	2.90

Industrial

Financial. Construction and Manufacturers' News

Construction and Operation

Alabama

EMPIRE—The Empire Coal Co Birmingham, has plans nearing completion for the construction of a byproduct coke plant at its properties near Empire, to consist of an initial battery of 40 ovens and auxiliary equipment. The project is estimated to cost close to $1,000,000.

TARRANT CITY—The National Cast Iron Pipe Co. has broken ground for the erection of a large addition at its local foundry, and will also make a number of improvements in the present works. The De Lavaud process of cast iron pipe production will be installed in the new plant A fund of more than $200,000 has been arranged for the expansion

Arkansas

CAMDEN—The Texas Co, Dallas, Tex, has commenced the construction of a new oil storage and distributing plant at Louann near Camden, with initial installation to comprise twenty-five 55,000 bbl tanks and auxiliary equipment

SMACKOVER—The Pan-American Petroleum & Transport Co, 120 Broadway, New York, has acquired a tract of local property, consisting of about 165 acres, and plans for extensive development Plans are under way for a storage and distributing plant of twenty-two 66,000 bbl tanks and auxiliary apparatus Edward L Doheny is president

PEARSON—The Lion Oil & Refining Co Kansas City Mo, will soon commence work on a local oil plant to consist of six 1,000 bbl. stills, 9 steel tanks and other operating equipment. It will cost in excess of $75,000

California

FRESNO—The California Products Co Butler and O Sts, Robert Hulme, head has preliminary plans under consideration for the establishment of a local plant for the manufacture of industrial alcohol and kindred specialties.

LOS ANGELES—The Minarock Products Co. is completing plans for the installation of a new crushing and screening plant, for the production of special rock and mineral products, to include complete rock crusher, grade screens, storage bins and conveying equipment. A. Godfrey Bailey, Jr, 110 Orpheum Bldg, is architect

Connecticut

NORWICH—The Uncas Paperboard Co, recently organized with a capital of $1,500,000, is planning for early operations at the local plant of the Ironsides Board Corp. recently acquired at a receiver's sale by James E. Smith of the Chesapeake Paper Board Co., Woodall St., Baltimore, Md, and who will head the new organization It is purposed to remodel a number of buildings at the mill, and install additional equipment. Others interested in the new company are Frank W Browning and Joseph H Eilers, both of Montville, Conn

Georgia

ATHENS—The George Brick Co has arranged a list of equipment for installation at its new local plant, to replace the works recently destroyed by fire and will commence rebuilding at an early date It is proposed to develop a capacity of 30,000 bricks per day H H. Hinton and R C Wilson head the company.

SAVANNAH—The Georgia-Florida Fertiliser Co. has perfected plans for immediate operations at the former plant of the Kirkland Fertilizer Co, near Savannah, recently acquired. A number of improvements will be made for increased production.

Illinois

TAYLORVILLE—The Hopper Paper Co recently organized, has revised plans under way for the construction of its proposed new mill, to be 2-story and basement, 80x165 ft, estimated to cost approximately $75,000 E. Hopper, president of the Kalamazoo Sanitary Mfg Co, Kalamazoo, Mich., heads the new organization Billingham & Cobb, Press Bldg, Kalamazoo, are architects

Indiana

SEYMOUR—The Silverstone Stucco & Plaster Products Co., 3323 Park Ave, Indianapolis, John R Briggs, president, recently incorporated, is planning for the construction of a new local plant for the manufacture of stucco under a new process, plaster and lime products, etc It is estimated to cost about $100,000 including machinery

Kansas

BONNER SPRINGS—The International Cement Corp, 342 Madison Ave, New York, has acquired the local plant of the Bonner Portland Cement Co., for a consideration said to be about $600,000 Plans are in progress for extensions in the present works including the installation of considerable new equipment for increased manufacture It is expected to develop a maximum output of close to 600,000 bbl. per annum Holger Struckman is president

Kentucky

LAWTON—The Enterprise Chemical Co, P O Box 545, Huntington, W Va, recently formed with a capital of $100,000, has plans under way for the erection of a local plant for the manufacture of lime products, to include crushing, pulverizing, screening and other operating departments. A hydrating plant is also contemplated It is expected to develop an output of 1,500 tons per day F L Parr is general manager, and William Lewis construction engineer.

Maryland

BALTIMORE—The United States Industrial Alcohol Co, 27 William St., New York, is contemplating plans and will take bids in the near future for the erection of a new 1-story addition to its local plant in the Curtis Bay district, 60x180 ft Samuel Moore is company engineer

BALTIMORE—The Board of Directors, Johns Hopkins University, has plans nearing completion for the erection of a new chemical laboratory at the institution, estimated to cost approximately $600,000, with equipment It is expected that bids will be called for at an early date. Edward L Palmer, Jr, 513 North Charles St, is architect

HAVRE DE GRACE—William E Veasey, Havre de Grace, is perfecting plans for the organization of a company to construct and operate a local plant for the manufacture of brick, tile and other burned clay products A list of equipment to be installed will soon be prepared.

BALTIMORE—Fire, Jan 5, destroyed the plant of the Commercial Envelope Co., 2400 Frederick Ave., manufacture of paper products, with loss approximating $50,000, including equipment It is expected that the plant will be rebuilt Howard Jones heads the company

Massachusetts

BOSTON—Henry Gibbons, 12-20 Glenwood Ave has filed plans for the erection of a new 1-story foundry

CLINTON—The Clinton Gas Light Co, Pleasant St, has plans under way for the construction of a 2-story addition to its artificial gas plant on Parker St, to cost about $125,000. W. W Russell, 77 Franklin St., Boston, is engineer

Michigan

MONROE—The River Raisin Paper Co. has tentative plans under consideration for the erection of a 1-story addition to its plant, to be used primarily for the manufacture of box-board and other carboard products. G H. Wood is president.

IRON MOUNTAIN—The Ford Motor Co., Highland Park, is considering plans for the construction of a new local plant for the manufacture of chemical products including wood alcohol, acetate of lime and other byproducts. The size and estimated cost are being determined.

LUDINGTON—The Marine Rubber Corp, recently organized under Delaware laws with capital of $1,250,000, will succeed the Ludington Rubber Co., taking over and operating a local plant for the manufacture of a line of rubber products for marine and other service Extensions and improvements are planned. A. H. Gruber is president, and Andrew W Newberg, vice-president.

Nevada

TONOPAH—The Tonopah Extension Co. has plans in progress for extensions in its local mill, including the installation of additional equipment to increase the output from 415 to 500 tons per day

New Jersey

NEWARK—The Armitage Varnish Co, 189-215 South St, has perfected plans for the immediate erection of a 3-story plant, 18x50 ft., estimated to cost about $25,000

RIDGEFIELD PARK—The Bogota Folding Box Co., Bogota, N J, has acquired the plant of the British American Chemical Co., Ridgefield Park consisting of a number of buildings totaling 55,000 sq ft, on a 7-acre tract of land for a consideration of $80,000 The selling company, represented by a receiver, is now defunct The purchaser is said to be planning to use the property for a new plant Herman M Hess and Michael Densen head the company

New York

BROOKLYN—Gerstendorfer Brothers, 231 East 42d St, New York, manufacturers of bronze powders, etc, are having plans completed for the erection of a new 7-story plant at Clinton and Bush Sts, estimated to cost $350,000 Russell G Cory, 30 Church St, New York, is consulting engineer

LONG ISLAND CITY—The Oscar Schlegel Mfg. Co., 124 East 13th St, New York manufacturer of paints, varnishes, etc, has leased a building now in course of erection at the northwest corner of Harris Ave and the Boulevard for the establishment of a new plant The Martini Artists' Color Laboratories, same address, manufacturer of artists' paints and colors, has leased property at the same location, Long Island City, for a new works.

SYRACUSE—Fire, Jan 3, destroyed a portion of the tanning plant of the Onondaga Hide & Leather Co, East Water St., with loss estimated at about $15,000, including equipment It is planned to rebuild

Ohio

CINCINNATI—The Kemper-Thomas Co, Park Ave, near Floral Ave., Norwood, manufacturer of paper products, will take bids at once for the erection of a new 3-story and basement addition, 60x220 ft, to cost about $150,000, including equipment Samuel Hannaford & Sons, 1024 Dixie Terminal Bldg., Cincinnati, are architects.

ZANESVILLE—Fire, Dec 21, destroyed the enamel department and other portions of the plant of the Mark Mfg Co, manufacturer of steel conduit, pipe, tubing etc., with loss estimated at close to $400,000, including equipment It is planned to rebuild. The company is a branch of the Steel & Tube Co. of America, Inc., 111 West Washington St., Chicago, Ill.

CAMBRIDGE—E. M. Darner, Zanesville, has acquired the local plant of the Guernsey Earthenware Co, at a receiver's sale, for a stated consideration of $80,500 The new owner is said to be planning to operate the pottery.

MIDDLETOWN—Z W. Ranck and W. H Muchmore, Shelby, O., have organized a new company to take over the property of the Shelby Wax Paper Co., Shelby. The equipment at the plant will be removed to the works of the Central Tissue Co., Middletown, wax paper department, which will be developed for large increase in capacity. Mr. Ranck will be president of the new company, and Mr Muchmore, vice-president and general manager.

Oklahoma

RINGLING—The Gilmer Oil Co Ardmore, Okla., has acquired a local refinery and has plans under way for extensions and improvements in the plant.

TULSA—J. J. Kerins, Tulsa, is perfecting plans for the organization of a company to construct and operate a new oil refining plant in the Tonkawa district. The initial plant will have a capacity of about 2,000 bbl. per day.

TULSA—The Producers' & Refiners' Corp., California Bldg. Denver, Colo., operating

local oil refineries, is completing arrangements for the purchase of the refining plants and properties of the Barnsdall Corp., the Texas-Pacific Coal & Oil Co., and the Fensland Oil Co., representing total assets of about $125,000,000, with plants in the Mid-Continent, Texas and Wyoming fields. The new owner plans for extensions and improvements for extensive increase in production.

MUSKOGEE—The Sinclair Refining Co. has perfected plans for the removal of its oil refinery at Vinita, Okla., to the refining plant at Muskogee, where the consolidation will be developed for considerable increase in production.

Oregon

ASTORIA—The Astoria Shope Brick Co has acquired a local site for the erection of a new plant with initial output of about 35,000 bricks per day, and will break ground at an early date. A list of machinery to be installed is being arranged. The company has recently been organized with a capital of $250,000.

PORTLAND—The Portland Oxygen & Hydrogen Co, Center and East 17th Sts, has awarded a contract to the Hurley-Mason Co., Gasco Bldg., for the erection of a 1-story addition to its plant.

Pennsylvania

ZELIENOPLE—The Common Council is having plans prepared for the installation of a filtration plant at the municipal waterworks to cost about $35,000. Leo Hudson, Wabash Bldg., Pittsburgh, is engineer.

HAYSVILLE—Fire, Jan. 3, destroyed a portion of the plant of the Sterling Varnish Co., including two buildings, with loss estimated in excess of $50,000, including equipment. Headquarters of the company are in Fulton Bldg., Pittsburgh. James Todd is president.

POTTSVILLE—The Common Council has ordered a sanitary survey of the city, preparatory to the installation of a new sewage filtration plant, estimated to cost in excess of $500,000, with equipment, for which plans will be authorized in the near future.

PHILADELPHIA—S. Kardan, 2d and Vine Sts., manufacturer of paper products, has plans under way for the erection of a new 5- to 8-story plant at South, Swanson and Bainbridge Sts., estimated to cost about $500,000 Clarence E. Wunder, 1415 Locust St., is architect.

FARMERS VALLEY—A new company has been formed by Warren, Pa., interests for the construction and operation of a local oil refining plant, on site owned by the B. B. Stroud Gasoline Co., Coleville, near Farmers Valley, which is interested in the project.

South Carolina

PREGNALL—The Atlantic Turpentine Co., St. George, S. C., recently organized, has acquired local property and plans for the early erection of a new plant for extensive production. H. H. Gross is president, M S Connor, secretary and treasurer, and T A Patrick, general manager, the last two officials being located at St. George.

Texas

ELECTRA—The Griswold Oil Co., Henrietta, Tex., has completed arrangements with the Electra Chamber of Commerce and Agriculture, for the acquisition of a local site for the erection of a new oil refinery, estimated to cost close to $500,000. The present refining plant at Henrietta will be removed to the new location, with the installation of additional equipment for extensive increase in output, including 2 new cracking plants, and new casinghead gasoline works. The company has also secured the local property of J. F Emerich in the South Electra field.

HOSKINS MOUND—The Freeport Sulphur Co., Freeport, Tex., has active construction in progress on its new local sulphur plant, estimated to cost in excess of $1,500,000. The works will include a large power house and a chemical-treatment water plant to handle approximately 3,500,000 gal per day. It is expected to have the plant ready for operation early in the spring. C. M. Chapman is consulting engineer for the company.

SAN ANGELO—The San Angelo Water, Light & Power Co. is planning for the installation of a filtration plant at its local waterworks. The company is operated by the Interstate Electric Corp., 141 Broadway, New York. M. F. Treadwell is local manager at San Angelo.

Washington

VANCOUVER—The Columbia River Paper Mills, Inc., operated by the California-Oregon Paper Mills Co., East 57th St., Los Angeles, Cal., is perfecting plans for the erection of a new local plant. The city council is vacating a number of streets for the mills.

West Virginia

WHEELING—The Wheeling Steel Corp. has commenced the construction of a new sintering plant at its East Steubenville works, and plans to rush the structure to completion. Special furnaces will be installed to utilize the flue dust from the blast furnaces, converting it into a solid for iron manufacture.

Wisconsin

KENOSHA—The Frost Mfg. Co., Fremont St., manufacturer of brass castings, is considering plans for the construction of a new 1-story foundry W. J. Frost is president.

Canada

WINNIPEG, MAN—The Swift-Canadian Co., operated by Swift & Co., Union Stock Yards, Chicago, Ill., plans for the rebuilding of its Elmwood fertilizer plant, partly destroyed by fire, Dec 22, with loss estimated at $35,000.

British Columbia

VICTORIA—D. D. McPhail, Kelso, Wash., and associates, are organizing a new company to construct and operate a large pulp and paper mill in the vicinity of Nitinat Lake. The initial plant unit is estimated to cost in excess of $500,000, and will be supplemented with other units at a later date, making an ultimate cost of more than $1,500,000.

Industrial Developments

LEATHER—The Carr Leather Co, Peabody, Mass, is running at full capacity with regular working force, and is said to have orders on hand to insure continuance on this basis for a number of months to come.

Glazed kid manufacturing plants at Camden, N J, Philadelphia, Pa, and Wilmington, Del, are maintaining full operations with full working forces and propose to continue on this basis for an indefinite period.

The A. C. Lawrence Leather Co, Peabody, Mass, has resumed production at its local pig skin tannery, which has been practically idle for close to 2 years past. Initial operations will be on a curtailed capacity basis for the time being.

The Essex Tanning Co, Peabody, Mass., is running under heavy output at its plant, and has orders on hand to insure this basis for some time to come. A full working force is being employed.

GLASS—The Owens Bottle Co, Clarksburg, W Va, has placed an additional unit in operation at its plant bringing production to a capacity basis, or 3 000 gross boxes of bottles per day. The plant will continue on this schedule for an indefinite period, giving employed to approximately 200 workers.

Glass factories in the vicinity of Paulsboro, N. J., are advancing operations and expect to give employment to an increased number of workers at the season matures. It is said that 1923 will be the busiest year since 1919.

Following a brief curtailment for inventory, the Indiana Glass Co, Dunkirk, Ind, has resumed production on a capacity basis and is said to have orders on hand to insure this schedule for a number of months to come.

Window glass manufacturers represented in the National Association of Window Glass Manufacturers have granted a wage increase of 13 per cent at all hand plants throughout the country, effective Jan. 29 and concluding June 11.

CERAMIC—The American Clay Products Co, New Hope, Pa, is perfecting arrangements for the opening of its local plant late in February. The works have been in course of erection since the spring of 1920, and are said to represent an investment of more than $1,000,000. The plant will specialize in the manufacture of shale brick and will develop an ultimate output of about 500,000 bricks per day.

The Carpenteria Clay Products Co., Carpenteria, Cal., has commenced operations at its new local plant, recently completed, and will concentrate on the manufacture of brick and hollow tile.

The Champion Spark Plug Co., Toledo, O., is advancing capacity at its plant and is now running on the basis of 120,000 spark plugs each working day.

The Bethlehem Spark Plug Co., Bethlehem, Pa., is running on a capacity basis and expects to continue this schedule for an indefinite period. An order has been secured from the International Harvester Co. for 1923 spark plugs, said to total $500,000; a large order has also been received from the Packard Motor Car Co.

The National Drain Tile Co., Summitville, near Anderson, Ind., has closed its local plant for an indefinite period.

The Thress Brick Co., Tuscaloosa, Ala., is planning for increased production at its plant.

RUBBER—The Goodyear Tire & Rubber Co., Akron, O., has resumed full production at its local plant following a short curtailment for inventory.

The Hood Rubber Co., Watertown, Mass., is maintaining full capacity at its mill and will continue on this basis for an indefinite period. A new record output has been established.

IRON AND STEEL—The American Sheet & Tin Plate Co. has resumed operations at its La Belle Works, Wheeling, W. Va., with a full working force, after a shut down for the past 6 months.

The Conners Steel Co, Birmingham, Ala., has resumed operations on a capacity basis at its hoop and band mills.

The Standard Tin Plate Co, Canonsburg, Pa., has resumed operations at 8 hot mills, suspended on account of necessary repair work a few months ago, making a complete battery of 24 mills in service on full turn. The plant is giving employment to about 2,500 men.

The Delaware River Steel Co. has arranged for the blowing in of its blast furnace at Chester, Pa, on foundry iron. A normal working force will be employed.

The Hall blast furnace, Sharon, Pa., will be dismantled. The unit has been inactive for a number of years past. A portion of the equipment will be utilized at a plant at Youngstown, O.

A total of 24 blast furnaces are now in operation in Alabama, the largest number in service at one time for the past 2 years. Production is being concentrated on pig iron, with full time working forces. Ten of the furnaces are owned by the Tennessee Coal, Iron & Railroad Co., 5 by the Sloss-Sheffield Coal & Iron Co.; 4 by the Woodward Iron Co.; 2 by the Republic Iron & Steel Co., and one furnace each by the Gulf States Steel Corp., the Alabama Co., and the Central Iron & Coal Co.

The McCullough Iron Works, Wilmington, Del, has been sold and the plant will be dismantled.

The United States Steel Corp., is maintaining 100 per cent capacity operations at its mills in the Youngstown, O., district.

MISCELLANEOUS—The National Sulphur Co, North Akron, O., has arranged for immediate operations at its new local plant, recently completed.

The Pyrites Co, Ltd, Roanoke, Va., has repairs in progress at its local plant and plans to resume production at an early date. The plant has been closed for about 18 months past.

The United States Graphite Co., Saginaw, Mich., is arranging for the immediate resumption of operations at its La Colorado properties at Torres, Mex.

The Morse Blacking Co., Peabody, Mass., manufacturer of shoe polishes and kindred products, is running on a capacity basis, with sufficient orders on hand to maintain this schedule for some time to come.

Four out of 8 oil refineries in the Ardmore, Okla., district are on the producing list, these being the Cameron Refining Co., operating at 2,000 bbl. per day, with capacity rating of 3,000 bbl.; the Pure Oil Refining Co., on a 2,700 bbl., daily output, and capacity rating of 7,000 bbl.; the Imperial Refining Co., on a basis of 4,000 bbl., with maximum plant capacity of 5,000 bbl.; and the Nyanza Refining Co., 1,500 bbl., daily production, with rated capacity of 3,500 bbl.

Employees at the refining plant of the Standard Oil Co., Bayonne, N. J., have submitted a petition to the company asking a general wage increase.

The Fort William Pulp & Paper Co., Ottawa, Can., is arranging to increase production at its mills to an average of 150 tons of newsprint per day.

The Anaconda Copper Co., 25 Broadway, New York, is planning to inaugurate operations at the first unit of its new zinc oxide plant at East Akron, O., now nearing completion, early in February.

The American Cotton Oil Co. has closed 6 mills in Georgia and 2 mills in South Carolina for an indefinite period. It is said that some of the plants will be abandoned. Divisional headquarters have been moved from Atlanta, Ga., to Memphis, Tenn.

Capital Increases, etc.

THE CENTRAL MICHIGAN PAPER CO., Grand Rapids, Mich., has filed notice of increase in capital from $25,000 to $300,000 for proposed general expansion.

THE NASSAU SMELTING & REFINING WORKS, INC., 603 West 29th St., New York, N. Y., has arranged for an increase in capital from $1,000,000 to $1,500,000.

THE LOUISVILLE PAPER CO., Louisville, Ky., has filed notice of increase in capital to $750,000 for proposed expansion.

THE GILL CLAY POT CO., Muncie, Ind., has filed notice of increase in capital from $100,000 to $200,000 for expansion.

THE TEXAS PORTLAND CEMENT CO., Dallas, Tex., has arranged for an increase in capital from $1,000,000 to $2,000,000 for proposed expansion.

THE THOMAS MADDOCK'S SONS CO., Trenton, N. J., manufacturer of sanitary ware, has filed notice of increase in capital from $600,000 to $1,135,000.

THE SWIGART PAPER CO., 653 South Wells St., Chicago, Ill., has arranged for an increase in capital from $750,000 to $950,000.

THE CHARLES H. PHILLIPS CHEMICAL CO., Stamford, Conn., has arranged for an increase in capital from $50,000 to $150,000 for expansion.

New Publications

BOOKS

IRON ORE (Summary of Information as to the Present and Prospective Iron-Ore Supplies of the World), Part 7, Foreign America. H. M. Stationery Office, London. 136 pp., 3 maps. Price, 4s. 1½d.

A comprehensive economic survey is made of the iron ore resources of the United States, Cuba and the West Indies, Mexico and Central and South America. Particular attention is given to the geological aspects of this question, to the economic position of the various competing districts and to the statistics of production and trade.

A FIRST BOOK OF CHEMISTRY. By A. *Coulthard*. Technical Research Chemist with the British Dyestuffs Corporation Ltd. Published by Pitman & Sons, London. 136 pages, 3 maps. Price, 4s. 4½d.

This is a rather unusual little book designed as a text for students in a junior technical school where a year's work devoting 3 to 4 hours a week to chemistry is undertaken. The author, probably because of his long teaching experience, has admirably succeeded in projecting himself to the beginner's viewpoint, with the result that he has produced a textbook of unusual value.

TESTING METHODS OF METALLURGICAL ANALYSIS (NON FERROUS). By *Seymour Pile* and *Reginald Johnston*, with a prefatory note by *C. T. Haycock*. Published by H. F. & G. Witherby, London. Price, 7s. 6d. net.

The authors have attempted to sort out from the extensive literature on non-ferrous chemical analysis those methods which appeared most practical for ordinary usage. These were thoroughly tested and attention was given to the various manipulative details so often necessary for the success of the particular method. The book is "intended to be to the analyst what a set of working drawings are to the mechanic."

COMMERCIAL TRAVELER'S GUIDE TO LATIN AMERICA, U. S. Department of Commerce, Miscellaneous Series No. 89, Superintendent of Documents, Government Printing Office, Washington, D. C. Price, $1.25.

Everything that the commercial traveler should know about the twenty republics and many colonies to the south of us, in order to make a profitable and enjoyable business trip, is encompassed in 734 pages. It is compiled by Ernest B. Filsinger, assisted by corps of experts of the Department of Commerce. Steamship lines and railroads, time tables and connections, road routes, hotels and rates, taxes on travelers and restrictions, duties on samples and advertising matter, nothing essential is omitted. "The traveler is told about the banks, postal service and postal rates, weights and measures, and all things that may obviate those vexatious delays which are especially troublesome to the uninformed and inexperienced traveler in Latin America. Every city and market of importance in the Latin Americas is listed with informtaion as to its characteristics, trade regulations, license fees, routes by which to reach it, etc., and the traveler is given abundant sound advice to be followed in canvassing each section.

Industrial Notes

THE PITTSBURGH-DES MOINES STEEL CO., Pittsburgh, Pa., announces that from Jan. 1, 1923, Joseph S. Harrison is made advertising manager of the company. J. A. Bickelhaupt, the former advertising manager, moves temporarily to Richmond, Va., and opens a sales and construction office for the company. The Richmond office will handle the entire southeast territory from Baltimore on the north and Birmingham on the west.

THE INDUSTRIAL BUREAU OF THE CHAMBER OF COMMERCE, 32 Court St., Brooklyn, N. Y., has issued a map showing graphically the vast industries of Brooklyn. Eleven of the main industries are shown by bar made on a percentage basis.

THE PRECISION INSTRUMENT CO., of Newark, N. J., and Detroit, Mich., announces that Alfred B. Carhart has resigned his position as vice-president and sales manager of the Crosby Steam Gage & Valve Co. to become president and general manager of the Precision Instrument Co., Inc., which has acquired control of the Precision Instrument Co. The present executive officers will retain their connection with the company. It is expected to enlarge the business considerably, with new capital, adding specialties, also staple lines of gages, valves and fittings. Mr. Carhart assumes his duties at once and will be located at the New York office at 114 Liberty St. The factory will later be moved to New York.

THE INGERSOLL-RAND CO. and the A. S. CAMERON STEAM PUMP WORKS announce the opening of a branch office at 718 Ellicott Square Bldg., Buffalo, N. Y.

HOWARD E. EDDY, formerly identified with Manning, Maxwell & Moore, Inc., of New York, has become vice-president and general manager of the Nelson Valve Co., Philadelphia, Pa. C. W. Brown, of Philadelphia is secretary and treasurer. C. D. Miller, formerly identified with the Bridgeport Works of Manning, Maxwell & Moore, Inc., is works manager, and C. W. Burrage of the same company mechanical engineer.

THE FRASSE STEEL WORKS, INC., Hartford, Conn., has been appointed the exclusive New England distributor for the Sizer Steel Corp., with plants at Buffalo and Solvay (Syracuse). The company manufactures electric carbon, alloy and tool steels, bars, billets and forging and die blocks.

THE PETROLEM IRON WORKS CO., Sharon, Pa., announces that its Denver office in the First National Bank Bldg., has been discontinued. T. J. Mullin, formerly the Denver representative, is now located in the St. Louis office in the Central National Bank Bldg. A new office to serve the Western territory has been opened in Casper, Wyo., at 407 Oil Exchange Bldg., in charge of H. S. Dilcher.

THE CARPENTER STEEL CO., of Reading, Pa., announces that statements in newspapers and elsewhere reporting the merger of the company with some other steel concern or its sale to other interests, are entirely erroneous.

H. H. REPLOGLE has resigned as manager of the intermediates and certified food color divisions of the National Aniline & Chemical Co. to assume the sales management of the Wamesit Chemical Co., Lowell, Mass., domestic manufacturer of lactic acid, lactates, lactart and lactic acid compounds.

THE NATIONAL TUBE CO., of Pittsburgh, Pa., has announced the establishment of an industrial fellowship in the Mellon Institute of Industrial Research of the University of Pittsburgh, Pa. This fellowship is engaged in a systematic study of practical methods for the prevention of corrosion in hot-water supply systems. It is also giving attention to the classification of waters of various chemical composition, with respect to their relative corrosive action upon iron and steel, particularly in the form of pipe lines, boiler-economizers, tubes, etc. The present incumbent of the fellowship is Clifford R. Texter, who for the past several years has been carrying out research on the corrosion of iron and steel where not exposed directly to the atmosphere. Mr. Texter will be glad to correspond with engineers and manufacturers interested in the field to which his fellowship relates.

THE WILSON WELDER & METALS CO., New York, is now represented exclusively in Maryland, Virginia and the District of Columbia by the Alexander Milburn Co., of Baltimore. A large stock of color-tipt welding metals and plastic-arc welding machines is available at this point for distribution throughout the territory and a complete demonstration plant in operation.

George Macnoe, manager of the Boston office of W. B. CONNOR, INC., has been recalled to New York to take charge of the contractors' sales department, handling heating and pumping equipment.

THE RUBBER ASSOCIATION OF AMERICA, INC., announces the removal of its office to 250 West 57th St., New York City.

William T. Hand has severed his connection with the TECHNICAL PRODUCTS CO., INC., and has organized the William T. Hand Equipment Co. at 2709 Grand Central Terminal, N. Y., which will specialize in new and used chemical process equipment.

THE LINDE AIR PRODUCTS CO. has obtained a site in St. Louis and North Anthony Sts., New Orleans, for a large branch factory for the production of hydrogen and oxygen and their products. The first unit of the plant is but a small part of the ultimate plant representing an investment of $130,000.

The Ashburn plant of E. I. DU PONT DE NEMOURS & CO. has lately been put in operation after having been closed for a year. M. C. Knabe has been appointed manager and P. C. Kaiser is assistant manager. The technical staff is composed of the following men: F. E. Jacquot, superintendent of powder lines, P. S. Cushing is superintendent of acid manufacture and G. A. Beane is superintendent of power.

THE PRECISION INSTRUMENT CO., Newark, N. J., and Detroit, Mich., is offering to the trade a new CO_2 recorder. This recorder will embody all the good features of the present Precision CO_2 recorder, but is an innovation in that it will remove CO_2 recorders from the present laboratory types to the boiler room equipment. The salient features are: Motor drive of the G.E. type, constant speed, direct drive, no belts; positive in action, elimination of water or steam troubles, no glass parts; simplicity of design and operation; accurate in results and powerful enough to overcome any boiler suction.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodose Hotel New York 1923, at the Commodore Hotel, New York.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its annual meeting in New York City during the week of Feb. 19, 1923.

AMERICAN SOCIETY FOR STEEL TREATING will hold its winter sectional meeting in the City Club, Chicago, Feb. 8 and 9, 1923.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL FOREIGN TRADE COUNCIL will hold its annual conference April 25, 26 and 27, 1923, in New Orleans, La.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

A PAPER INDUSTRIES EXPOSITION will be held in Grand Central Palace, New York City, during the week of April 9, 1923, by the International Exposition Co.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society joint meeting. March 9 American Chemical Society, Nichols Medal. March 23 Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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The Future of the Federated Societies

NEWLYWEDS are usually admonished that the second year of married life is the hardest—or perhaps it is the third—and that the first year of nuptial bliss will be no criterion of the permanence of their relations. It is after the glow of the honeymoon has faded and the bright light of a workaday sun has revealed the stern realities of the job that the danger of wreck or disaster impends. Somehow it is not easy to foresee, to project themselves into the future. Imagination is inadequate and realization comes with somewhat of a shock. In the crisis they either quit the game, disillusioned, or readjust and adapt themselves to life as they find it.

But it is not in domestic relations alone that the experience holds true. It is a factor in all human relations, whether for social, business or professional purposes. The first year is one of hope and expectation, ambition and determination; the second and third years bring the test of stability and permanence. And so it is that Federated American Engineering Societies having been launched in a spirit of public service and having given a fair account of itself for a couple of years, finds itself facing the critical period of its existence.

In our judgment the crisis is largely psychological and arises either from a failure to appreciate the aims and purposes of the Federated or a tendency to expect and demand too much of it. In the first place the Federated was organized "to further the public welfare wherever technical knowledge and engineering experience are involved," to make the voice of engineers as a group articulate in public affairs. Hence there is no personal gain to be derived from membership in the Federated. It is not a question of what a member may get out of it, but what he is willing to put into it. It exists as a medium through which engineers may be of service to the public, not themselves. It is a case of giving, not receiving; and the measure of success of the organization is what it has done for the public welfare.

In the second place much of the work of the Federated is not spectacular nor does it appear with the regularity of daily, weekly or monthly routine. Hence, although the organization must justify its existence by its works, it can act only or mainly when there is a call for its services. It will not constantly have opportunities to look into industrial waste or study Muscle Shoals or make an investigation of the 12-hour shift. But it is there for just such purposes when the problems arise and can be financed—and that existence is an accomplishment in itself.

As we see the Federated, it is something to be perpetuated if engineers are to have a medium of expression on public matters when occasion arises. It can help fulfill its destiny if it will adopt machinery to make the voice of the engineer articulate in public affairs by conducting referendums much after the manner of the Chamber of Commerce of the United States. Further, it must face its problems with courage and avoid the soft pedal in its work. And it must conduct its overhead and administrative affairs in the utmost economy, putting financial emphasis on productive work. Its membership, on the other hand, must continue unstinted support and not be too exacting in demands for productive activity. By all means let us continue the Federated and support it through this trying third year. Once the crisis is past and the organization has found itself it will justify its existence, not only among engineers but in the mind of the public for which it was organized. In the meantime let's get some action on that Muscle Shoals investigation, and look about to see what local industrial surveys can be made in medium-sized cities. If the engineers will investigate and supply the data, industrial and commercial leaders can be depended upon to translate them into action.

The Dangers of One Big Company

AT A DINNER of Group 8 of the New York State Bankers Association on Jan. 15 CHARLES M. SCHWAB said that in the 43 years he had been engaged in American industries, steel production had increased from 800,000 to 50,000,000 tons a year. "The greatest economy that can come to this country," he is reported as adding, "is manufacturing in as large quantities as possible and cutting the overhead. To have every steel works in one big company would be good economically."

Mr. SCHWAB is a man of rare illumination and supreme ability. Usually we agree with him. But suppose such a super-organization were legally possible and practically feasible, who is there besides Mr. SCHWAB himself or Judge GARY with the ability to direct its affairs? The wrong man at the head means failure in part or in whole. But let's imagine the One Great Company established and the right man at the head. Although Mr. SCHWAB is a hearty, very human speaker, he measures his words. He said it would be a good thing economically, and we agree that the costs of steel would probably come down in some measure. But we doubt if it would be a good thing in any other respect, or even economically in the long run.

How much the steel would sell for to consumers would depend in part on how much water the promoting bankers would pump into the new securities. If this were to absorb the economies, the whole thing wouldn't be worth while, except to the promoters. When Mr. SCHWAB took hold of the Bethlehem Steel Corporation he fought like a Trojan to have the preferred stock made non-cumulative as to dividends. He won his point after a hard struggle—and his foresight saved

him. It took long and weary years to develop the company.

Then, although the elimination of competition does away with a great measure of overhead expenses, as the speaker said, it permits low standards of material to be established. There is a nation-wide demand for better steel, better cement better materials for specific purposes. How could the One Great Company meet this demand with its ideals set on tonnage? The chance for improvement would be unfavorable. The One Great Company could do it—but would it? We think not.

We have no illusions of the blessings of competition. It has as many bad effects as it has good ones. But we believe it is the moderate-sized manufacturing concerns, that must strive for quality or quit, which have contributed most to improvements in the merchandise produced. As often as not it is their better quality of product which makes them grow great. Standard products are excellent in their way, but when we want something better we need to be able to get it.

No very big corporation can be administered without system and order. The bigger it is the more system must be established. But system is like competition: it has its merits and also its faults. Among the latter is its potency to destroy initiative Under too much of it a great deal of the best talent withers and ceases to function. We get standard qualities and such betterments as are planned for, but all the illumination that would have come from the minds that wither as soon as they must proceed in goose-step is lost.

We hope the One Big Company may never be established

In What Direction Goes Your Research?

SPEAKING in his own characteristic way, our good friend Dr. WHITAKER recently said: "At the end of 1918 we were like many other research organizations going strong, but not in the right direction." He was referring, of course, to the disinclination for peace-time pursuits that had resulted from the craze for war production. It occurs to us, however, that quite often our research is inclined in the wrong direction. Permit us to give an example or two that may serve to make our meaning clearer.

The other day a friend, for whose technical ability we have the greatest respect, came to us and in one of his happy moments confided news of his recent successful research. Without divulging his secret, we can, for our present purposes, assume that he has discovered a new substitute for honey. His product looks like honey and tastes like it Unfortunately it has no nutritive value, but it is harmless and, most important of all, not a single one of the usual chemical tests can distinguish it from honey. Furthermore, the product is cheap; it is made from corncobs. With it every apiculturist can turn out ten or a hundred jars of honey where only one, or maybe none, came before. Our friend's fortune is made, his invention is a success, but after all, what has he accomplished? He has merely invested his scientific talents in the forbidden field of adulteration; he has contributed nothing to the lasting good of his fellow men.

For our second example we must be permitted to draw a slightly different shade of meaning between the terms adulteration and sophistication. Research of rather questionable merit has carried us far in the latter direction. Not unnaturally many of our manufacturers have wanted to please the every whim and fancy of a whimsical public and to do this they have called for the help of the chemist. The soap maker, for example, wants to produce a white laundry soap because the housewife insists on such a product. In order to get it for her at a price she is willing to pay, the chemist is forced to add chalk or talc or some other inert filler in no small quantity. The addition of these materials helps to make a nice white product, but certainly it does not enhance the detergent properties of the soap. During the war some of us learned for the first time that large amounts of sugar were being used in making cheap transparent toilet soap, which has no advantage other than its appearance. However, the whim or fad of the customer is satisfied and that means business.

But it is not alone in the soap industry that the chemist is guilty of such connivance. The motorist, for example, demands a fuel that is without a disagreeable odor, that is bright and sparkling and will stay that way. Thanks to the chemist's wits such a product is available, but only after a refining process that adds to its cost and in some cases doubtless sacrifices its quality. Much the same condition exists in the field of lubrication.

Other examples might be adduced from practically all of our great industries, but these, we believe, are sufficient to point out a deplorable trend in some of our industrial research. The chemist himself may not be able immediately to correct this situation, but at the same time he should not lose sight of the fact that the greatest reward will come, not to the imitator or the mimic, but to the originator who leaves the beaten path and dares to search in new and untrodden fields.

Better Not Fool Ourselves

ABOUT a dozen years ago there was published a book called "All the Children of All the People," by WILLIAM H. SMITH, who was superintendent of schools in a Middle Western city. It is still in print, and well worth reading. Mr. SMITH's contention is that we make a mistake in trying to mold all young people into one form by means of standardized curricula. As to that we have nothing to say in these columns, but his illustrations are very illuminating to those of us who have to administer affairs, or who aspire to do so.

Every one of us, claims Mr. SMITH, is short in some respects and long in others. We are born short and born long; both. There was an Irish-American hired man, brought up near the old Five Points in New York City, who could make any plant grow; but he couldn't learn to read or write. A boy, one of the author's pupils, could not learn the multiplication table and remember it. He grew to manhood, become an inventor and large manufacturer, achieved remarkable affluence —but never knew the multiplication table. In telling this to a leader of the New York Bar lately he remarked, "That's my trouble. I know some of the items, but not all; then I have to add or subtract to get my figures." The writer's brother, a man of rare intelligence and sound judgment, never could learn the sequence of the alphabet. He could rattle it off up to l, m—but there he always became confused. A very able teacher could not tell the time by the clock, and neither could an eminent judge. He carried a watch, but only for show. Another man who wrote and pub-

lished excellent verse that is recorded in the anthologies, and was an able United States Consul in a leading European city, could not do long division. An idiot girl, inmate of an asylum, who could not read nor even count, could make any kind of lace with a crochet needle, if she only saw the pattern. The list could be continued indefinitely. The point is that we are born both long and short and often remain so. If we are born short, we may master the subject well enough to pass, to get along; but we are bound to make a poor showing in competition if we specialize on our short suits.

Many of us are short in administration; born short and remain short. Indeed the vast majority of us suffer from this very lack. We see it proved in the many failures that occur as a direct result of faulty administration. And yet only a very few of us seem to know this. Administrative posts are well paid, and of course we want the pay. But we are so short in administrative intelligence that we are blind to our own defects; and we court failure and distress that we should gladly avoid—if we only knew enough.

It is not distinguished or agreeable or even honorable to boss a job unless one can do it well. Otherwise it causes misery all around and brings the onus of failure upon the man who undertakes it. It is not even profitable except for the little while it takes to prove the man to be no good. Surely it's better to do a thing well than to command others to do it. Why this false ambition to command? It is far better to look inward, to discover our real talents, and then to develop them and to rejoice in doing well that which we can do well. If we try seriously and try hard we can find out better than all the psychologists and mental testers together. But we shouldn't fool ourselves. We must be honest about it.

Indefinite Repetition Would Be Intolerable

THREE statements in the preliminary report of the Coal Commission express the essence of the public's interest in the industry:

"With resources of coal in the ground adequate for the needs of perhaps a hundred generations of Americans, the nation's coal bin is too often depleted and too often the prices paid for coal are much higher than seem warranted by the wealth of coal available."

"These experiences of unsatisfied demand and unsatisfactory prices have created in the popular mind a conviction that the natural benefits to be expected from a condition of plenty have been denied through artificial interference."

"The widespread public dissatisfaction with the service rendered by the coal industry is not confined to matters of shortage and price, for a train of unfortunate consequences has followed those recurring periods of scarcity: deterioration in the quality of fuel delivered; congestion of railway traffic, necessitating the neglect of other freight to give preference to coal, to the serious harm of other business; and breakdown of mutual confidence of producers and consumers of coal as expressed in the customary contractual relations."

And well does the commission add, "Every industry and every citizen throughout the country is directly or indirectly dependent upon coal." Of the dependence of the chemical and metallurgical industries there can be no question, for over a third of the entire bituminous coal consumption is by industries involving technical processes or chemical control. The commission then continues:

"It is clear that an indefinite repetition of these crises in the production and distribution of coal would be intolerable." This is a statement in which every branch of industry and every clear-thinking individual will concur.

It is not strange that the commission in less than three months has not been able to reach formal conclusions on the important problems presented to it. But it has made definite progress in establishing satisfactory fundamentals that require thorough investigation and some decision as to national policy. The main points of the preliminary report are very illuminating.

One of the causes of high prices of coal in some instances has been profiteering; the instability of the industry has been largely due to labor troubles; and car shortage at times of coal scarcity and high price is undoubtedly an important transportation deficiency. The commission discusses these three factors briefly, but passes on to the problem of over-development as apparently of equal or greater importance; and whether one considers that this over-development is itself a cause of the other troubles or a result of them is immaterial.

The effect of over-development is clearly shown by the commission to be an added cost to coal consumers for the maintenance of 200,000 miners and their families above the needs of the country for miners and the burden of capital charges on something like a billion dollars. It is high time that the national policy with respect to such matters as these be determined.

Very few will disagree with the query in the final paragraph of the report. All will simply hope that the right answer may be reached at an early date:

"The commission believes that the public interest in coal raises fundamental questions of the relation of this industry to the nation and of the degree to which private right must yield to public welfare. It may be that both private property in an exhaustible resource and labor in a public service industry must submit to certain modifications of their private rights, receiving in return certain guarantees and privileges not accorded to purely private business or persons in private employ."

Co-operation in Statistical Work

THE government is issuing at this time many requests to industries for a statistical report on their operations in 1922, looking forward to the annual reports on these industries. In some cases these questionnaires become so numerous and are so lengthy that one is tempted to throw them all in the waste basket in disgust. But in the long run that is poor policy.

The government through its careful, regular study of industrial operations of all sorts furnishes impartial, reliable statistics of great value. There is no industry which would not profit by knowing more of itself. The next time these questionnaires come, it will be well to stop and remember that it is the industry which is served, not any bureaucratic office or academic official.

Prompt, accurate and complete returns on the part of every operator will speed up the results greatly; and in work such as this, promptness in issuance of the data will add greatly to their value. It will be well to co-operate in work of this sort so that there need be no break in the continuity or question as to the reliability of the figures that are prepared.

Readers' Views and Comments

Why Not Get Away From Traditions?

To the Editor of Chemical & Metallurgical Engineering

SIR:—In the Dec. 27 issue of *Chem. & Met.* Mr. Nasmith takes the phrase "Why not get away from traditions?" literally. The expression (not mine, by the way) did not suggest getting away from *all* tradition, but only from that which has a hampering influence.

It is evident that Mr. Nasmith is experienced in the baking art but in his defense of tradition overlooked an opportunity to explain why oven walls are built as thick as 25 in. He believes in the importance of "solid heat" and "flash heat," yet does not offer a definition of the terms. It is probably true that many points of disagreement would be cleared up or eliminated if disputants should at the outset agree upon definitions of terms.

In the case under discussion "flash heat" probably means the subjection of the goods to the action of the comparatively high temperature of radiant heat while passing over the fuel bed; this to get the "rise." "Solid heat" is probably what is termed in other industries "soaking heat," and is furnished by the hot gases; this is the baking heat.

An oven wall of 25 in. thickness is probably one extreme. The oven described as made of a steel shell covered with insulation is the other. Somewhere between these extremes is the correct design. As the brick walls exert a regulating or "flywheel" effect on temperature, only such mass of brickwork should be used as is consistent with this regulation and with the structural requirements. A wall thickness of 21 in. and 25 in. is, I think, quite as ridiculous as a steel shell insulated on the outside. The former has the advantage, however, in that the fault is one involving economics of construction and will not manifest itself to the operator.

A consideration of the specific heats, or heat capacities, of brickwork and the insulated-steel oven should suggest a brick lining in the latter of about two courses, or 9 in. More than this would be superfluous because of the low temperature involved (less than 600 deg. F.), and because the brickwork is heated on one side only and consequently cannot exert a maximum "regenerative" effect. One can be assured that the temperature found a few inches from the heated surface of oven brickwork can have no useful effect on baking; and even if the temperature were high enough the time required to make this heat available would be too great to assist in reducing rapid fluctuations of temperature within the oven.

The experience of the proprietor of the bakery who was forced to replace a new and efficient type of oven by an older and less efficient one, simply because the operators could not or would not operate it efficiently, illustrates a point raised in my first letter—that is, mental inertia. Some operators are of a bovine mentality and any departure from old practice is frequently resented. Often the resentment is followed by deliberate, but secret, efforts to "queer" the new apparatus. If this condition is to be met by surrender as in the case quoted, then progress may as well take off its hat and sit down.

I can appreciate the feelings of the operating staff of the chemical plant that was left with a monstrosity on the departure of the designing engineer. What seems curious is how he managed to do it. Where was the staff during construction? Was it the vogue to turn the design over to inexperienced men, and then fail to keep informed on what was being done? This looks more like clever salesmanship than honest-to-goodness engineering.

Because "the one in the arts who really knows cannot and does not express himself in writing," it does not follow that "the one who writes seldom does so from experience." Mr. Nasmith knows better than that.

Kansas City, Mo C. O. SANDSTROM.

Galvanic Corrosion on Yacht Sea Call

To the Editor of Chemical & Metallurgical Engineering

SIR:—It may interest your correspondents A. Hough, Robert J. McKay and Henry Howard and your readers generally that a very similar case to that of the Sea Call occurred in Ceylon about 16 years ago. A passenger steamer was built by a well-known Colombo engineering firm to the order of a native shipping company, in conformity with specifications of the latter, which provided for a sheathing of sheet copper outside a steel hull, with the object of insuring a clean bottom in tropical waters. The vessel had been in commission for only a very short time when, on a voyage off the coast of Ceylon, the captain, noting her weird behavior, wisely decided to beach her. He barely succeeded in running her ashore when the corroded steel hull fell apart at the water line. An interesting lawsuit ensued between the shipping company as plaintiff and the contracting shipbuilder. The Supreme Court of Ceylon upheld the latter as not responsible for a defect arising from the customer's own specifications and not specifically provided against in the contract.

The trouble arose through the specifier ignoring the fact that electrochemical action ensues between two dissimilar metals in close proximity when, both touching, they are immersed in an electrolyte such as sea water. The already known protective action of copper plating was harmlessly effective in keeping wooden hulls clear of marine vegetation and barnacles, and no electrolytic action took place so long as only one metal was involved which was passive to sea water. In the case of an iron or steel vessel, however, copper is strictly inapplicable, because of the difference of electrical potential which sea water establishes between the copper and the steel, in virtue of which the steel assumes an electropositive condition and becomes eaten away in consequence, while acting as a generator of electricity which flows to the copper. The copper itself, being electronegative, is not acted on, and naturally suffers no corrosion.

In the case of the Sea Call the Monel metal would behave somewhat similarly to copper in relation to steel, and therefore, while corrosion of the latter would be

bound to take place, the homogeneous Monel metal would remain unaffected.

All such similar arrangements may be considered as the analogue of a simple galvanic cell, in which a zinc and a copper element are immersed in an acid solution or electrolyte. As is well known, the zinc is consumed in the action of such a cell, and so with iron, steel or any other electropositive element, but the copper or electronegative metal suffers no loss.

If any of your correspondents or other readers are interested further in the Ceylon case, I will gladly furnish them with more details.

PATRICK T. MACNAMARA.
Late Superintendent of Ceylon Telegraphs
Brooklyn, N. Y.

Dirt in Steel

To the Editor of Chemical & Metallurgical Engineering

SIR:—Your editorial on "Dirt in Steel" in your issue for Jan. 10 stirred one of my friends to the point where he asked me to step into his chamber of horrors. What I saw would have caused a Ku Klux from Morehouse to bolt over the line into Arkansas. But as he (this friend, not the Ku Klux) is one of those retiring fellows who never break into print, he would not accept my suggestion that he write you himself. So when I left, I took some of his exhibits with me, concealed in my greatcoat.

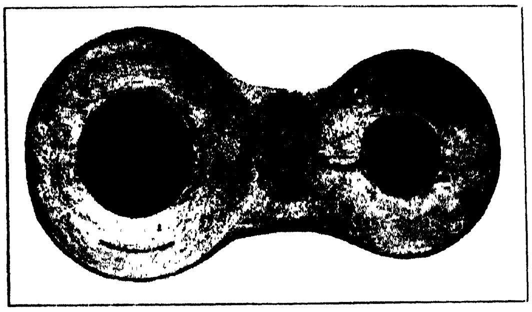


FIG. 1—SPRING SHACKLE, PICKLED SOMEWHAT REDUCED

It appears that some spring shackles were giving a great deal of trouble—wearing out too soon or something like that. When they were sectioned and pickled as in Fig. 1, it showed that what steel there was, was segregated, but there was little steel—it was mostly slag. Note the slag in Fig. 2. No, Mr. Editor, this was not a casting.

I believe that in the Hartford region the first thing they do with troublesome steel is to pickle it 30 minutes in 1:1 HCl, and see the pock marks.

At another place my friend found that the shop had made some keys from a supposedly high-grade tool steel, yet they gave a great amount of trouble, cracking and shearing off. Fig. 3 shows the high-grade tool steel. No, Mr. Editor, it is not raisin bread or "spotted dog" of pleasant memory.

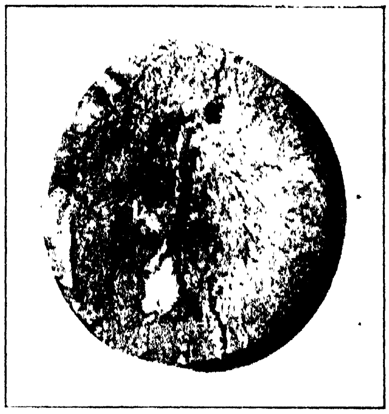


FIG. 4—FRACTURE OF ALLOY SHAFT

One of the most puzzling things was an alloy steel shaft. It was returned from the erecting shop, undoubtedly broken and of most extraordinary cross-section, looking like Fig. 4. Its analysis was O.K., and under the miscroscope it looked all right, too—properly sorbitic and all that. But when someone had a happy thought and repolished the section and looked at the steel again, he saw what is shown in Fig. 5. No, Mr. Editor, it is not an airplane view of the Allied trenches at Mons.

There was much more to the same effect, but this was all I could readily abstract without detection. It will suffice to give an idea of the tons of evidence you could find to support your main contention that many troubles with steel are not due so much to the metal as to the dirt.

MARTIN SEYT.

Fig. 2—Slag in spring shackle.

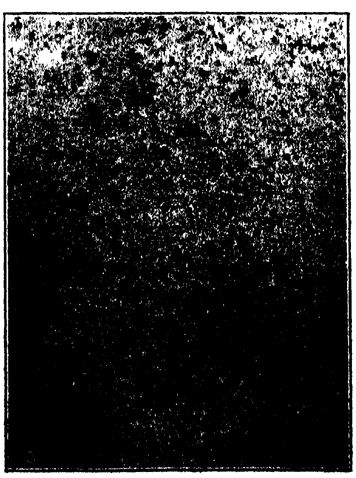


Fig. 3—Inclusions in tool steel.

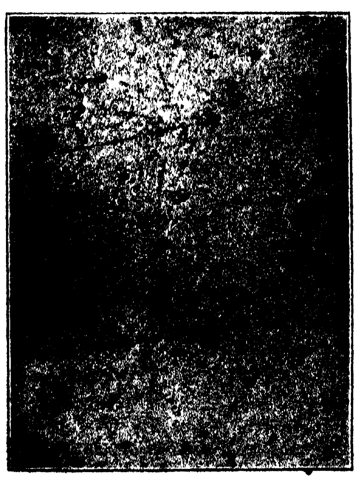


Fig. 5—Ranked dirt in alloy shafting

Manufacture of Spark Plug Porcelain

Porcelain Bodies Developed by Careful Scientific Research Are Formed Into Spark Plug Cores With the Aid of Specially Designed Semi-Automatic Machinery

BY ALAN G. WIKOFF

As USED in the spark plugs of automobile engines, porcelain is required to withstand sudden changes in temperature without cracking or chipping and also to remain a good insulator even at increased temperatures. In airplane engines, the service requirements are even more severe, since the motor is operated continuously with the throttle wide open. The amount of scientific research which is required in the development of porcelains having the necessary properties for successful application in plugs is perhaps not fully realized until attention is called to the fact that one of the companies in this field maintains one of the largest research organizations in the entire ceramic industry. As the company is also a very large producer, a discussion of its methods will give an idea of the high degree of development which has been reached in the spark plug industry.

The Champion Porcelain Co.,* formerly the Jeffery Dewitt Co., was organized in Newark, N. J., in 1908 to manufacture complete spark plugs. In 1910 it moved to Detroit and as the demand for the spark plug porcelains grew it began to devote its entire efforts to the manufacture of porcelain, discontinuing the assembling of the complete plugs.

The Champion Spark Plug Co., of Toledo, became one of the largest users of these porcelains and finally, about 1917, its demand required the entire output of the Jeffery Dewitt Co.

In 1920 there was an amalgation of the two companies, the Champion Porcelain Co. now being a subsidiary of the Champion Spark Plug Co.

Ball clay, china clay, kaolin, flint and feldspar from a variety of sources form the raw materials for the porcelain body. An essential requirement is that each should be extremely low in iron. The first step in the manufacturing process is to combine the raw materials in such proportions that the resultant body will have as low a thermal expansion and will be as good an insulator at high temperatures as is possible with present knowledge. The batch composition necessary to give these properties has been determined only after thousands of experiments. In accordance with recent developments, the finished porcelain has a composition approaching that of sillimanite.

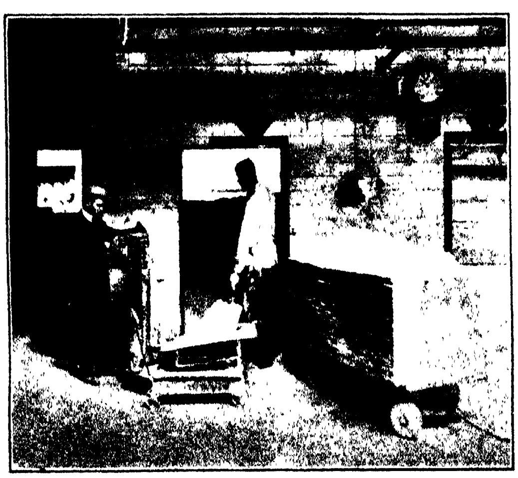


FIG. 1—WEIGHING BATCHES

Batches are weighed out as shown in Fig. 1 in amounts sufficient to form charges for the ball mills. A measured amount of water is added to each charge and the mill is operated for a definite period which is determined by the number of revolutions rather than by the time. In this way uniform grinding results are obtained. There are five 6-ft. Abbé pebble mills driven by individual motors through Link-Belt silent chain (Fig. 2). Porcelain mill-lining blocks and balls made in the plant are being used with excellent results.

The ground batch is dumped into agitators, where a uniform suspension is produced which is filtered through

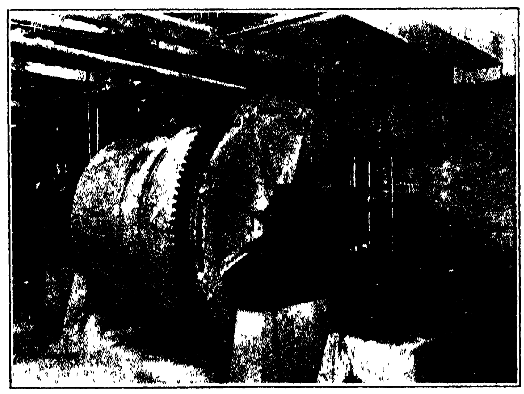


FIG. 2—PEBBLE MILL FOR GRINDING BATCHES

120-mesh lawn and then fed to the four Crossley filter presses, Fig. 3. The press cakes are piled on a skid and transferred by a lift truck to the horizontal pug mill shown in Fig. 4, in which any tendency toward segregation of particles in the press is overcome, the clay being discharged as a cylinder quite homogeneous in character.

Further improvement in the quality of the body is obtained by the process of aging. The clay is worked in piles, Fig. 5, by pounding with wooden mallets, Fig. 6. After the proper time has elapsed it is taken out on skids and pugged once more, this time in vertical American or Crossley machines, Fig. 7.

It is interesting to note that the only manner in which material can enter or leave the production department is by way of an elevator equipped with a Toledo platform scale so that a check can be kept without difficulty.

From the thoroughly pugged clay, cylindrical blanks about 1 in. in diameter with a ¼-in. hole through the center are formed on Crossley vertical pug mills which have been rebuilt specially for this purpose. From these blanks the spark plug cores are made. Many difficult problems were encountered in attempting to redesign these machines so as to overcome segregation, lamination, uneven distribution of air and other defects which would interfere with the high degree of uniformity required.

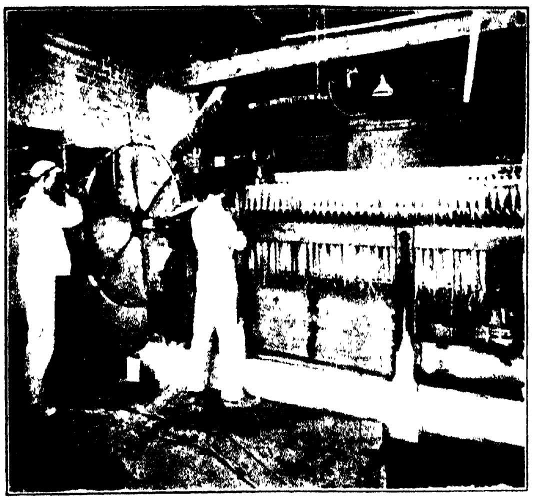


FIG. 3 FILTER PRESSES

As the perforated cylinder comes from the pug pieces of the required length are cut off by means of wires. Each of the twelve machines has a capacity of about 27,000 blanks per day. The blanks are placed on trays holding about 170 and allowed to air-dry for 24 hours in racks accommodating forty trays, before passing to the steam-heated tunnel drier. These operations are illustrated in Fig. 8. The racks are brought to the drier on a monorail hoist and rest on platform cars while passing through, Fig. 9. Temperature and time factors are adjusted so that all drying shrinkage or air shrinkage is removed. Control is maintained through a Tycos wet and dry bulb recording thermometer at the cold end, steam pressure recorder at the coils and a temperature recorder at the hot end of the drier.

Thorough drying brings the blanks to a condition which renders comparatively simple the operation of shaping. Specially designed grinding machines, Fig. 10, are used for this purpose. The blanks are placed on the spindles or on the centers depending upon the exact nature of the piece being made and rotated against a rapidly revolving silicon carbide wheel, the face of which is dressed to such a contour as to impart the required shape to the blank.

After receiving their external form the turned pieces are transferred to another position on the same machine and the petticoat is formed by counterboring with a formed tool which rotates at high speed. During this operation air is blown continuously through the bore in order to remove all dust. Both the turning and counterboring operations, however, are performed simultaneously.

The completed forms are placed on trays provided with suitable supports so that the forms are separated to prevent abrasion and chipping. Trays of dry blanks are sold to the girl operators and bought back on the basis of the number of perfect forms. One form in each tray is stamped with the batch number and the end is dipped in cobalt sulphate solution. On firing the form will develop a blue color, and as the capacity of a tray is the same as that of a sagger, each sagger will contain an easily distinguishable marker bearing the batch number.

Although the grinding operation is complete in considerably less than a minute, the blank has been reduced to about one-third of its original weight. Consequently, it has been necessary to provide for the removal of an amount of dust equal to approximately twice the output of finished product. This is handled by a twelve-unit

FIG. 5 AGING THE CLAY

dust recovery installation. The bulk of the dust accumulates in troughs under each row of machines, from which it is removed by means of a screw conveyor. The remainder collects in bags which are rapped automatically at intervals to remove the deposits.

When the amount of dust produced is considered, the almost complete absence of dust in the atmosphere of the grinding room is remarkable.

Owing to their special nature, it has been necessary

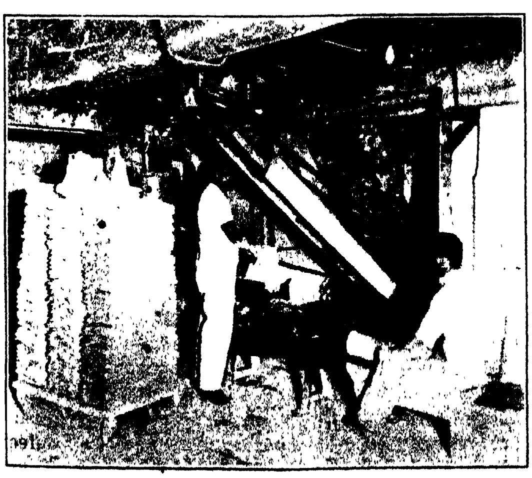


FIG. 4—PUGGING PRESS CAKES.

FIG. 6—WORKING CLAY DURING AGING

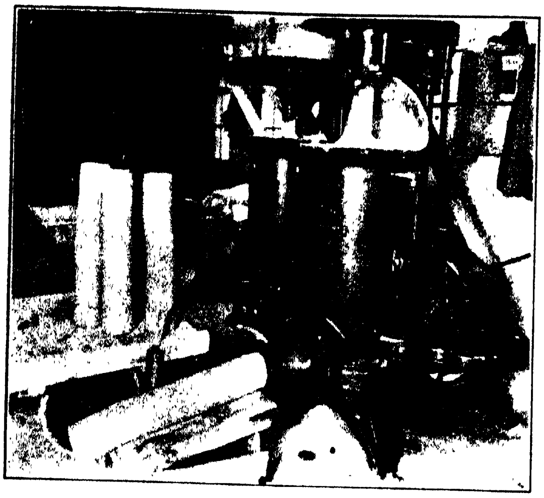


FIG. 7—PUGGING THE AGED CLAY

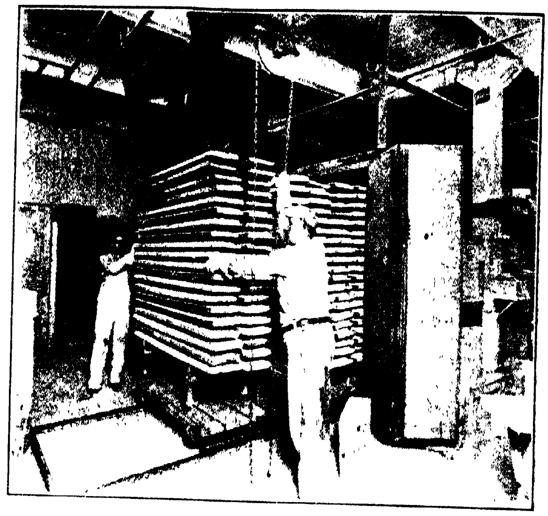


FIG. 9—TUNNEL DRIER

to develop and make the grinding machines within the establishment. An interesting variation is the machine used to make the balls for the mills. A small shop is devoted to the preparation of the grinding wheels, the surface being cut out on a lathe with a diamond-tipped tool guided by hand. Here also the worn wheels are redressed.

Application of a carefully selected glaze completes the operations prior to burning. The raw materials—clay, flint, feldspar, whiting—are ground very fine in porcelain-lined mills and distributed to the spraying machines in the form of a slip, the viscosity of which must be very closely controlled in order to obtain optimum results. The composition is such that the glaze will have as high a hot dielectric capacity as possible. Composition ranges for glazes maturing between cones 17 and 20, as set forth by Robert Twells, Jr.,[1] will give some idea of the formulas used for high-fire glazes.

Recently a method for selecting glazes within a field where all of the glazes appear equally suitable has been described by F. H. Riddle and J. S. Laird.[2] It was found that glazes which fit the body increased the tensile strength over that obtained for the unglazed body, while glazes which craze weaken the specimens very markedly. Appearance of the glaze alone is likely to be very misleading.

[1]J. Am. Ceramic Soc., vol. 5, p. 430, July, 1922.
[2]J. Am. Ceramic Soc., vol. 5, p. 500, August, 1922.

Spraying takes place on the ingenious machines shown in Fig. 11. Mounted on rapidly revolving spindles, the forms are carried past sprays of glaze slip so arranged that all parts receive an even coating with the exception of the shoulders, which would stick together in the saggers if glazed.

The glazed ware is set directly into a sagger—a round refractory container—as shown at the left, Fig. 11. A special composition applied to the inside bottom of the sagger provides a sticky surface which holds the forms upright and separated during the handling which precedes burning. In the kiln, the paste of course burns out, but the ware remains in place unless violently disturbed.

So severe are the burning conditions that the life of an ordinary fireclay sagger averages about one heat. Silicon carbide saggers have sufficiently greater life to more than offset the difference in first cost and are giving excellent service at the present time.

Periodic round downdraft kilns were formerly used exclusively for burning the spark plug porcelain. During 1919 a Dressler tunnel kiln was installed so that the periodic kilns are now in service only occasionally. However, it may be of interest to consider both types briefly in order to contrast the methods of burning.

Each of the six periodic kilns is equipped with eleven thermocouples (ten base metal and one noble element) connected with a Brown electric pyrometer. City gas is

FIG. 8—BLANK-FORMING DEPARTMENT

FIG. 10—CORE-GRINDING DEPARTMENT

used as fuel, the pressure being kept constant to within $\frac{1}{16}$ in. by means of gas boosters and regulators. Heating conditions are watched through twenty-one peep-holes, firing being continued to cone 17 down (1,470 deg. C.; 2,678 deg. F.).

Saggers are stacked in the kiln with a clay wad or seal between the rim of each sagger and the bottom of the one above it in order to exclude the products of combustion and also to enable the placing of each sagger in a level position so that the ware will not stick together. Setting and drawing are laborious operations, as the heavy saggers have to be handled on ladders in the upper parts of the kilns. Fig. 12 gives an idea of the drawing process.

For the Dressler tunnel kiln, which is of the muffle type, the saggers are set on cars as indicated in Fig. 13. The lower part of the cars consists of a cast-iron frame with roller-bearing trucks. Above this is a superstructure of refractory blocks which serve to protect the iron from excessive heat. The saggers are not placed directly on the car floor, but are supported on brick piers so as to permit free circulation, which is essential in this kiln.

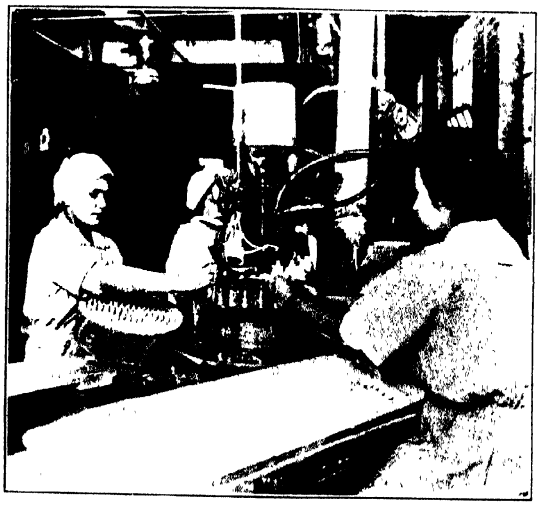


FIG. 11—SPRAYING ON THE GLAZE

The cars shown are at the loading and unloading station on the track which runs parallel to the kiln for its entire length. Before entering the kiln, the loaded cars must pass through the heavy guard at the right, Fig. 14, in order to make certain that there are no projections which might cause trouble within the kiln A transfer truck moves the car in line with the kiln track.

As the kiln is always filled with cars—forty-eight in this case—the introduction of a car of green ware means the simultaneous removal of a finished car at the other end. Pushing mechanism powerful enough to move the train of forty-nine cars is provided in the form of a mechanical pusher. There are automatic control buttons which stop the cars should the pusher fail to stop when the proper point has been reached, thus preventing a car being pushed through the wall at the exit end. It is also impossible to push out a car until the transfer truck is in its proper position.

Operation is ordinarily on a 1-hour basis, that is, one car is entered and one withdrawn every hour, making the time of travel through the kiln 48 hours. A 1½-hour schedule has also been used.

The kiln itself is 305 ft. long with an arched roof or crown and platforms or bench walls on each side of the track corresponding in height with car floors. All arrangements for heating and cooling are supported on these platforms. The heating zone, Fig. 15, which extends from the mouth of the kiln to a point a little beyond the center, has horizontal combustion chambers on either side. For a distance of about 30 ft. in the zone of maximum temperature these chambers are built up of double-walled carborundum blocks assembled in a special trapezoidal form, Fig. 16. As the temperature diminishes toward the mouth of the kiln, the chambers are continued first with fireclay construction and then with iron pipes in the section nearest the entrance.

FIG. 12—DRAWING PERIODIC KILN

Combustion takes place near the center of the kiln and the products of combustion are drawn through the internal chamber toward the mouth of the kiln by an exhaust fan. Heat transfer takes place by conduction through the inner walls with radiation from the outer walls in the high-heat zone and also by convection currents set up in the channels between the double walls. As the combustion gases are not permitted to escape into the kiln, the character of the kiln atmosphere may be controlled as desired.

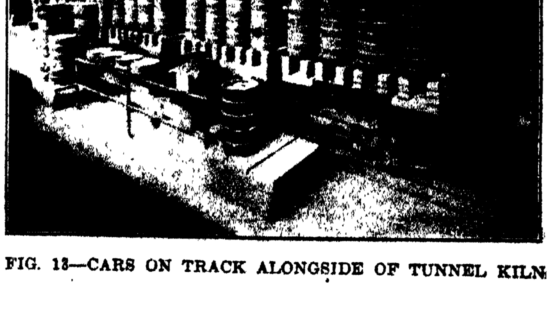


FIG. 13—CARS ON TRACK ALONGSIDE OF TUNNEL KILN

FIG. 14—LOADED CAR ENTERING TUNNEL KILN

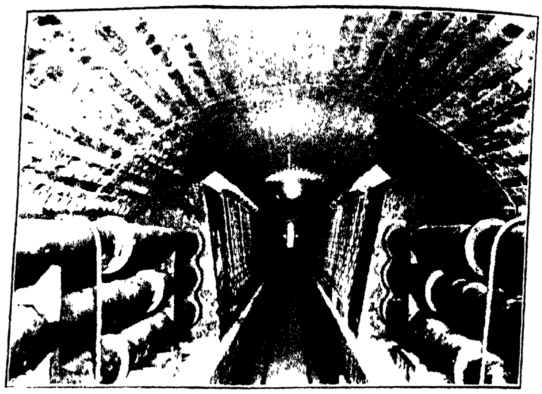


FIG. 15—HEATING END OF KILN

City gas is used as in the case of the periodic kilns. It is interesting to note that, so far as is known, this is the only kiln which is operating at from cones 18 to 20 down (2,714 to 2,786 deg. F.; 1,490 to 1,530 deg. C.) Being the first to operate at such high temperatures, this kiln has been experimental so far as the refractory lining of the high-heat zone is concerned. For the muffles, carborundum seems to be the only refractory which will give satisfaction. The kiln arch throughout the furnace zone is built of silica brick. The top and sides of the kiln are covered with insulating material. Further protection for the iron work on the cars is afforded by a series of water-cooling pipes extending along each side of the tracks through the furnace zone, a distance of about 75 ft. A sand seal is not necessary in this type of kiln.

During their progress through the heating zone, the cars of ware are brought gradually to the required temperature. Heat exchange between combustion flues and cars is such that on a 1½-hour schedule the combustion gases leave the kiln at 480 to 550 deg. F. This is lowered somewhat on a 1-hour schedule.

Leaving the high-heat region, the cars enter the cooling zone, Fig. 17, which constitutes the remainder of the kiln. From the discharge end of the kiln, cool air passes through pipes along the sides, absorbing heat from the convection currents, which are guided by the curtain wall shown at the right, Fig. 17. When this photograph was taken the left-hand curtain wall had not been completed, so that the cooling pipes are visible. Preheated air for the burners is obtained in this way, but there is also a considerable surplus which may be used for drying.

Since the cars move on a fixed schedule and it is thus impossible to give them individual attention as regards time of heating or soaking, uniform control of kiln conditions within rather narrow limits is essential for successful operation. Accordingly, a very complete set of indicating and recording pyrometers, draft gages, combustion meters, etc., has been provided. The operating installation is housed near the kiln, while another set for check and permanent record is located in one of the laboratories.

Because of the fact that temperature conditions in each part of the kiln remain constant, the ware receives more uniform treatment than is possible in a periodic kiln, and the yield of No. 1 ware is increased. Labor requirements are cut practically in half and the more efficient utilization of heat reduces the fuel consumption by about 70 per cent. Working conditions are also improved, since loading and unloading are done in the open on the track along the side of the kiln. With the periodic kiln the men inside must often work at uncomfortably high temperature, while the man in the doorway (Fig. 12) is in a strong draft.

Rigid inspection for dimensions and the possible existence of defects follows burning.

When thoroughly satisfied as to the quality of the product, it receives the familiar trademark. Formerly decalcomania—transfer paper bearing the design in the form of an inorganic pigment mixed with a suitable binder—was used, the design being fixed by firing to cone 015 (1,472 deg. F.; 800 deg. C.) in regular decorating kilns.

Now the design is applied by a rotating rubber stamp to the work, which is carried to it by a turntable carrying twenty spindles on which the work is placed by the operator. Each decorating unit, Fig. 18, consists of one of these printing machines and a tube furnace containing twenty electrically heated tubes through which the cores move much after the manner of cars in a tunnel kiln. As each piece is decorated it is placed in a slot in front of the tube. As each revolution of the turntable is completed a cross-head carrying twenty plungers advances and forces the entire row of plugs into the tubes, causing the ware within the furnace to advance a corresponding amount, thus discharging a row of finished plugs at the lower end. During the

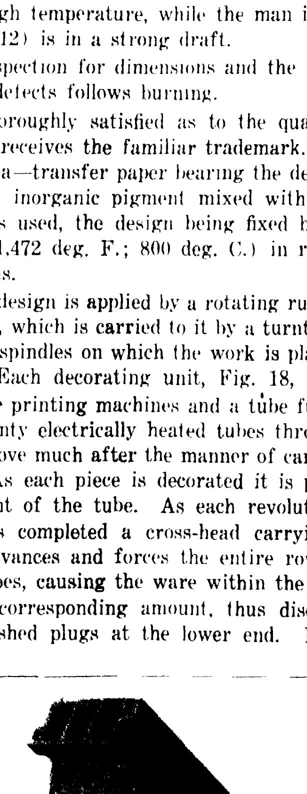


FIG. 16—CONSTRUCTION OF ELEMENTS FORMING COMBUSTION CHAMBER

peration the plugs are heated to about 800 deg. C. and ooled down in a comparatively short time, so that this aethod constitutes an excellent heat test in addition to liminating the handling required in connection with he decorating kilns. Five of these electrical units turn ut the entire production, which is then shipped to the Champion Spark Plug Co., at Toledo, where the metallic parts are assembled with the porcelain to form the finished spark plug.

B. A. Jeffery, vice-president and active head of the production and service departments, is responsible for a great many of the special mechanical features which make the processes different from those used in the average plant and which have done much toward increasing the efficiencies of the various processes.

RESEARCH DEPARTMENTS

Without complete knowledge and intelligent application of fundamental scientific data, the production of modern high-grade ignition and high-tension porcelain would be impossible. No other organization in this field has shown greater appreciation of this fact, for Dr. Jeffery, president of the company, has built up a research staff of six highly trained technical men with nine assistants and has provided them with every facility for conducting precise investigations. The research department, which is under the direction of Frank H. Riddle, is made up of five laboratories—control, chemical, raw material, electrical and process. Ceramic research is also conducted here for the Jeffery-Dewitt Insulator Co., Kenova, W. Va., so that the latter company receives the benefits of this highly-developed organization.

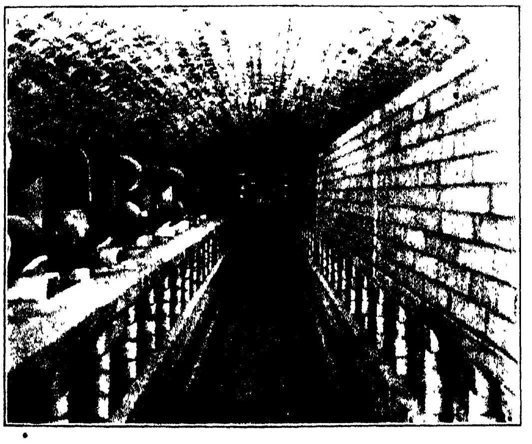


FIG 17 COOLING END OF KILN

In the control laboratory, Fig. 19, the blue markers from each sagger are subjected to test before the rest of the plugs are released for shipment. Here also experimental bodies are tested before the batches go into production.

For the continuous-heat test, the plugs are mounted on the rim of a horizontal disk which in rotating passes them through a stream of cold air and then through the flame of a Meker burner. This apparatus will be seen on the table beside the bookcase at the left. Heating the plugs for 1 minute over a Meker burner and rapping them sharply while hot constitutes the 60-second test.

Against the wall in the background is the equipment for the hot dielectric test. A constant voltage is passed through the plug while it is being heated in an electric muffle furnace and the temperature at which the porcelain ceases to be an insulator is recorded. Leakage is shown on an indicating wattmeter. The present product cuts out quite regularly at 1,700 deg. F. Maintenance of a constant voltage presented a problem which was finally solved by converting alternating current to direct current and back to alternating current again with regulators on each step.

FIG 18 DECORATING UNITS

Impact tests are made by placing the plug in a holder so that one end protrudes and subjecting the exposed part to blows from a steel hammer which slides on a vertical graduated rod, seen on the corner of the table at the extreme right. The weight is dropped from a noted height and if breaking does not result, the operation is repeated from the next higher graduation and so on until the specimen breaks.

On the table in the center of the picture is a 2,000-lb. Olsen cement-testing machine provided with special grips for determining the tensile strength of porcelain.[1] The test specimens have either conical or dumb-bell shoulders, and the central portion of minimum cross-section is left free from glaze to avoid the effect of the glaze in increasing or decreasing the strength of the specimen. The recording instrument room for the Dressler tunnel kiln is also part of this laboratory. Structure of the finished product is studied by means of an excellent petrographic microscope.

[1]See "The Tensile Strength of Porcelain," by F. H. Riddle and J. S. Laird. *J. Am. Ceramic Soc.*, vol. 5, p. 385, July, 1922.

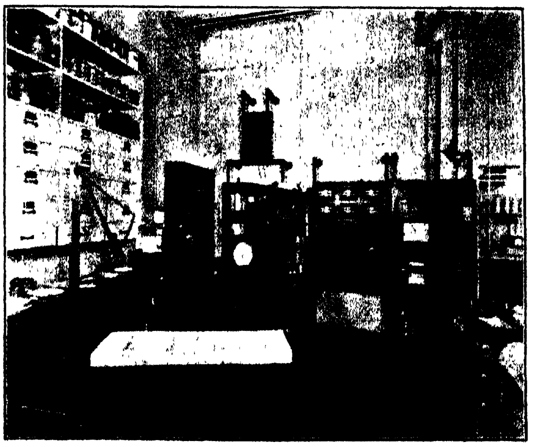


FIG. 19—CONTROL LABORATORY

FIG. 20 RAW MATERIAL LABORATORY

Equipment for complete silicate analysis is provided in the chemical laboratory, which also has a comparometer and a Joly balance for specific gravity determinations.

In what may be called the raw material and production batch following laboratory, screen analyses up to 300 mesh are made on each mill charge, shrinkage is determined on each press cake and a record of firing on raw materials is filed. Fig. 20 shows part of this laboratory, with the mercury volumeter for determining shrinkage, fired clay disks, feldspar cones, and viscosimeter at the right. The firing tests on raw materials are filed in the cabinet at the left.

A continuous production record is kept, in which progress of the batches through the various manufacturing processes is indicated by colored lines, a different color being used for each batch.

One of the primary functions of the electrical laboratory is to make and calibrate thermocouples. The calibration outfit is of the Bureau of Standards potentiometer type. There is also a very sensitive device for determining the thermal expansion of porcelain heated in a Crisco bath. An electrically heated apparatus now in process of development will enable this determination to be made at 1,000 deg. C. Measurements of electrical conductivity and dielectric properties can also be made.

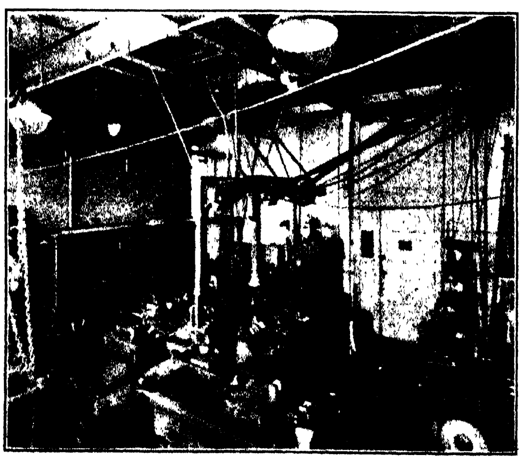


FIG. 21—PART OF MECHANICAL AND ELECTRICAL LABORATORY

Since much of the special apparatus is best made within the department, a small but well-equipped machine shop has been included. This is shown in Fig. 21, with some of the electrical equipment at the left.

As far as possible, the process laboratory (Figs. 22 and 23) contains one unit of each type of machine in the plant so that development work can be carried right through to large-scale units without interfering in any way with the production departments. It is thus possible to know beforehand exactly how a new body will behave when placed in production.

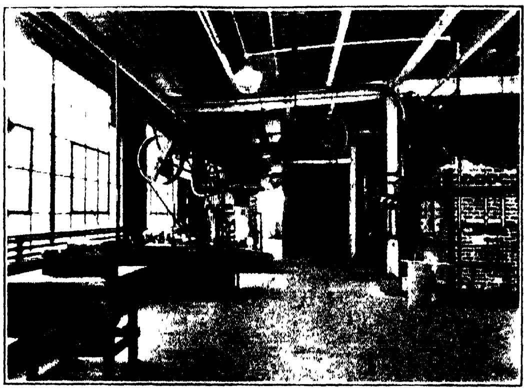


FIG. 22 FURNACE END OF PROCESS LABORATORY

The inclusion of a full-sized pebble mill would be out of the question, of course, but a number of small ball mills have been calibrated accurately in terms of larger plant units.

Along the window side of the laboratory (left, Fig. 22; right, Fig. 23) there is the following equipment: A full-size pug, a half-size pug, a glaze sprayer and a grinding unit of five machines. In the background at the left of Fig. 23 is a drier with complete temperature and humidity control, while the surface combustion furnace which duplicates kiln conditions as nearly as possible is shown at the right, Fig. 22. There is also a small surface combustion furnace with alundum crucible on which it is possible to reach cone 36 (3,362 deg. F.; 1,850 deg. C.).

FIG. 23—GENERAL VIEW OF PROCESS LABORATORY

For determining porosity, the fuchsine penetration test is used. Fuchsine dissolved in methanol (because

this solvent will absorb many times its own volume of air) is forced into the porcelain under high pressure. Upon breaking the specimen, the penetration, if any, is easily observable.

Preliminary lots of blanks where the quantity is too small for the pug are thrown by hand on a wheel.

All pyrometer protection tubes used in the plant are made in this department, a tube press, casting racks and molds being provided for this purpose. The results have been so satisfactory that experiments are being conducted toward the commercial production of these tubes.

It would be difficult to find a plant in which co-operation between research and production departments is more complete, and the results which have been obtained speak for themselves regarding the value of such co-operation.

Data and illustrations for this article were made available through the courtesy and assistance of Dr. J. A. Jeffery, president, B. A. Jeffery, vice-president, and Frank H. Riddle, director of research.

Theoretical Derivation of the Vapor Pressure Curve of Xylol

Novel Method of Calculating the Curve by Studying the Vapor Pressure Curves of Its Homologs

BY DEXTER C. EDWARDS

A SEARCH of the literature of coal-tar products showed a large number of determinations of the vapor pressures of benzol, toluol and naphthalene at various temperatures, but no figures were available for the vapor pressure curve of xylol. Since it was desired to have a close approximation to this curve for some experimental work, an attempt was made to derive it theoretically.

The line of reasoning back of the scheme adopted was as follows: All substances have zero vapor pressure at the temperature of absolute zero. Likewise all substances have a vapor pressure of 760 mm. of mercury at their boiling point. The next step in the reasoning was that, though the relative paths followed between these two points varied, yet for any particular class of substance this path would be the same in its relative proportion.

Vapor pressure curves were then plotted for benzol, toluol and naphthalene from the data available for these substances in Landolt-Börnstein, Beilstein and other sources, all values given being used and the curves drawn through the average of these points. These curves were plotted between Centigrade degrees and millimeters of mercury. Separate large-scale curves were plotted for the lower range of temperatures in order to be able to read accurately the corresponding vapor pressures. From these curves, the vapor pressures for these three substances at definite temperatures were obtained. These data are given in Table I. Then the absolute temperature for each of these temperatures was placed in the adjacent column. The next column contains a row of figures obtained in each case by dividing the corresponding absolute temperature by the absolute temperature of the particular substance at its boiling point.

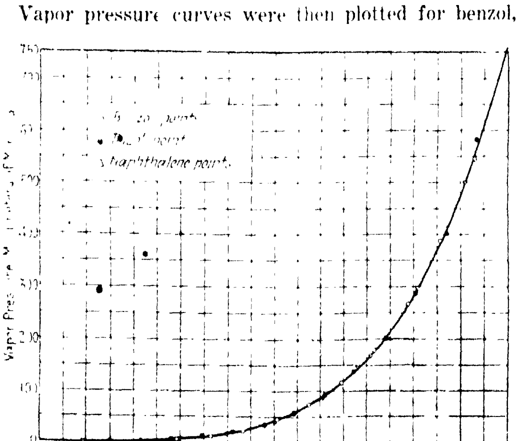


FIG. 1—CURVE FROM WHICH VAPOR PRESSURE OF XYLOL WAS CALCULATED

TABLE I VAPOR PRESSURES FOR BENZOL, TOLUOL AND NAPHTHALENE

Benzol

1	2	3	4
Deg C	Deg C, Absolute	Absolute Deg / Absolute B P	Vapor Pressure mm Mercury
-20	253	0.717	6
-10	263	.746	13
0	273	.774	25.8
+10	283	.802	45.2
20	293	.830	75.0
30	303	.858	118.7
40	313	.887	181.1
50	323	.915	269.0
60	333	.943	388.6
70	343	.972	547.4
80 B P	353	1.000	760.0

Toluol

1	2	3	4
Deg C	Deg C, Absolute	Absolute Deg / Absolute B P	Vapor Pressure mm Mercury
-20	253	0.661	1.7
-10	263	.687	3.5
0	273	.713	7.2
+10	283	.739	13.3
20	293	.765	22.5
30	303	.792	36.0
40	313	.817	59.0
50	323	.843	92.5
60	333	.869	140.0
70	343	.896	203.0
80	353	.922	288.0
90	363	.948	404.0
100	373	.974	582.0
110 B P	383	1.000	760.0

Naphthalene

1	2	3	4
Deg C	Deg C, Absolute	Absolute Deg / Absolute B P	Vapor Pressure mm Mercury
—20	253	.515	.
0	273	.556	.
+20	293	.597	.
+40	313	.638	0.2
60	333	.678	1.9
80	353	.719	7.1
100	373	.760	18.9
120	393	.801	42.2
140	413	.842	88.0
160	433	.883	170.0
180	453	.923	298.0
200	473	.964	500.0
218 B P	491	1.000	760.0

The derived value of the ratio of the absolute degrees Centigrade at any point, divided by the boiling point of that substance in absolute degrees Centigrade, as shown by column 3 in each table, is plotted against the corresponding vapor pressure, on the curves in Fig. 1. These points are seen to fall on the same curve, when drawn on this scale, so the variation in any case would not be very great.

Since this curve shows that these three substances have the same shape vapor pressure curve, then it is logical to assume that the vapor pressure curve of xylol should have this same shape. This being true, it is possible to work backward to the vapor curve of xylol. For this purpose it is necessary to assume a boiling point for xylol. The figure chosen is 140 deg. C., which

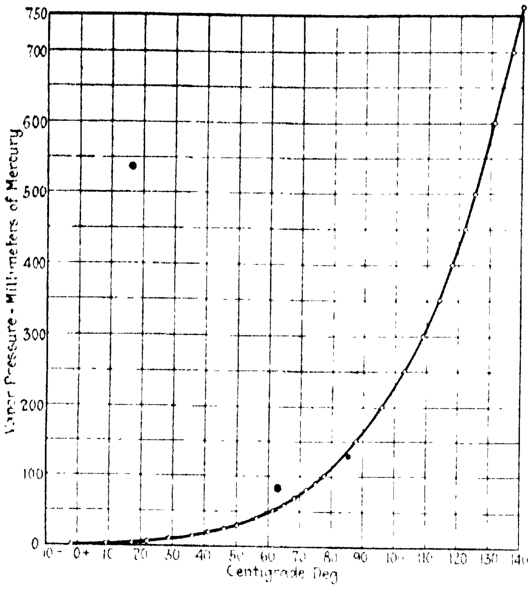


FIG. 2 CALCULATED VAPOR PRESSURE CURVE OF XYLOL.

is about the average of the three isomers, ortho, meta and para xylol. Next, a column of vapor pressures is set down as shown in column 1 in Table II. The values for the ratio corresponding to these vapor pressures are next obtained from the curve drawn from the data in Table I. These are placed in column 2. Each of these ratios is then multiplied by the absolute boiling point of xylol, 413 deg., thus producing the figures shown in column 3. These figures, less 273 deg., are the corresponding temperatures in Centigrade degrees, and are shown in column 4.

TABLE II VAPOR PRESSURES OF XYLOL

Xylol			
1 Vapor Mercury mm Mercury	2 Absolute Deg Absolute B P	Deg C Absolute	4 Deg C
1	657	271	2
3	683	282	9
5	702	290	17
7	715	295	22
10	731	302	29
15	749	309	36
20	762	314	41
25	773	319	46
30	782	323	50
40	797	329	56
50	808	334	61
60	817	338	65
70	827	341	68
80	836	345	72
90	843	348	75
100	849	351	78
150	875	361	88
200	894	369	96
250	911	376	103
300	924	382	109
350	936	387	114
400	946	391	118
450	955	395	122
500	963	398	125
600	979	404	131
700	992	410	137
760	1 000	413	140 B P

The values in columns 1 and 4 of Table II are then plotted and produce the vapor pressure curve for xylol, shown in Fig. 2.

The writer frankly admits that he knows of no law permitting the assumptions made above. But owing to the fact that the three coal-tar substances benzol, toluol and naphthalene followed the same relative curve as is shown, it was thought safe to assume that xylol would behave the same way. In any case, the resultant error should be quite small.

Methods of Controlling Electron Currents in High Vacuum*

Most of the applications of high-vacuum tubes have depended upon the control of electron currents, as for example by the grid in the three electrode tube. The action of the grid is due to the charge on the grid modifying the space charge effect. This is the action that is employed in practically all tubes used today for radio transmission and receiving. There are many other methods, however, of controlling electron currents. A very important method is that used in the magneton, where there are only two electrodes in the evacuated space and the control is obtained by means of a magnetic field generated by an external coil of wire. A still simpler form of magneton suitable particularly to very large power tubes consists of a very large filament in the axis of a cylindrical anode with very large straight filaments. The magnetic field produced by the current through the filament is enough to prevent electrons flowing between cathode and anode. By heating the filament with alternating current, the current periodically falls to low value and at these times current can flow to the anode. This gives a pulsating or oscillating current, which can be used for radio transmission. A 1,000-kw. tube of this kind is in process of development; preliminary tests have been in every way satisfactory.

Another form of tube by which electron currents can be controlled is the Dynatron. This depends upon subjecting one of the three electrodes in the tube to electron bombardment in such a way as to cause electrons to be splashed out of it, just as water can be splashed out of a cup by attempting to fill it too rapidly from a faucet. A tube of this kind acts like a real negative resistance, and can be used for producing electrical oscillations with considerable efficiency.

One of the most important applications of electron discharges from hot cathodes is in the Coolidge X-ray tube which is now almost universally used as a source of X-rays. These tubes were first made about 1913 and are gradually being improved in many respects. The latest type of tube, suitable for use by dentists, is a small tube weighing only a few ounces and only about 3 in. long. Because of the special features of this tube, the entire X-ray outfit, including the transformer, lead screen, regulating apparatus, etc., weighs only a few pounds and takes up a space of only a small fraction of a cubic foot. One very great advantage of this new form of tube, besides its convenience is its absolute safety, even in the hands of inexperienced operators, for there are no high voltages in any part of the apparatus which is accessible.

Canadian Mineral Production Higher in 1922

The Dominion Bureau of Statistics announces that its preliminary estimate of the mineral production of Canada during 1922 shows that the total value amounted to $180,622,000, an increase of practically $6,000,000 over the production of the previous year.

The value of the metals produced was $61,731,000, as compared with $49,343,232 in the preceding year; fuels and other non-metallics dropped $4,000,000 to a total of $83,891,000 and the production of structural materials and clay products has been estimated at the same valuation as last year—namely, $35,000,000.

In the metals the outstanding feature was the production of gold, which reached a total of 1,200,000 oz.

*Abstracted from a lecture by Dr. Irving Langmuir, Pittsburgh, Pa., Nov. 28, 1922.

Effect of Chemical Solutions On Various Woods Used in Tanks

By S. J. Hauser and Clarence Bahlman
The Hauser-Stander Tank Co., Cincinnati, Ohio

What Kind of Wood Can We Use With Such a Solution?—In What Way and How Extensively Do the More Common Chemicals Affect the Most Industrially Important Woods? — These Questions Are Comprehensively Studied in This Article

ALTHOUGH wooden tanks have been extensively employed for containing chemical solutions, little attention has been paid to the kind of wood best suited for any specific liquid. Very often a manufacturer hesitates to purchase wooden tank equipment because both he and the tank builder are uncertain as to the ability of the material to withstand the action of the solution in question. With this in mind, the writers undertook to determine, in a limited way, the effect of various chemical solutions, in varying concentrations and at different temperatures, upon the more important woods used in tank construction. It was not expected that these experiments would solve all of the problems, but it was believed that much valuable light might be thrown upon the subject.

Of course, the life of a wooden tank, or vat, in industrial use is governed not only by its resistance to the contained chemical but also by the skill and care used in its construction as well as the way it is used and the care given it by the plant operatives. Laboratory experiments alone may not definitely determine which wood is most suitable for a specific purpose, inasmuch as practical experience and the various physical properties and defects of the different woods have a great influence in the proper selection; still they are a wonderful help in making a decision. Very often laboratory results assist materially in explaining the failure of a wooden tank on the one hand and help to avoid future failures on the other.

We therefore feel justified in submitting our results, incomplete as they are in a somewhat condensed form, believing that they will furnish a clearer conception of just what might be expected of certain tank woods when exposed to chemical solutions.

The following six woods were used in these experiments: red gulf cypress, Douglas fir, long leaf yellow pine, California redwood, hard maple and white oak. Uniform test strips (4x1x½ in.) were prepared from thoroughly air-seasoned lumber and only such pieces as were free from knots and other defects were employed in the experiments.

Our experiments were confined to a study of the effect of various hot and cold solutions upon the different woods, determining the absorption of the liquid, expansion or contraction of the wood and other physical action such as softness, brittleness, warping, etc. Also, the relative amounts of color and taste imparted to water by the various woods were recorded. The strips were completely submerged and a separate container was used for each kind of wood.

The common acids, alkalis and salts, as well as linseed oil, turpentine and distilled cottonseed oil fatty acids were employed. For absorption and expansion or contraction the strips were weighed and calipered, then immersed in the cold solution for a week, when examinations were made again. After this they were returned to the solution for 3 weeks more and the physical examinations were made. Where hot solutions were used the strips were immersed for a week, and each day the solutions were brought up to boiling for 1 hour. Tests were also made on strips coated with asphalts, pitches and various so-called acidproof paints.

After the desired period of immersion, the strips were removed and dried on the outside with a rag, and then permitted to remain for 15 minutes exposed to the atmosphere before weighing or calipering. The increase in weight was expressed as grams absorbed per strip—i.e., per cubic inch—and also as percentage gain in

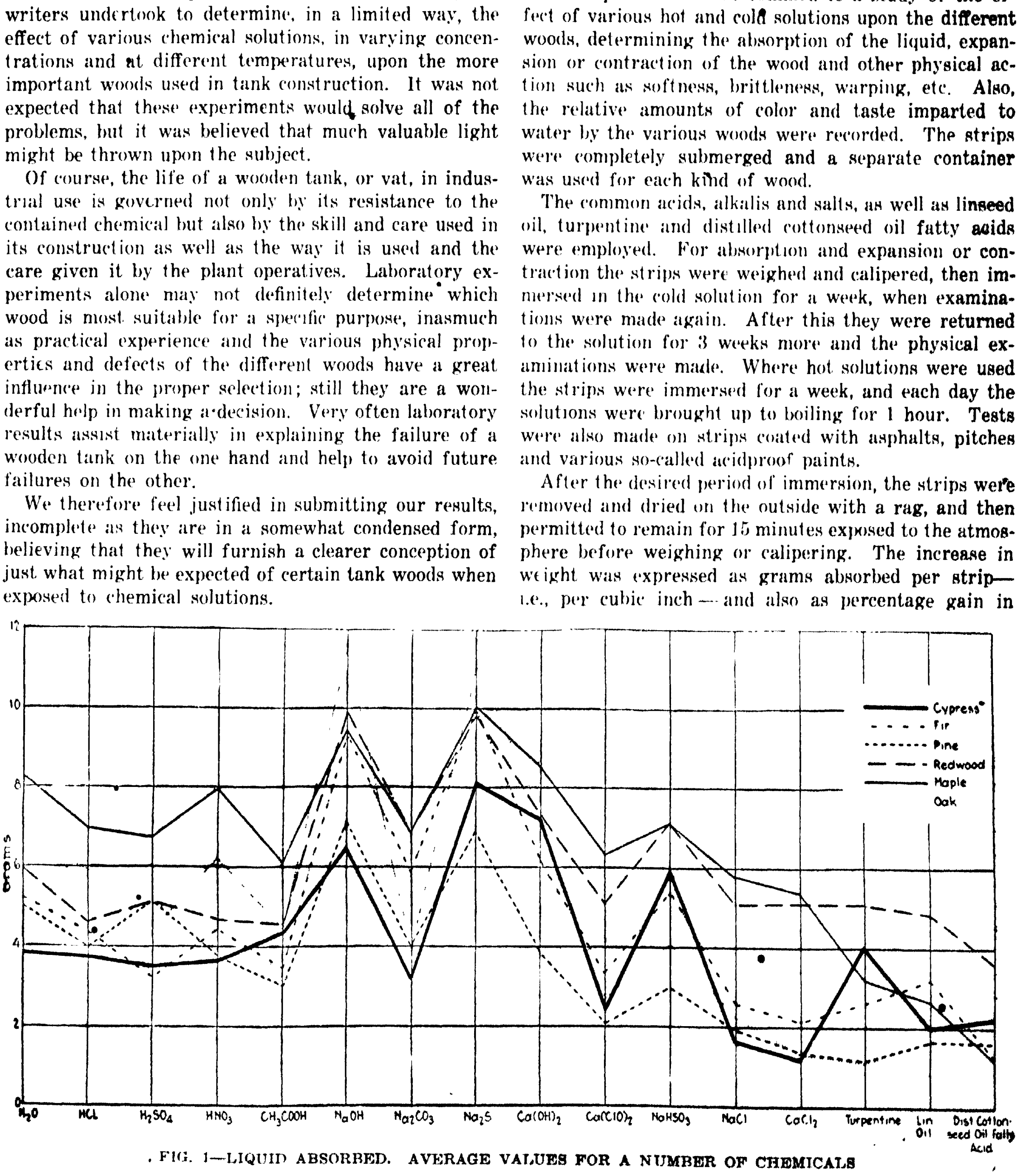


FIG. 1—LIQUID ABSORBED. AVERAGE VALUES FOR A NUMBER OF CHEMICALS

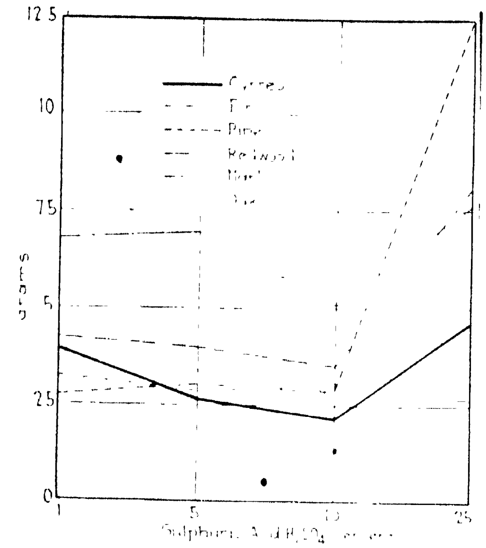


FIG. 2—LIQUID ABSORBED. H_2SO_4 AT VARYING CONCENTRATIONS

weight. The increase or decrease in dimensions at this point was designated as Temporary Expansion or Contraction. The strips were then permitted to dry under atmospheric conditions for one week, after which they were calipered again, and this result was expressed as Permanent Expansion or Contraction.

After these examinations were made, the strips were returned to their respective solutions and kept submerged for 3 weeks more, when they were removed and their physical condition noted. A record was also kept of the color imparted to the liquid. With the hot solutions, instead of waiting 15 minutes after removing the strips therefrom before weighing or calipering, they were weighed and measured shortly after removing the excess liquid and drying with a rag.

EXPERIMENTAL RESULTS

Effect of Wood Upon the Solutions—Obviously there are two effects for which we would be on the lookout in these experiments. One is the effect of the wood upon the solution, and the other is the effect of the solution upon the wood. So far as the former effect is concerned, the color and taste of the solution after having been in contact with the wood were observed. These coloring matters may be due, of course, either to matter extracted from the wood without pronounced chemical action, or to substances formed by the chemical action upon the wood, or perhaps to both. Pronounced colors, however, usually indicate destructive action.

Oak and redwood both yielded pronounced color to water within 24 hours. Maple imparted only a slight coloration after 48 hours, while cypress, fir and pine did not color the water in 2 weeks. Boiling tests were also applied to strips of wood, fresh water being used each day on 8 successive days. Color was imparted to the solution every day by oak and redwood, on 5 days only by fir and maple, although a slight coloration was observable on the succeeding 3 days. With cypress there was a strong color for 3 days, slight color the day following, and then no coloration whatever on the 4 succeeding days. Pine gave a strong coloration for 2 days only, and a slight coloration throughout the remaining six.

The water used in the foregoing tests was tasted in each case and it was found that boiling water intensified the taste but gave the same general resuts as follows: Pine gives a pronounced taste to the water throughout the test, whereas cypress gives none at all. It can be concluded from these tests that cypress, inasmuch as it imparts neither taste nor color to a solution, would be easily the best wood to use for making tanks for food products.

With acids and alkalis, the colors extracted from the woods vary somewhat with the strength of the chemical used, but in general gave the same order of receptivity, cypress giving the least color, the redwood and oak the most.

The Effect of the Solutions Upon Wood—It is, of course, nearly impossible to get any absolute standard of reactivity of a given solution upon a given wood. Therefore some rather empirical standards have been adopted. The first is the quantity of liquid absorbed by the wood, and the second is the expansion or contraction of the strip of wood during the action. In addition, of course, there are also the appearance and physical conditions of the strips themselves aside from any quantitative measures.

QUANTITY OF LIQUID ABSORBED

The results of the many tests have been condensed into charts and tables, and it is hoped that the type of results obtained may be interpreted from these charts. Fig. 1 shows the amount of liquid at room temperature absorbed in grams by the strips of wood. The results of the different concentrations have been averaged and the points represented on the chart are therefore average points. In general it will be noted that the curves seem to vary somewhat similarly. In other words, one solution is more readily absorbed by all the wood than another solution. In general too it will be noted that maple and redwood absorb more than cypress. A good many other interesting minor points can be observed by studying the chart, but it must be borne in mind that the tests are not absolute tests and the results are recorded in empirical units.

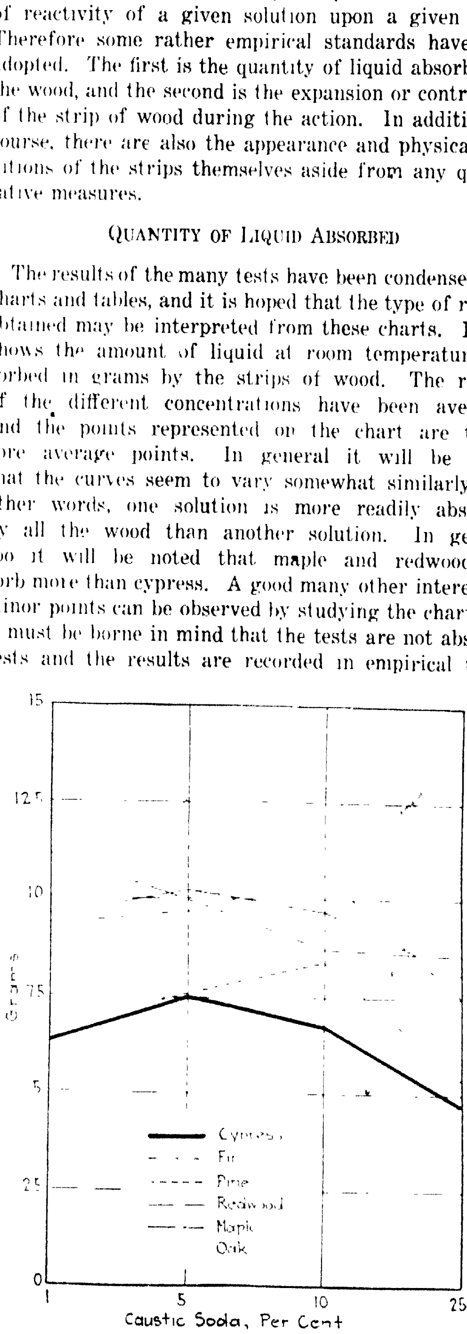


FIG. 3—LIQUID ABSORBED. NaOH AT VARYING CONCENTRATIONS

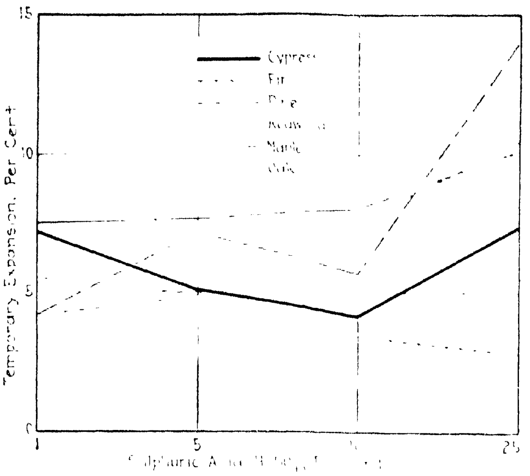


FIG. 4—EXPANSION IN H_2SO_4 AT DIFFERENT CONCENTRATIONS

However, it is certainly true that corrosion should vary somewhat directly as the amount of liquid or solution absorbed, and one would expect, therefore, to find more corrosion and disintegration of the wood which absorbs more of the solution. The results obtained with hot liquids are not given here, but were similar to those obtained with the cold liquids, as a rule greater absorption taking place with the hot liquids, although there were a few exceptions to this rule.

As was stated above, the values for any one wood in a given solution are average values, and it may be added here that as the concentration of the solution increased, the quantities absorbed varied irregularly. This was in some ways a surprise, for it was expected that the absorption would either increase or decrease as the strength of the solution varied. To bring this point out more definitely, Figs. 2 and 3 represent the effect of varying concentrations of sulphuric acid and caustic soda on the different woods used. It is perhaps significant to note that the general shape of the curve is in each case somewhat identical, but more quantitative conclusions are probably not warranted. Similar results were also obtained with hot solutions and with other chemicals not listed.

Expansion and Contraction

Variations in the contraction or expansion of the different woods used were also noted, and the irregularities for different strengths of the solution were apparently as vagrant as those noted under the amount of liquid absorbed. Figs. 4 and 5 show the expansion or contraction observed when the different woods were immersed in sulphuric acid and caustic soda of varying strengths. With cold solutions all the woods showed temporary expansion. The permanent expansions are not shown in the chart and are considerably more various than the results of the temporary expansion. In general there was less expansion and in some cases contraction. Hot liquids also showed a definite tendency to contract the woods. Still another measurement, that of shrinkage upon drying, was made roughly, and not unnaturally the shrinkage was rather great when the samples were dried after being removed from hot liquids. Cypress and pine were the only woods, upon drying, that did not show contraction in any of the cold solutions. The tendency of certain chemicals to cause swelling or shrinkage is probably best shown by using the figure obtained after the various woods had dried for a week following immersion in either hot or cold liquids. Fig. 6 indicates the effect of the various liquids at room temperature upon the different woods. The permanent expansion or contraction caused by certain hot liquids is shown in Fig. 7. In all cases, however, the various woods showed greater expansion or less contraction, as the case may be, before being dried than after drying.

Physical Condition of the Wood

Perhaps the most interesting set of data is that obtained by studying the physical condition of the strips of wood after removing them from the solution. In general, water solutions of salt, such as calcium chloride, sodium chloride, organic liquids, such as turpentine, linseed oil and the cottonseed oil fatty acids, produced no effect either in hot or cold solutions. Cold calcium hydroxide and cold solutions of sodium bisulphite had no effect. Sulphite of soda in the cold produced no noticeable effect except to soften redwood and had also a slight softening effect on the oak. Neither hot nor cold sodium carbonates had any noticeable action on any of the woods, except oak was somewhat shrunken after being removed from hot solutions. Considerable effect was noticed in the solutions of mineral acids and a table is herewith appended in which these effects have been summarized. Only four kinds of action are recorded in the table for simplicity's sake: Softening, warping or distortion, charring or shredding. A very great number, eighteen in all, were observed, all of them attempting to make some quantitative distinction in the effect noticed. In the table, however, any softening effect is

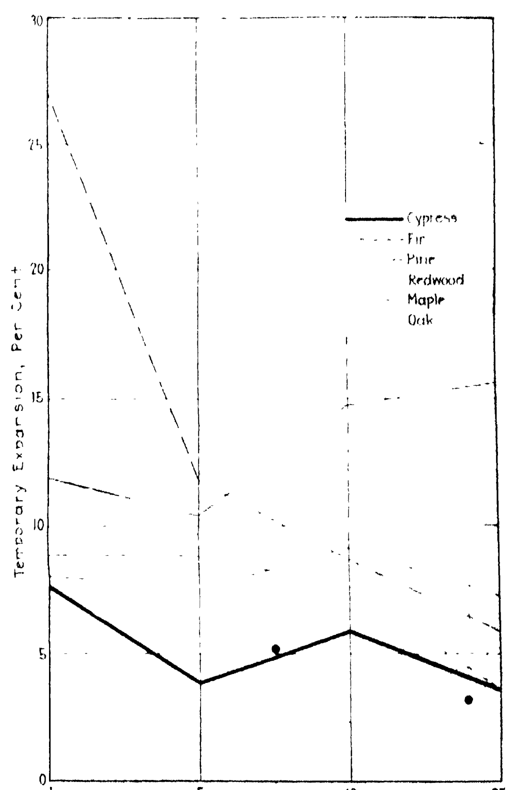


FIG. 5—EXPANSION IN NaOH AT DIFFERENT CONCENTRATIONS

EFFECT OF SOLUTIONS ON THE PHYSICAL NATURE OF WOOD

		Cypress		Fir		Pine		Redwood		Maple		Oak	
		Cold	Hot	Cold	Hot	Cold	Hot	Cold	Hot	Cold	Hot	Cold	Hot
HCl (Hydrochloric Acid), per cent	5				S			W	S, W				....
	10				S			W	S, W		S		...
	25		S, W		S, W		S	W	S, W	S, W	S, W	W	S, W
	50	S, W		S, W				S, W		S, W		S, W	. ..
	conc	S, W		S, W		S, W		S, W		S,W, Ch		S, W	
H_2SO_4 (Sulphuric Acid), per cent	1		S		S			W	S				W
	5		S		S			S, W	S, W		S		
	10		S, W	S	S			S, W	S, W	W	S	W	
	25	W	S, W	S, W	S, W		S, W	S, W	S,W,Ch	S, W	S, W	S, W	S, W
HNO_3 (Nitric Acid), per cent	5		S		S		S, Shd	S, W	S, W		S, Shd		S, W, Shd,
	10		S, Shd		S, Shd		S, Shd	S, W	S,W,Shd	W	S, Shd	S,W,Shd	S, W, Shd
	25	S, W	S, Shd	S, W	S, Shd	S, W	S, Shd	S, W	S,W,Shd	S,W,Shd	S, Shd	S,W,Shd	S, W, Shd
NaOH (Sodium Hydroxide), per cent	1				W			S, W	S	W	W	W	W
	5				W			S, W	S	W	W	W	W
	10			W	W		W	S, W	S, W	W	W	W	W
	25			W	W		W	S, W	S, W	W	W	W	W

Note: A blank space represents no test

designated by a capital S. This softening effect may have been very slight or very severe, and it may have taken the direction of pliability, which is also included as a softening effect. There are many different kinds of action represented by the capital W, standing for warping. The strip may have been cracked lengthwise, warped in the usual sense of the word, badly distorted, noticeably shrunken or expanded, but these have all been included in the one term in the table. Charring and shredding are terms which need no further elaboration. In addition it should be noted that some of the woods are rendered distinctly brittle by the action of solutions. For example, hydrochloric acid, 5 per cent, renders redwood very brittle, and much stronger acid has the same effect on maple and oak, but no detrimental effect is noticed on cypress, fir or pine. Sulphuric acid also produces some brittleness in redwood, even at 1 per cent concentration, whereas 5 per cent acid has very little action on any of the other woods. Even 25 per cent sulphuric acid has very slight action on pine, and attacks cypress to only a small extent.

Perhaps we can summarize these qualitative conclusions by some definite statements as to the effect of the various solutions on wood.

Conclusions

Redwood and oak are objectionable from the standpoint of color.

Fir and pine produce pronounced tastes. Cypress imparts neither color or taste to any degree.

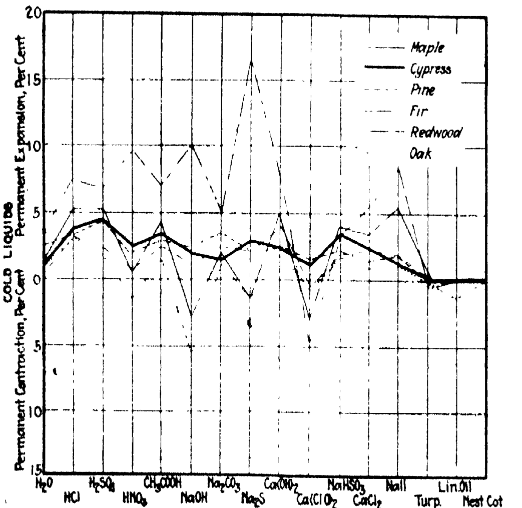


FIG. 6—EXPANSION OR CONTRACTION IN VARIOUS COLD SOLUTIONS

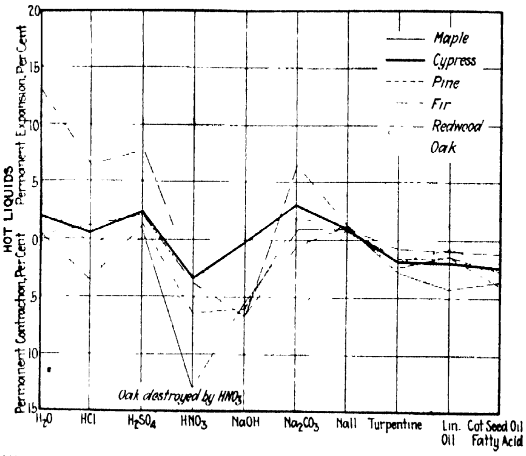


FIG. 7—EXPANSION OR CONTRACTION IN HOT SOLUTIONS

All of the woods absorb the various chemicals to a greater or lesser degree. Oak, maple and redwood have the greatest absorptive powers and fir, cypress and pine the least. Caustic soda and other alkaline solutions are absorbed to the greatest extent, followed by the acid solutions, then the salts and least of all the organic liquids.

Many of the liquids, particularly caustic soda, HCl, HNO_3, bleaching powder and the hot organic liquids, tend to cause shrinkage. This is most pronounced with oak and maple and the least pronounced with cypress and pine.

Nitric acid and caustic soda are the most corrosive of the various liquids tested, then H_2SO_4 followed by HCl and bleaching powder. Most of the other solutions had little or no corrosive action upon the woods.

There is always one wood (and often more) which is able to resist the action of the various chemicals at least in moderate concentrations.

Of the thirty-eight liquids used the number which noticeably affected the different woods at room temperatures (disregarding slight softness and roughening of grain) was as follows: Pine 4, cypress 7, fir 8, maple 13, oak 15 and redwood 22.

Protective Coatings

Waxes or gums, asphalts and coal-tar pitches are sometimes employed as a protective coating upon woods which are to be exposed to the action of corrosive liquids. These products may be either liquids or solids at normal temperatures. The liquids, usually called acidproof paints, are applied with a brush, whereas the solids are melted and then applied. In the latter case,

usually a prime coat of the same or similar material in liquid form is first applied to act as a binder. With those solids which have low melting points or no fixed melting point, as in the case of coal-tar pitch, some substance is frequently mixed with the protective material or else duck or burlap, properly secured to the tank and placed between coatings of the pitch, etc., is used to prevent the material from running down the vertical sides of the tank. Whether these preparations are successful in preventing the penetration of a liquid will depend upon the resistance of the coating to the action of the chemical and upon the completeness with which the pores of the wood are covered. Various coal-tar and asphaltic paints as well as solid materials were tested to determine their resistivity to the various chemical solutions. Melting point determinations were also made on the solid materials.

Most of the samples tested showed great resistivity to the various chemicals used but in the case of strips covered with liquid preparations, absorption took place, expansion or contraction occurred and the other physical manifestations were evident, although much retarded. It would seem that although the material itself was unacted upon, the chemical solution would get through the thin protective film and attack the wood. With the solid materials, especially when the wood was thoroughly and heavily coated, the penetration was very much reduced and thus very much better production was afforded.

From the tank builder's point of view it is desirable to receive information as to the purpose for which the tank is to be used, the chemical and strength of solution to be contained therein, the temperature of the solution and other conditions, as well as the dimensions. He will then be able to determine the proper wood to use, the thickness thereof, the correct metal for hoops or rods—i.e., whether iron, acid-resisting bronze, Monel metal, copper, brass, lead covered, etc.—the proper spacing and sizes of hoops or rods and their protection if necessary; the best method of construction bracing and supports, as well as whether or not linings or protective coatings should be employed.

Function of Magnesium in Fertilizer

Recent investigations by the Bureau of Plant Industry in co-operation with the North Carolina Department of Agriculture have shown that an important leaf disease of tobacco and other plants known to tobacco growers as "sand drown" is due to an insufficient supply of magnesium in the soil or fertilizer. In this disease the green and yellow pigments of the chlorophyll are affected and there is a blanching of the leaf tissues. This blanching invariably begins on the lower, older leaves of the plant and first symptoms usually appear at the tips and outer margins of the leaves.

Corn is affected in much the same way as is tobacco, the leaf blades presenting a striped effect. The disease occurs chiefly on light sandy soils and is more serious in wet seasons, hence the popular name "sand drown." It is an interesting fact that the disease is intensified by increase in the quantity of sulphates in the fertilizer. It has been found that this trouble is prevented by the application of comparatively small quantities of magnesium salts to the soil. The low-grade potash salts which contain magnesium, as well as dolmitic limestones, are effective preventives. Certain organic fertilizing materials such as cottonseed meal, tobacco stems and manure, which contain appreciable quantities of magnesium, tend to prevent the disease.

Coke Industry Recovered in 1922 Despite Difficulties

Byproduct Output Was 28,319,000 Tons—8,007,000 Tons of Beehive Produced—Ovens Consumed 53,311,000 Tons of Coal

BY R. S. MCBRIDE
Assistant Editor

THE year 1922 in the coke industry can well be characterized as one of recovery despite difficulties. The industry has continued to demonstrate that it is a splendid barometer of industrial conditions—perhaps even better than the iron and steel industry, which is commonly so highly regarded as an index of industrial development.

The estimated production of coke during 1922, based upon official returns of the U. S. Geological Survey for 11 months and estimates for December, is 37,326,000 tons, of which 28,319,000 tons was byproduct coke and 8,007,000 tons was from beehive ovens.

Byproduct coke has again outstripped beehive coke and more or less dominates the situation. One should not conclude from these data for the year as a whole, however, that the byproduct branch of the business is really more than three times as large under normal circumstances as the beehive branch, for during the middle of the year the beehive industry suffered more severely through strike conditions, especially in the Connellsville district. This fact is brought out quite clearly by the monthly production figures for the year, which are given in Table I.

BYPRODUCT OVENS END YEAR WELL

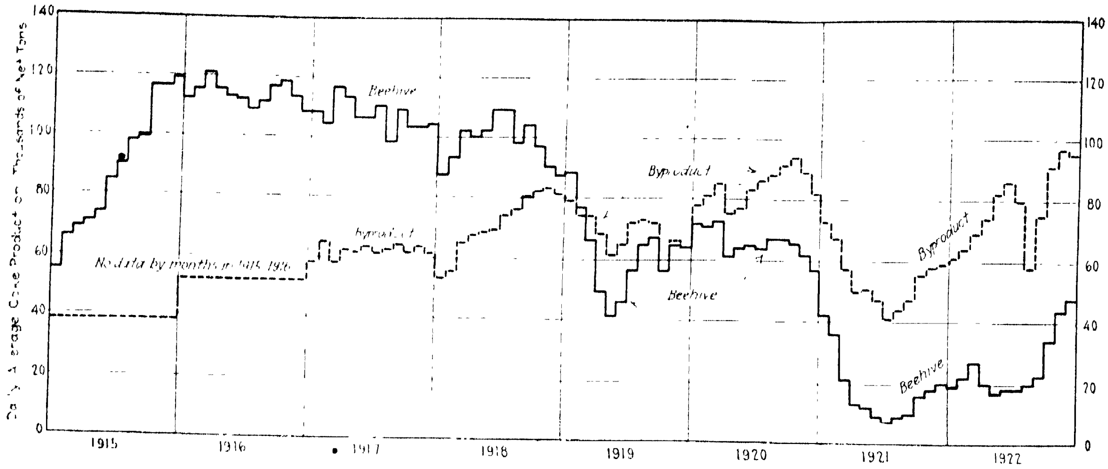
The byproduct coke ovens of the country were operating at approximately 50 per cent of capacity at the beginning of 1922. For the first 6 months of the year the activity of this branch of the business increased steadily, so that in June about 70 per cent activity was estimated by the U. S. Geological Survey. The coal shortage during July and August, however, cut down activities again, production during July being 68 per cent and during August only 49 per cent of the installed-oven capacity. With the resumption of adequate fuel supply in September a prompt renewal of activity ensued, and production during November and December was approximately 80 per cent of the entire installed-oven capacity of the country.

During the year there were regularly from ten to fifteen plants idle. Altogether sixteen plants were idle for a full month or more; but during no single month were more than fourteen of the total number, seventy-one plants, entirely shut down. Seven plants were idle the entire year. No new plants began operation during 1922, but a few ovens were added to some of those already in operation.

NEW OVENS CONSTRUCTED

At the beginning of 1922 three plants had new ovens under construction. These were the Woodward Iron Co., thirty ovens; Chicago Byproduct Coke Co., five ovens, and Milwaukee Coke & Gas Co., fifty ovens. All of these were completed during the year and some of them began operation.

The coke industry normally takes about 15 per cent of the bituminous coal produced in the United States. However, in July of 1922 there were used in the coke ovens then active approximately 28 per cent of the entire coal production that month. Of course with normal coal production, no such percentage of the coal would



PRODUCTION OF BEEHIVE AND BYPRODUCT COKE, BY MONTHS 1915-1922

In the earlier year the older type of ovens produced the more coke, but in 1919 the output of byproduct ovens passed the beehive and is now well in advance

TABLE I—COKE PRODUCTION IN 1922
(In Net Tons)

	Byproduct Coke		Beehive Coke		
	Production	Daily Average	Production	Daily Average	Totals
January	1,879,000	61,000	496,000	19,000	2,375,000
February	1,795,000	64,000	549,000	22,000	2,344,000
March	2,137,000	69,000	732,000	27,000	2,869,000
April	2,208,000	74,000	528,000	20,000	2,736,000
May	2,537,000	82,000	432,000	17,000	2,969,000
June	2,580,000	86,000	458,000	18,000	3,038,000
July	2,486,000	80,000	450,000	18,000	2,936,000
August	1,794,000	58,000	539,000	20,000	2,333,000
September	2,244,000	75,000	606,000	23,000	2,850,000
October	2,806,000	91,000	878,000	34,000	3,684,000
November	2,908,000	97,000	1,139,000	44,000	4,047,000
December (est.)	2,945,000	95,000	1,200,000	48,000	4,145,000
Totals	28,319,000	78,000	8,007,000	26,000	36,326,000

TABLE II—COAL CONSUMED IN COKE PRODUCTION, 1922 (In Net Tons)

	Byproduct Ovens	Beehive Ovens	Total
January	2,699,000	782,000	3,481,000
February	2,579,000	866,000	3,445,000
March	3,071,000	1,155,000	4,226,000
April	3,172,000	833,000	4,005,000
May	3,645,000	681,000	4,326,000
June	3,707,000	772,000	4,429,000
July	3,571,000	710,000	4,281,000
August	2,577,000	850,000	3,427,000
September	3,223,000	956,000	4,179,000
October	4,032,000	1,384,000	5,416,000
November	4,179,000	1,797,000	5,916,000
December (est.)	4,230,000	1,890,000	6,120,000
Total	40,685,000	12,626,000	53,311,000

ever go into coke ovens, but the quantity so used will undoubtedly be large at all times.

In Table II are given figures for the coal consumption in both byproduct and beehive ovens and the total of the two, by months. These figures are those estimated by the U. S. Geological Survey on the assumed basis of 69.6 per cent yield of byproduct coke from coal and 63.4 per cent yield of beehive coke and coal, the average yields for the industry during the preceding calendar year. The December figures are estimates.

At the beginning of 1922 there were in stock at many of the byproduct coke plants several hundred thousand tons of coke for which no market was available. Certainly at no previous time in the history of the industry was there ever on hand anything like this quantity of coke. However, as it became evident during the summer that anthracite would not be available in anything like the usual quantities, purchasers became increasingly interested in the use of coke as a substitute for anthracite. During midsummer the movement of this coke for gas making and for other industrial operations became active and with the early autumn it was an exception to find any unsold coke in stock.

The use of coke as a domestic fuel in place of anthracite has developed more slowly, but inability to get anthracite has compelled attention to this fuel and it is believed that thousands of households are served by coke which have never before used this fuel. This wide market, of course, promises to offer a balance-wheel for the industry which it has never before had. The exact tonnages so employed this year are not known, but it is certain that several times as much coke has been employed for domestic fuel as ever before.

New Constituent Found in High-Speed Steels

Recent work at the Bureau of Standards has discovered an unidentified constituent of relatively great hardness in two samples of high-speed steels. It had previously been found that electrolytic etching with weak solutions of ammonia and with sodium hydroxide has a very similar effect upon the various constituents found so far in alloy steels—namely, both solutions darken chromium carbide and tungsten carbide, while iron carbide and iron tungstide remain unaffected even after etching for several minutes.

The new constituent did not respond to the test for iron carbide and iron tungstide and did not assume any shape usually met with in the case of tungsten carbide. It did respond, however, to the test for chromium carbide—that is, it was darkened by either sodium hydroxide or ammonia. It appeared to be similar in behavior on etching to the very minute particles noted in the matrix of high-speed steel in the condition as received from the mill which were brought out by either ammonia or sodium hydroxide.

Since it would appear from the results of previous investigators that a large part of the chromium present in the high-speed steel is dissolved in the matrix (this would depend on the heat-treatment received), while a large part of the vanadium is present in the free state as carbide, it seemed possible that the constituent referred to above might be a carbide of vanadium. To test this an iron-carbon-vanadium alloy is now being prepared for study wherein it is hoped to have the vanadium and carbon present entirely as vanadium carbide.

Thermal Properties of Aluminum-Silicon Alloys

BY JUNIUS D. EDWARDS
Assistant Director of Research, Aluminum Co. of America

Accurate Determination of Densities of Aluminum Alloys Containing Variable Amounts of Silicon—Data at Various Temperatures Up to 1,000 Deg. C.—Data on Crystallization Shrinkage, Total Solid Shrinkage and the Tendency to Form Pipe

A RECRUDESCENCE of interest in the aluminum-silicon alloys has recently been effected by the discovery of methods of preparing them, and particularly of producing what may be called the modified alloys. The history and general properties of these alloys have been described by Jeffries;[1] reference should be made to this article for photomicrographs and descriptions of the structure of the alloys. Suffice it to say that the normal silicon alloys made by melting together silicon and aluminum in the proper proportions, and casting in green sand, exhibit relatively large plates and needles of eutectic silicon. The modified alloys show a very fine dispersion of the silicon and if there is excess aluminum above the eutectic ratio (which ratio varies somewhat with the degree of modification), it may appear as relatively large dendrites. The modified alloy may be produced electrolytically, and by treatment with compounds of the alkali metals with fluorine, as, for example, the method of Pacz.[2]

Another method[3] of producing modified alloys is by the addition of small amounts of metallic sodium or potassium, or both, to the molten alloy before casting. A description of this method by the present writer has already been published in this journal.[4] Modified alloys by this latter method are included in the series of density measurements here reported.

The thermal volume changes of the alloys of aluminum and silicon are believed to be unique among aluminum alloys. The character and magnitude of these changes have been investigated in a series of measurements of the densities of the alloys of aluminum with minor amounts of silicon at temperatures up to about 1,000 deg. C. These measurements have revealed many interesting facts and led to a clearer understanding of the mechanism of solidification of such alloys. Furthermore, they have provided fundamental data necessary for the most intelligent application and manipulation of the aluminum-silicon alloys.

EXPERIMENTAL METHODS

Methods developed in a previous investigation of the density of aluminum have been utilized and further developed in the present investigation. These methods have been described in *Chemical & Metallurgical Engineering*.[5, 6, 7] Density at room temperatures was measured by weighing in water and in air. The values for density are expressed as the mass of the metal in grams per milliliter and of course are comparable with weights *in vacuo*. Weighings made in air with brass weights on an equal arm balance will be about 0.03 per cent less.

Density of the solid alloys was measured at higher temperatures, by weighing in oil (Crisco) at temperatures up to about 250 deg. C. for the lower range and in a mixture of fused salts at the temperatures around 560 deg. C.

Density of the liquid alloy was measured in the densimeter, consisting of a graphite crucible of known volume, centered in a larger container. The whole apparatus is turned from a cylinder of graphite, so that there is an annular space surrounding the inner crucible which may be filled with a suitable molten metal to aid in producing a uniform temperature in the inner crucible which it surrounds. The crucible of known volume is completely filled with the molten metal at a temperature lower than that at which its density is to be measured. The cover is then screwed on tightly and the crucible raised to the desired temperature, by increasing the temperature of the electric furnace in which the apparatus is placed. The temperature is ascertained by means of a thermocouple placed in the metal bath in the annular ring. As the alloy within the crucible is heated, it expands and fills the known volume exactly; the excess metal runs out through two very small channels formed by the cover and two small grooves in the top face of the inner crucible.

When the desired temperature has been reached and maintained for a sufficient period to insure uniformity, any beads of metal extruded from the inner crucible are detached, the bath metal poured out, and the metal in the inner crucible allowed to solidify. When solid it can be removed and weighed. The volume of the crucible is determined at room temperature by filling with mercury and weighing the mercury. Its volume at the temperature of measurement is calculated from the known expansivity of graphite. From the weight and volume, the density of the alloy is readily calculated.

DENSITY OF AL-SI ALLOYS AT 20 DEG. C.

In Fig. 1 are plotted the results of density measurements on silicon alloys, normal and modified, containing from 0.5 to 18 per cent silicon, and cast in graphite and in sand. There is also included one sample of hard rolled sheet. Table I contains a selection of the numerical results, giving the chemical composition. The samples cast in graphite were cylindrical, and 1 in. in diameter.

The measurements were made at the prevailing room temperatures and all measurements have been corrected to the density at a uniform temperature at 20 deg. C. This correction was always less than 0.1 per cent of the density, so that it was sufficiently accurate to use an average expansion coefficient of 0.000022 per degree C. in calculating this correction.

The samples which were modified by the addition of alkali metal, were treated with approximately 0.05 per cent metallic sodium plus 0.05 per cent metallic potassium just prior to casting. The structure of typical normal and modified alloys is illustrated in references 1 and 4.

In alloy systems where there are no compounds formed, it is usually found that the specific volumes (the reciprocals of the densities) of the alloys will be very nearly a linear function of their composition.

[1] "Aluminum-Silicon Alloys," by Zay Jeffries, *Chem. & Met.*, vol 26, pp 750-754 (1922).

[2] U. S Pat 1,387,900, Aug. 16, 1921.

[3] Edwards, Churchill and Frary, U. S. Pat. 1,410,461, March 21, 1922

[4] "Aluminum-Silicon Alloys," by Junius D. Edwards, *Chem. & Met.*, vol. 27, p 654 (1922).

[5] "Density of Aluminum From 20 Deg. to 1,000 Deg. C.," by Edwards and Moorman, *Chem. & Met.*, vol. 24, pp. 61-64 (1921).

[6] "Mechanism of Solidification of a Copper-Aluminum Alloy," by Edwards, *Chem. & Met.*, vol. 24, pp. 217-220 (1921).

[7] "Causes of Piping in Aluminum Ingots," by Edwards and Gammon, *Chem. & Met.*, vol. 24, pp. 338-340 (1921).

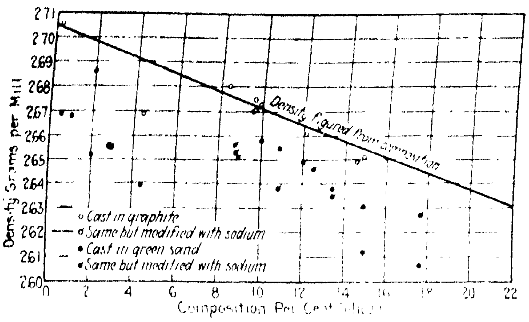


FIG. 1—DENSITY OF ALUMINUM-SILICON ALLOYS AT 20 DEG. C.

According to Richards,[7] the density of silicon at 20 deg. C. is 2.42. The density of aluminum of the purity used in making these alloys is about 2.705

The density curve of the alloys, calculated on the basis of such a linear relation between the specific volumes, is represented by the solid line in Fig. 1. The specimens cast in graphite, and having presumably the lowest porosity, are closely grouped along this graph. The densities of the sand-cast specimens containing approximately 2 and 4 per cent silicon were very much lower than this curve, and even after remelting and casting in graphite were still below the curve. The question arises as to whether the large variations in density observed with alloys of practically the same composition are caused by structural changes or are merely the result of variations in porosity. The density of the samples modified by the addition of a very small amount of alkali metal is slightly lowered. However, the lowest densities are not characteristic of the greatest grain refinement. The lowest densities are observed in the sand-cast specimens, whereas the greatest grain refinement is secured in the modified alloys chill cast. This would seem to indicate large variations in "porosity" of some kind. However, practical experience has demonstrated that aluminum-silicon alloys are unusual in their lack of permeability to liquids so that pore spaces if present must be isolated and small.

Frilley[8] has recorded a series of measurements on the density of the aluminum-silicon alloys. His data on the 10 and 20 per cent silicon alloys are about 5 per cent lower than the values given in the present paper. The reasons for these low results are not apparent.

DENSITY OF SOLID ALUMINUM-SILICON ALLOYS AT HIGHER TEMPERATURES

In order to complete the density curves up to the melting point, the densities of two representative normal alloys were determined at temperatures of 200 deg. C. and 563 deg. C. These determinations also permitted an approximate calculation of the expansivity. Density at the lower temperature was determined by weighing

[7] J. Am. Chem. Soc. vol. 37, p. 1646 (1915)
[8] Revue Métallurgie, vol. 8, p. 457 (1911)

TABLE II—DENSITY OF NORMAL ALUMINUM-SILICON ALLOYS AT 200 DEG. C. AND 563 DEG. C.

Composition					Density (Grams per Milliter)		
Si Per Cent	Fe Per Cent	Cu Per Cent	Mn Per Cent	Al Per Cent	20 Deg. C	200 Deg. C.	563 Deg. C
7.81	0.39	0.12	nil	91.68	2.678		2.570
7.81	0.39	0.12	nil	91.68	2.680	2.647	
7.81	0.39	0.12	nil	91.68	2.680	2.640	
11.63	0.45	0.11	nil	87.81	2.661		2.560
11.63	0.45	0.11	nil	87.81	2.663	2.635	
11.63	0.45	0.11	nil	87.81	2.663	2.626	
0.11	0.13	0.008	nil	99.752	2.689	2.653	

TABLE I—DENSITY OF ALUMINUM-SILICON ALLOYS

Composition, Per Cent Si	Fe	Cu	Treatment	Density at 20 Deg. C	Condition of Specimen
0.52	0.24		Normal	2.669	Sand-cast bars, ½ in. sq
2.01	0.30		Normal	2.652	Sand-cast bars, ½ in. sq
2.01	0.30		Normal	2.686	Recast in graphite
4.38	0.44		Normal	2.639	Sand-cast bar, ½ in. sq
4.38	0.44		Normal	2.669	Recast in graphite
8.37	0.42		Normal	2.680	Cast in graphite
8.83	0.41	0.26	Modified	2.653	Sand-cast test bar
9.61	0.43		Normal	2.675	Cast in graphite
9.79	0.43	0.04	Modified	2.654	Hard-rolled—14 gage
9.92	0.36	0.06	Normal	2.673	Cast in graphite
10.88	0.39	0.03	Normal	2.655	Sand-cast test bar
10.88	0.39	0.03	Modified	2.638	Sand-cast test bar
12.07	0.47		Normal	2.661	Cast in graphite
13.40	0.42	0.04	Normal	2.638	Sand-cast test bar
14.88	0.54	0.02	Normal	2.651	Cast in graphite
14.95	0.55	0.03	Normal	2.631	Sand-cast test bar
17.66	0.52	0.04	Modified	2.627	Sand-cast test bar

the sample in air and when immersed in Crisco at a temperature of 200 deg. C. The density of the Crisco was determined at the same time as the weighing of the alloy by means of a platinum cylinder whose volume was accurately known.

A slow change in composition of the Crisco at this temperature made it difficult to secure an accuracy greater than 0.2 per cent. A new sample of Crisco was used for each series of measurements, and its density was checked by repeated weighings of the platinum cylinder.

Weighings at 563 deg. C. were made in a fused mixture of lithium and potassium sulphates. According to Nacken, quoted in Landolt Bornstein Tabellen, there is a eutectic mixture of these two salts which freezes at 535 deg. C. and contains 20 mol per cent of potassium sulphate. I used a mixture containing about 25 weight per cent of potassium sulphate, and found it quite satisfactory, although the freezing point of the salt (about 540 deg. C.) and the melting point of the aluminum-silicon eutectic (577 deg. C.) gave only a very small temperature range to work in, and made the measurements tedious and difficult

DENSITY OF LIQUID ALUMINUM-SILICON ALLOYS

The graphite densimeter was used for determining the density of the liquid alloys. The density of relatively pure aluminum is known from the previous measurements referred to, and the effect of the addition of 8 and 12 per cent silicon was observed in the present series. Results are given in Table III.

These alloys were all normal alloys. The modified alloys, strictly speaking, exist only in the solid state, because the modification is a structural change taking place during the crystallization of the liquid. A liquid alloy with alkali metal added has only the potential property of becoming a modified alloy.

TABLE III—DENSITY OF LIQUID ALUMINUM-SILICON ALLOYS

Composition					
Si Per Cent	Fe Per Cent	Cu Per Cent	Al Per Cent	Temperature Deg. C	Density g. ml
7.81	0.39	0.12	91.68	663	2.413
7.81	0.39	0.12	91.68	802	2.375
7.81	0.39	0.12	91.68	904	2.345
11.63	0.45	0.11	87.81	643	2.441
11.63	0.45	0.11	87.81	801	2.392
11.63	0.45	0.11	87.81	904	2.356

A graph of these results indicates the expansion of the liquid alloy to be practically linear from the melting point to at least 1,000 deg. C., and the greatest deviation from a straight line fitted to the data is less than 0.1 per cent. In Table IV are given convenient values for these alloys as taken from the plotted graphs. Fig. 2 shows the freezing points of the aluminum-silicon

TABLE IV—DENSITY OF ALUMINUM-SILICON ALLOYS

Temperature	Condition of Metal	Density: Silicon 0.2 Per Cent	Silicon 7.81 Per Cent	Silicon 11.63 Per Cent
Centigrade Temperature Scale				
20	Solid	2.706	2.679	2.662
200	Solid		2.644	2.630
600	Liquid			2.456
700	Liquid	2.373	2.404	2.423
800	Liquid	2.345	2.375	2.391
900	Liquid	2.318	2.346	2.358
1000	Liquid	2.291	2.317	2.326
Fahrenheit Temperature Scale				
68	Solid	2.706	2.679	2.662
1300	Liquid	2.371	2.402	2.422
1400	Liquid	2.356	2.386	2.404
1500	Liquid	2.341	2.370	2.386
1600	Liquid	2.326	2.354	2.368
1700	Liquid	2.311	2.338	2.350
1800	Liquid	2.296	2.322	2.332
1900	Liquid	2.280	2.306	2.314
2000	Liquid	2.265	2.290	2.296

alloys containing from 0 to 15 per cent silicon, and Fig. 3 a series of isotherms giving the densities of these alloys at 700, 800, 900 and 1,000 deg. C.

The normal eutectic composition is usually given as about 10 per cent silicon. Fraenkel[10] reported 10 per cent and a eutectic temperature of about 576 deg. C. Roberts[11] reported 10 per cent and 578 deg. C.

Observations made in the course of the present work indicated a normal eutectic temperature of approximately 577 deg. C. and a eutectic composition between 11 and 12 per cent, or more exactly, 11.6 per cent of

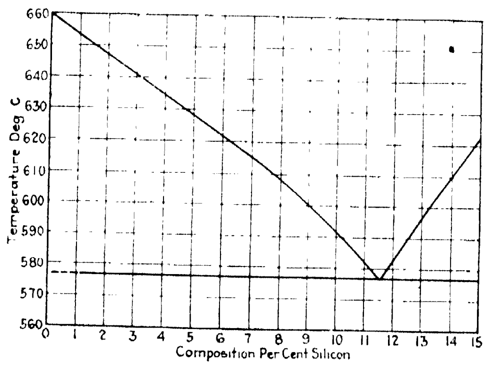


FIG. 2—EQUILIBRIUM DIAGRAM, Al-Si ALLOYS

silicon. As previously noted[4] the presence of a modifying agent will change the eutectic composition and temperature in a very significant manner.

Thermal Expansivity of Aluminum-Silicon Alloys

Data on the thermal expansivity of aluminum are quite well known, but there are only a few measurements available on silicon, and they are at temperatures below 100 deg. C. For comparison, two of these values are given in Table V.

TABLE V—THERMAL EXPANSIVITIES OF ALUMINUM AND SILICON

Metal	Temperature Deg. C.	Expansivity $\frac{\Delta l}{l_0}$	Authority
Aluminum	40	0.0000229	Bureau of Standards (1921)
Silicon	40	0.0000076	Fizeau (1869)

There may be some question as to the purity of the silicon tested by Fizeau, but the data as they stand indicate that silicon has only about one-third the ex-

[10] Z. anorg. Chem., vol. 58, p. 154 (1908).
[11] J. Chem. Soc., vol. 105, p. 1,383 (1914).

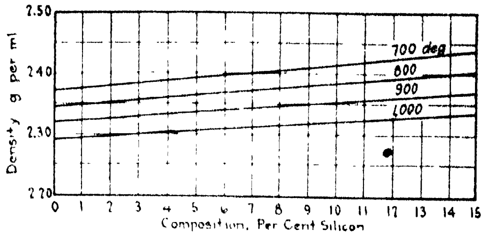


FIG. 3—DENSITY OF ALUMINUM-SILICON ALLOYS AT ELEVATED TEMPERATURES

pansivity of aluminum. This fact is reflected in the expansivities of the aluminum-silicon alloys. The average linear expansion coefficient of the sample of relatively pure aluminum quoted in Table II, between 20 and 200 deg. C., is calculated as 24.8×10^{-6}. This value agrees with that calculated from the expansion formula published by the Bureau of Standards—namely 24.8×10^{-6}. The expansivity of the eutectic alloy (11.63 per cent silicon) as calculated from the density measurements at 20 and 200 deg. C. is 22.2×10^{-6}, which is about 10 per cent less than the expansivity of aluminum. No great confidence can be placed in this value unless supported by other evidence, as a small error in the density measurements—say 0.1 per cent, for example—would make a difference of about 8 per cent in the expansivity. However, other unpublished information makes it appear that this value is correct to within 3 per cent.

The average expansion coefficient of the eutectic alloy between 20 and 577 deg. C., as determined from measurements of total solid shrinkage, is approximately 23.5×10^{-6}, while that of aluminum over the same range is about 29×10^{-6}. It seems demonstrated, therefore, that the linear expansion of the aluminum-silicon alloys is appreciably less than that of aluminum.

Solid and Crystallization Shrinkage of Aluminum-Silicon Alloys

The solid shrinkage and crystallization shrinkage are important factors in determining the casting qualities of an alloy. The crystallization shrinkage is the percentage change in volume in changing from a liquid at the freezing point to a solid at the melting point. In Fig. 4 are shown the complete density curves for pure aluminum (99.75 per cent aluminum) and the 7.81 and 11.63 per cent silicon alloys. The construction of such curves was described in detail in the article on the freezing phenomena of the copper-aluminum alloys.

The most striking characteristic of these curves is that, although the solid aluminum-silicon alloys are

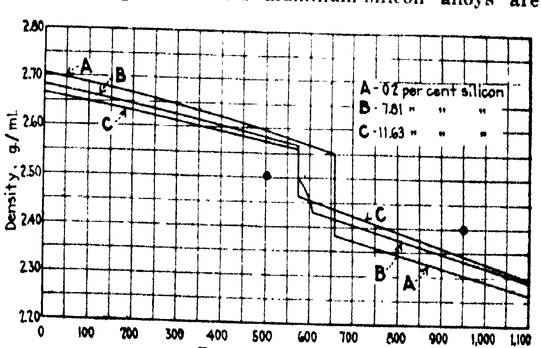


FIG. 4—TEMPERATURE-DENSITY CURVES FOR THREE ALLOYS

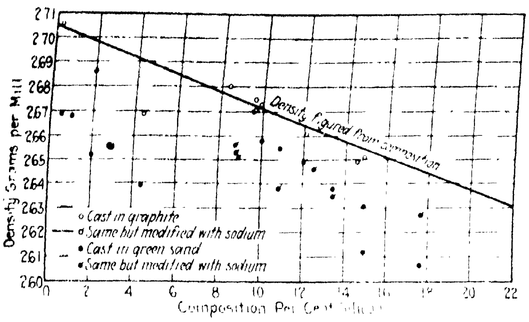


FIG. 1 DENSITY OF ALUMINUM SILICON ALLOYS AT 20 DEG. C

According to Richards,[7] the density of silicon at 20 deg. C. is 2.42. The density of aluminum of the purity used in making these alloys is about 2.705

The density curve of the alloys, calculated on the basis of such a linear relation between the specific volumes, is represented by the solid line in Fig. 1. The specimens cast in graphite, and having presumably the lowest porosity, are closely grouped along this graph. The densities of the sand-cast specimens containing approximately 2 and 4 per cent silicon were very much lower than this curve, and even after remelting and casting in graphite were still below the curve. The question arises as to whether the large variations in density observed with alloys of practically the same composition are caused by structural changes or are merely the result of variations in porosity. The density of the samples modified by the addition of a very small amount of alkali metal is slightly lowered. However, the lowest densities are not characteristic of the greatest grain refinement. The lowest densities are observed in the sand-cast specimens, whereas the greatest grain refinement is secured in the modified alloys chill cast. This would seem to indicate large variations in "porosity" of some kind. However, practical experience has demonstrated that aluminum-silicon alloys are unusual in their lack of permeability to liquids so that pore spaces if present must be isolated and small.

Frilley[8] has recorded a series of measurements on the density of the aluminum-silicon alloys. His data on the 10 and 20 per cent silicon alloys are about 5 per cent lower than the values given in the present paper. The reasons for these low results are not apparent.

Density of Solid Aluminum-Silicon Alloys at Higher Temperatures

In order to complete the density curves up to the melting point, the densities of two representative normal alloys were determined at temperatures of 200 deg. C. and 563 deg. C. These determinations also permitted an approximate calculation of the expansivity. Density at the lower temperature was determined by weighing the sample in air and when immersed in Crisco at a temperature of 200 deg. C. The density of the Crisco was determined at the same time as the weighing of the alloy by means of a platinum cylinder whose volume was accurately known.

A slow change in composition of the Crisco at this temperature made it difficult to secure an accuracy greater than 0.2 per cent. A new sample of Crisco was used for each series of measurements, and its density was checked by repeated weighings of the platinum cylinder.

Weighings at 563 deg. C. were made in a fused mixture of lithium and potassium sulphates. According to Nacken, quoted in Landolt Bornstein Tabellen, there is a eutectic mixture of these two salts which freezes at 535 deg. C. and contains 20 mol per cent of potassium sulphate. I used a mixture containing about 25 weight per cent of potassium sulphate, and found it quite satisfactory, although the freezing point of the salt (about 540 deg. C.) and the melting point of the aluminum-silicon eutectic (577 deg. C.) gave only a very small temperature range to work in, and made the measurements tedious and difficult

[7] J. Am. Chem. Soc. vol 37, p 1646 (1915)
[8] Revue Métallurgie, vol 8, p 457 (1911)

TABLE I DENSITY OF ALUMINUM-SILICON ALLOYS

Composition, Per Cent Si	Fe	Cu	Treatment	Density at 20 Deg C	Condition of Specimen
0 52	0 24		Normal	2 669	Sand-cast bars, ¼ in sq
2 01	0 30		Normal	2 652	Sand-cast bars, ¼ in sq
2 01	0 30		Normal	2 686	Recast in graphite
4 38	0 44		Normal	2 639	Sand-cast bar, ¼ in sq
4 38	0 44		Normal	2 669	Recast in graphite
8 37	0 42		Normal	2 680	Cast in graphite
8 83	0 41	0 26	Modified	2 653	Sand-cast test bar
9 61	0 43		Normal	2 675	Cast in graphite
9 79	0 43	0 04	Modified	2 654	Hard-rolled—14 gage
9 92	0 36	0 06	Normal	2 673	Cast in graphite
10 88	0 39	0 03	Normal	2 655	Sand-cast test bar
10 88	0 39	0 03	Modified	2 638	Sand-cast test bar
12 07	0 47		Normal	2 661	Cast in graphite
13 40	0 42	0 04	Normal	2 638	Sand-cast test bar
14 88	0 54	0 02	Normal	2 651	Cast in graphite
14 95	0 55	0 03	Normal	2 631	Sand-cast test bar
17 66	0 52	0 04	Modified	2 627	Sand-cast test bar

TABLE II—DENSITY OF NORMAL ALUMINUM-SILICON ALLOYS AT 200 DEG C AND 563 DEG C

Composition Si Per Cent	Fe Per Cent	Cu Per Cent	Mn Per Cent	Al Per Cent	Density (Grams per Milliter) 20 Deg. C	200 Deg C.	563 Deg. C
7.81	0 39	0 12	nil	91 68	2 678		2 570
7.81	0 39	0 12	nil	91 68	2 680	2.647	
7 81	0 39	0 12	nil	91 68	2 680	2 640	
11 63	0 45	0 11	nil	87 81	2 661		2 560
11 63	0 45	0 11	nil	87 81	2 663	2 635	
11 63	0 45	0 11	nil	87 81	2 663	2 626	
0 11	0 13	0 008	nil	99 752	2 689	2 653	

Density of Liquid Aluminum-Silicon Alloys

The graphite densimeter was used for determining the density of the liquid alloys. The density of relatively pure aluminum is known from the previous measurements referred to, and the effect of the addition of 8 and 12 per cent silicon was observed in the present series. Results are given in Table III.

These alloys were all normal alloys. The modified alloys, strictly speaking, exist only in the solid state, because the modification is a structural change taking place during the crystallization of the liquid. A liquid alloy with alkali metal added has only the potential property of becoming a modified alloy.

TABLE III—DENSITY OF LIQUID ALUMINUM-SILICON ALLOYS

Composition Si Per Cent	Fe Per Cent	Cu Per Cent	Al Per Cent	Temperature Deg C	Density g ml
7 81	0 39	0 12	91 68	663	2 413
7 81	0 39	0 12	91 68	802	2 375
7 81	0 39	0 12	91 68	904	2 345
11 63	0 45	0 11	87 81	643	2 441
11 63	0 45	0 11	87 81	801	2 392
11 63	0 45	0 11	87 81	904	2.356

A graph of these results indicates the expansion of the liquid alloy to be practically linear from the melting point to at least 1,000 deg. C., and the greatest deviation from a straight line fitted to the data is less than 0.1 per cent. In Table IV are given convenient values for these alloys as taken from the plotted graphs. Fig. 2 shows the freezing points of the aluminum-silicon

it freezes over a considerable range of temperature. Examination of ingots cast from 7.8 and 11.6 per cent silicon alloys showed that the 7.8 per cent alloy, which has a freezing range of 608 to 577 deg. C., showed the rounded edges and small piped cavity characteristic of the 8 per cent aluminum-copper alloy. The eutectic silicon alloy, however, had a more pronounced pipe than the 7.8 per cent alloy, even though its crystallization shrinkage was less. This difference in appearance is illustrated by Fig. 5. A 10 per cent silicon alloy might therefore be expected to have somewhat better casting qualities than a 12 per cent alloy.

The liability to segregation will probably be lower in the silicon alloys than in the copper alloy, because the densities of solid and liquid during freezing are very much closer together than in the case of the copper alloy. Some estimates on the 8 per cent silicon alloy showed that the densities of solid and liquid in equilibrium during freezing never differed by more than 5 per cent.

Ethylene Glycol: Its Uses and Properties

Some Interesting Fields of Usefulness for a Distinctly New and Unusual Solvent, Reagent and Preservative

BY G. O. CURME, JR., AND C. O. YOUNG
Carbide & Carbon Chemicals Corporation

IT is a point of interest that the organic chemical compounds which have had the greatest individual value to the chemical industries, as well as to the public at large, have been those classified chemically as members of the alcohol series. In particular ethyl alcohol, in its legitimate uses, and glycerine have found countless applications and are almost indispensable to the requirements of everyday life. To the rather limited number of such commonly available compounds there has been added, through recent commercial developments, the substance ethylene glycol, a solvent, reagent and preservative of unusual properties.

Ethylene glycol is a pure chemical substance, corresponding to the formula $C_2H_4(OH)_2$. It is a dihydric alcohol, of composition intermediate between that of glycerine and ethyl alcohol, and possesses valuable properties of both these important chemicals, as well as characteristic properties of its own. The pure ethylene glycol on the market is a water-white liquid (sp.gr., 1.116), without odor, possessing a pleasantly sweet taste. It is non-volatile (b.p., 198 deg. C.) at ordinary temperatures, and on exposure to the air it does not evaporate, but attracts moisture, thus giving it valuable moistening properties. It has a low freezing point, and furthermore serves well to lower the freezing point of water solutions; in moderate concentrations, it prevents freezing below the coldest winter temperatures.

As a solvent, ethylene glycol has many of the characteristics of ethyl alcohol and is an efficient solvent for many classes of compounds, such as esters, medicaments, resins, flavors and dyes. It is, of course, miscible with water in all proportions and also with ethyl alcohol and many other organic solvents. It has none of the intoxicating properties of ethyl alcohol; indeed, it appears to be quite harmless when taken internally, even in large amounts.

In view of the large uses for ethylene glycol which are possible in the foodstuff and pharmaceutical fields, research has been carried out to establish definitely its physiological action[1] as well as the bactericidal effects expected from its similarity to ethyl alcohol. Ethylene glycol has been demonstrated to be innocuous on the animal economy. Doses of considerable magnitude, continued for many weeks, produced no outward manifestation on test animals (rabbits). On autopsy, these animals showed no abnormal reactions or changes. From the results obtained it is apparent that this substance can be used without apprehension in the compounding of products for internal consumption.

In tests run in parallel with ethyl alcohol and glycerine, ethylene glycol has been shown to have marked preservative properties against standard cultures of bacteria. Ethylene glycol showed some inhibition at a 10 per cent concentration and was completely disinfectant at 20 per cent concentration. In these tests ethylene glycol showed a close approach to the bactericidal power of ethyl alcohol and to double that of glycerine.

In a commercial sense, ethylene glycol is so new to the chemical industries that the full number of its uses has not been standardized. New applications are being made continuously with good success, showing that in time it will take its place as a standard material in the same industrial class with ethyl alcohol and glycerine, not as a substitute, but as a pure material with irreplaceable properties of its own.

USES IN FOODS AND MEDICINES

Ethylene gylcol is a high-grade solvent and preservative for use in the manufacture of concentrated fruit flavors, fountain supplies and flavoring extracts. It also has much to recommend it as an ingredient in the compounding of food pastes, canned goods, ketchups, mincemeats, salad dressings and other commodities of like consistency. Flavoring extracts with glycol as the vehicle are considerably brighter in appearance, with less tendency toward turbidity, than similar products in which glycerine is used.

In the drug and medicine field ethylene glycol will be found to be a valuable solvent and preservative in liquid products wherein it is the desire to reduce or entirely eliminate ethyl alcohol. Its properties make it a much more desirable substance than glycerine, the preservative action of which is not uniform. Being much less viscous than glycerine, ethylene glycol alters but slightly the original character and consistency of the product, which thus retains the same appearance as when ethyl alcohol is used as the solvent and preservative. In many cases, too, the lower volatility of ethylene glycol makes it preferable to ethyl alcohol in compounding preparations which are apt to suffer from drying out due to loss of the alcohol. Toilet preparations and cosmetics which have combined antiseptic and emollient properties, such as facial creams, may also use glycol with success.

USEFUL MOISTENING AND ANTI-FREEZING PROPERTIES

The combined preservative and moistening characteristics of ethylene glycol recommend it for a wide number of uses, including the manufacture of many cosmetics, the preparation of anatomical and biological specimens, the treatment of skins and furs by the taxidermist, the moistening of tobacco and similar instances where a non-volatile material free from

[1]The discussion of the physiological action of ethylene glycol in this paper has been taken from a private communication from H. C. Fuller, which will be published in full detail at a later date.

injurious action or unpleasant taste or odor is required. For moistening smoking tobacco, especially, ethylene glycol possesses a distinct advantage in that no sharp, disagreeable products are formed upon burning, as is the case with a number of the moistening agents now used.

To the textile and leather industries ethylene glycol offers possibilities as an aid in the finishing and dyeing of fabrics and as a means of preserving the suppleness and flexibility of leather during processing.

The advantageous freezing-point depression which ethylene glycol shows in water solution again makes it valuable for use in preparation of extracts, medicines and toilet preparations and for industrial purposes such as lowering the freezing point of cooling water in automobiles and airplane radiators, exposed dashpots, gages, etc. In this latter connection, glycol solutions of different concentrations have been found to remain fluid at the following temperatures:

Concentration Per Cent of Ethylene Glycol	Safe Limit of Use, Deg. F
10	+14
15	[illegible]
22	[illegible]
30	-22
40	-38

As in the cases where denatured alcohol, glycerine or other anti-freezing mixtures are used, water solutions of ethylene glycol freeze over a range of several degrees as the temperature drops. Complete solidification, which results in damage to the radiator or water jacket, does not occur until a temperature considerably lower than that given in the above table is reached. Anti-freezing mixtures composed of ethylene glycol are not so volatile as alcohol solutions and do not lose their concentration through evaporation, nor do they possess the disagreeable odor characteristic of some denatured alcohol used today. As compared with glycerine or glucose, there is a much greater freezing point depression per weight of glycol used, and less tendency to become gummy or to caramelize. Because ethylene glycol is not an electrolyte and is perfectly neutral, there is no corrosion of any parts, even where copper, brass or aluminum are in contact with iron or with one another. Then, too, in effective concentration there is no action on rubber connections.

Ethylene glycol, on account of its low freezing point and lubricating properties, may also be used in gas meters and ice machines and where the use of a petroleum oil lubricant is undesirable.

Possibilities as a Reagent and Raw Material

As a technical reagent ethylene glycol has already found valuable application abroad in the preparation of explosives. Ethylene glycol dinitrate is in some ways superior to nitroglycerine in the manufacture of dynamite, being less sensitive to shock, having greater force in explosion, and, what is most important, constituting a necessary part of a dynamite, not subject to freezing, even in the coldest weather.

Another glycol derivative, glycol diacetate, has been found to be a cellulose ester solvent, comparable with the widely used amyl and butyl acetates. It has the great advantage that it is practically odorless; furthermore, it has a higher boiling point (186 deg. C.), which permits the same effect with less material in prepared cellulose solutions. The solvent properties of glycol diacetate toward organic compounds and dyes suggest also applications similar to those of the glyceryl acetates which are used so frequently in the printing and dyeing of cotton and as solvents in the coloring of pyroxylin plastics.

The commercial production of ethylene glycol comes at a time when the American chemical industry is asserting itself strongly in world competition after the removal of the direct effects of the war. In Europe ethylene glycol is already finding ever-increasing fields of usefulness. Consequently an American source of this material will no doubt be of value to many of our industries and will assist in keeping them in the forefront.

New York City

Manufacture of Varnishes in 1921

Reports made to the Bureau of the Census show a decrease in the volume of business done by the establishments engaged primarily in the manufacture of varnishes, japans and lacquers during the year 1921 as compared with 1919. The total value of products reported for 1921 amounted to \$71,239,000, compared with \$83,632,000 for 1919, a decrease of 14.8 per cent. Of the 222 establishments reported for 1921, 43 were located in New York, 35 in Illinois, 30 in New Jersey, 28 in Ohio, 17 in Pennsylvania, 12 in Missouri, 11 in Massachusetts, 8 each in Indiana and Michigan, 6 in California, 5 in Kentucky, 4 in Connecticut, 3 each in Maryland and Minnesota, 2 each in Maine, Oregon, Rhode Island and Virginia and 1 in Wisconsin.

The decrease in the value of products has been accompanied by decreases in the cost of materials used, and in the amount paid to salaried employees; but the returns show an increase in the average number of wage earners employed and in the amount of wages paid. In May, the month of maximum employment, 4,396 wage earners were reported; and in February, the month of minimum employment, 3,954 the minimum representing 89.9 per cent of the maximum. The average number of wage earners employed during the year was 4,138 as compared with 4,022 in 1919. A classification of the wage earners with reference to the prevailing hours of labor in the establishments in which employed shows that for 2,411, or 58.3 per cent of the total (average) number, the hours per week were between 48 and 54; for 618, or 14.9 per cent, they were 48 per week; and for 777, or 18.8 per cent, they were less than 48 per week; only 332, or 8 per cent, were reported by establishments in which the prevailing hours of labor per week were 54 or more.

The statistics for 1921 and 1919 are summarized in the following statement; the figures for 1921 are preliminary and subject to such change and correction as may be found necessary from a further examination of the original reports.

	1921*	1919*	Per Cent of Decrease†
Number of establishments	222	229	
Persons engaged	6,962	7,385	5 7
Proprietors and firm members	54	72	
Salaried employees	2,770	3,291	15.8
Wages earners (average number)	4,138	4,022	§2 9
Salaries and wages	\$12,888,000	\$12,821,000	§0 5
Salaries	7,027,000	8,253,000	14 9
Wages	5,861,000	4,568,000	§28 3
Paid for contract work	4,400	39,900	89.0
Cost of materials	44,084,000	51,508,000	14 4
Value of products	71,239,000	83,632,000	14 8
Value added by manufacture‡	27,155,000	32,124,000	15 5

* Figures for 1921 do not include establishments reporting products under \$5,000 in value, thus excluding 10 establishments which employed 84 wage earners, and in the aggregate reported products to the value of \$31,060. The figures for 1919, however, include 9 such establishments, which employed 6 wage earners, and reported products to the value of \$20,035.

† Percentages omitted where base is less than 100

‡ Value of products less cost of materials.

§ Denotes increase.

The Low-Temperature Carbonization of Coal

IV—Improved Type of Primary Retort for Low-Temperature Carbonization and Results Obtained Therewith

BY HARRY A. CURTIS AND WALTER J. GELDARD

IN ONE of the previous papers[1] of this series the authors described the various commercial-size retorts for low-temperature carbonization which were built and tested at Irvington, N. J., up to the time when the Clinchfield plant was put into operation. The development work at Irvington was continued, however, for a little more than a year after the Clinchfield plant was started. During this time the most noteworthy large-scale development at Irvington consisted in the construction and testing of a modification of the Clinchfield type of retort. This latest retort, known in the company's records as Retort No. 25, is shown in Figs. 1 and 2. It differed in a number of ways from the Clinchfield type, the most important modifications being as follows:

a. A readily removable cast-iron top on the retort in place of the complete carborundum muffle used at Clinchfield.
b. A regenerative type of heating in place of the recuperative type.
c. The discharge screws placed just below level of retort floor at discharge end instead of at bottom of a vertical chute several feet long.
d. Provisions for greater agitation of the coal during carbonization, through increasing the number of paddles per shaft and through increasing the speed of rotation of the shafts.

Aside from these major differences there were many minor ones, such as gearing the two paddle shafts together; provisions for wider variations in speed of paddle shafts; two pairs of discharge screws in place of one pair, etc.

Retort No. 25 was designed by C. V. McIntyre with, of course, the co-operation of various other members of the company's technical staff. While later experience at Clinchfield has pointed out ways in which to improve Retort No. 25, this retort, nevertheless, represented a very distinct advance in the art of low-temperature carbonization.

COAL FEED

Coal to be carbonized was crushed to pass a ¾-in. screen, weighed, put through a drier and delivered as required to a feed screw hopper. Coal was fed to the retort by a 9-in. screw operated intermittently, the rate of feed being controlled by an electric "flasher" for varying the "on" and "off" periods of the screw. This method of feed control proved far inferior to the Clinchfield type, where the screws are run continuously, their speed being controlled by gear changes.

AGITATION OF COAL IN RETORT

The two paddle shafts were made of steel pipe with the paddles held in place by two bolts per pair of paddles. Provision was made for eighty paddles per shaft, more than twice the number used in the Clinchfield retorts. The paddle shafts carried 34-in. gears at the feed end of the retort, these gears meshing with each other, the left-hand gear being driven by a pinion. A train of gear changes on the pinion drive permitted rotation of paddle shafts at various speeds between 0.43 r.p.m. minimum and 19.55 r.p.m. maximum. A 25-hp. motor was used to drive the paddle shafts.

While there was wider range of possible paddle speeds, the whole mechanism for agitating the coal in Retort No. 25 must be considered as mechanically inferior to the corresponding Clinchfield machinery. The idea of using steel or wrought-iron pipe for paddle shafts is probably a good one, since it is very much cheaper than the cast-steel paddle shafts used at Clinchfield. In Retort No. 25, however, the bearings were poor and it was very difficult to get at the stuffing boxes behind the large gears. It would probably be better to put steel gudgeons in the ends of the pipe and carry the shafts on heavy bearings a foot or so away from the retort end castings. The end thrust on the paddle shafts should be taken care of at the feed end of the retort.

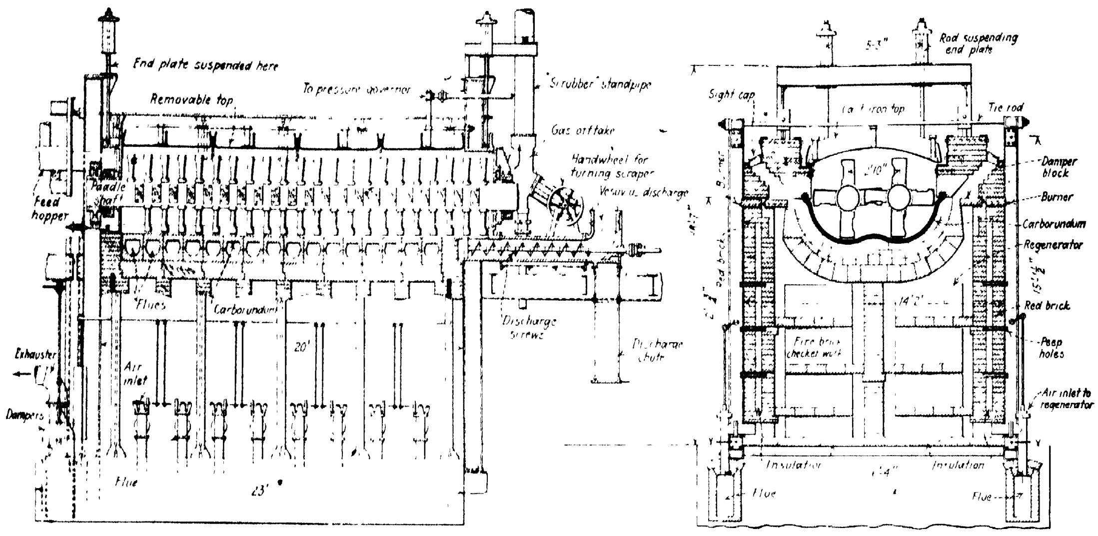
The question as to just how much agitation of the coal is desirable during carbonization has not been clearly settled. It was found, however, that the capacity of Retort No. 25 was very considerably decreased by removing half the paddles—i.e., using only the number of paddles adopted in the Clinchfield type of retort. Since the paddle speed during this test was still nearly twenty times that used at Clinchfield, it is very likely that the agitation of the coal in the Clinchfield retorts is very far below the optimum for high capacity of retort.

REMOVABLE TOP FOR RETORT

This represented a very considerable improvement in Retort No. 25 as compared with the Clinchfield retorts. In the first place, the cost of the cast-iron top is much less than the cost of the carborundum which it replaces. But its big advantage lies in the fact that the time of shut-down required to clean the carbon deposit from the retort wall is greatly reduced. At Clinchfield it requires a minimum of 12 days to cool a retort, clean it out and bring it back into operation. The last time Retort No. 25 was cleaned out the total time of shut-down was 32 hours. When it is considered that a retort must be cleaned once every 60 to 90 days, it will be seen that the removable top is a great advantage. As a minor point the comfort of the workmen cleaning

GAS OFFTAKES, PRIMARY RETORTS

[1] *Chem. & Met.*, vol. 28, No. 1, p. 11, Jan. 3, 1923.



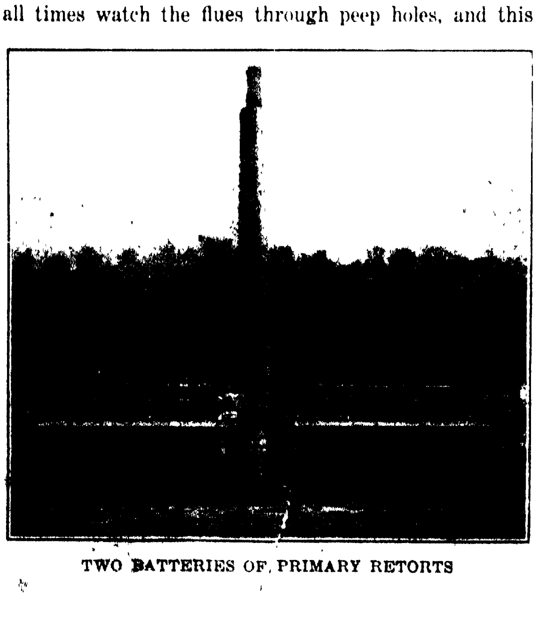
FIGS. 1 AND 2—RETORT NO. 25, A MODIFICATION OF THE CLINCHFIELD TYPE OF RETORT

the retort may be mentioned. The men don't mind how hot it is underfoot when they have head room and plenty of air, but they have to be driven to crawl into a hot retort through a manhole.

Heating System

The heating system on Retort No. 25 was much superior to that used on the Clinchfield retorts. Aside from any increased thermal economy to be secured through use of a regenerator type of furnace in place of a recuperator type, the use of regenerators on Retort No. 25 gave a cheaper furnace. The height of the Clinchfield retort above the foundations is over 25 ft., while the height of Retort No. 25 was only 15 ft. The burners on the Clinchfield retort are located in a tunnel underneath the retort, the flames impinging against the retort near the bottom. These burners are troublesome to operate and the burnerman cannot observe the flues without making a long climb to the top of the retort.

On Retort No. 25 the gas manifolds ran along either side of the retort with the flames passing down the flues and under the retort. The burnerman could at all times watch the flues through peep holes, and this aided very materially in getting good temperature control.



TWO BATTERIES OF PRIMARY RETORTS

Discharge Mechanism

In the Clinchfield type of retort the carbon residue from the retort drops down a vertical chute about 6 ft. long. A pair of breaker arms at the bottom of the chute break up the larger pieces and a pair of overlapping screws carry the material out and force it up over a dam which serves partly to seal the retort. This whole discharge arrangement is a mechanical abomination. The chute serves as a sort of chimney into the retort and the stacking effect of the hot gas therein draws air into the retort unless a relatively heavy gas pressure be carried in the retort. The sealing arrangement at the end of the discharge screws, known as a "Vesuvius" discharge, throws a heavy load on the discharge machinery and causes the gears, pinions and screw flights to wear out rapidly. It operated so poorly that it was eventually abandoned at Clinchfield and the hot carbon residue permitted to fall directly from the screws onto the conveyor belt.

On retort No. 25 the discharge chute and breaker arms were eliminated and the screws moved up to a position just below the floor level of the muffle. Two pairs of discharge screws were used in place of one pair. Unfortunately, the "Vesuvius" discharge at the outer end of the discharge screws was retained. Also there was no means provided for opening the inner end of the discharge screw housing to permit removal of tramp iron which occasionally gets into the retort with the coal and stalls the screws.

While the discharge mechanism of Retort No. 25 represents a considerable advance over the Clinchfield arrangement, it is believed that there is room for much improvement in this mechanism.

Gas Offtake

The gas offtake on Retort No. 25 was almost identical with that on the Clinchfield type of retort. The offtake was at the top of the discharge end casting of the retort. The gas issuing here was passed up through a vertical scrubber standpipe to the foul gas main, with a liquor spray operating in the standpipe. The hand-operated scraper or reamer for the gas offtake as used at Clinchfield was somewhat modified by gearing it to a

hand-operated driving shaft, and a screw thread was cut on the stem of the scraper in order to advance it regularly into the offtake. This scraper worked satisfactorily on Retort No. 25, but a similar installation on the Clinchfield retorts failed completely.

It is thought that the gas offtake and scrubber standpipe could be much improved. There is considerable objection to spraying the foul gas between the pressure governor (Tagliabue at Clinchfield; Smoot on Retort No. 25) and the retort, since the good effect of the governor is partly neutralized by the varying conditions of the spray in the scrubber standpipe.

Operation Data

Retort No. 25 was put under heat in January, 1921. After about 3 weeks' operation, fire destroyed most of the Irvington plant. Repairs were completed by the end of March and several more test runs made in April and May.

It was found very easy to control the temperature on Retort No. 25. Seven thermocouples were located in the retort shell at various points, with one couple in the gas space at the feed end and one couple in the gas space at the discharge end of the retort. With a shell temperature of 1,350 to 1,400 deg. F. (732 to 760 deg. C.) the retort would readily handle 1,700 lb. of coal per hour, reducing the volatile from 35 per cent in the coal to 14 per cent in the carbon residue discharged. Under these conditions the temperature in the gas space in the feed end of the retort was approximately 665 deg. F. and in the discharge end 1,035 deg. F. The retort made approximately 2,650 cu.ft. of gas per ton of coal carbonized, the gas having a calorific value of over 900 B.t.u. and often running as high as 1,000 B.t.u. (light oil vapors not removed). The fuel gas consumption per ton of coal carbonized was approximately 2,250 cu.ft., or about 85 per cent of the gas generated. In battery formation, with better regulation, the fuel gas consumption would no doubt be less.

The tar made was a light, mobile tar of specific gravity about 1.07 at 60 deg. F., the yield being approximately 25 gal. of dry tar per ton of coal.

The following data on one test run of 8 days illustrate the general character of the results obtained in all the tests:

1 Coal used. Pittsburgh Terminal coal (Pennsylvania) 162½ tons (dry)

	Dry Basis
Combustible volatile, per cent	35 3
Fixed carbon, per cent	57.9
Ash, per cent	6.8
Total	100
Sulphur, per cent	1 78
Nitrogen, per cent	1.66
B t.u.	13,925

Coal dried to a moisture of about 1 9 per cent before carbonized

2. Rate of feed, average 1,691 lb. per hour.
3. Retort shell temperature, average 1,392 deg F
   Temperature in gas at feed end, average, 610 deg. F.
   Temperature in gas at discharge end, average, 1,058 deg F
4. Gas made per ton dry coal carbonized, cu ft . . . 2,660
   Average B t.u. . . . 899
   Highest average B t u. for any 24 hr. . . . 1,010
5. Fuel gas used, cu.ft per ton coal carbonized . . . 2 406
6. Dry tar per ton of coal, gal. . . . 24.8
   Specific gravity of dry tar at 60 deg F . . . 1.0783

Distillation of tar: (Sample 2/9/21 to 2/12/21).

Fraction	Per Cent by Volume	Sp.gr. of Fraction	Per Cent Tar Acids in Fraction
0-170° C	2 77	0 8423	21
170-230° C	13.88	0.9235	36
230-270° C.	13 10	0 9828	47
270-300° C.	10.51	1.0071	38
300-310° C.	5 49	1 0193	37
Pitch	54.25	(M.P. 175.3 deg. F.)	

7. Carbon residue, estimated yield, per cent . . . 83.7
   Combustible volatile in dry semi-Carbocal, per cent . . 14.02

The foregoing results are remarkably good for a commercial-size retort. Unfortunately, experimental work at the Irvington plant was discontinued in the spring of 1921. It is planned, however, to rebuild Retort No. 25 eventually, and set it up with the improvements which have been developed during the past year. A test based on several months' continuous operation can then be made.

The New Idea in Trade Association

Equipment Association Differs Essentially From Single-Commodity Group in That Its Major Interest Lies With Equipment Users

By Roberts Everett
Secretary, Chemical Equipment Association

FOR 50 years there have been trade associations in the United States—one or two manufacturers' associations are of that age. Since shortly before the war, and with the increase most of course during the war, there have come into existence about 5,000 American organizations classified as trade and industrial or allied associations until, as an article in a New York newspaper recently said:

> Industry has been wittily compared to the medical profession and to the labor unions. Just as a consulting specialist will examine a patient as far down as the fourth vertebra but no further, and a pipe fitter will fit a pipe but not perform the next operation, so even obscurely small processes or manufacturing groups in industry are limiting themselves in organizations for combined self and public interest.

These associations, almost without exception, are composed of manufacturers of a single product—for example, machine tools, lumber, coal or bread.

The trade association motive and its distinguishing method, as represented by and expressed in these single-commodity organizations, have been and are quite obvious. The motive has been selfish—the promotion of the internal welfare of member companies or of the entire industry of which they are members; and the method, the promotion of those companies' common product as against some competitive product, the obtaining of legislative advantages for themselves as a group, the development of cost-accounting methods for their more intelligent common action, etc.

Searching for the Common Interest

In the last few years, however, a new idea in trade association has found expression. Its origin may be discovered in the equipment fields of a few important industries, and the idea itself is a reflection of an inherent relationship between industrial equipment of any sort and the field or fields in which such equipment is used. This new idea has expressed itself in motives no less selfish than those of the older, more numerous type of trade association; but in its method is its novelty.

Equipment companies, except they are manufacturers of a single item of equipment—for instance, spark plugs for the automobile industry, or ovens for the baking industry, or tanks for chemically based industries—have not among themselves the same things in common as have the manufacturers who, in any single industry, employ the diversified machinery, apparatus and supplies which a representative group of their equipment companies produce. Automobile manufacturers, or wholesale bakers, or dye producers, have identical problems in their separate industries, identical interests

throughout the whole range of their businesses, because the product which they make is common to them all. But what of the companies which produce the manifold equipment that these manufacturers in single industries employ?

Their interests, their problems, their constant concern are not so common. Even in manufacturing, for instance, their problems are not universally alike, for one class of equipment may be based on iron or steel, another on non-ferrous metal, another on wood, another on paper; one may depend on mechanical equipment, another on human craftsmanship; one on plant, another on science. But how about distribution? Only loosely are the selling interests of equipment manufacturers the same. One may distribute his product by registered parcels post; another may require a flat car to move a single item. Then is it cost accounting? No, for costs and cost-finding methods vary with the variety of equipment. Legislation? One equipment producer may depend for his raw material upon a foreign country and is therefore interested in a low tariff; another may require protection to make money. In one association successfully embodying the new idea in trade associations today are members whose "plant" consists of a laboratory, a stenographer and a shipping clerk, and other members whose capitalization runs to $20,000,000 and whose factories and offices dot the entire country.

The New Idea

Obviously, an entire group of equipment manufacturers—or to put it another way the manufacturers of the entire range of equipment essential to the life of any single industry—have just one broad thing in common: *Their direct interest in that industry or group of allied industries which use their equipment.*

So the new idea in trade associations—an idea being successfully exemplified today—comes down to this: To perfect an organization based on common interest not in the promotion of a product common to a group of companies, but in promotion of a group of altogether external industries which bear the relation to the members of the organization of buyer to seller. The equipment manufacturer finds himself directly, abruptly and inescapably affected by the prosperity or poverty, the progressiveness or inertia, the optimism or discouragement of the industries which use his varied but essential products.

The new idea in trade associations reveals itself in equipment organization, as has been said, in method. An equipment association, just as naturally and obviously as does a single-commodity association, seeks primarily the protection of its members' business interests and those interests' advancement. But to find this it must survey the field of the users of the products which its members make; it must not merely "work for the buyer as well as for the seller," it must "work for the buyer because therein only can it work for the seller." To protect its interests and to increase them, it must safeguard its relationships already established with the buyer, and then advance that buyer's business so that the scope of such relationships may likewise widen.

The new idea in trade associations, then, brings the equipment group whose products are at the manufacturing base of an industry or an allied group of industries into the organized democracy of modern industry with a fundamental basis and purpose of constructive good will toward the industries which it supplies. It enlists the equipment group in the active, progressive development of the direct markets to which its equipment goes. It makes the equipment man an active agent in the development of his customers' and his prospective customers' affairs.

Activities of the Equipment Association

What are some of the logical activities of an equipment association? One is market expansion, another is educational market cultivation. Included in the first class is such co-operative work as the Chemical Equipment Association is now undertaking with the government in relation to export markets. Included in it is such clearing to its membership of domestic market information as the Chemical Equipment Association is now performing. Many other phases of market expansion are possible, even reaching to the public as a whole, if necessary.

In the second class may be included all activities which begin or end with a co-operative study of a particular industry's methods of manufacture, its use of equipment, the possibilities of adapting equipment used successfully in one industry to the more economical performance of an allied industry's manufacture, or accordingly, activities that result in better education in the use of equipment. Again using the Chemical Equipment Association as an example, one of its purposes is to "collect and disseminate information as to design, raw material and construction," obviously an activity which calls for co-operation with the industries using the equipment in establishing the most effective designs, construction and raw material possible. Another purpose of the Chemical Equipment Association, as still another example, is to "promote a better knowledge of conditions controlling the industry's development"—surely calling for the highest form of constructive co-operation with the manufacturing industries using chemical equipment.

Both of these classes of activity—market expansion and what is here termed as a very inclusive phrase, educational market cultivation—are premised on the user's needs. They both lead back to palpable, substantial benefits to the equipment group, but only through the latter's having actually engaged itself with the welfare and the needs of the user.

Research work and standardization work are two more logical activities of an equipment group. The Chemical Equipment Association, for instance, has as one of its purposes the standardization of trade phrases. Both these activities imply initial and constant consideration of the user's needs.

Business Ethics

Perhaps most important of all its natural activities is the prevention of trade abuses. One successful equipment association has gone so far as to establish a code of commercial practice which practically affords financial redress to the holders of equipment purchased through misrepresentation. It is true that such a defining of the honorable and the dishonorable in business affords a protection against unscrupulous action to the equipment manufacturer also. But that it protects him as well, in a manner otherwise probably impossible, does not lessen the fact that such activity by the equipment association foremost and signally protects the user.

Publicity—not merely for equipment manufacturers but constructively for the industries which use equipment—the general encouragement of high standards in

the allied using industries, legislative action when such action supports the interests of a using industry—these and still others that can be instanced are logical activities of an equipment association.

Constructive Influence Exerted

In a few industries which have been fortunate enough to develop trade associations at their supply and equipment ends, these associations have won a rapid esteem for the constructive influence they have exerted. An authoritative report to one industry in which such an equipment association exists, an industry in which certain unfortunate conditions prevailed at its inception, has cited that the association "in two short years has done very much to change the general conception of the industry from that of something undignified to something dignified, important and progressive." In another very important industry, the activities of an equipment association through certain standardization work and the adoption of certain general policies of relationship toward the using industry have automatically saved the latter amounts perhaps incalculable over a number of years.

Association Advantages

Nor is it to be concluded, simply because in its method the nature of equipment forces the employment of a new idea, that an equipment association proves negligent in its results to its own members. In return for its constructive interest in the industries which its members supply, those members attract an invaluable good will, an identification that goes beyond the merely commercial. Their association automatically becomes a receiving station of invaluable trade news, of business to be placed, of activities pending, that is cleared to them for immediate and confidential use. Their committees' findings in investigations of trade matters, their officers' contact with government officials and agencies, give its members inevitably informational assets and a prestige of position that brings directly traceable returns.

It has already been demonstrated in a number of fields that the industries using equipment have themselves expanded appreciably through the activities of the equipment trade association. In such expansion, it is only natural that the informational assets and the prestige of position which the members of an equipment organization enjoy give them some advantage in sharing in this new equipment business.

New York City

Manufacture of Cordage and Twine, 1921

The Department of Commerce announces that reports made to the Bureau of the Census show a decrease in the activities of the establishments engaged primarily in the manufacture of cordage and twine during the year 1921 as compared with 1919. The total value of products reported amounted to $74,712,000 in 1921, and to $133,366,000 in 1919, a decrease of 44 per cent.

In addition, rope, cordage and twine to the value of $3,473,000 in 1921 and $9,163,000 in 1919 were reported by manufacturers whose chief products were jute and linen goods. Also, cordage and twine valued at $8,958,000 were reported in 1919 by cotton mills and establishments in other industries; corresponding figures for 1921 are not available at this time.

Legal Notes

By Wellington Gustin

Cancellation Provision Renders Contract Covering Purchase and Sale of Iron and Steel Bars Unenforceable

A little provision crept into an important contract between the Northwestern Bridge & Iron Co. and the Interstate Iron & Steel Co. which the United States Circuit Court of Appeals has held to make the contract unenforceable, and the U. S. Supreme Court upholds this court by denying to the plaintiff a writ of certiorari bringing up the case for further consideration. (278 Federal, 51.)

The Northwestern Bridge & Iron Co. of Milwaukee was a fabricator and erector of structural iron and steel and the Interstate Iron & Steel Co. was a manufacturer of iron and steel, with rolling mills at Marion, Ohio, East Chicago, Ind., and South Chicago, Ill. In March, 1917, they entered into two agreements, one respecting iron bars and the other steel bars. Both agreements were on the regular printed sales contract form of the seller steel company.

The Northwestern Bridge & Iron Co. brought suit on the two agreements for damages for breach by the steel company for failure to manufacture and deliver 200 tons of iron bars and 200 tons of steel bars, less a small amount of each shipped. Before the trial court it obtained a judgment for $35,259.37 damages against the steel company.

Clause Which Rendered Contracts Unenforceable

On the appeal the judgment was assailed upon various grounds, but the one which goes to the root of action is the contention that the contracts are not enforceable because of the clause in the contract reading:

"It is understood that if the tonnages are not specified as called for in this contract they shall be automatically cancelled."

Similar Cases Cited

In the suit the manufacturing seller set up that this provision left it entirely optional with the buyer to take or not to take any or all of the tonnage, and, no consideration appearing for the agreements to sell, neither party became obligated by the contracts. On this question a nnmber of decided cases were cited and the Court of Appeals found that contracts with provisions more or less similar, but involving substantially the same principle, have been held to be unenforceable. In American Cotton Oil vs Kirk, 15 C. C. A., 540 the memorandum of sale of 10,000 bbl. of oil provided "deliveries to be made per week as Kirk & Co. [buyers] desire." Passing on the validity of this contract, the court said:

"Suppose Kirk & Co. had not desired and had not ordered any such quantities as would require 100 years to complete the delivery—is there any way open to the defendant to put plaintiffs in default? We think not, and that there is no mutuality of promises for the sale of a definite or ascertainable quantity of oil."

In Oakland Motor Car Co. vs. Indiana Auto Co., 201 Federal, 499, the agreement was for sale of automo-

biles wherein there were provisions that no order shall be binding unless accepted by the manufacturer at least 30 days prior to date of delivery, and for cancellation by either party for just cause. There was no question, says the court, that the provision for cancellation alone would have rendered the contract unenforceable. But it was contended that the qualification "for just cause" saved the contract from the operation of the rule. The court held that the addition of those words did not exempt the contract from the application of the rule requiring the mutuality of obligation as a necessary element of a binding contract for future sale and delivery.

A provision in a contract of sale requiring the buyer to make periodical specifications of his requirements of products of substantially equal quantities is not a mere formality to be observed or not, but a material provision, and the parties will be held to its observance, especially where the seller is a manufacturer and the articles are of various dimensions, which the manufacturer cannot know until the buyer specifies them.

Where Printed and Written Provisions Are Inconsistent, Latter Prevail

Again, the court says, every part of a written instrument should be given effect so far as possible. But it was urged that in the printed form of the contract there is recited a sale and purchase of the iron and steel bars, and therefore in order to give effect to this part of the contracts they should be held to be sales rather than options to purchase. The rule of law is that where there is irreconcilable difference between formal printed portions of an instrument and other parts of it which are written in the latter will prevail. If the effect of this special clause is to make it optional with the buyer whether he will take any of this tonnage, this is inconsistent with the recited sale and purchase, and the special clause would prevail. The words "buy" and "sell" express a conclusion, and if the things actually agreed upon fall short of making a contract of purchase and sale, then no such contract is effected. Now from the contract it appears that these parties were dealing with something which had no existence and could therefore not be the subject of a present sale, but the subject matter of the contract had first to be manufactured after the buyer made timely requisition therefor as in the contract provided.

Buyer Did Not Specify Tonnages

For over 3 months after the contracts were executed the buyer did not see fit to make any specifications whatever, although the contract provided for substantially equal monthly tonnages during the contract period. The buyer had every reason to believe that the special provision for automatic cancellation operated to cancel each month's tonnage, where no specification was given. The court says it surely could not expect to wait until the end of the contract period, and then, if deemed advantageous, order out the entire 400 tons.

And the provision that if the tonnages were not specified as called for therein, they should be automatically canceled was not a mere provision for the protection of the seller, to be exercised by it or not at its option, especially where another part of the contract provided for cancellation by the seller at its option in case of delay in payment.

Neither did the seller steel company waive its right to set up the invalidity of the contracts because of the provision for automatic cancellation, by disputing the buyer's right under the contract to specify greater widths than 6 in., instead of asserting the invalidity of the contract, or by offering to supply the entire tonnage ordered in lesser widths, it previously having called attention to the provision for automatic cancellation. This claim of waiver of conditions in the contract on the part of the seller arose out of specifications submitted for the steel of greater widths than contemplated under the agreements. The court says the seller might have been willing to supply the full tonnage of the smaller width steels and iron. But this waived nothing, and was merely a proposal to enter into another agreement to supply at the contract prices tonnage which, had the agreements been valid, would at that time have been largely canceled.

Again, there appears no such situation as was present where contracts seemingly somewhat similar have been upheld, such as contracts to supply a buyer's entire season's requirements, to take a manufacturer's entire output, to sell to the buyer alone all the seller may acquire of a particular article for a definite time. But the two contracts in question in this case left the buyer with the unqualified right, and with entire impunity, to cancel the contracted tonnage from month to month until at the end of the time fixed none of it remained; both parties being free to buy or sell elsewhere as they saw fit. Such contracts are in quite a different class from those just mentioned. The latter are unenforceable and hence invalid.

Iron Ore Produced in 1922

The iron ore mined in the United States in 1922, exclusive of ore containing more than 5.5 per cent of manganese, is estimated at 46,963,000 gross tons, an increase of 60 per cent as compared with that mined in 1921. The ore shipped from the mines in 1922 is estimated at 50,046,000 gross tons, valued at $158,222,000, an increase of 88 per cent in quantity and of 76 per cent in value as compared with the figures for 1921. The average value of the ore per gross ton at the mines in 1922 is estimated at $3.16; in 1921 it was $3.37. The stocks of iron ore at the mines, mainly in Michigan and Minnesota, apparently decreased from 13,836,267 gross tons in 1921 to 10,699,000 tons in 1922, or 23 per cent.

These estimates, which are based on preliminary figures furnished by producers of 98 per cent of the normal output of iron ore, were made by Hubert W. Davis, of the United States Geological Survey, Department of the Interior. They show the totals for the principal iron-ore producing states, and, by grouping together certain states, the totals for the Lake Superior district and for groups of southeastern and northeastern states.

Imports and Exports

The imports of iron ore from Jan. 1 to Sept. 21, 1922, amounted to 684,387 gross tons, valued at $2,894,496, or $4.23 a ton. The imports for the year 1921 were 315,768 gross tons, valued at $1,075,909, or $3.41 per ton. The exports of iron ore for the 11 months ended Nov. 30, 1922, amounted to 602,095 tons, valued at $2,770,160, or $4.60 a ton, as compared with exports for the entire year 1921 of 440,106 tons, valued at $2,077,620, or $4.72 a ton. The statistics of imports and exports were compiled from the records of the Bureau of Foreign and Domestic Commerce of the Department of Commerce.

Book Reviews

CHEMICAL ENGINEERING CATALOG. Seventh edition. The Chemical Catalog Co., Inc., New York.

This very useful publication which appears for the seventh year is now almost a standard reference book for chemical engineers. There need be no lengthy descriptive review, as the scope of the book is well-known.

It is a little too top-heavy on laboratory ware with the 65-page catalog of the Will Corporation inserted bodily, but I see no satisfactory solution to that particular problem. The Classified Directory is well made up and extremely useful. In the next edition I would suggest slightly less body to the type in which the subject headings are printed. A more graceful type would make the directory pages easier on the eyes.

The list of scientific and technical books is more complete than in past years and should prove valuable, although the publishers are usually more than generous with catalogs and this is, I should say, the least useful part of the book.

CHARLES WADSWORTH.

VAN NOSTRAND'S CHEMICAL ANNUAL. Edited by *J. C. Olsen*. Fifth issue, thoroughly revised and enlarged, 1922. D. Van Nostrand Co Price, $4 net.

There must be thousands of chemists (I know scores of them personally) who have had occasion to bless this useful book. Especially when one is at some distance from an adequate library where large reference books are available, it is invaluable to have such a compendium. Even with large books at hand, the convenience of using a little book is a big item in its favor. I should therefore conjure the editors not to expand it much further. It is bound to be incomplete, but in its selective incompleteness lies its merit. Keep it small.

To those who know nothing of this book I recommend an introduction by purchase. It will be impossible to discuss the handbook adequately for the complete stranger in a review. As chemist and chemical engineer I have found it a friendly companion and have frequently started on trips with Olsen and a slide rule.

The new edition contains more specific gravity tables, additional vapor tension tables and some table of properties of important elements. These are all sane additions. The specific gravity tables will be especially useful.

It is often a disappointment to find such meager data on solubility, but in all cases checked this has been due to the absence of data and not to any editorial oversight. The establishment of a solubility determination verein seems to be in order. The fifth edition is worthy of its predecessors.

CHARLES WADSWORTH.

Recent Chemical & Metallurgical Patents

American Patents Issued Jan. 9, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be stud'ed later by *Chem. & Met.'s* staff and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,441,203-4-5—Process of Manufacturing Artificial Silk and Other Products From Nitrocellulose. E. Bindschedler and G. Juer; assigned to Tubize Artificial Silk Co., Hopewell, Va.

1,441,206—Guanidine Salts. J. S. Blair and J. M. Braham.

1,441,219—Fertilizer Stock. A. Ehrenreich and Allen Rogers; assigned to Ocean Leather Co, New York

1,441,243—Tanning Liquor From Cellulose Waste Sulphite Lye. A Romer, Stuttgart.

1,441,341—Recovery of Aromatic Compounds. F. X. Govers, New York.

1,441,417—Purification of Hydrocarbons. D F. Gould; assigned to The Barrett Co.

1,441,541—Acetyl Cellulose. W. J. Stevenson, London, England.

1,441,542—Method of Treating Oil-Bearing Shale. H R Straight.

1,441,568—Electrodeposition of Copper. C G. Fink; assigned to Chile Exploration Co

1,441,573. Manufacture of Phosphorus R Franchot and K P McElroy; assigned to Ferro Chemicals Co., Washington, D. C.

1,441,598 Product From Furfural and Process of Manufacture. M. Phillips and G H. Mains, Detroit.

1,441,605—Waterproofing Composition. C D. Shaffer, assigned to Textile Leather & Metal Preserver Co., Kalamazoo, Mich.

1,441,612—Chrome Pigments — Norman Underwood, Oakton, Va.

1,441,655 — Manufacture of o-Sulphonic Acids of Aromatic Amines. F. Boddiley, J. B. Payman and H. Wignall; assigned to British Dyestuffs Corp., England.

1,441,664—Manufacture of Ink. Roy Cross, Kansas City.

1,441,694—Process of Making Fertilizer K P. McElroy; assigned to Ferro Chemicals, Inc., of Washington.

1,441,695—Process of Fixing Nitrogen. K P McElroy; assigned to Ferro Chemicals, Inc, of Washington.

1,441,696—Absorbent for Gases. C. P. McNeil and E P Brown, Whiting, Ind.

1,441,982—Artificial Resins. A. Heinemann, Berlin, Germany

1,441,989 — Production of Cellulose Ethers Leon Lilienfeld, Vienna, Austria.

Complete specifications of any United States patent may be obtained by remitting 10c to the Commissioner of Patents, Washington, D C.

Limekiln — Valentine Arnold, of Woodville, Ohio, has patented certain improvements on a limekiln. These consist substantially in constricting the kiln above the burning zone so as to have it act as a gas choke. This burns the lime more effectively than is possible under the present conditions. The other improvement is the change in shape of the kiln from circular to rectangular below the burning zone. A distinct operating advantage is claimed for this improvement as well as the other. (1,439,597. Dec. 19, 1922.)

Synthesis of Ammonia From Its Elements—T. C. Clancy, of Niagara Falls, N. Y., has assigned to the Nitrogen Corporation of Providence two patents (1,439,291 and 1,439,292), both of which have to do with the preparation of a catalyst which is claimed to be an improvement on his already patented process. The catalyst in brief is made from calcium ferrocyanide by immersing small lumps of pumice about the size of a pea in a solution of pure calcium ferrocyanide, which is sulphur free, etc. The solution is then evaporated to dryness and the lumps of pumice are dried further. Finally, they are put into an autoclave and heated gradually up to a temperature of 350 deg. for a number of hours. As the temperature increases air or oxygen must be excluded from the autoclave, and this is usually done by displacing them with hydrogen and nitrogen. The improvement in the process consists in finally heating the catalyst in the presence of ammonia for a number of hours at a temperature which is somewhat more than 400 deg. but below 650 deg. A catalyst prepared in this way is very much more durable and can be used for upward of 40 days instead of 25 days. (1,439,291 and 1,439,292. Dec. 19, 1922.)

Apparatus for Solvent Recovery—W. K. Lewis and William Green, of Newton, Mass., have developed a process for the recovery of solvents used in applying rubber to belting and other fabric. The patent is much broader than this specific case, however, and the principles may be applied to a large number of processes. The drawings and details of the process are somewhat too complicated for a brief review. Briefly, the solvent is removed from the belting by means of heated flue gases in a closed chamber. The advantage of using flue gases here is that it eliminates the use of air, with which benzol particularly forms a very explosive mixture. The flue gases and benzol vapors then are pumped through a tower suitably packed and through which is flowing a stream of heavy hydrocarbon oil, which absorbs the benzol (or gasoline). The flue gases then continue through the cycle, are somewhat preheated first and then passed into the chamber in which the

belting is dried. The solution of benzol (or gasoline) in oil is then pumped through heat exchanges and through a still, which removes the benzol (or gasoline) from the oil, which in turn is returned to the tower for absorbing more solvent. The use of high vacuum, the injection of steam into the still, and the use of the counter-current flow principle throughout the system are among the unique characteristics of the process. (1,437,980. Dec. 5, 1922.)

Process for the Manufacture of Compressed Hydrogen—Georges Claude, of Paris, France, has assigned this patent to L'Air Liquide Société Anonyme pour L'Etude et L'Exploitation des Procédés Georges Claude, of Paris, France. The process consists essentially in compressing hydrogen to from 50 to 300 atmospheres and then absorbing all the other gases which are normally associated with it, such as methane and carbon monoxide, in ether at a temperature of approximately 60 deg. C. Curiously enough, at moderate pressures of 300 atmospheres and at very low temperatures the differential solubility of carbon monoxide and hydrogen is very much greater than it is at ordinary pressures and temperatures. Advantage is taken then of this fact in separating the carbon monoxide from the hydrogen. The other gases have a higher differential and do not present so serious a problem. (1,438,581. Dec. 12, 1922.)

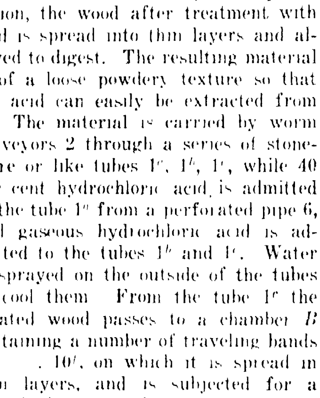
Urea Phosphate—German patent No. 286,491 describes the manufacture of urea phosphate by treating phosphoric acid with urea. Fuller Clarkson and Joseph M. Braham, of Washington, D. C., have attempted to prepare this substance, which is so excellently suited for a fertilizer, by following the specifications given in this patent which recommended adding to about a 50 per cent solution of phosphoric acid the corresponding amount of urea, and heating until all the urea went into solution, filtering and crystallizing. It was found that no crystals could be separated out unless a few crystals of urea phosphate were added to the solution to induce crystallization and that at best the maximum yield obtainable was 31 per cent. The conclusion was that urea phosphate cannot be made in accordance with the process described in this patent and this led to a series of experiments in which were studied the effect of varying the concentration of the reacting substances, the temperature of the solution and the crystallization temperature. It was found that an acid concentration considerably above 50 per cent is desirable, and further that the exact ratio of concentration of acid and urea in solution is not of great importance. They recommend the use of a 75 per cent solution of phosphoric acid and the addition of equi-molecular amount of urea in solutions. (1,440,056. Dec. 26, 1922.)

Apparatus for Extracting Valuable Material—W. C. Graham, of Denver, Colo., has patented an apparatus in which soluble matter is extracted from such materials as shredded or finely divided sugar beets or like material. The principle of the apparatus is to feed the finely divided material into a hopper with a screen in it and to wash it through the screen and subsequently through a large pipe or conduit by means of a centrifugal pump into a chamber. Here it is packed by the pressure of the pump. The chamber into which the finely divided solid flows is very large and consequently the solvent liquor, water in most cases, would reach a very high concentration during transit. (1,437,801. Dec. 5, 1922.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England

Glucose and Dextrine—In the process for obtaining dextrine and glucose from wood by treating it first with liquid and then with gaseous hydrochloric acid as described in the parent specification, the wood after treatment with acid is spread into thin layers and allowed to digest. The resulting material is of a loose powdery texture so that the acid can easily be extracted from it. The material is carried by worm conveyors 2 through a series of stoneware or like tubes 1^a, 1^b, 1^c, while 40 per cent hydrochloric acid is admitted to the tube 1^a from a perforated pipe 6, and gaseous hydrochloric acid is admitted to the tubes 1^b and 1^c. Water is sprayed on the outside of the tubes to cool them. From the tube 1^c the treated wood passes to a chamber B containing a number of traveling bands 10^a . . 10^f, on which it is spread in thin layers, and is subjected for a period of up to 11 hours to a temperature between 12 and 50 deg. C. and a pressure of about 1 cm of mercury. From the chamber B the wood passes to a chamber C containing a number of heated hollow floors 15^a . . . 15^g. The odd floors 15^a, 15^c, etc., are of greater diameter than the even floors 15^b, 15^d, etc., and are formed with central openings 18. The material is carried over the floors by scrapers 21 carried by arms 20 on a central shaft 22 and passes through the openings 18 and over the edges of the floors 15^b, etc. The temperature is maintained at 15 to 30 deg. C. and the evaporated hydrochloric acid gas is removed, compressed and re-used. The material passes into another chamber similar to the chamber C but maintained at a temperature of about 50 deg. C. and a pressure below atmospheric. The vapors are passed through a washing vessel, so that the liquid and gaseous hydrochloric acid used are recovered in nearly their original forms. The treated wood is boiled in water and the resulting solution filtered, neutralized and concentrated or fermented. (Br. Pat. 186,139. H. Terrisse and M. Levy, Geneva. Nov. 15, 1922.)



Centrifugal Machine—In apparatus of the type in which centrifugal force is used to drive washing liquid from the periphery to the axis of the separator through separated solid matter by the provision of a peripheral annular space to which the washing liquid is conveyed by passages from the axis of the separator, filtering material is carried by ribs or the like provided on the inner surface of the separator casing. The washing liquid is

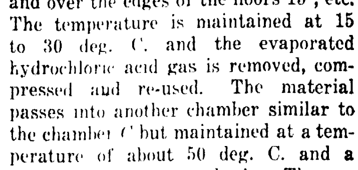


FIG. 1 FIG 2

supplied through a funnel i, Fig. 1, and is forced centrifugally through passages or pipes d into an annular space formed between the outer periphery b of the separator and a filtering cloth c or other filtering material carried on ribs or the like on the periphery. The washing liquid then passes inward through the separated solid g and escapes at the overflow h. Various openings may be provided in the top cover to provide different outlets and thereby variable thicknesses of separated material. Perforated annular pipes or conduits may take the place of the ribs on the outer wall. After washing, the separated material may be projected in a dry state while the machine is running through an opening f, Fig 2, normally closed by a valve k actuated by a handle y through a sliding sleeve w, bell crank levers v and rods u. (Br. Pat. 187,429. Chemische Fabrik Griesheim-Elektron, Frankfurt-on-Main, and F. Sander, Griesheim-on-Main. Dec. 13, 1922.)

Ink—Printing-ink is made by treating waste sulphite-cellulose lyes with nitric acid and a catalyst, preferably metallic copper or zinc, the product being used with coloring matters such as prussian blue and cinnabar, or being treated with sulphuric acid before the first reaction is completed to produce a black ink. (Br. Pat. 187,537. K. J. Smidt, Copenhagen, and R. Jaeger, Berlin. Dec. 13, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Arsenic Investigation Report Predicts Shortage

Government Bureaus Believe Urgent Demands Will Be Met and That Conservation Will Relieve Future Shortage

WHILE calcium arsenate supplies will not be entirely adequate for the requirements of 1923, supplies of white arsenic will be diverted from the manufacture of lead arsenate and from the manufacture of glass, thereby making available supplies sufficient to meet the more urgent demands. This is the purport of the report made jointly by the Bureau of Entomology and the Geological Survey in response to a Senate resolution. B. R. Coad, of the former, and G. F. Loughlin, of the latter bureau, are the authors of the report. They point out that there is an apparent shortage of about 5,000 tons of white arsenic in the supplies needed prior to May 1. It is admitted, however, that this shortage may be decreased by importations and by increases in production.

Industry Lacks Stability

There is great need, the report shows, for stabilizing the arsenic industry. It is apparent that the sources of supply are adequate and it is predicted that there will be sufficient white arsenic produced to meet the requirements of 1924 and subsequent years, provided the market can be kept sufficiently stable to encourage producers. Rapid increases in the demand for calcium arsenate may be expected, declares the report, "as the use of calcium arsenate as an insecticide has emerged from experimental stage"

Dr. Coad was given access to the books of the American Smelting & Refining Co., and of the United States Smelting, Refining & Mining Co. He has verified the statement of those companies that practically all of their output has been sold directly to the consumers and that their entire output until June 1 is under contract. The contract price for the material is around 9 cents per pound. The Anaconda Company also contracted for its output last October, so that the principal domestic producers, the report says, "are, therefore, unable to take advantage of the high prices (15 to 17 cents per pound in December, 1922) for any appreciable quantity of white arsenic. The conclusion is obvious that any recent speculation in white arsenic has been with imported material." Even in the case of foreign arsenic, it was admitted that such speculation as was discovered involves only extremely small amounts. No stock is taken in the rumors that large amounts of white arsenic are being held to influence the price.

With the view of stabilizing the arsenic industry, a co-operative study by the Geological Survey, the Bureau of Mines, the Bureau of Chemistry and and the Bureau of Entomology "of the appearance and supplies of arsenical ores, their reduction and the manufacture and use of arsenic compounds" is suggested in the report. Reference also is made to the benefits which will follow concerted action among producers, manufacturers and consumers.

The shortage of 1922 was brought about by the sudden slump in the demand for this material in 1921. The decline in the price of cotton made it impossible for the Southern farmers to buy Apparently the manufacturers did not foresee the possibilities of heavy purchases in 1922. As a result prices reached a point early in 1922 where manufacturers were discouraged from adding to their stocks, which were unusually large at the beginning of 1922.

Early last year, the report points out, there was 8,000,000 lb. of calcium arsenate in warehouse storage. Southern banks, convinced that calcium arsenate had passed the experimental stage, were liberal in financing purchases and as a result stocks soon were exhausted. Altogether about 16,000,000 lb. of calcium arsenate was sold in 1922, without satisfying the demand.

It was not until the fall of 1922 that prices for white arsenic were high enough to stimulate production. The steady increase in production which began in 1914 was offset in part by a decline in imports. A part of that increase undoubtedly was due to war demands. The present demand for white arsenic is estimated by the Geological Survey to be 12,000 tons a year. The capacity of the white arsenic refineries is 18,000 tons annually. The Geological Survey also estimates that at least 25,000 tons could be saved each year as a byproduct in the smelting or arsenical ores in the Western states.

The present minimum annual demand for white arsenic is itemized by Dr. Coad as follows: Calcium arsenate, 3,500 tons; glass, 2,000 tons; lead arsenate, 2,000 tons; weed killers, 1,500 tons; paris green, 1,200 tons; dips, 1,000 tons; proprietary mixtures, 750 tons.

Ford Would Make Calcium Arsenate

That Henry Ford has under consideration the possibility of manufacturing calcium arsenate at Muscle Shoals, in case he should obtain rights there, was revealed in the course of debate in the House of Representatives on Jan. 16. Representative Wright of Georgia declared that the Detroit manufacturer is investigating to see if the manufacture of calcium arsenate cannot go hand in hand with the fixation of nitrogen.

Mr. Wright expressed the belief that "practically every big industry and financial concern in the United States is fighting the Ford offer." This led Representative Garner, the ranking member on the Ways and Means Committee, to suggest that the President himself is the most powerful opponent among those who have arrayed themselves against the Ford Muscle Shoals proposition.

Representative Hull of Iowa entered the debate to state that he is opposed to the Ford offer because Mr. Ford is insisting that Congress do an immoral act in proposing that it award to him something which the government does not own—the Gorgas steam plant.

Executive Order May Adjust Wage Scale of Federal Employees

An executive order may have to be issued to provide an adequate scale of salaries for professional positions in the government service. Congress has wrestled with this question for more than two years, and now as the session is about to close, the reclassification legislation seems to be jammed hopelessly. It is just possible that Congress, on learning that the President is prepared to meet this situation by an executive order, may compromise its differences and provide the long-needed legislation.

If an executive order is issued, it is believed the scale would be about as follows: Chief professional, $7,500 and up; full professional, $5,700 to $7,500; associate professional, $4,500 to $5,700; assistant professional, $2,460 to $4,500; junior professional, $1,860 to $2,460.

Ceramic Society Plans Comprehensive Program

Symposia on Burning and on Consumers' Problems, With Question Boxes to Bring Out Valuable Discussion

For the silver jubilee convention of the American Ceramic Society, Pittsburgh, Feb. 12 to 16, the refractories division has prepared an exceptionally valuable program. General papers on various phases of the industry will be supplemented by sessions on burning and on consumers' problems. The question boxes, which have been found so helpful at recent meetings of the division, are designed to bring out discussion on important points which are not covered by the papers. The program of this division—and of the other divisions of the society as well—will be presented at the Fort Pitt Hotel, Pittsburgh, Tuesday and Wednesday, Feb. 13 and 14.

Following is the program:

SESSION ON CONSUMERS' PROBLEMS

1. Refractory Requirements for Stokers, George I. Bouton, Murphy Iron Works.
2. Refractories From Consumer's Standpoint in the Gray Iron Foundry Air Furnace, R. F. Harrington, Hunt-Spiller Manufacturing Corp.
3. Metallurgical Requirements of Refractories in Copper Smelting and Refining, Francis R. Pyne, U. S. Metals Refining Co.
4. Refractory Requirements for Oil Refining, Alan G. Wikoff, *Chemical & Metallurgical Engineering*.
5. Refractories in Malleable Iron Furnaces, H. G. Schurecht, U. S. Bureau of Mines.
6. Refractories and the Malleable Iron Plant, A. F. Gorton and Mr. Schwartz, National Malleable Castings Co.
7. Suspended Boiler Arches, J. E. Harlow, M. H. Detrick Co.
8. Metallurgical Requirements of Refractories, D. A. Lyon, U. S. Bureau of Mines.
9. Metallurgical Requirements of Refractories in the Gas Industry, W. H. Fulweiler, United Gas Improvement Co.
10. Metallurgical Requirements for Refractories in the Electrochemic Metallurgy of Zinc, B. M. O'Harra.
11. Metallurgical Requirements for Refractories in the Aluminum Industry, R. J. Anderson.
12. Metallurgical Requirements for Refractories for Furnaces Melting Copper Alloys, H. W. Gillett.

QUESTION BOX ON CONSUMERS' PROBLEMS

1. Is it necessary to inspect 9 in. sizes for dimensions? E. E. Ayars.
2. What specification limits should be considered as reasonable on dimensions of 9 in. fireclay brick? A. F. Greaves-Walker.
3. Will results in practice justify the expenditure and added cost necessary in order to make firebrick mixes from definite percentages of definitely sized clay grains? A. F. Greaves-Walker.
4. Should the softening point specifications on high heat duty firebrick be raised in view of the fact that consumers are gradually increasing temperatures, or should another classification be added with more severe requirements? A. F. Greaves-Walker.
5. Is a serious effort being made by manufacturers of fireclay refractories to produce 9-in. brick of full size standard dimensions? A. F. Greaves-Walker.
6. Is the A.S.T.M. spalling test too severe? If so, what changes are suggested? A. F. Greaves-Walker.
7. What is the effect of TiO_2 in amounts less than 2½ per cent on the fusion point of clay refractories? A. F. Greaves-Walker.
8. What is the best type of refractory brick to use in the side walls of air furnaces? C. E. Bales.
9. Does the use of powdered coal decrease the life of firebrick in malleable iron furnaces? C. E. Bales.
10. What is the cause of rapid failure of firebrick in the open checkerwork baffles of oil-fired boilers, subjected to a temperature of 2,300 deg., and against which the oil flame does not impinge? E. E. Ayars.
11. Is the present fusion point of the well-known brands of flint city refractories lower than it was on the same brands in 1900? A. F. Greaves-Walker.

SESSION ON BURNING

1. Burning Fireclay Refractories, E. H. Gartrell, Ashland Brick Co.
2. Use of Pyrometers in Burning Refractories, R. P. Brown, Brown Instrument Co.
3. Producer Gas for Burning Refractories, W. D. Richardson, Ceramic Engineering Co.
4. Burning Refractories, George A. Balz, Seaboard Refractories Co.
5. Notes on Burning Refractories, With Special Reference to Control of Labor Costs, L. C. Hewitt, LaClede-Christy Clay Products Co.
6. A New Tunnel Kiln, R. H. Miller.
7. Insulation of Periodic Kilns, J. H. Krusen, A. P. Green Fire Brick Co.
8. Burning Silica Brick, F. A. Harvey, U. S. Refractories Corp.
9. Changes in Constitution of Fireclays With Varying Heat-Treatment, A. A. Klein, Norton Co.
10. Discussion of Mr. Klein's Paper to be led by U. S. Bureau of Mines Men.

QUESTION BOX ON BURNING

1. Are Shaker Grates or Hand Stokers Suitable for Obtaining of Cone 20 in a Round Down-Draft Kiln? E. E. Ayars.
2. Is Oil Firing Adaptable to the Round Down-Draft Kiln in the Burning of Refractories at Cones 18 to 20? E. E. Ayars.
3. Is the Coal Consumption Per Thousand Brick at a Given Cone Higher With Low Volatile Coal Than With a High Volatile Coal When Burning Refractories Above Cone 10? A. F. Greaves-Walker.

GENERAL—SPECIFICATIONS, RESOURCES

1. Some Thermal Studies, M. F. Beecher, Norton Co.
2. Analysis of High-Alumina Refractory Products, C. A. Underwood, American Refractories Co.
3. Progress Report on Tests for Firebrick Specifications, R. F. Geller, U. S. Bureau of Standards.
4. Chrome Refractories, J. S. McDowell and H. S. Robertson, Harbison-Walker Refractories Co.
5. Ganister of the Baraboo Range, Dr. W. O. Hotchkiss, University of Wisconsin.
6. Quantitative Status of the Flint Fireclays of Maryland and Kentucky, Prof. W. R. Jillson, Kentucky Geological Survey.
7. The Flint Clay Situation in Pennsylvania, Dr. G. H. Ashley, Pennsylvania Geological Survey.
8. The Flint Clay Situation in Ohio, Wilbur Stout, Ohio Geological Survey.
9. Refractory Possibilities of Some Georgia Clays, Prof. R. T. Stull, U. S. Bureau of Mines.
10. Prospecting for Fireclays, E. W. Hess, Clearfield, Pa.
11. Silica Cement, E. N. McGee, Semet-Solvay Co.
12. Refractory Products of France, R. V. Widemann, Paris, France.
13. The Slag Test, R. M. Howe, Mellon Institute.
14. Resistance of Certain Types of Brick to Action of Slags, R. M. Howe, Mellon Institute.
15. Effect of Certain Gases at Various Temperatures Upon Structure of Refractory Brick, R. M. Howe, Mellon Institute.
16. The Development of Apparatus for the Determination of Heat Transfer Values in Refractories, A. S. Watts and R. M. King, Ohio State University.
17. Some Investigation Concerning the Influence of the Alkalis and Alkali Earths on the Fusion Temperatures of the Different Types of Refractory Clays, A. S. Watts and R. M. King, Ohio State University.
18. British Silica Bricks, W. J. Rees, director of research, University of Sheffield, England.
19. Testing of Refractories, W. J. Rees, director of research, University of Sheffield, England.

QUESTION BOX

1. How close can the volumetric determination of Cr_2O_3 in chrome ore be made to check with the gravimetric determination? C. A. Underwood.
2. Are two precipitations of lime in magnesite sufficient, or should the method requiring one cold and two hot precipitations be employed? C. A. Underwood.
3. Can diaspore, bauxite and spinel be thoroughly decomposed by acid treatment? C. A. Underwood.
4. Does the presence of alkali sulphates interfere with the precipitation of calcium oxalate? C. A. Underwood.

At all convention sessions and social functions, the ladies will have a most cordial welcome, and the local committee has arranged special entertainment for them.

There will be a reception and tea from 4 to 5:30 p.m. Monday, to which the gentlemen are invited. Luncheon at Heinz's on Tuesday will be followed by inspection of this famous plant. A luncheon and theater party will be given on Wednesday.

"Methanol" Officially Adopted for Alcohol Nomenclature

At a recent meeting of the board of governors of the National Wood Chemical Association, a resolution was adopted recommending the universal adoption of the designation "crude methanol" or "refined methanol" in place of the term "wood alcohol." The recommendation, which was broadcast to members of the association, follows:

> The large number of casualties due to drinking liquor containing wood alcohol has for many years directed attention to the necessity of adopting some measures that would remove the danger to human life and surround the use of this product with a greater degree of safety.
>
> One of the most advanced steps in this direction was taken when the American Chemical Society suggested the use of a word which did not contain the word "alcohol" and that the term "methanol" be employed. This term has since been used extensively by many large manufacturers, also by the Forest products Laboratory, the United States Tariff Commission, the Mellon Institute of Industrial Research, and others.
>
> Our association has given the matter due consideration and at a recent meeting of the board of governors adopted a resolution recommending that the term "wood alcohol" be discontinued and the term "crude methanol" or "refined methanol" used hereafter as the case might be. Railroad companies will be requested to make such changes in their classifications and tariffs as they may consider necessary to apply the same rates on shipments of "methanol" as are now published on shipments of wood alcohol, and your co-operation in effecting this change will do much toward accomplishing the desired result.

It is felt that this industrial endorsement of the chemists' recommendation marks a worth while decision.

Eastern Potash Corporation in Hands of Receiver

The Federal Court, New Jersey, has appointed custodial receivers for the Eastern Potash Corporation of New York, in the persons of James Kerney, Trenton, and Joseph H. Quigg, Newark. The company has an authorized capital of $7,500,000, and for some months past has been building a large plant in the Raritan River section of the state, for the manufacture of potash, chemicals and byproducts, utilizing local green sands and marl for raw materials. The new works are said to be practically completed, but have never been placed in operation. The liabilities of the company are stated as $3,000,000, and assets of approximately $1,000,000 in excess of this amount, without available cash. The corporation also owns a controlling interest in the Raritan Refining Co., with plant on the Raritan River, Raritan Township, N. J., and the Eastern Limestone Corporation, with works at McAfee, N. J.

Business Paper Editors Visit Capitol

Hear Durgin on Simplified Practice and Hoover on European Conditions

The National Conference of Business Paper Editors met in Washington on Jan. 15 for the purpose of conferring with Secretary Hoover, visiting the United States Bureau of Standards and conferring with the officials of the Chamber of Commerce of the U. S.

At the offices of the Chamber of Commerce the subjects discussed were the present status of the ship subsidy, the Chamber's referendum on education, and the effect on trade associations of the recent consent decree in the case of the United States vs. Gypsum Industries Association.

SIMPLIFIED PRACTICE

At the Bureau of Standards the members of the Conference were luncheon guests of the technical staff, later visiting the laboratories. One of the features of the afternoon was an illustrated lecture on simplified practice by William A. Durgin, head of the division devoted to that subject.

"Many of our industries—many more of our businesses—believe that we are suffering from too great variety in almost every article of commerce in this country," he said. "Leading men in widely different fields agree that the reduction of variety, the simplifying of industrial and commercial practice in any line, will secure some or all of these advantages:

"Simplified practice will decrease stocks, production costs, selling expenses, misunderstandings and all costs to user.

"Simultaneously, simplified practice will increase turnover, stability of employment, promptness of delivery, foreign commerce, quality of product, profit to producer, distributor and user."

Secretary Hoover has established the Division of Simplified Practice to serve as a centralizing agency in bringing producers, distributors and users together and to support the recommendations of these interests when they shall mutually agree upon simplifications of benefit to all concerned. Any group in any branch—production, distribution or use—can secure the services of the division upon request.

HOOVER ON ECONOMIC PROBLEMS

In the evening the Conference met with Secretary Hoover in the cabinet room in the Willard Hotel and listened to an instructive discussion of domestic and foreign economic and industrial topics of the day.

Industry and commerce in Europe have been hit on the head with a mallet as a result of the French seizure of the Ruhr Valley. It has sent a shiver down America's commercial spine, but it carries no threat of a financial catastrophe. In fact the Franco-German relations constitute the only really sore spot on the world's body politic. Sterling is nearly at par. Italy is showing great progress as are most of the other countries of Europe. Even Russia is improving fundamentally.

The effect of France's action will be felt most in America by the producers of small grains. Our manufacturing industries will not be affected greatly. As a matter of fact, it may stimulate the buying of our products by foreigners, since the drastic action of the French gives rise to some fear that the disturbance may become more general, thereby interfering with deliveries. This may cause buyers abroad to place orders immediately, which otherwise might not go forward for many months.

The situation also tends to accentuate that each nation lost the war from a material point of view. The French are the only ones who have refused to admit that fact. Europe, however, is in a much better position now to stand the shock of the French policy than it would have been a year ago. Great progress has been made throughout Europe, with the exception of France, Germany and Austria, in the matter of social, political and economic stability. The improvement in England is particularly marked and unemployment is 30 per cent less than a year ago.

Important Hydro-Electric Development Under Way in Canada

The pulp and paper interests of Canada have been aroused by the important announcement that a dam is to be built at the Grande Discharge from Lake St. John, Quebec, the headwaters of the Saguenay River, which will ultimately develop a million horse power, and will mark another step toward the realization of a dream on the part of certain Quebec politicians, that the province will eventually be lighted and heated electrically.

The contracts between the Provincial Government and the Quebec Development Co. providing for the carrying out of the project have been signed. The cost of the construction according to expert estimates will reach over $12,000,000. Price Brothers, who are at present increasing the capacity of their pulp mills, have guaranteed to buy $1,600,000 worth of power per year.

Public Meeting Planned in Honor of Pasteur

The evening of Jan. 28 will be devoted to exercises in honor of Louis Pasteur at the Town Hall, New York City. Chemical and medical societies have already held memorial meetings in commemoration of the hundredth anniversary of the birth of the French scientist, but this open meeting is planned especially for the general public. Ambassador Jusserand of France will preside and three or four brief addresses will be made by prominent educators and officials dealing with Pasteur's many activities. No charge will be made for the tickets of admission and they will be sent to the various contributors and societies for distribution.

Explains German Connection of New Potash Firm

Representative States That German Interests Are Not Backing Potash Importing Corporation

German interests are not backing the newly formed Potash Importing Corporation of America, according to an official statement of the company given to the New York *Times* on Jan. 18. The statement said that "neither the German Potash Syndicate nor any other German interests has stock in the Potash Importing Corporation of America; neither can they in any way influence the policy of the new corporation."

A. Vogel, American representative of the German Potash Syndicate, said:

"It has been stated that the German Potash Syndicate was anxious to conclude an agreement with an American corporation in order to avoid taxation at home and that Germany would be seeking another loophole to avoid reparations payments, as it is believed that payments for German potash will be allowed to accumulate in this country. The new agreement does not in any way change the liability of the syndicate to pay its German taxes, nor does the syndicate intend to accumulate dollar accounts in this country on account of the reparations matter, because the syndicate is in no wise involved in the reparations question.

"The chief reason for the syndicate entering into an agreement with the Potash Importing Corporation of America is the fact that I notified the syndicate more than a year ago that I would wish to retire within a reasonable time and that it would be necessary for the syndicate to look out for a successor, preferably in the form of an American corporation. The syndicate, therefore, accepted an offer of the Potash Importing Corporation of America to market and distribute the syndicate's products in the United States from May 1, 1923."

"Radium" Company Cited for Fraudulent Advertising

Advertisements by the Aaban Radium Company, Chicago, Ill., that a product manufactured by it contained radium is the basis of a citation just issued by the Federal Trade Commission.

Based upon a preliminary inquiry, the Federal Trade Commission has reason to believe that this firm's product contains no radio-active material and that its advertisements to that effect are deceptive.

Messrs. Abbott E. Kay and R. T. Nelson, co-partners trading as the Aaban Radium Company, are named in the citation and have been called upon to file an answer and appear at a hearing to be conducted by the Commission. At this hearing witnesses representing both sides will be examined to determine the truth or falsity of the firm's advertisements and thereafter a decision will be reached by the Commission.

Coal Commission Report Disappointing

Brings Out No New Data or Explanation of Price Spread Between Mine and Consumer

In its effort to be absolutely fair and to avoid placing responsibility before the blame is proved, the President's Coal Commission has brought out a report which is certain to be a disappointment to the consumers of coal and to many members of Congress. In the coal trade itself there is a very evident sense of relief. In the average investigation of this kind, it is customary to have some harsh things to say to operators, wholesalers and retailers, even before it has been established that they are guilty.

The Jan. 15 report has all the indications of a desire to avoid expressing conclusions until all the facts can be weighed. As a consequence, it may be predicted that the smaller consumers and a certain element in Congress will feel that the report is colorless and that the commission is not reaching the seat of the trouble. It does not express an opinion as to whether or not current prices are just. It does not say whether or not the miners are receiving a higher rate of wage than the consumers should be called upon to pay. No one is accused of profiteering. The report indicates in a general way something as to the spread between the cost at the mine and the delivery cost of coal, but it gives no clue as to who is responsible. Labor, transportation, over-development, storage and other matters are discussed, but little is said about the business factors in coal. For that reason it is certain that some of the gentlemen on Capitol Hill will conclude that the commission has written "Hamlet" with *Hamlet* left out.

Little New Data in Report

The more constructive thinkers both within and without the industry seem to be agreed that the commission did well in making haste slowly. Even those who are expressing much disappointment with the report are inclined to suspend final judgment as to the possibility of the commission bringing out something concrete at a later date.

A careful analysis of the report shows that there is little material in it which could not have been written on the first day that the commission sat. Nevertheless the presentation of this material is regarded as very valuable because the wide publicity will contribute greatly to the popular understanding of the entire subject. The report must be regarded more as a statement of the problems of the commission than as a contribution to their final solution. Not the shred of new statistical information is contained in the document. From a constructive point of view, this failure is regarded as the most serious because the report as it stands holds out no assistance to the New York conference. An unusual opportunity was offered to get material of a statistical character before that body, but this seems to have been made impossible by the mix-up over the cost forms.

A significant feature of the report is the indication that the commission is not inclined to allow the industry to blame all of its ills on slowness of transportation.

Employees of Commission

In connection with its denial of charges that political patronage is being handed out in the way of clerical positions the commission has issued a personnel statement giving the exact numbers of its employees in the various classifications. It follows:

"The commission's staff as at present constituted includes fifty-six technical employees and ninety-three non-technical employees. The members of the technical staff include: Four engineers, thirty-eight investigators, six assistant investigators, seven examiners, one mineral geographer.

"The non-technical employees include: One secretary, one chief clerk and disbursing officer, one administrative assistant, one confidential clerk, forty statistical clerks, eleven stenographers, eight typists, two comptometer operators, seven clerks, three calculating machine operators, one statistical draftsman, six operatives, one graphotype operator, two file clerks, three apprentices and five messengers.

"No member of the commission has a private secretary or messenger."

Export Statistics to Be Compiled in New York

After a careful study of the manner in which import and export statistics are being collected, Commerce Secretary Hoover has decided to continue to compile those figures in New York. Legislative authority recently was given which enabled the transfer of this statistical work from the Treasury to the Commerce Department. The same law authorized the Secretary of Commerce to consolidate the Bureau of Commerce statistics in New York with the Bureau of Foreign and Domestic Commerce and to transfer the work wholly or in part to Washington.

Since import and export figures must be handled largely during a comparatively few days of the month, the impression long has prevailed that if the work were transferred to the Bureau of the Census in Washington, a large number of employees could be temporarily released from their regular duties to handle that peak. The survey of the situation, however, developed that the work is expedited in New York by the fact that the statistical force has close contact with the collector's office in the New York Custom House.

Figures covering the imports during the last nine days of September and during the month of October are becoming available only at this time. This long delay has been occasioned by the changes of schedules caused by the enactment of a new tariff act and by certain other changes in the classifications.

Rubber Planters Confer With Manufacturers

British Representatives Meet With American Manufacturers in Attempt to Assure Future Supplies

British rubber planters and American rubber manufacturers held meetings in New York last week, for the purpose of seeking some way of adjusting the rubber situation so that a price level equitable to both groups may be arranged.

The British planters, Sir Stanley Bois, Eric P. Miller and B. J. Burgess, represent the Rubber Association of London, a group of planters controlling 70 per cent of the world's rubber supply. The American manufacturers represent the Rubber Association of America, whose membership is responsible for 70 per cent of the world's rubber consumption.

The American committee is made up of H. Stewart Hotchkiss, vice-president of the United States Rubber Co.; B. G. Work, president of the B. F. Goodrich Co.; William O'Neill, of the General Tire & Rubber Co.; C. W. Litchfield, of the Goodyear Tire & Rubber Co.; F. H. Brown, of Meyer & Brown, Inc.; William B. Pfeiffer, of the Miller Rubber Co., and Horace De Lisser, of the Ajax Rubber Co.

Washington Interested

The Department of Commerce is said to be interested in what the present conference may do. Assistant Secretary of Commerce Houston conferred with the British party Thursday night and returned to Washington.

The work of the conference, which met in the rooms of the Rubber Association in the Fisk Building, New York, began with an exposition to the visitors of the conditions surrounding the rubber manufacturing industry in this country. In their turn the British committee put before the American manufacturers a thorough outline of the situation in England and its colonies.

Complaint Against Jobber Posing as Manufacturer

Whether or not a jobber and wholesaler may rightfully advertise as a manufacturer is the question involved in a complaint issued by the Federal Trade Commission against the American Turpentine Co., a concern trading as the North American Fibre Products Co.

According to the complaint, the Amercan Turpentine Co. is a jobber and wholesaler of paints, varnishes and similiar products, with its principal office in Cleveland, Ohio. The company, it is alleged, resells its commodities under the name of the North American Fibre Products Co., and in the sale thereof advertises that such commodities are manufactured by the company so selling them.

The commission contends that this practice is an unfair method of competition, as it leads the public to believe that the respondent's products are purchased direct from the manufacturer, thereby saving all intermediate profits.

Courses in Cereal Chemistry at Minnesota University

During the first week in January, twenty-four men and women interested in cereal chemistry gathered together for a week of intensive study of wheat and wheat products. The work was given at the University of Minnesota and was in charge of C. H. Bailey. The morning sessions were devoted to lectures and the afternoons to laboratory work.

Dr. Bailey had charge of the work on hydrogen-ion determinations; R. A. Gortner discussed "Colloids and Proteins"; L. S. Palmer, "Wheat in Nutrition"; J. J. Willaman, "Enzymes in Fermentation"; H. K. Hayes, "Wheat Breeding"; E. O. Stakman, "Wheat Diseases"; R. N. Chapman "Wheat and Flour Insect Pests" and A. C. Arny, "Wheat Classification."

The afternoon sessions were devoted to: Viscosity measurements of flour, using the MacMichael viscosimeter; hydrogen-ion determinations of flour; hydrogen-ion determinations of fermenting dough; electrical conductivity measurements of flour.

Applicants for the course were many times the number accepted. The latter were necessarily limited because of lack of laboratory facilities to handle a larger number. This large demand for intensive training is conclusive evidence of the great desire on the part of cereal chemists for fuller information in this particular field of cereal chemistry. Certainly such a course as here outlined could not be better given than at the University of Minnesota, for nowhere, either in the United States or abroad, is more intensive work or more capable research work being done than at this university. The names of Dr. Gortner and Dr. Bailey are at the top of the list of those who are applying the most advanced methods of physical and colloidal chemistry to the solution of fundamental flour and baking problems.

SCIENTIFIC CONTROL IN BAKING

The physical properties of wheat flour seem to revolve largely around the colloid properties of its gluten. The capacity of the gluten to absorb water and to vary largely in its viscosity depend on the hydrogen-ion content of the medium in which it finds itself. This hydrogen-ion content is affected to a greater or less extent by the buffer action of the salts present, notably the phosphates. These buffer effects vary with the wheat flour grade.

Fermentation, so necessary for the production of bread, is an enzymatic process, and the speed with which a fermenting dough reaches the point where it is ready for the oven is largely a function of intensity of the acidity of such dough.

In some of the largest bakeries of this country, the dough fermentation period is under scientific control by following the change in p_H as the fermentation proceeds. When the proper p_H has developed the dough is placed in the oven.

Paper Plant Expansion Keeps Pace With Water-Power Development

As a result of the negotiations recently concluded between the provincial government of Quebec and the new company organized to develop the power resources of Lake St. John and the Saguenay River already in its initial stages, announcement was made at the offices of the Canadian Export Paper Co., Ltd., that Price Brothers & Co., Ltd., for which it acts as export selling distributor, has entered upon a 3-year program of expansion which will ultimately increase its present daily output capacity of 300 to 900 tons of paper, or 280,000 tons a year, thereby setting a new record for Canada.

The initial work of installation is already under way and the program calls for the production of 200 tons a day new output by January, 1924, and 200 tons additional at the beginning of each of the two succeeding years until the maximum is reached. Price Bros. & Co., Ltd., owns or controls about 9,000 square miles of freehold and leasehold timber limits in the valley of the Saguenay River and the Lower St. Lawrence which have been roughly estimated to contain 20,000,000 cords of pulp wood.

Wide Interest Evidenced in Paper Exposition

In the Paper Industries Exposition to be held during the week, April 9 to 14, at Grand Central Palace, New York, while the American Paper and Pulp Association and its related associations are meeting, three main groups will feature the list of exhibits. The first group will cover paper-making machinery and the chemicals entering into the manufacture of paper; the second will be the making of paper itself, and the third the conversion of paper into its various subdivisions in which it reaches the public, such as boxes, twine, and specialties, as well as the large field of distribution to printer and consumer in the form of writing paper and other papers.

The manufacturers of paper mill supplies have been prompt to take advantage of this opportunity to present their equipment to the paper mill executives who will be at the exposition. A large attendance of paper manufacturers and merchants during the week is likely because of the fact that the exposition will be held during the week of the annual conventions of American Paper and Pulp and the National Paper Trade Associations and their affiliated organizations. The manufacturers of beaters, rolls and other similar heavy equipment are already well represented among the exhibitors as are also the chemical supply companies, which sell bleach, colors, and all of the wide range of chemicals entering into the manufacture of paper. The manufacturers of specialties, such as boxes, paper, twine and the like, are included among those who have contracted for exhibit space.

The chief efforts of the exposition management, however, have at the outset been devoted to the securing of educational exhibits for the show. The Forest Products Laboratory, of Madison, Wis., and the Research Laboratory of the United States Forest Service have been invited to present an exhibit. An effort, for instance, is being made to have a special exhibit of the United States Bureau of Standards, which operates its own paper mill at the laboratory in Washington, where tests are made of paper made by different processes from miscellaneous materials.

Plan Complete Study of Fastness of Dyes

Experiments to determine the effects of various dyestuffs upon different textiles are to be undertaken in the near future by the United States Bureau of Standards. Fastness in relation to moisture and light, oxidation and chemical changes under varying conditions are to be studied especially. The experiments will continue some months.

Exporters of textiles in particular are interested in a number of problems regarding the dyes put into their goods which have arisen, accumulating over a course of years. It has been found that a dye which is satisfactory for the domestic trade sometimes fails to maintain its quality on exported fabrics.

The Bureau of Standards has been asked to determine the degree of washing advisable under different conditions; the varying quality and quantity of dyestuff necessary to hold successfully in different mixtures of yarns; to study the problem of fading in mixed colors and generally cover the subject.

It is expected that several trade associations of textile manufacturers will contribute to a fund with which the bureau may carry forward these experiments on a scale larger than that which would be possible with the limited appropriation at its disposal.

Selenium Chloride Used for Activating Carbon

A new and improved method of making a superior grade of purified carbon at moderate cost has been recently invented by Prof. Victor Lenher of the chemistry department of the University of Wisconsin, and patented jointly with the General Electric Co.

The material yielded by the process may be used for various purposes, such as an activated carbon in gas masks, or in the recovery of gasoline from natural gas. As a purifier material it may be employed in the manufacture of dry-cell batteries or for electrodes.

The new process consists of treating charcoal with selenium oxychloride, a solvent for the hydrocarbons, removing the solution, and washing the residue. The product of such a treatment is much purer than the product of other methods, it is said, and possesses great absorptive properties, and may be used more effectively than ordinary activated charcoal for the absorption of gases. Relatively moderate temperatures below 100 deg. C. are used.

New Jersey Chemists Hear Chamot and Herty

Record Attendance Attracted by Highly Practical Topic, "How Shall the Chemist Live?"

"Solving Problems by Means of the Microscope" and "How Shall the Chemist Live?" were the subjects discussed at the January meeting of the New Jersey Chemical Society, at the largest gathering ever held by that organization. Prof. E. M. Chamot of Cornell University, and president of the Technical Photographic and Microscopical Society, recommended the microscope as a short-cut for chemical research. Recourse to that instrument, he declared, will save both time and money, particularly in "solving those problems which arise in that no-man's land lying between physics and chemistry and physics and the biological sciences. By means of some excellent slides, Dr. Chamot demonstrated the advantages of the microscope in examining such things as ancient coins, glazes on porcelain, textiles and furs. It was interesting to note that in the two last named cases, the microscope shows marked difference in the structure of mulberry silk from the domesticated silk worm, wild silk and artificial silk. The characteristic properties of most animal hairs serve as a quick and easy method of determining the sort and nature of any furs.

How Shall the Chemist Live?

It was Dr. Charles H. Herty's discussion of the economic status of the chemist, however, that most strongly appealed to the New Jersey chemical workers. Anything that affects the chemical industry, Dr. Herty declared, is bound to have its reaction on the chemical profession of this country Therefore, the policy of short-sighted executives who have abandoned industrial research can only be regarded as a serious blow to the chemist. After reviewing the various lines of activity open to the chemist in both academic and industrial work, Dr. Herty called attention to the special appeal offered by the synthetic organic chemical industry. Here is an industry with a greater proportion of output per chemist than in any other branch of industry. The greatest enhancement per unit of raw material is directly attributable to the work of the chemist.

American Chemists Should Lead

Dr. Herty warned the leaders in the field of synthetic organic chemistry against being satisfied with simply doing as well as another nation has already done. "This country," he said, "has the right to expect that American chemists, if given the chance, will lead the world in the development of chemical industries, but this can only be accomplished by research work of the highest type by men who dare venture into untrodden fields." Very aptly Dr. Herty applied to the chemical industry that biological truth—"when growth stops, decay sets in." He showed clearly by means of employment figures taken from the Tariff Commission's Census of Dyes and Organic Chemicals that the chemist is keeping pace with his industry. In 1920, 2,406 chemists were employed in the synthetic organic chemical industry to produce 370,000,000 lb. of products. In 1921, 1,561 chemists in this same industry produced but 121,000,000 lb. of products.

In concluding his talk, Dr. Herty called attention to unsound public opinion regarding the chemical industry. He attributed much of this to the chemists' failure to keep the public properly informed. "We have no right," Dr. Herty said, "to keep the laymen in ignorance of what we are doing, and I should like nothing better than to see New Jersey, as the center of the chemical industry of the country, take the lead in helping the people to know what chemistry has to offer."

Make Byproducts Pay to Eliminate Waste

An important step forward in the campaign looking to the elimination of waste in industry is about to be made, Secretary Hoover has intimated. Plans are practically complete for a survey of the lumber industry with the idea of developing the wastes which can be eliminated profitably.

Waste cannot be eliminated, to any important extent, by legislation. If it is to be prevented, it must be made profitable. The contemplated investigation will be made under a co-operative agreement between the Department of Commerce and the lumber industry. It is believed that a systematic and nation-wide study of wastes, by industries, will reveal great opportunities for the utilization of byproducts.

Personal

Thomas M. Bains, Jr., of California has been appointed assistant professor of mining engineering, University of Illinois, Urbana. He will have charge of the coal-washing and ore-dressing laboratory.

H. C. Barlow, formerly of the chemical and metallurgical branch of the Dominion Bureau of Statistics, has returned to his former position as assistant chemist for the Deloro Smelting & Refining Co., Deloro, Ont., having resigned from the bureau.

Robert Gilman Brown has been elected president of the Institution of Mining and Metallurgy, 1923-1924, to succeed S. J. Speak.

Arthur P. Denton has resigned as sales manager, Pacific Portland Cement Co., to become district engineer for the Portland Cement Association, with headquarters at the San Francisco office.

T. A. Dines has been chosen president of the Midwest Refining Co., Denver, to succeed Henry M. Blackmer, who has been made chairman of the board. Mr. Blackmer will continue his active association with the company, leaving the details of the administration of its affairs to Mr. Dines. Mr. Dines has been connected with the Midwest company since 1915, when he was elected treasurer.

Walter F. Graham, who for some time past has been associated with the Henry Souther Engineering Corporation in Hartford, Conn., has resigned to take charge of the foundry operations of the Curtis Bay Ship & Engine Co., Baltimore, Md.

Herbert R. Hanley, formerly of Bakersfield, Calif., has accepted the position of associate professor of metallurgy at the Missouri School of Mines, Rolla, Mo.

Colonel George T. Slade has been elected president of the Tide Water Oil Co., New York, succeeding Robert B. Benson, who has become chairman of the board.

Dr. Julius Stieglitz, director of the department of chemistry, University of Chicago, spoke before the Philadelphia Section of the A.C.S., Jan. 18, on "The Laws of Chemistry Govern the Mechanism of Life."

Robert E. Swain, professor of chemistry at Leland Stanford University, sailed for Europe on Jan. 18. He expects to be gone about 6 months and will visit various countries of continental Europe.

James G. Vail, of the Philadelphia Quartz Co., presented a paper on "Uses of Sodium Silicate" before the Association of Corrugated Paper and Fiber Box Manufacturers, New York City, Jan. 18.

The following men from the University of Chicago will give talks by radio from the Chicago *Daily News* station: Feb. 20, Prof. Julius Stieglitz, on "Chemistry and Medicine"; Feb. 27, Prof. H. I. Schlesinger, on "Radioactivity," and March 6, Prof W. D. Harkins, on "The Structure of Atoms."

The following officers have been elected for the Southeast Texas Section of the A.C.S. for the year 1923: President, L. S. Bushnell; vice-president, W. A. Slater; councilor, F. M. Seibert; treasurer, L. B. Howell, and secretary, P. S. Tilson.

Obituary

Albert H. Miller, chief metallurgist of the Nicetown works of the Midvale Steel & Ordnance Co. and an expert in steel analysis, died Jan. 11, at Ambler, Pa. He was 43 years old. Mr. Miller was a graduate of the University of Pennsylvania and entered the employ of the Midvale company in 1901.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

The Present Trend of Business

Return of Confidence, Higher Prices, Easier Money Conditions and Growing Volume of Manufacture Form Basis of Favorable Prediction*

BY PERCY H. JOHNSTON
President, Chemical National Bank of New York

AN ANALYSIS of the present situation reveals indications that business has entered a period of increased activity and that an appreciation of values in the commodity markets is under way. The fact that confidence in future values has been largely restored is evidenced by the pronounced rise in the price level which has occurred in the past few months in contrast to a continued decline during the preceding year and a half. While difficulties in handling the increased freight traffic by the transportation system have become an important factor in the current industrial situation, yet the railroads are dealing efficiently with the problem and it is not thought that the ill effects of congestion will be more than transitory.

More serious, indeed, is the possible shortage of labor and a resultant rise in the wage scale. It is of significance that in England, with whose products we must compete in the markets of the world, no correspondingly definite rise in commodity prices has yet occurred and instead of an increase in the wage scale, recent reductions have been reported. In fact there is in England considerable unemployment.

INCREASED PURCHASING POWER

Of the forces at work tending to bring about an increased volume of business and higher prices the most important is the enormous supply of credit available for industry and commerce, due primarily to an unprecedented amount of gold at present in the country. The increased cost of production of articles of manufacture, due to a higher wage scale and the enhanced value of raw materials, tends to raise the price of the finished product. Other forces which will tend to effect a rise in commodity values are the increased purchasing power of the wage-earner; the recent tariff law, which increases the price of importations of both raw materials and manufactured products; and finally the speculation which invariably accompanies easy money conditions and a rising commodity market. Increased volume of trading will be accentuated both by the fact that inventories have been well liquidated, and that the ultimate consumer who has deliberately, during the period of falling prices, postponed purchases not of an absolutely necessary nature, will immediately supply his accumulated needs when he is convinced that the market is rising.

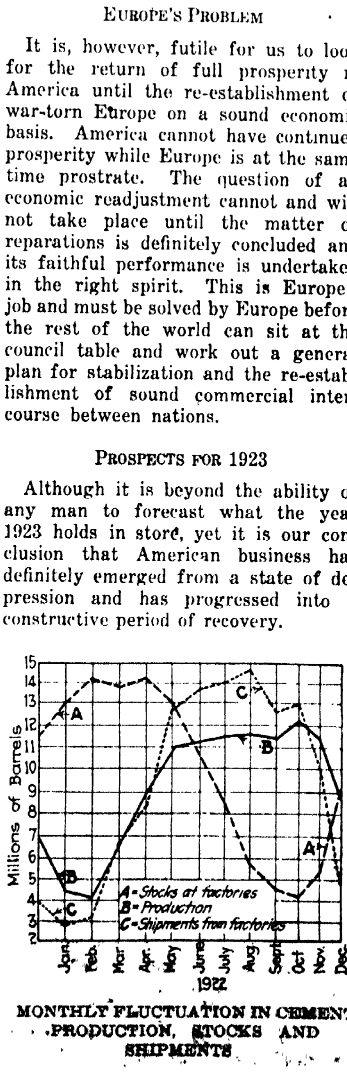
*Extracts from the president's report to the stockholders, Jan. 9, 1923.

EUROPE'S PROBLEM

It is, however, futile for us to look for the return of full prosperity in America until the re-establishment of war-torn Europe on a sound economic basis. America cannot have continued prosperity while Europe is at the same time prostrate. The question of an economic readjustment cannot and will not take place until the matter of reparations is definitely concluded and its faithful performance is undertaken in the right spirit. This is Europe's job and must be solved by Europe before the rest of the world can sit at the council table and work out a general plan for stabilization and the re-establishment of sound commercial intercourse between nations.

PROSPECTS FOR 1923

Although it is beyond the ability of any man to forecast what the year 1923 holds in store, yet it is our conclusion that American business has definitely emerged from a state of depression and has progressed into a constructive period of recovery.



MONTHLY FLUCTUATION IN CEMENT PRODUCTION, STOCKS AND SHIPMENTS

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	174.21
Last week	171.71
January, 1922	144
January, 1921	181
January, 1920	242
April, 1918 (high)	286
April, 1921 (low)	140

A marked rise in this week's index number results from the considerably higher prices for both cottonseed and linseed oils. Slightly lower quotations on caustic soda did not affect the index appreciably.

Record Shipments of Cement Made in 1922

Both Output and Shipments Show Marked Gains Over 1921, According to Geological Survey Figures

During the year just ended the output of finished portland cement is estimated to have reached 113,870,000 bbl., as compared with 98,293,000 bbl. in 1921, a gain of 16 per cent. These figures, which are those of the U. S. Geological survey, are based on actual returns from producers, although lack of reports from four producers made it necessary to estimate figures in their cases.

A total of 116,563,000 bbl. of cement was shipped to consumers throughout the United States during 1922. This represents the heaviest total of shipments recorded in the history of the industry. Shipments during 1921 reached 95,051,000 bbl., or a little over three-quarters of the total for the year just passed.

CEMENT PRODUCTION SHIPMENTS AND STOCKS

	1921 No. of bbl.	1922 No. of bbl.
Production	98,293,000	113,870,000
Shipments	95,051,000	116,563,000
Stocks on hand at end of year	11,938,000	9,134,000

Stocks of finished portland cement at factories, Dec. 31, 1922, amounted to 9,134,000 bbl., or 2,804,000 under the quantity on hand one year ago.

There were also about 2,823,000 bbl. of clinker, or unground cement, at the mills at the end of December, as against 1,949,000 bbl. at the beginning of the month.

As shown in the accompanying table, stocks on hand Dec. 31, 1922, were not only lower than those available Dec. 31, 1921, but shipments exceeded production by nearly 3,000,000 barrels.

Stabilizing Influence Seen in New York Chemical Market

Manufacturers Advance Prices on Acetate of Lead and Hydrofluoric Acid—Potassium Salts Show Strength on Spot

ACTIVITY in the chemical market has been limited to a few special items during the past week and trading in general was of a routine nature. Prices for most chemicals held to their former levels, with a few increases noted, due, it was said, to increased producing costs. The chemical market in general seems to be quite slow in hitting the new year stride and several leading interests are expressing their disappointment at this condition. It is generally believed, however, that the gradual recovery will lead to a completely stabilized market which will show satisfactory results in the long run.

Dealers in arsenic were inclined to offer spot goods at lower prices. Several fair-sized tonnages were reported on dock from Japan. It should be pointed out, however, that the market still retains a very strong position and any pronounced buying activity will tend sharply to advance spot quotations. Producers of acetate of lead announced an increase of 1c. per lb. for all grades. The recent rise in the metal is directly accountable for the new price. Caustic potash is quite firm on the spot market, due to the difficulty experienced in obtaining foreign shipments. Caustic soda for export was a shade easier, although the domestic inquiry continued fairly active. The bichromates showed a slight tendency to strengthen on the spot market and dealers were not anxious to offer any round lots at inside figures. Ammonium nitrate was in very strong demand, with spot stocks completely exhausted. Fluoride of soda, acetate and chlorate of soda, formaldehyde and oxalic acid continued along moderate lines with demand merely of a routine nature.

Principal Price Changes

Acetate of Lead — Producers announced an increase of 1c. per lb. on all grades due to the increase in lead prices. Quotations for white crystals range around 13@13½c. per lb. Demand is quite active.

Acetate of Soda—Several sales were recorded around 6½c. per lb. The general range, however, is around 6¾@7c. A few stressed lots were noted on the spot market and these had a strong tendency to weaken quotations.

Arsenic — Several large shipments from Japan weakened the spot market and jobbers were quite willing to accept business at 15¼c. per lb. Buyers showed no anxiety to pay top figures and actual trading was of a limited nature. The range was around 15¼@15⅜c.

Bichromate of Soda—Small lot trading seemed to feature this market and prices ranged around 7¾@8c. per lb. Round lots were offered down to 7½c.

Bleaching Powder — Producers continue to quote 2c. per lb. for large drums, f.o.b. works in carload lots. Spot goods all in limited supply and dealers quote $2.25 per 100 lb. for odd lots. The demand continues along very active lines.

Carbonate of Potash — A moderate improvement was reported in the calcined and hydrated grades. Offerings were not as plentiful as noted during the past few weeks and inward manifests seem to have decreased considerably. Calcined 80-85 per cent is now quoted at 5¾@6c. per lb. with hydrated at 7c. per lb.

Caustic Potash—Imported 88-92 per cent is reported higher on spot at 7c. per lb. The strong position of the foreign market is keeping prices unusually high. Consuming inquiry continues moderately active.

Caustic Soda—Slightly lower prices for export were announced due to the lack of buying interest. Spot quotations range around $3.45@$3.50 per 100 lb. f.a.s. Domestic inquiry is quite active with contracts quoted at $2.50 per 100 lb., basis 60 per cent f.o.b. works in carload lots.

Chlorate of Soda—Demand continues along routine lines, with domestic makers quoting around 6½@6¾c. per lb. Imported material is being held at the same level.

Cyanide of Soda — Domestic producers continue to quote 23c. per lb for 96-98 per cent goods and report a fair consuming business. Imported material ranges around 19@22c. per lb., according to strength and quantity.

Fluoride of Soda—Activity has been quite limited during the week and prices for imported goods were lower at 9@9½c. per lb. Domestic prices ranged around 10@10½c. per lb.

Formaldehyde Producers continued to quote 16c. per lb. for carload lots and 16½c. for smaller quantities. Demand is somewhat easier due to several second hand offerings around 15¾c. per lb.

Oxalic Acid—Domestic material on spot ranges around 13c. per lb. with imported held at 13¼@13½c. duty paid. Demand has been quite active of late.

Soda Ash—Domestic business was reported quite satisfactory with several carlot transactions at $1.75 per 100 lb. in single bags. Contract business was reported in fair demand at $1.20 per 100 lb., f.o.b. works, basis 48 per cent, single bags, carload quantities.

Linseed Oil—Prices for spot goods were advanced 3c. per gal., due to the higher seed market. Oil in carload quantities, cooperage basis, sold around 90c. per gal. for immediate delivery.

Paint and Varnish Industry in 1921 and 1922

Census Figures for January-June, 1922, Are 1.5 to 50.5 Per Cent More Than in 1921

The first semi-annual statistics of paint and varnish production taken at the request of the industry by the Census Bureau show a marked expansion of these industries during the first half of 1922, thus confirming forecasts made at the November convention of the National Oil, Paint and Varnish Association. The report covers the output in the first 6 months, Jan. 1 to June 30, 1922, with comparisons for the calendar years of 1920 and 1921. The accompanying tabular statement presents the statistics.

The data were compiled from reports from 402 establishments, of which 104 reported the manufacture of white lead in oil; 120 the manufacture of zinc oxide in oil; 228 the manufacture of other paste paints; 337 the manufacture of ready mixed and semipaste paints; and 246 the manufacture of varnishes, japans and lacquers.

The next report will cover the 6 months period ended Dec. 31, 1922, and for comparative purposes the figures for the calendar year will be given, as well as the calendar year figures for 1921 and 1920.

PRODUCTION OF PAINTS AND VARNISHES, 1920, 1921 AND 1922

	1922 Jan 1 to June 30 (6 months) Lb.	1921 (Full Year) Lb.	1920 (Full Year) Lb.	Per Cent of Increase* 1921-1922†	Per Cent of Increase* 1920-1921
Paints:					
Paste paints	207,469,000	382,490,000	343,626,000	8.5	11.3
White lead in oil	138,942,000	273,874,000	209,372,000	1.5	30.8
Zinc oxide in oil	4,341,000	5,770,000	7,946,000	50.5	—27.4
Other paste paints	64,186,000	102,846,000	126,308,000	24.8	—18.6
Ready mixed and semi-paste, including wall paints, "mill whites," and enamels	Gal. 31,159,000	Gal. 44,500,000	Gal. 55,248,000	40.0	—19.5
Varnishes, Japans, and lacquers	24,998,000	34,316,000	49,594,000	45.7	—30.8

* A minus sign (—) denotes decrease. † Increase with respect to one-half of 1921.

23,260 for a Dollar

German marks as a medium of international exchange almost dropped off the market Jan. 18 when cable transfers on Berlin fell to $0.000043. This is a new low record, equivalent to 23,260 marks to the American dollar.

The note circulation of the Reichsbank at the end of December, 1922, amounted to 1,200,000,000,000 marks, compared with 754,000,000,000 marks at the beginning of December and 469,000,000,000 at the beginning of November.

Better Volume of Business in Chicago Market

Price Tendency Generally Upward With Fairly Active Trading

CHICAGO, Jan. 18, 1923.

A very good volume of business was reported from practically all divisions of the industrial chemical market. Spot goods were moving well and withdrawals on contracts were quite heavy. Prices held firm, particularly on imported material, where the uncertainty of replacements strengthened the market. The tendency all along the line was upward; buyers apparently realized it and were taking on supplies beyond their immediate requirements.

PRICES WELL MAINTAINED

Alkalis were well maintained in price and were reported as moving in a good volume in the spot market. The ground 76 per cent *caustic soda* was quoted in moderate lots at \$4.25 per 100 lb. and the solid at \$3.50. *Caustic potash* was sharply advanced in the spot market and 8c. per lb. on the 88-92 per cent material was the best offer noted. This advance was not surprising, as the spot price on caustic potash has been below the import cost for some time past. *Soda ash* was in good demand and the price was steady at \$2.25 per 100 lb. basis cooperage.

Potash alum was in fair request and only moderate supplies were available for spot delivery. The iron-free lump was quoted in single cask lots at 4½@5c. per lb. and the powder in similar quantities at 5½@6c. per lb. *Ammonium chloride*, white granular, was in good demand, with the spot price firm at 8@8½c. per lb. It was possible to better these figures slightly on material for shipment from the East. Barium salts were unchanged in price and were in only fair demand. *Barium chloride* was offered in small or moderate lots at \$110 per ton. The *carbonate* was quiet and supplies were available at \$90 per ton. *White arsenic* continued very scarce and high priced with only a few very small lots offered at 17c. per lb. The shortage of arsenic has had an adverse effect on the copper sulphate market and very little of the material is moving. Due to the strength of the metal, however, the price has been maintained at 6c. per lb. for less than carload lots. *Carbon tetrachloride* was firm and unchanged at 10½@11c. per lb. in large drums. *Carbon bisulphide* continued scarce and the spot price was well maintained. The best offer for delivery from stock was 7½c. per lb., but it was possible to do some better on material for shipment from the works. Moderate lots of *formaldehyde* moved to the consuming trade and the price was firm at 17c. per lb. in less than 5-bbl. lots. *Furfural* was available at 25c. per lb. in 1,000-lb. lots and should find a good market if formaldehyde continues to advance. *Glycerine* was quiet and supplies of the c.p material were available in drums at 18@18½c. per lb.

Phosphoric anhydride was in better demand, but the price was unchanged at 40c. per lb. for 1-lb. tins in case lots. *Cyanide of potash* was firm and unchanged at 55c. per lb. *Yellow prussiate of potash* was weaker on spot and supplies were available at 40c. per lb. The *red prussiate of potash* was also weaker and it was possible to do 92c. per lb. in single cask lots.

LINSEED OIL AND TURPENTINE

Buyers were not interested in linseed oil and only small quantities were moving. Boiled oil in single-drum lots was quoted at 96c. per gal. and the raw in similar lots at 94c.

Turpentine was too high priced to be of interest to most buyers and consequently very little moved. Today's price for single drums was \$1.59 per gal.

Steel Market Continues Active

Prices Are Stiffening and Consumption Is at a Higher Rate

PITTSBURGH, Jan. 19, 1923.

The steel market continues at the active rate reached in December, there being very free placing of orders by all classes of buyers, though it is noticeable that the proportion of early delivery business is larger than what might be considered normal. Prices are stiffening, in general, and while it can hardly be said that the whole steel market is in the act of advancing, there is something occurring along that line.

The various steel consuming lines appear to be operating at somewhat better rates than in December.

PRODUCTION AND LABOR SUPPLY

The rate of steel production seems to depend chiefly upon labor supply. The actual physical capacity, between 50,000,000 and 55,000,000 tons of ingots a year, is far above the recent operating rate or any that is likely to be attained. While labor supply has improved somewhat since October, it has not improved as much as might have been predicted on the basis of the season of year, which curtails outdoor work and must release many men. As construction activity promises to be as heavy this spring as last autumn, if not heavier, the steel industry's prospect is that it will have a greater labor shortage next April than it had last October.

Steel ingot production was quite uniform during the last 3 months of the old year at a rate of about 40,000,000 tons a year, representing somewhat more than 75 per cent of capacity. By the end of this month the rate may be 5 per cent better and the high point may represent a gain of 10 per cent, the high point naturally falling in March, always a good month for operation. For later months, much depends on labor supply and something may depend on the pressure of buyers for deliveries, though in general it looks as though the steel industry could run fairly well on momentum to the middle of the year, even should the present buying movement taper off, of which there is no sign thus far.

In most finished steel products there is more or less of a rising tendency. With one exception, conspicuous in consequence, this tendency is seen only in what is frequently called "the independent market," which has sometimes, and particularly in 1920, been an entirely separate institution. The Steel Corporation's general policy, as exemplified by its action last November in continuing its old sheet and tin plate prices, has been to make no advances. Shapes and plates, however, it has advanced this week, from 2c. to 2.10c., while it leaves bars at the old price of 2c. The object seems to be to restore the old differential, which ruled pretty steadily before the war. Among the independents at least bars have really been stronger marketwise than plates or shapes for some time past.

The Cambria Steel Co. started the advancing movement in the heavy rolled steel products late last week, advancing its price on bars, shapes and plates from 2c. to 2.10c., and other independents have been following, practically all being now on a 2.10c. basis. This make the market 2@2.10c. on bars and 2.10c. on shapes and plates. A few independent mills are quoting above 2.10c. on the less desirable plate business.

RISING PRICE TENDENCY

An advance in the independent market in sheets is imminent, several mills having already withdrawn from the market at the old prices. The Steel Corporation could hardly take action in any event, as it is practically sold up on sheets until June. The regular market is 2.50c. on blue annealed, 8.35c. on blacks, 4.35c. on galvanized and 4.70@5c. on automobile sheets. A respectable tonnage of blue annealed, for early delivery, is now going at 2.60c. The prediction is that the independents will advance black and galvanized \$3 a ton, to 3.50c. and 4.50c. respectively. They are all sold for a large part of the current quarter and an advance if made will doubtless carry with it an opening of order books for the second quarter.

Semi-finished steel, including billets, slabs and sheet bars, is strong at its recent advance of \$1 a ton in the minimum, and offerings are scant, the market being quotable at \$37.50@\$38.50.

Pig iron is rather quiet in point of turnover, the quietness attracting some attention. Prices are steady or firm, but are not being very seriously tested, as the inquiry is almost entirely for small prompt lots. The market stands at \$27.50 for bessemer, \$25@\$26 for basic and \$27@\$28 for foundry, f.o.b. valley furnaces.

Connellsville coke has softened a trifle in the week, but shows little sign of receding to its level of early in December, prompt furnace being now at \$8@\$8.25 and prompt foundry at \$9@\$9.25. There is no interest whatever exhibited in the matter of second quarter contracts. Connellsville steam coal is off somewhat, frequently going at as low as \$2.75, byproduct holding firm at \$3.75@\$4.

Current Prices in the New York Market

FOR CHEMICALS, OILS AND ALLIED PRODUCTS

Although these prices are for the spot market in New York City, a special effort has been made to report the American manufacturer's quotations whenever available. In many instances these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported and resale stocks are reported when of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb	$0 39	$0 41
Acetone, drums	lb	21	21½
Acid, acetic, 28%, bbl	100 lb.	3 50	3 60
Acetic, 56%, bbl	100 lb.	7 00	7 15
Glacial, 99½%, carboys	100 lb	12 80	13 25
Boric, crystals, bbl	lb	11	11½
Boric, powder, bbl	lb	11	11½
Citric, kegs	lb	49	50
Formic, 85%	lb	18 -	49
Gallic, tech	lb	45	50
Hydrochloric, 18° tanks, 100	lb	80	1 00
Hydrofluoric, 52%, carboys	lb	12	12½
Lactic, 44%, tech, light, bbl	lb	.11 -	11½
22% tech, light, bbl	lb	.05 -	05½
Muriatic, 20°, tanks, 100	lb	1.00	1 10
Nitric, 36°, carboys	lb	.04½-	05
Nitric, 42°, carboys	lb	06	06½
Oleum, 20%, tanks	ton	17.00	18 00
Oxalic, crystals, bbl	lb	.13	13½
Phosphoric, 50%, carboys	lb	.08½	09
Pyrogallic, resublimed	lb	1 50 -	1 60
Sulphuric, 60°, tanks	ton	9 00 -	10 00
Sulphuric, 60°, drums	ton	12 00	14 00
Sulphuric, 66°, tanks	ton	14 50 -	15 00
Sulphuric, 66° drums	ton	19 00 -	20 00
Tannic, U S P, bbl	lb	65 -	70
Tannic, tech, bbl	lb.	.40 -	45
Tartaric, imp crys, bbl	lb	30½ -	31
Tartaric, imp, powd, bbl	lb	31 -	32
Tartaric, domestic, bbl	lb	-	32
Tungstic, per lb of WO	lb	1 00	1 20
Alcohol, butyl, drums	gal	18	23
Alcohol ethyl (Cologne spirit), bbl.	gal	4 75	4 95
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 188 proof No. 1	gal	39	41
Alum, ammonia, lump, bbl	lb	03½	03¾
Potash, lump, bbl	lb	03¼	03½
Chrome, lump, potash, bbl	lb	05	05¼
Aluminum sulphate, com., bags	100 lb	1 50	1 65
Iron free bags	lb	02¼	02½
Aqua ammonia, 26°, drums	lb	06¼	07¼
Ammonia, anhydrous, cyl	lb	30	30½
Ammonium carbonate, powd casks	lb	09	09½
Ammonium nitrate, tech, casks	lb	10	11
Amyl acetate tech, drums	gal	2 80	3 05
Arsenic, white, powd, bbl	lb	15¼	15½
Arsenic, red, powd, kegs	lb	13	13½
Barium carbonate, bbl	ton	75 00	77 00
Barium chloride, bbl	ton	94 00	100 00
Barium dioxide, drums	lb	18	18½
Barium nitrate, casks		08½	08¾
Barium sulphate, bbl	lb	04	04¼
Blanc fixe, dry, bbl	lb	04	04½
Blanc fixe, pulp, bbl	ton	45 00	55 00
Bleaching powder, f.o.b. wks., drums	100 lb	2 00	2 50
Resale drums	100 lb	2 25	2 50
Borax, bbl	lb	05½	05¾
Bromine, cases	lb	27	28
Calcium acetate, bags	100 lb	3 50	3 60
Calcium carbide, drums	lb	04½	04¾
Calcium chloride, fused, drums	ton	22 00	23 00
Gran. drums	lb	01½	01¾
Calcium phosphate, mono, bbl.	lb	06½	07
Camphor, cases	lb	93 -	95
Carbon bisulphide, drums	lb	07 -	07½
Carbon tetrachloride, drums	lb	10	10¼
Chalk, precip—domestic, light, bbl	lb.	04¼	04½
Domestic, heavy, bbl.	lb	03½	03¾
Imported, light, bbl	lb	04½	05
Chlorine, liquid, cylinders	lb	06 -	06½
Chloroform, tech, drums	lb	35 -	38
Cobalt oxide, bbl.	lb	2 10	2 25
Copperas, bulk, f o b wks	ton	20 00	22 00
Copper carbonate, bbl	lb	20	20½
Copper cyanide, drums	lb	50	55
Copper sulphate, crys., bbl.	100 lb	6 00	6 25
Cream of tartar, bbl	lb	25	26
Dextrine, corn, bags	100 lb	3 25	3 50
Epsom salt, dom., tech bbl.	100 lb	2 10 -	2 25
Epsom salt, imp., tech, bags	100 lb	1 10 -	1 25
Epsom salt, U.S.P., dom., bbl.	100 lb.	2 50 -	2 75
Ether, U.S.P., drums	lb.	13 -	.15
Ethyl acetate, com., 85%, drums	gal.	.80 -	.85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal	.95 -	1.00
Formaldehyde, 40%, bbl.	lb.	.16 -	16½
Fullers earth, f o b mines	net ton	$16 00 -	$17 00
Fullers earth, imp, powd	net ton	30 00 -	32 00
Fusel oil, ref, drums	gal	3 55 -	4 05
Fusel oil, crude, drums	gal	2 30 -	2 40
Glaubers salt, wks, bags	100 lb	1 20	1 40
Glaubers salt, imp, bags	100 lb	1 00	1 25
Glycerine, c p, drums extra	lb	18½	19
Glycerine, dynamite, drums	lb	17 -	17½
Iodine, resublimed	lb	4 50	4 60
Iron oxide, red, casks	lb	12 -	18
Lead			
White, basic carbonate, dry, casks	lb	08 -	.08¾
White, in oil, kegs	lb	10¾-	12
Red, dry, casks	lb	10¼-	.10¾
Red, in oil, kegs	lb	12 -	14
Lead acetate, white crys., bbl	lb	13 -	13½
Lead arsenate, powd, bbl	lb	21	22
Lime-Hydrated, bbl	per ton	16 80 -	17 00
Lime, Lump, bbl	280 lb	3 63 -	3.65
Litharge, comm., casks	lb	09½ -	10
Lithophone, bbl	lb	06½	07
Magnesium carb, tech, bags	lb	07	07½
Methanol, 95%, bbl	gal	1 23	1 25
Methanol, 97%, bbl	gal	1 25 -	1 27
Nickel salt, double, bbl	lb	10 -	10½
Nickel salts, single, bbl	lb	11	11½
Phosgene		60 -	.75
Phosphorus, red, cases	lb	35 -	40
Phosphorus, yellow, cases	lb	30	35
Potassium bichromate, casks	lb	10 -	10¼
Potassium bromide, gran., bbl	lb	18	25
Potassium carbonate, 80-85%, calcined, casks	lb	05¼-	06
Potassium chlorate, powd	lb	07½-	08
Potassium cyanide, drums	lb	47 -	80
Potassium hydroxide (caustic potash) drums	100 lb	7 00 -	7 25
Potassium iodide, cases	lb	3 55 -	3 65
Potassium nitrate, bbl	lb	06½	07
Potassium permanganate, drums	lb	16 -	16½
Potassium prussiate, red, casks	lb	85 -	90
Potassium prussiate, yellow, casks	lb	38 -	39
Salammoniac, white, gran., casks	lb	06½	06¾
Gray, gran, casks	lb.	08 -	08½
Sal soda, bbl	100 lb	1 20 -	1 40
Salt cake (bulk)	ton	25 00 -	27 00
Soda ash, light, 58% flat, bags, contract	100 lb	1 60 -	1 67
Soda ash, light, basis, 48%, bags, contract, f o b wks	100 lb	1 20 -	1 30
Soda ash, light, 58%, flat, bags, resale	100 lb	1 75 -	1 80
Soda ash, dense, bags, contract, basis 48%	100 lb	1 17½	1 20
Soda ash, dense, in bags, resale	100 lb	1 85	1 90
Soda, caustic, 76%, solid, drums, f a s.	100 lb	3 45 -	3 70
Soda, caustic, 76%, solid, drums, contract	100 lb	3 35	3 40
Soda, caustic, basis 60%, wks, contract	100 lb	2 50 -	2 60
Soda, caustic, ground and flake, contracts	100 lb	3 80	3 90
Soda, caustic, ground and flake, resale	100 lb	4 00	4 15
Sodium acetate, works, bags	lb	06½-	07
Sodium bicarbonate, bbl	100 lb	1 75 -	1 85
Sodium bichromate, casks	lb	07½	08
Sodium bisulphate (niter cake)	ton	6 00 -	7 00
Sodium bisulphite, powd, U S P, bbl	lb.	04½-	04¾
Sodium chlorate, kegs	lb	06½	07
Sodium chloride	long ton	12 00	13 00
Sodium cyanide, cases	lb	19	.23
Sodium fluoride, bbl	lb	09 -	.10
Sodium hyposulphite, bbl.	lb	03 -	03½
Sodium nitrite, casks	lb	08¾-	09
Sodium peroxide, powd, cases	lb	.28 -	.30
Sodium phosphate, dibasic, bbl	lb.	03¾-	.04
Sodium prussiate, yel. drums	lb	18½-	20
Sodium silicate (40°, drums)	100 lb	.80 -	1 15
Sodium silicate (60°, drums)	100 lb	2.25 -	2.40
Sodium sulphide, fused, 60-62% drums	lb.	.04½-	.04¾
Sodium sulphite, crys., bbl.	lb.	03½-	.03¾
Strontium nitrate, powd., bbl.	lb.	.09½-	.10½
Sulphur chloride, yel drums.	lb.	.04½-	.05
Sulphur, crude	ton	18.00 -	20.00
Sulphur dioxide, liquid, cyl.	lb.	.08 -	.08
Sulphur, flour, bbl.	100 lb.	2.50 -	3.15
Sulphur, roll, bbl.	100 lb.	2.15 -	2.20
Talc—imported, bags	ton	$30 00 -	$40.00
Talc—domestic powd., bags	ton	18 00 -	25.00
Tin bichloride, bbl	lb.	.11 -	11½
Tin oxide, bbl	lb.	.45 -	.47
Zinc carbonate, bags	lb.	.14 -	.14½
Zinc chloride, gran, bbl	lb.	.07 -	.07½
Zinc cyanide, drums	lb.	.42 -	.44
Zinc oxide, XX, bbl	lb.	07½-	.08
Zinc sulphate, bbl	100 lb.	2 75 -	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl	lb	$ 95 -	$1.00
Alpha-naphthol, ref., bbl	lb	1 05 -	1.10
Alpha-naphthylamine, bbl	lb	.28 -	.30
Aniline oil, drums	lb	.16½-	17
Aniline salts, bbl	lb	.24 -	25
Anthracene, 80%, drums	lb.	.75 -	1.00
Anthracene, 80%, imp., drums, duty paid	lb.	.65 -	.70
Anthraquinone, 25%, paste, drums	lb	70 -	.75
Benzaldehyde U S P, carboys	lb.	1 35 -	1.40
Benzene, pure, water-white, tanks and drums	gal	35 -	.40
Benzene, 90%, drums	gal	26 -	.32
Benzene, 90%, drums, resale	gal	34 -	.35
Benzidine base, bbl	lb	85 -	.90
Benzidine sulphate, bbl	lb	75 -	.80
Benzoic acid, U S P, kegs	lb	72 -	.75
Benzoate of soda, U S P, bbl	lb	.57 -	.65
Benzyl chloride, 95-97%, ref., drums	lb	.25 -	.27
Benzyl chloride tech, drums	lb	20 -	.23
Beta-naphthol, subl, bbl	lb	55 -	.60
Beta-naphthol, tech, bbl	lb	25 -	.26
Beta-naphthylamine, tech	lb	1 00 -	1.25
Carbazol, bbl	lb	75 -	.90
Cresol, U S P, drums	lb	.14 -	.20
Ortho-cresol, drums	lb	.18 -	.22
Cresylic acid, 97%, resale, drums	gal	1.25 -	1.30
95-97%, drums, resale	gal	95 -	1.00
Dichlorbenzene, drums	lb	07 -	.09
Diethylaniline, drums	lb	.50 -	.60
Dimethylaniline, drums	lb	.39 -	.41
Dinitrobenzene, bbl	lb	.20 -	.22
Dinitroclorbenzene, bbl	lb	.22 -	.23
Dinitronaphthalene, bbl	lb.	.30 -	.32
Dinitrophenol, bbl	lb	.35 -	.40
Dinitrotoluene, bbl	lb	.22 -	.24
Dip oil, 25%, drums	gal.	.25 -	.30
Diphenylamine, bbl	lb.	.54 -	.56
H-acid, bbl	lb	.75 -	.80
Meta-phenylenediamine, bbl	lb	95 -	1 00
Michlers ketone, bbl	lb.	3.50 -	3.75
Monochlorbenzene, drums	lb	08 -	10
Monoethylaniline, drums	lb	95 -	1.10
Naphthalene, crushed, bbl	lb.	.05½-	.06
Naphthalene, flake, bbl	lb.	.06 -	.06½
Naphthalene, balls, bbl	lb	.07 -	.07½
Naphthionate of soda, bbl	lb.	.58 -	.65
Naphthionic acid, crude, bbl	lb	.60 -	.65
Nitrobenzene, drums	lb.	.10 -	.12
Nitro-naphthalene, bbl	lb.	.30 -	.35
Nitro-toluene, drums	lb	.15 -	.17
N-W acid, bbl	lb	1 20 -	1.30
Ortho-amidophenol, kegs	lb	2 30 -	2.35
Ortho-dichlorbenzene, drums	lb	.17 -	.20
Ortho-nitrophenol, bbl	lb.	.90 -	.92
Ortho-nitrotoluene, drums	lb.	12½-	.14
Ortho-toluidine, bbl	lb	14 -	.16
Para-amidophenol, base, kegs	lb	1 25 -	1.30
Para-amidophenol, HCl, kegs	lb	1 30 -	1.35
Para-dichlorbenzene, bbl	lb.	.17 -	.20
Paranitraniline, bbl	lb	.75 -	.80
Para-nitrotoluene, bbl	lb	55 -	.65
Para-phenylenediamine, bbl	lb	1 50 -	1 55
Para-toluidine, bbl	lb	85 -	.90
Phthalic anhydride, bbl	lb.	.35 -	38
Phenol, U S P, drums	lb	35 -	.37
Picric acid, bbl	lb	20 -	22
Pyridine, dom., drums	gal	nominal	
Pyridine, imp., drums	gal	2 80 -	3 00
Resorcinol, tech., kegs	lb	1 50 -	1 55
Resorcinol, pure, kegs	lb.	2 00 -	2 10
R-salt, bbl	lb.	55 -	.60
Salicylic acid, tech., bbl	lb	40 -	.42
Salicylic acid, U S P, bbl	lb.	.45 -	.47
Solvent naphtha, water-white, drums	gal.	.37 -	.40
Crude, drums	gal.	.22 -	.24
Sulphanilic acid, crude, bbl.	lb.	.20 -	.22
Thiocarbanilide, kegs	lb.	.35 -	.38
Toluidine, kegs	lb.	1.20 -	1.30
Toluidine, mixed, kegs	lb.	.30 -	.35
Toluene, tank cars	gal.	35 -	.37
Toluene, drums	gal.	.40 -	.43
Xylidines, drums	lb.	.40 -	.45
Xylene, pure, drums	gal.	.45 -	.50
Xylene, com., drums	gal.	.40 -	.42
Xylene, com., tanks	gal.	.30 -	[illegible]

Naval Stores

Rosin B-D, bbl	280 lb.	$6 15 –
Rosin E-I, bbl	280 lb.	6 30 –
Rosin K-N, bbl	280 lb.	6 50 – $6 75
Rosin W.G.-W W., bbl	280 lb.	7 75 – 8 25
Wood rosin, bbl	280 lb.	6 25 –
Turpentine, spirits of, bbl	gal	1 53 – 1 54
Wood, steam dist, bbl	gal.	1 35 –
Wood, dest. dist, bbl	gal.	1 25 –
Pine tar pitch, bbl	200 lb	– 6 00
Tar, kiln burned, bbl	500 lb	– 12 50
Retort tar, bbl	500 lb.	– 11 00
Rosin oil, first run, bbl	gal	43
Rosin oil, second run, bbl	gal	47 –
Rosin oil, third run, bbl	gal	53 –
Pine oil, steam dist	gal.	– .90
Pine oil, pure, dest dist	gal	– .85
Pine tar oil, ref	gal.	– .46
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal.	– .35
Pine tar oil, double ref, bbl	gal.	– .75
Pine tar, ref, thin, bbl	gal.	– .25
Pinewood creosote, ref, bbl.	gal.	– .52

Vegetable Oils

Castor oil, No. 3, bbl.	lb	$ 11¾ – $ 12¼
Castor oil, AA, bbl	lb.	12¼ – 12¾
Chinawood oil, bbl	lb	16 – 16¼
Coconut oil, Ceylon, bbl	lb	09¾ – 10
Coconut oil, Cochin, bbl	lb.	.10 – 10¼
Corn oil, crude, bbl	lb.	11 – 11¼
Cottonseed oil, crude (f.o.b mill), tanks	lb	09¾ –
Summer yellow, bbl	lb	11¼ – 11¾
Winter yellow, bbl	lb	11¾ – 12
Linseed oil, raw, car lots, bbl.	gal	.90 – 91
Raw, tank cars (dom.)	gal	.89 – 90
Boiled, 5-bbl. lots (dom.)	gal.	95 – 96
Olive oil, denatured, bbl	gal	1 10 – 1 15
Palm, Lagos, casks	lb.	08 – 08¼
Palm kernel, bbl	lb	.08½ – 09
Peanut oil, crude, tanks (mill)	lb	.12½ – 13
Peanut oil, refined, bbl	lb	.15½ – 16
Rapeseed oil, refined, bbl	gal.	83 – 84
Rapeseed oil, blown, bbl	gal.	.87 – 88
Soya bean (Manchurian), bbl.	lb.	.11¼ –
Tank, f.o.b. Pacific coast	lb.	.09½ – .09¾

Fish Oils

Menhaden, light pressed, bbl	gal	$0 60 –
White bleached, bbl	gal	.64 – 65
Blown, bbl.	gal.	68 – 69
Whale No. 1 crude, tanks, coast	lb	.06 – 06½

Dye & Tanning Materials

Divi-divi, bags	ton	$38 00 – $39 00
Fustic, sticks	ton	30 00 – 35 00
Fustic, chips, bags	lb	04 – 05
Logwood, sticks	ton	28 00 – 30 00
Logwood, chips, bags	lb	02½ – 03½
Sumac, leaves, Sicily, bags	ton	65 00 –
Sumac, ground, bags	ton	55 00 – 60 00
Sumac, domestic, bags	ton	35 00 –
Tapioca flour, bags	lb.	.03½ – 05

EXTRACTS

Archil, conc, bbl.	lb	$0 18 – $0 20
Chestnut, 25% tannin, tanks	lb	02 – 03
Divi-divi, 25% tannin, bbl	lb	04 – 05
Fustic, crystals, bbl	lb	20 – 22
Fustic, liquid, 42°, bbl	lb	08 – 09
Gambier, liq, 25% tannin, bbl.	lb	08 – 09
Hematine crys, bbl	lb	14 – 18
Hemlock, 25% tannin, bbl	lb	04 – 05
Hypernic, solid, drums	lb	24 – 26
Hypernic, liquid, 51°, bbl	lb.	14 – 17
Logwood, crys, bbl	lb.	.19 – 20
Logwood, liq, 51°, bbl.	lb.	.09 – 10
Quebracho, solid, 65% tannin, bbl.	lb	.04½ – 05
Sumac, dom., 51°, bbl.	lb.	.06½ – .07

Waxes

Bayberry, bbl	lb	$0 30 – $0 31
Beeswax, refined, dark, bags	lb	.30 – 32
Beeswax, refined, light, bags	lb	.34 – 35
Beeswax, pure white, cases	lb	.40 – 41
Candelilla, bags	lb	.34 – 35
Carnauba, No 1, bags	lb.	.38 – 40
No 2, North Country, bags	lb.	.23 – .24
No 3, North Country, bags	lb.	.17 – 17½
Japan, cases	lb.	.15 – 15½
Montan, crude, bags	lb.	.03½ – .04
Paraffine, crude, match, 105-110 m p	lb.	.04 – .04½
Crude, scale 124-126 m p, bags	lb.	.02½ – .02¾
Ref., 118-120 m.p., bags	lb.	.03¼ – .03½
Ref., 125 m.p., bags	lb.	.03½ – .03¾
Ref, 128-130 m.p, bags	lb.	.04 – .04¼
Ref., 133-135 m p, bags.	lb.	.04½ – .04¾
Ref., 135-137 m p., bags	lb.	.05 – .05½
Stearic acid, sgle pressed, bags	lb	.10 – 10½
Double pressed, bags	lb	.10½ – .10¾
Triple pressed, bags	lb.	.11 – .11½

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb.	$3.20 – $3.25
F.a.s. double bags	100 lb.	3.60 – 3.75
Blood, dried, bulk	unit	4.60 –
Bone, raw, 3 and 50, ground	ton	30 00 – 35.00
Fish scrap, dom., dried, wks.	unit	5.00 – 5.10
Nitrate of soda, bags	100 lb.	2.60 – 2.65
Tankage, high grade, f.o.b. Chicago	unit	4.60 – 4.65

Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$3 50 – $4 00
Tennessee, 78-80%	ton	7 00 – 8 00
Potassium muriate, 80%, bags	ton	35 55 – 38 25
Potassium sulphate, bags.	unit	1.00 –

Crude Rubber

Para—Upriver fine	lb	$0 29 – $0 29½
Upriver coarse	lb	24 – 24½
Upriver caucho ball.	lb	26 – 26½
Plantation—First latex crepe	lb	34 – 34½
Ribbed smoked sheets	lb.	34 – 34½
Brown crepe, thin, clean	lb	27 – 28
Amber crepe No 1	lb	27 – .28

Miscellaneous Materials

Asbestos, crude No 1, f o b, Quebec.	sh ton	$450 00 – $550.00
Asbestos, shingle, f o b, Quebec	sh ton	60 00 – 80 00
Asbestos, cement, f o b, Quebec	sh ton	15 00 – 17.00
Barytes, grd, white, f o b mills, bbl	net ton	16.00 – 20.00
Barytes, grd, off-color, f o b. mills bulk.	net ton	13 00 – 21 00
Barytes, floated, f o b. St Louis, bbl	net ton	24 00 – 28 00
Barytes, crude f.o.b. mines, bulk	net ton	8 00 – 9 00
Casein, bbl, tech	lb.	12 – 14
China clay (kaolin) crude, f o b Ga	net ton	7 00 – 9 00
Washed, f.o.b Ga	net ton	8 00 – 9 00
Powd., f.o.b Ga.	net ton	14 00 – 20 00
Crude f o b. Va.	net ton	8 00 – 12 00
Ground, f o.b. Va.	net ton	13 00 – 20 00
Imp., lump, bulk.	net ton	14 00 – 20 00
Imp, powd.	net ton	40 00 – 45 00
Feldspar, No. 1 pottery.	long ton	6 00 – 7 00
No 2 pottery	long ton	5 00 – 5 50
No. 1 soap	long ton	7 00 – 7 50
No. 1 Canadian, f.o b mill	long ton	20 00 – 21 00
Graphite, Ceylon, lump, first quality, bbl	lb.	05 – 05½
Ceylon, chip, bbl.	lb.	04 – 04½
High grade amorphous crude	ton	35 00 – 50 00
Gum arabic, amber, sorts, bags	lb	15 – 16
Gum tragacanth, sorts, bags	lb.	50 – 60
No 1, bags	lb.	1 75 – 1 80
Kieselguhr, f o b. Cal	ton	40 00 – 42 00
F o b N Y	ton	50 00 – 55 00
Magnesite, crude, f o b Cal.	ton	14 00 – 15 00
Pumice stone, imp, casks.	lb	03 – 05½
Dom, lump, bbl	lb	05 – .05½
Dom, ground, bbl	lb	06 – 07
Shellac, orange fine, bags	lb	83 – .84
Orange superfine, bags	lb.	85 – 86
A. C. garnet, bags	lb	80 – 81
T N, bags	lb	81 – 82
Silica, glass sand, f o b Ind	ton	2 00 – 2 50
Silica, sand blast, f o b Ind	ton	2 50 5 00
Silica, amorphous, 250-mesh, f o b Ill	ton	17 00 17 50
Silica, bldg. sand, f.o b Pa.	ton	2 00 – 2 75
Soapstone, coarse, f o b, Vt., bags	ton	7 00 – 8 00
Talc, 200 mesh, f o b, Vt., bags	ton	6 50 – 9 00
Talc, 200 mesh, f o b Ga, bags	ton	7 00 – 9 00
Talc, 200 mesh, f o b Los Angeles, bags	ton	16 00 – 20.00

Refractories

Bauxite brick, 56% Al_2O_3, f o b Pittsburgh	ton	$45-50
Chrome brick, f.o.b. Eastern shipping points	ton	50-52
Chrome cement, 40-50% Cr_2O_3	ton	23 27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23 00
Fireclay brick, 1st quality, 9-in. shapes, f o.b. Ky. wks	1,000	40-46
2nd. quality, 9-in. shapes, f o b. wks	1,000	36-41
Magnesite brick, 9-in. straight (f.o.b. wks)	ton	65-68
9-in. arches, wedges and keys	ton	80-85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f o b. Chicago district	1,000	48-50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	48-50
F.o.b. Mt. Union, Pa	1,000	42 44
Silicon carbide refract brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N. Y.	ton	$200.00 – $225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11 – .11½
4-6% C.	lb.	.11½ – .12
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	102.50 – 107.50
Spiegeleisen, 19-21% Mn.	gr. ton	35.00 – 37.00
Ferromolybdenum, 50-60% Mo, per lb. Mo.	lb.	1.90 – 2.15
Ferrosilicon, 10-15%	gr. ton	38.00 – 40.00
50%	gr. ton	80.00 – 85.00
75%	gr. ton	150.00 – 160.00
Ferrotungsten, 70-80%, per lb. of W	lb.	$0.90 – $0.95
Ferro-uranium, 35-50% of U, per lb. of U.	lb.	6.00 – ......
Ferrovanadium, 30-40%, per lb. of V	lb.	3.50 – 4.00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f o b shipping points	ton	$6 00 – $9.00
Chrome ore, Calif concentrates, 50% min Cr_2O_3	ton	22 00 – 23 00
C i f Atlantic seaboard	ton	18 50 – 19 00
Coke, fdry, f o b ovens	ton	9 00 – 9 25
Coke, furnace, f.o b ovens	ton	8 00 – 8 50
Fluorspar, gravel, f o.b. mines, New Mexico	ton	17.50 – ....
Fluorspar, No 2 Lump—Ky. & Ill mines	ton	25.00 – ....
Ilmenite, 52% TiO_2	lb	.01½ – .01¾
Manganese ore, 50% Mn, c i f Atlantic seaport	unit	.30 – ....
Manganese ore, chemical (MnO_2)	ton	75.00 – 80.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N. Y	lb	.70 – .75
Monazite, per unit of ThO_2, c i f., Atl seaport	lb.	.06 – .08
Pyrites, Span., fines, c.i f. Atl. seaport	unit	.11½ – .12
Pyrites, Span, furnace size, c i f. Atl seaport	unit	.11½ – .12
Pyrites, dom fines, f o.b. mines, Ga	unit	Nominal
Rutile, 95% TiO_2	lb.	.12 – ....
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.00 – 8.50
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	7.50 – 8.00
Uranium ore (carnotite) per lb of U_3O_8	lb	3.50 – 3.75
Uranium oxide, 96% per lb U_3O_8	lb	2 25 – 2.50
Vanadium pentoxide, 99%	lb	12 00 – 14 00
Vanadium ore, per lb. V_2O_5	lb	1.00 – ....
Zircon, washed, iron free, f o.b Pablo, Fla	lb.	.04½ – .13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	14 625
Aluminum, 98 to 99%	22.00-23.00
Antimony, wholesale, Chinese and Japanese	6.62-7.00
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00 33.00
Nickel, ingot and shot resale	36 00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, straits	38 625
Lead, New York, spot	7.60
Lead, E St Louis, spot	7.55
Zinc, spot, New York	7 05-7.10
Zinc, spot, E. St. Louis	6.70-6.75

OTHER METALS

Silver (commercial)	oz.	$0.65¾
Cadmium	lb	1 15
Bismuth (500 lb lots)	lb	2 50
Cobalt	lb	3 00@3.25
Magnesium, ingots, 99%	lb	1.00@1.05
Platinum	oz	110.00
Iridium	oz	250.00@275.00
Palladium.	oz.	65.00@70.00
Mercury	75 lb.	72.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20 75
Copper bottoms	30 75
Copper rods	20.50
High brass wire	19.50
High brass rods	17.00
Low brass wire	21 10
Low brass rods	22 00
Brazed brass tubing	24 25
Brazed bronze tubing	29.00
Seamless copper tubing	25 25
Seamless high brass tubing	23.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11 30@11.50
Copper, heavy and wire	11 25@11.50
Copper, light and bottoms	9.25@9.50
Lead, heavy	5.75@6.00
Lead, tea	3.50@3.75
Brass, heavy	6.25@6 40
Brass, light	5.35@5 75
No 1 yellow brass turnings	6.00@6.50
Zinc	3.50@4.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.14	$3.14
Soft steel bars	3.04	3.04
Soft steel bar shapes	3.04	3.04
Soft steel bands	3.84	3.84
Plates, ¼ to 1 in. thick	3.14	3.14

Industrial

Financial. Construction and Manufacturers' News

Construction and Operation

Alabama

RIVER FALLS—The Andalusia Brick Co has plans under way for extensions and improvements in its plant, including the installation of considerable additional equipment. O. L. Benson, Andalusia, and Harold Stanley, River Falls, head the company.

Arkansas

LITTLE ROCK—The Arkansas Brick & Tile Co has inquiries out for power equipment and other operating machinery for installation at its plant.

California

TOBY (Kern County)—The Fremont Salt Co, is planning for extensions and improvements in its plant at Toby, near Mojave, estimated to cost about $50,000, including equipment. J. C. Martin is general manager.

SAN DIEGO—The Savage Tire Co, manufacturer of automobile tires, will install additional equipment at its plant for considerable increase in production.

LOS ANGELES—The Soda & Potash Corp. recently organized with a capital of 3,00,000 shares of stock, no par value, is perfecting plans for the construction of a new plant on local site secured some time ago. The works will include an experimental laboratory for developing new processes of manufacture, and are estimated to cost in excess of $1,500,000, including machinery. The company is also arranging for the operation of raw material lands in Nevada, where extensive deposits of sodium sulphate, carbonate and bicarbonate are available. C. W. Culpepper is president. Edward F. Shaw, treasurer, and F. J. McGuire, secretary.

SANTA BARBARA—The Shell Co of California, San Francisco, has acquired property at Salsipuedes Ave, near Milpas St, as a site for the construction of a new storage and distributing plant, estimated to cost in excess of $500,000, with equipment. Work will be placed under way at an early date. Headquarters are at 343 Sansome St, San Francisco.

SAN FRANCISCO—The Western Sugar Refinery, 2 Pine St, will commence the immediate erection of a new 1-story building at its plant, covering two city blocks on 23d and Delaware Sts., estimated to cost about $245,000. The company is a subsidiary of the Spreckels Sugar Co same address.

OAKLAND—The Richmond Sanitary Mfg Co., manufacturer of sanitary ware, has awarded a contract to Sommerstrom Brothers, 306 11th St, Oakland, for the erection of a new 2-story building at 9th and Alice Sts., estimated to cost about $25,000. L. L. Ford, 306 14th St, is architect.

TEHACHAPI—The Henry Cowell Lime & Cement Co., 2 Market St, San Francisco, is said to be perfecting plans for the early erection of its proposed new cement-manufacturing plant on property recently acquired at Tehachapi, near Bakersfield, estimated to cost more than $1,000,000 with machinery.

RICHMOND—The Synthetic Iron Coloring Products Co., 17th and Chanslor Sts, is planning for the rebuilding of the portion of its drying department recently destroyed by fire.

PITTSBURG—The Columbia Steel Corp, recently organized with a capital of $20,000,000, to take over and merge the Columbia Steel So., with local mills, and the Utah Coal & Coke Co., Salt Lake City, has plans under way for extensions and improvements in the Pittsburg works, to include the erection of a number of new mills and open-hearth furnaces. Tho work will cost in excess of $500,000. Wigginton E. Creed, head of the Pacific Gas & Electric Corp., 445 Sutter St., San Francisco, is president of the new corporation.

Florida

TAMPA—The Citrus Growers Supply Co, recently formed with a capital of $25,000, has plans under consideration for the establishment of a new plant for the manufacture of insecticides for use on citrus trees. E. M. Starnes is president, and R. B. Campbell, vice president.

Georgia

AUGUSTA—Merry Brothers, operating a local brick-manufacturing plant at the foot of Gwinnett St, will install additional equipment for the manufacture of hollow tile. A new kiln, about 800 ft long, is being constructed. The company is headed by A. H. and E. B. Merry.

Illinois

CHICAGO—G. K. Nikolas & Co, 1227 West Van Buren St, manufacturers of lacquers and kindred products, will soon award a general contract for the erection of their proposed new 3-story plant, 50x70 ft, adjoining the present works, to cost approximately $50,000. Meyer & Cook, 30 North Dearborn St, Chicago, are architects.

TAYLORVILLE—The Hopper Paper Co has acquired the local plant of the E Z Opener Bag Co, and will use the structure in connection with its proposed new paper mill for which plans are being completed. The new mill to be constructed will be located on an adjoining site and is estimated to cost $75,000, with the present building, it will provide for an initial capacity of about 20 tons per day. B. Hopper is president, and K. R. Cobine, secretary, treasurer and general manager; Walter H. Provine, Taylorville, is vice president in charge.

Indiana

EAST CHICAGO—The Pressed Steel Mfg Co, of East Chicago, Ind, announces that it will begin construction on its 2-story factory and office structure this year, the building to be used for the production of the Murphy steel car ends. According to plans the company proposes to build a brick, steel and concrete structure to cost $700,000.

INDIANAPOLIS—The Marion Paint Co, 358 South Meridian St, has leased a building at 366 Meridian St, for extensions in its plant. Additional equipment will be installed for considerable increased production.

NEW ALBANY—The Gohmann Brothers & Taylor Co, Silver St, is planning for the erection of a 2-story and basement foundry, 30x220 ft, at its stove and range works, estimated to cost approximately $35,000. Bids will be asked at an early date. Arthur R. Smith, Norton Bldg, Louisville, Ky, is architect in charge.

PENDLETON—The Reformatory Board, Indianapolis, has tentative plans under consideration for the construction of a foundry at the new Indiana Reformatory, Pendleton. J. W. Nash, Indianapolis, John O'Neil and Joseph E. Henning comprise the committee in charge of purchases. G. A. H. Shideler is superintendent at the institution.

INDIANAPOLIS—The Radio Chemical Co, recently organized, has arranged for the establishment of a new plant at 315 North Delaware St.

Louisiana

FOWLER—The Southern Carbon Co, Monroe, La., has plans under way for the construction of a new plant at Fowler, comprising 8 operating units for the prodnction of carbon black and kindred specialties, estimated to cost approximately $800,000, with machinery. The company is also arranging for the erection of a new 2-unit plant at Spyker, and has commenced work on a 6-unit factory at Swartz. The entire project is expected to cost close to $1,500,000, including machinery.

Maryland

BALTIMORE—The Tin Decorating Co., Boston and Linwood Aves., has awarded a contract to the West Construction Co., American Bldg., for the erection of a new 1-story plant, 106x168 ft., estimated to cost about $45,000. Work will be placed under way at once.

Massachusetts

INDIAN ORCHARD—The Fiberloid Corp., manufacturer of celluloid composition products, has tentative plans under consideration for the rebuilding of the portion of its plant destroyed by fire, Jan. 8, with loss estimated at close to $50,000, including equipment.

MANISTEE—The Fuler Fibre Co., Fller City, is pushing construction on its new local plant and plans to have the structure ready for the machinery installation at an early date. The initial works will give employment to about 100 men. M. Oberdorfer is vice-president.

LUDDINGTON—The Stearns & Culver Salt Co has work under way on enlargements and improvements in its plant to develop a capacity of about 600 000 bbl. of salt per year.

Nebraska

OMAHA—The Board of Trustees, Creighton University, has tentative plans in progress for the erection of a 4-story and basement chemistry building at the institution, estimated to cost approximately $300,000. John Latenser & Sons, 732 Peters Trust Bldg, are architects. John F. McCormick is president of the institution.

OMAHA—The Metropolitan Utilities District will build by day labor a new 2-story and basement filtration plant at 28th and Fillmore Sts, 130x240 ft, estimated to cost about $600,000, with equipment. F. D. Wead is chairman of the board.

New Jersey

NEWARK—The Utility Color & Chemical Co, 379-95 Frelinghuysen Ave, manufacturer of varnishes, colors, etc, is planning for the immediate rebuilding of the portion of its plant destroyed by fire, Jan 9, with loss estimated at $35,000, including machinery and stock. Mortimer Davis is president.

NEWARK—The Eberhard Faber Rubber Co, New St, will commence the immediate erection of an addition to its plant at 60 Hoyt St, to cost about $25,000.

LAMBERTVILLE—The Perseverance Paper Mills, Inc, is perfecting arrangements for the rebuilding of the portion of its plant recently destroyed by fire. The company specializes in the production of newsprint under a new process. Henry Weeks is general manager.

ELIZABETH—The Durant Motor Co, Newark Ave, has commenced the installation of oven and other equipment, electrically operated, for drying and baking paints and enamels.

PLAUTERVILLE—Plans are being perfected by stockholders of the Smith Rubber & Tire Co, now in charge of William L. Brunyate, 304 Essex Bldg, Newark, trustee in bankruptcy, for a reorganization of the company and settlement of the receivership. Improvements and repairs will be made at the plant, closely following, and operations resumed.

New York

NEW YORK—The Vacuum Oil Co., 61 Broadway, manufacturer of lubricating oils, etc, has purchased property on the East River water front, from 10th to 11th St for a consideration said to be $200,000, to be used as a site for a new storage and distributing plant for domestic and export purposes. The property was formerly a part of the plant of the Quintard Iron Works.

North Carolina

GREENSBORO—The Andrews Container Co., organized with a capital of $150,000, has acquired a local building to be equipped as a plant for the manufacture of solid fiber and corrugated products. O. B. Andrews is president.

Ohio

AKRON—The Benzol Motor Fuel Co has construction under way on a new plant on East Tallmadge Ave, North Akron, for the manufacture of a new fuel for automobile service, composed of motor benzol and gasoline. The works are estimated to cost about $55,000, and will include storage tankage with capacity of approximately 20,000 gal. G. M. Tucker and C. C. Dilley will be in charge.

CINCINNATI—The Cincinnati Galvanizing Co., McMicken and Tafel Sts., will call for bids early in February for the construction of a new 2-story plant at Chickering St. and Spring Grove Ave., totaling about 15,000 sq.ft., estimated to cost approximately $150,000, including equipment. Carl

J. Kiefer, Room 810, Fourth National Bank, is architect and engineer. Christian Schott is president.

NILES—The Mahoning Valley Steel Co is planning for immediate extensions and improvements in its plant, to include the remodeling of furnaces, installation of bar-shearing and other apparatus. The capacity will be considerably increased

AKRON—The Goodyear Tire & Rubber Co is planning for the immediate rebuilding of the portion of its chemical works, destroyed by fire, Jan. 3, with loss reported at $12,000

Oklahoma

HENRYETTA The Henryetta Glass Co, recently acquired by new interests, has plans under way for extensions and improvements, including the installation of additional equipment for increased production F. A. Patterson heads the new organization

ARDMORE—The Chickasaw Refining Corp, recently organized with a capital of $2,500,000, is perfecting plans for the operation of the local Chickasaw refinery Extensions and improvements will be made in the plant. J. A. Cotner heads the company.

TULSA—The Sinclair Crude Producing Co, an interest of the Sinclair Consolidated Oil Corp, 45 Nassau St, New York, has plans nearing completion for extensions and improvements in its plant and system in the Salt Creek fields The work will include a new pipe line, over 700 miles long, with pumping plants and auxiliary equipment The expansion will cost approximately $500,000

PAULS VALLEY—A bond issue of $188,000 has been approved for a waterworks system, to include a complete purification plant V. V. Long & Co, Colcord Bldg, Oklahoma City, are engineers.

Pennsylvania

PHILADELPHIA The American Bag & Paper Co, 2nd and Vine Sts, has taken bids on a general contract and will soon commence the erection of a new 7-story paper mill, 95x275 ft, at South Bainbridge, Water and Swanson Sts. Clarence E Wunder, 1115 Locust St, is architect

PHILADELPHIA—The Pennsylvania Brick & Tile Co has filed plans for the erection of a new building at its proposed plant at Wensley St and the Delaware River, for the manufacture of cement brick and kindred products The ultimate plant is being designed for an output of 150,000 bricks per day The company has recently been organized under state laws, with H. P. Marr, Kennett Sq, Pa, as treasurer

CONSHOHOCKEN—The Ruth Glass Co is arranging for the early installation of additional machinery for increased production A day and night working schedule will soon be adopted The company specializes in the manufacture of hollow ware

South Carolina

COLUMBIA—The Columbia Electro Plating Works, Inc, is planning for the rebuilding of the portion of its plant recently destroyed by fire The estimated loss has not been announced

Tennessee

UNION CITY—T. C. Fennell and R. E. Wilkins, both of Humboldt, Tenn, are planning for the organization of a company to establish and operate a tanning plant on property acquired at Union City

Texas

DALLAS—The Oak Cliff Paper Mills, Inc, Oak Cliff, near Dallas, has plans nearing completion for additions and improvements in its plant for considerable increase in capacity A new structure to be erected will be used primarily for the manufacture of fiber board, corrugated board and kindred products The expansion is estimated to cost $150,000 E. T. Fleming is president

CISCO—The Eastland-Pioneer Oil Refining Co, recently organized, has taken over the former local refining plant of the Liberty Refining Co, idle for some time past, and will make extensions and improvements to increase the capacity to about 6,000 bbl per day The present refinery will be thoroughly modernized It is purposed to rush the work and have the plant ready for operation at an early date. R. E. Whitlock is general manager.

Virginia

HOPEWELL—In connection with extensions in its local pulp mill, the Stamscott Co., Inc., will make enlargements in its chemical department, devoted to the manufacture of specialties for the production of celluloid, lacquers and other products.

NEWPORT NEWS—Gateways, Inc., 128 24th St., recently organized, has acquired the local plant of the Duristo Paint Co., and will operate the property in the future. Extensions and improvements are planned M. K. Armstrong is president of the new company, and E. D. Pettengill, treasurer

Washington

PROSSER—The Prosser Evaporating Co. is considering plans for the rebuilding of the portion of its plant, destroyed by fire, Jan 2, with loss estimated at about $15,000.

West Virginia

PARKERSBURG The Blackwood Electric Steel Corp has broken ground for the construction of the initial units of its new local plant, consisting of a number of 1-story buildings, with main structure, 140x230 ft The plant will be equipped for the manufacture of electric steel castings. Mills, Rhines, Bellman & Nordoff Ohio Bldg, Toledo, O, are architects and engineers F. S. Blackwood heads the company

Industrial Developments

GLASS—The American Window Glass Co has resumed operations at its plant at Hartford City Ind, following a curtailment for a number of days due to equipment breakage

Hand blowing glass plants in the vicinity of Clayton, N. J., are running at full capacity, giving employment to the largest number of workers in about 10 years past

Window glass plants in Western Pennsylvania are operating at maximum output, with shipments of material during the past few weeks breaking all previous records Working forces at a number of the factories are being increased

CEMENT—The Coplay Portland Cement Co, Coplay, Pa, has resumed production at its local mill, following a shut down during the holidays for repair work

The Phoenix Portland Cement Co, North Birmingham, Ala, is perfecting plans for the early completion of its new local mill which has been in course of construction for a number of months past It is purposed to have the first units in full production early in May The mill will have a rated ouput of 1,500,000 bbl per year

The Lehigh Portland Cement Co has closed its Mill F at Coplay, Pa, for necessary repairs to equipment, and plans to resume as soon as the work has been completed with production on a full capacity basis At a later date, Mill D will be closed for a similar purpose

The Alpha Portland Cement Co. is maintaining production at a normal basis at its mill at Alpha, N. J. The Edison Portland Cement Co is also running full at its plant at New Village, N. J.

LEATHER Tolman, Dow & Co Inc, operating a tannery at Woburn, Mass, is running at close to normal, producing about 1,200 sides of buck and patent leather per day.

England, Walton & Co., Philadelphia, Pa, said to be the largest tanners in the world of oak belting butts, have advanced production about 30 per cent during the past 5 to 6 weeks Increased working forces are being employed at the different tanneries

The Murray Leather Co. Woburn, Mass, is operating a regular capacity, devoting production to patent sides as well as buck skin A normal working quota is being employed

PAPER—Paper mills in the vicinity of Three Rivers, Que, are practically all working at full capacity, with largest available working forces.

The Price Brothers Co, Quebec, is arranging for immediate increase in production at its paper mills in the vicinity of Ottawa, Ont., to include the installation of additional equipment. It is purposed to develop a capacity of 200 tons a day before the close of the year.

The Wayagamack Co, Three Rivers, Que., has advanced production at its local paper mills, and is now giving employment to about 500 men.

The Bathurst Co., Bathurst, N. B., is pushing construction on a new local mill to be used for the manufacture of newsprint, and purposes to have the first unit in service at the earliest possible date. The plant will have a rated capacity of 15,000 tons per annum.

IRON AND STEEL—The Blandon Rolling Mill, Reading, Pa., is planning for the immediate resumption of operations at its local mill, following an idle period of about 24 months. Employment will be given to 125 workers.

The Colorado Fuel & Iron Co., Denver, Colo., has blown in two additional blast furnaces at its plant at Pueblo, Colo., giving employment to a large increased working force.

The American Steel & Wire Co., Anderson, Ind, has placed its local mills on a double turn, giving employment to approximately 600 men

The La Belle Iron Works, Steubenville, O., has blown in its No. 2 furnace, following a shut down for a number of months. A total of 8 sheet mills have also been placed in service after an idle period of about 2 months. The units will be operated at capacity.

The Carnegie Steel Co is making ready for operation at its Bellaire, O., plant and has issued orders for necessary repairs and improvements The company is running full at its Edgar Thomson Works in the Pittsburgh, Pa., district, as well as at its other mills in this section

The Shenango Furnace Co, Sharon, Pa., has completed the remodeling of its No. 3 furnace, and the stack is again in blast. The capacity has been increased from 350 to 500 tons per day.

The Republic Iron & Steel Co., Youngstown, O, is maintaining full operations at its eight furnaces in the Mahoning Valley section, and will continue on this basis for some time to come The company is dismantling its plant in the vicinity of Sharpsville, Pa, and will remove the equipment to another location

The Newton Steel Co, Newton Falls, O., is arranging for the immediate operation of three of its eight new sheet mills, recently completed The five other mills will commence rolling within the next 60 days.

The United States Steel Corporation is operating at 100 per cent at its bar mills in the Youngstown, O, district

METALS—The National Lead Co, New York is operating at full capacity at its different plants under a day and night schedule, giving employment to a large working force

The Susquehanna Casting Co., Wrightsville, Pa has advanced the wages of employees 5 per cent, effective at once. The Riverside Casting Co., with plant at the same place, has made a similar advance.

The Utah Copper Co., Salt Lake City, Utah, is operating at full capacity at its plants at Magna and Bingham The company is said to be producing more metal at the present time than at any other period during the past 4 years

MISCELLANEOUS The Prince Metallic Paint Co, Bowmanstown, Pa, is increasing production at its local plant, and has adopted a day and night working shift, giving employment to more workers.

The Shore Fertilizer Mfg. Co, Plant City, Fla., is completing the construction of a new local plant and plans to place the mill in service before the close of the month.

The Federal Sugar Refining Co., New York, is arranging for the immediate resumption of operations at its mill at Yonkers, N. Y, which has been idle for about 8 weeks past The refinery will give employment to approximately 1,200 men.

A total of 104 sugar mills in Cuba are now in operation, as compared with 54 mills at this same time a year ago.

The Boston Hose & Rubber Co., Boston, Mass., is advancing production at its plant. During the last quarter of 1922 the output averaged 25 per cent more than at any other 3 months' period in the history of the company

Sanitary ware plants at Trenton, N. J., are increasing production, and adding to their working forces

Capital Increases, Etc.

THE RUMFORD CHEMICAL WORKS, INC., Providence, R. I., has filed notice of increase in capital from $1,250,000 to $2,000,000.

THE BEAVER FALLS ART TILE CO., Beaver Falls, Pa., has arranged for an increase in capital from $80,000 to $200,000.

THE JONATHAN BARTLEY CRUCIBLE CO., Oxford St., Trenton, N. J., has filed notice of increase in capital from $125,000 to $500,000.

THE HART GLASS MFG. CO., Dunkirk, Ind., has increased its capital from $300,000 to $500,000 for general expansion.

THE AMERICAN PRINTING INK CO., 2324 West Kinzie St., Chicago, Ill., has arranged for an increase in capital from $100,000 to $350,000.

New Publications

BOOKS

FOOD PRODUCTS FROM AFAR. By *E. H. S. Bailey* and *H. S. Bailey*. 285 pages, over 50 illustrations. Price $3. Published by the Century Co, New York City.

Although written by chemists, this book is offered as a popular treatise of general interest on the subject of how and where our country gets its food. It is a work of popular interest that may be somewhat enhanced to chemists in view of the fact that the senior author is professor of chemistry in the University of Kansas, while the junior author, his son, is chief chemist for the Southern Cotton Oil Co.

PAMPHLETS, ETC.

A FEW SUGGESTIONS TO MCGRAW-HILL AUTHORS is the title of a 20-page pamphlet recently issued by the McGraw-Hill Book Co., Inc., 307 Seventh Ave., New York It is designed to give prospective authors information that will enable them to prepare better manuscripts and save both themselves and the publishers time and unnecessary expense.

DENTAL FILLING ALLOYS is the title of a treatise by N. K. Garhart, of the Garhart Dental Specialty Co., Boston, Mass.

THE ENGINEERING EXPERIMENT STATION of Purdue University, Lafayette, Ind., has issued a bulletin, No. 9, on "The Production of Nitric Oxides and Ozone," by K. B. McCochron and R. H. George Copies may be obtained by writing to the director, Dean Potter.

THE SECRETARY OF COMMERCE, Washington, D. C., has issued his tenth annual report, for 1922.

THE FEDERAL BOARD FOR VOCATIONAL EDUCATION, Washington, D. C., has issued its sixth annual report to Congress, for 1922.

THE IMPERIAL INSTITUTE, London, England, has issued a booklet on "Molybdenum Ores," by R H. Rastall. Price 5s., net.

THE U. S. DEPARTMENT OF AGRICULTURE, Washington, D. C, has issued Parts I and II, "List of Workers in Subjects Pertaining to Agriculture"; Bull. 1108, on "Tables for the Microscopic Identification of Inorganic Salts," by William H Fry, Bull 1122, on "Absorption by Colloidal and Non-colloidal Soil Constituents," by M. S. Anderson, W H. Fry, P. L Gile, H E Middleton and W. O Robinson, Circular 233, on "Motion Pictures of the U. S Department of Agriculture."

THE UNIVERSITY OF ILLINOIS has issued Bull. 131, on "A Study of Air Steam Mixtures," by Leroy A Wilson with Charles Russ Richards; Bull. 132, on "A Study of Coal Mine Haulage in Illinois." by H H Stock, J. R. Fleming and A J Hoskin, Bull. 133, "A Study of Explosions of Gaseous Mixtures," by A. P. Kratz and C Z Rosecrans.

THE IMPERIAL MINERAL RESOURCES BUREAU, London, England, has issued booklets on "Nickel," "Iron Ore" and "Coal, Coke and Byproducts," priced at 1s 6d, 6s and 7s, respectively.

NEW BUREAU OF MINES PUBLICATIONS Twelfth Annual Report by the Director of the Bureau of Mines to the Secretary of the Interior for the Fiscal Year Ended June 30, 1922; Bull. 167, Coal-Dust Explosion Tests in the Experimental Mine 1913 to 1918, inclusive, by George S. Rice, L M Jones, W. L. Egy and H. P. Greenwald; Bull. 188, Lessons From the Granite Mountain Shaft Fire, Butte, by Daniel Harrington; Bull. 209, Fusibility of Ash From Coals of the United States, by W A. Selvig and A. C. Fieldner; Tech. Paper 265 Mesothorium, by Herman Schlundt; Tech Paper 303, Value of Coke, Anthracite and Bituminous Coal for Generating Steam in a Low-Pressure Cast-Iron Boiler, by John Blizard, James Neil and F. C. Houghten, Tech. Paper 306, Operation and Maintenance of Electrical Equipment Approved for Permissibility by the Bureau of Mines, by L. C. Ilsley; Tech. Paper 308, Analysis of Kentucky Coals; Tech. Paper 318, Coke-Oven Accidents in the United States During the Calendar Year 1921, by William W. Adams; Reports of Investigations Serial No. 2416, Properties of Typical Crude Oils From the Producing Fields of Southern Louisiana and Southern Texas, by N. A. C. Smith, A. D. Bauer and N. F. LeJeune; Serial 2406, on Titanium, by R. J. Anderson; Serial 2410, on Contraction and Shrinkage of Non-Ferrous Alloys as Related to Casting Practice, by Robert J. Anderson.

THE COLONIAL SUPPLY Co., Pittsburgh, Pa., is issuing the "Colonial Soldier Almanac for 1923."

New Companies

THE CHAREX CHEMICAL Co., Rochester, N. Y., care of Charles E. Bostwick, Insurance Bldg, Rochester, representative, has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are H. C. and H M Williamson.

THE STEARNS & CULVER SALT Co, Ludington, Mich, has been incorporated with a capital of $300,000, to manufacture chemical salts and kindred products. The incorporators are E. E. Barthell, W. T Culver and W A. Spencer, Ludington. The last noted represents the company.

THE CAPITOL BLOCK & BRICK Co., Trenton, N. J., has been incorporated with a capital of $50,000, to manufacture brick, tile, blocks and other burned clay products. The incorporators are Peter J and Paul N. Jachetti, 436 Bert Ave, Trenton. The last noted represents the company.

THE HERCULES OIL Co, 4650 Iowa St., Chicago, Ill, has been incorporated with a capital of $10,000, to manufacture lubricating oils and affiliated products. The incorporators are Henry J Brandt, Lawrence A. Cohen and A. L. Rittenberg.

THE J. B. NEWTON TURPENTINE Co., Hillsdale, Miss., has been incorporated with a capital of $100,000, to manufacture turpentine and kindred products The incorporators are J. B., R. M. and J R. Newton, all of Hillsdale.

CRANE & Co, INC., Dalton, Mass., has been incorporated with a capital of $3,000,000, to manufacture paper products, succeeding the company of the same name with local mills. Reuben C. Pierce is president, and Payson E. Little, treasurer.

THE FRANKS CHEMICAL Co, Brooklyn, N. Y, has been incorporated with a capital of $30,000, to manufacture chemicals, soaps, etc. The incorporators are J. M. Franks, P. M Lah and A. M. Rosenthal The company is represented by Davis, Siegel & Nathan, Broadway and 34th St., New York, N Y.

THE CHICAGO JAPANNERS, INC, 1160 West 22nd St., Chicago, Ill., has been incorporated with a capital of $150,000, to manufacture paints, oils, varnishes, etc. The incorporators are Thomas P. McVicker and William J. and G. A Miskella.

THE STATE LINE CHEMICAL CORP, Bristol, Va, has been incorporated with a capital of $30,000, to manufacture chemicals and chemical byproducts. The incorporators are G C Cole, M. T Repass, and Joseph A Caldwell, all of Bristol

THE DUTCHESS COUNTY CHEMICAL Co., Jersey City, N. J., care of the Capital Trust Co of Delaware, Dover, Del, representative, has been incorporated under Delaware laws, with capital of $600,000, to manufacture washing powders, cleansers, and other chemical compounds The incorporators are H C Schuckhaus, Jersey City, M A Kern, New York, and A. H. Wylie, Washington, D C.

THE LUCAS BRICK Co., Portland, Ore, has been incorporated with a capital of $100,000, to manufacture brick, tile and other burned clay products. Moses M. Lucas is president and treasurer and Brighton E Lucas, clerk and representative, both of Portland.

THE HENNETT METAL TREATING Co, West Hartford, Conn., has been incorporated with a capital of $50,000, to operate a metal-treating plant. The incorporators are H. R. Barker, A J. German and A L. Davis, all of Waterbury, Conn.

THE KISKI LIME PRODUCTS Co., care of the Corporation Trust Co. of America, du Pont Building, Wilmington, Del., representative, has been incorporated under Delaware laws, with capital of $50,000, to manufacture lime and kindred products.

THE CENTRAL OIL Co., El Dorado, Ark., has been incorporated with a capital of $1,000,000, to manufacture petroleum products. The incorporators are Patrick Marr, W S Eakens and R. G. Ferrell, all of El Dorado

THE DE LONG-KENDRICK Co, Newark, N. J., has been incorporated with a capital of 1,000 shares of stock, no par value, to manufacture metal alloys. The incorporators are Louis DeLong, Richard B. Downing and Kenneth A. Depew, 345 Halsey St., Newark. The last noted represents the company.

J. B. CHAPPELL, INC., Philadelphia, Pa., has been incorporated with a capital of $10,000, to manufacture paints, varnishes, etc. Walter Beahart, Roxborough, Philadelphia, is treasurer, and represents the company.

THE HOFFMAN BROTHERS TANNING Co., 4701 Grand Ave., Chicago, Ill., has been incorporated with a capital of $250,000, to manufacture leather products. The incorporators are Olaf C. and Anton R. Hoffman, and Carl Peterson.

THE NATIONAL SPEEDWAY REFINING Co., care of the Capital Trust Co. of Delaware, Dover, Del., representative, has been incorporated under state laws with a capital of $150,000, to manufacture refined oil products.

THE FIELD PRODUCTS CORP., New York, N. Y., care of M. Brandt, attorney, 276 Fifth Ave., New York, representative, has been incorporated with a capital of $30 000, to manufacture chemicals and chemical byproducts. The incorporators are W., D. and H. J. Greenfield.

THE WULBERN FERTILIZER Co., Charleston, S. C., has been incorporated with a capital of $150,000, to manufacture commercial fertilizer products. E. N. Wulbern is president and treasurer; and William E. Jones, secretary, both of Charleston.

THE LIBERTY MIRROR WORKS, INC., Pittsburgh, Pa., has been incorporated with a capital of $150,000, to manufacture mirrors, glass products, etc. William H. Colbert, 6615 Kelly St., Pittsburgh, is treasurer and representative.

THE SMACKOVER VALLEY OIL Co., Camden, Ark., has been incorporated with a capital of $250,000, to manufacture petroleum products. A. M. Sutton is president and general manager; and W. M. Worthen, secretary, both of Camden.

Coming Meetings and Events

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual convention in Norfolk, Va., May 7 to 9.

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York.

AMERICAN FOUNDRYMEN'S ASSOCIATION will hold a meeting in Cleveland, O., April 28 to May 4.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its annual meeting in New York City during the week of Feb 19, 1923

AMERICAN SOCIETY FOR STEEL TREATING will hold its winter sectional meeting in the City Club, Chicago, Feb 8 and 9, 1923.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

CANADIAN PULP AND PAPER ASSOCIATION will meet at the Ritz-Carlton Hotel, Montreal, Jan 25 and 26.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL FOREIGN TRADE COUNCIL will hold its annual conference April 25, 26 and 27, 1923, in New Orleans, La.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

A PAPER INDUSTRIES EXPOSITION will be held in Grand Central Palace, New York City, during the week of April 9, 1923, by the International Exposition Co.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

# CHEMICAL
& METALLURGICAL
ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY and IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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The Law And the Profits

IN ENGLAND last year, in a hearing before the Board of Trade, the question was argued before a referee whether or not calcium carbide might be included among the substances covered by the safeguarding of industries act. The referee was learned in the law, but was in no sense a chemist, so the argument became long and very much tangled up. He did not have even the aid of a chemist to shed light on the subject, consequently the hearing became a curious discussion in chemistry by lawyers. His conclusion was that calcium carbide is not a synthetic organic chemical, and is therefore not properly included under the act.

Sir WILLIAM J. POPE discusses the subject in *Chemistry and Industry* (vol. 42, No. 1) and declares the proceedings to have been "an orgy of misinterpretation and misapprehension." It was admitted that calcium carbide is a synthetic compound, but the expounder of the law shied at admitting it to be organic. Then Sir WILLIAM brings to bear his proofs that organic chemistry is the chemistry of carbon compounds, and he makes a good case of it. He quotes from KEKULÉ, LAURENT, VAN'T HOFF (who said that "organic chemistry has for its object not only the study of the compounds of carbon, but also that of the element itself"), H. E. ARMSTRONG, BEILSTEIN, and numerous other authorities. Next he takes up those who have endeavored to qualify the statement. Thus SCHORLEMMER called it "the chemistry of hydrocarbons and their derivatives," but Sir WILLIAM points out that while this would exclude carbon monoxide, it includes carbon dioxide as a derivative of methane, but again would exclude purine. FRANKLAND said that organic chemistry is restricted to compounds the molecules of which consist of two or more atoms of carbon, directly combined either with carbon, nitrogen or hydrogen. This excludes, for instance, perchlormethyl ether, $(CCl_3)_2O$, from the category. REMSEN says that, strictly speaking, the carbonates should be included in organic series, but that it is customary to treat these widely distributed substances under the head of inorganic chemistry. G. S. NEWTH in his textbook on inorganic chemistry says, "No exact definition of organic chemistry has ever been framed" and that it is "the chemistry of carbon compounds with certain generally acknowledged exceptions." He is wrong in his opening paragraph: All the carbon compounds is an exact definition, and the exceptions are not generally acknowledged. E. P. MOELLER is his "Law of Atomic Linking" (1895) declares that "in all organic compounds carbon and hydrogen appear as never failing constituents." Of course that is absurd.

The conclusion we reach is that it is better in contracts and in law and in all writing that is likely to pass through the fire of juristochemistry, to say *carbon* rather than *organic* compounds. By juristochemistry we mean those chemical discussions and disputes that are carried on at court without a knowledge or understanding of the science.

Salesmen's Report On the Chemical Exposition

FOR some months past a special committee of the Salesmen's Association of the American Chemical Industry has been investigating the Chemical Exposition with a view to proposing constructive measures for improving the usefulness of that annual affair. The final report of the committee is recorded in our news columns.

From a reasonably intimate familiarity with the Chemical Exposition we have read the report carefully to see what elements of novelty it contains. It is a constructive document and shows a commendable desire on the part of the Salesmen's Association to obtain for the exposition the hearty support of the chemical industry *per se*. It proposes also to insure an appropriate attendance by holding during exposition week a congress of chemical and consuming industries as represented by various technical and trade organizations. It suggests a fund to be created out of a part of the Exposition Company's receipts to be expended on educational exhibits of the chemical industries; and finally it recommends representation for the executives and sales departments of the industry on the advisory committee of the exposition.

It is not in derogation of the salesmen's efforts to say that all of these proposals are not new; but at least they are brought together at one time as the expression of opinion of an important organization. All of them will be susceptible of easy execution with the exception of the proposed congress, which will require the best efforts of the Salesmen's Association to induce a large number and variety of technical and trade associations to forego their customary meetings and join in a common plan for the promotion of the chemical industry. It is not impossible, but it will not be easy to accomplish.

Two points of interest about which considerable controversy has been waged—namely, annual or biennial expositions, co-operative or private shows—have been settled for the moment. The annual show is regarded as essential for the time being, and the co-operative show is dismissed as undesirable if private management will heed the desires of those who make the show possible. It would now seem as though we can look forward without distraction to a satisfactory Chemical Exposition in 1923.

Fuel Supply a Factor In Industrial Development

NATURE has provided one of the most convenient forms of fuel in the natural gas resources of the country. These resources have been developed on a tremendous scale largely for public utility gas supply. During recent years, however, there have been numerous discoveries of natural gas so located that it cannot be utilized economically for city supply. The question has therefore been raised how best to apply this splendid resource to industrial purposes. In the state of Texas there have been a number of such problems confronting property owners and public officials. Referring to one of these cases, a state official said: "It has been our purpose and effort to bring these fields into contact with enterprises which would convert this gas to commercial uses not wasteful. And I believe that the fields present today an inviting opportunity to capital."

The case to which this official made reference is but one of a number where large supplies at points some distance from great municipal centers offer immediate prospect of cheap, adequate fuel supply. No group of industries is better suited to use this resource than the chemical and metallurgical industries. The time is past when resources of this sort are going to be used extensively for the crude operations of brick-making, boiler firing and other heating work that can be done equally well by coal. In general state officials frown upon that type of natural gas utilization; in fact it is forbidden in some states. But many fine industrial heating operations that require close control of temperature can use gas supplies such as these to great advantage; and it is well recognized that the efficient burning of this gas for heating operations of high order can properly be encouraged by the public official.

It will be well if industries having heating problems of this sort will investigate some of the Texas, Wyoming and other Western gas occurrences for which there are no other close-by markets. There should be a basis of mutual service to the local communities and to those industries through their development.

The Outlook for Better Trade Statistics

ONE of the notable accomplishments of the Department of Commerce since it has been under HERBERT HOOVER's direction has been a marked improvement in the character and scope of the governmental statistical services. With the inauguration of the *Survey of Current Business* timely figures on production, stocks and prices were made available to industry. Progress in the case of foreign trade statistics, however, has been somewhat less pronounced, but recently some changes have been made which promise greatly to facilitate the compilation and dissemination of import and export figures. In the first place, new schedules have been worked out which show imported commodities in much greater detail and at the same time so arranged as to give figures which are easily compared with production and export data. Production plus imports minus exports has long been a favorite formula for the statistician who wishes to approximate the total consumption of a commodity.

The revised import schedules went into effect with the enactment of the new tariff, Sept. 22, 1922. New export schedules have been in use for several months and certain improvements have already become evident. Quantity figures are now obtained for many commodities for which only values were previously available. This greatly increases the accuracy of these statistics, for in the past, as has been pointed out by the manager of the foreign commerce department of the Chamber of Commerce of the United States, export declarations have often been carelessly made at purely fictitious values. Thus copper wire had been billed at 4 cents a pound, white lead at 2 cents a pound, and so on. Obviously export values thus obtained are practically worthless in sizing up an export market.

Furthermore our statistical service has been considerably strengthened by the recent action of Congress in authorizing the transfer of all statistical work on imports and exports from the customs service of the Treasury Department to the Bureau of Foreign and Domestic Commerce. With the new schedules in operation, with the government's statistical machinery working more efficiently and with both importer and exporter co-operating to make their declarations as accurate as possible, 1923 should mark a new era in a sort of service that can be made a most effective agent in the promotion of our foreign trade.

Intelligent Use Of Intelligence Tests

THERE are at least two general types of intelligence tests. One is an information test that seeks to ascertain the breadth and accuracy of an individual's knowledge. The other is a test that evaluates his mental agility, quickness of decision and accuracy of judgment. All intelligence tests seem to have played in hard luck. The prominent experimenters were often inexpert and dogmatic and their conclusions have pyramided until we have been given such monstrous statements as "the average adult intelligence in America is that of a 12-year-old boy." WALTER LIPMAN has pointed out how silly this is. The average intelligence must by definition be that of the average adult. Whence then the startling conclusion? A pre-war experimenter had carried out a series of tests on less than a hundred Californians. He assumed that the average rating obtained was equivalent to adult intelligence, or 16 years, and he extrapolated back to the theoretical value which should be obtained by persons of 14 and 12. Then came the remarkable army tests, over 2,000,000 of them. The California experimenter tried to translate these results into the California rating, a procedure both hazardous and questionable, and arrived at the remarkable conclusion mentioned above.

At present the attitude toward intelligence tests oscillates between amusement and ridicule. This is unfortunate, for we are neglecting a most useful tool. A recent folder from the Engineering Foundation tells an interesting story of the use of intelligence tests. It seems that the salesmen in a certain organization were all given an intelligence test and strangely enough the relation between high intelligence and sales return was apparently nil. This was a facer until it was discovered that the salesmen were not well paid and those who stayed with the company long enough to develop good records were stolid men contented with the low pay and slight advancement. This led to the use of the test in such a way as to eliminate as candidates for the job of salesmen, first, those who were of such inferior mentality that they could not reach the lower critical

score, and second, those who obtained a mark above a certain other critical score, since the latter would not long be satisfied with the low pay of the salesman in that organization.

The whole subject is in its infancy, so it is refreshing to hear of intelligent use of intelligence tests. We commend the idea to your attention as being promising of fruitful results in industry.

Promoting a Policy of Interchange of Information

IT IS significant of a nascent era in chemical industry that such studies as those of C. C. VAN NUYS on rectification are fostered and encouraged and then made available for chemical engineers. Within the scientific memories of most of us distillation and rectification were essentially empirical, practically solved problems. Experience told how many trays to use and how large the column should be.

Mr. VAN NUYS has attacked the problem thermodynamically and his analysis of variables and limiting conditions has been more rigid and more complete than any yet published. The results and formulas given in his articles, the first of which appears in this issue, are the basis of production in plants of the Air Reduction Co. They have passed the pragmatic test: they work. Purer products and higher yields at the same time have been an immediate result.

The significant facts are, first, the inception of this theoretical research and its distinct success; and second, the publishing of the theoretical basis upon which the results are built. Such things cannot help but produce an optimistic feeling and strengthen the belief that perhaps chemistry will yet pass through that beneficent revolution which has made American metallurgy the most progressive industry in the world—a revolution that will foster and encourage a free exchange of ideas.

An Outside View of Our Tariff Problems

OCCASIONALLY the chemical industry is accused of inbreeding. The criticism is made that we have isolated ourselves from the general public and have been satisfied to look out on the great economic problems of the nation from the very narrow, if not selfish, viewpoint of our industry or profession. Without debating the justification of such a criticism, we believe it is nevertheless worth while to take note of the prevalence of this view. It is for this reason that we wish to call the industry's attention to a rather unusual article on the tariff by Prof. F. W. TAUSSIG, which appeared in a recent number of the *Quarterly Journal of Economics*. Its author has long been recognized, at least among economists, as an outstanding authority on the tariff, although his well-known views along the lines of free trade and low duties have never won for him a large following among the protectionists. His present article, however, is of the nature of a historical account of the economic and industrial developments leading up to the enactment of the new tariff. Excerpts from it having particular bearing on the chemical industry have been reprinted on page 210 of this issue.

It is our belief that in this discussion of the "purely economic aspects of the case" our readers will find a rather novel line of thought. The comparison of the German and American industrial ways and aptitudes and the conclusions as far as the dye industry is concerned would seem to be fundamentally sound. On the other hand, we can scarcely be expected to add our approval to the author's apparent disposition to subordinate the "war argument"—i.e., the chemical industry's relation to the national defense—in favor of such an idealistic consideration as the economist's theory of the international division of labor. As far as we are concerned, stern realities have already answered "the old question of whether it is worth while to restrict the advantages of the international division of labor because of a possibility of sudden disruption."

The question of rates and the application of the American valuation plan bring up still other controversial issues on which we have already made our stand. Suffice it here to say that the effectiveness of these provisions will turn largely on their administration and that time alone will tell whether or not "the new rates of duty are extremely high" or the American valuation plan is a workable administrative procedure.

Coal and Chemical Engineering

ANNUALLY the American miner takes from the ground a larger tonnage of coal than of any other single mineral product; yet in general the utilization of this material has followed the happy-go-lucky, spendthrift American method of "easy come, easy go." Lately, however, with increasing cost of coal production and with increasing irregularity in coal markets, even the coal-mine operator is beginning to see that there is a real engineering problem in the utilization of our fuel resources. A representative of one of the large coal companies recently expressed himself thus: "We feel that the time has come when a distinct advance should be made in the marketing of our product and look to gasification as a solution of at least part of our problem."

Somewhat the same point was stressed by the official representative of the American Gas Association when he appeared before the Federal Coal Commission. He emphasized the fact that the gas industry is a branch of chemical engineering requiring particular kinds of coal for processes which are not haphazard but based upon the latest and best of science and technology.

These are but two of the recent evidences that coal is recognized as an important raw material for American industry. And gasification of the coal before use as a fuel is a logical step forward in the application of these ideas.

A great deal of research on coal processing has already been done, but we need much more. We need particularly to learn how to get daily the maximum output in millions of heat units per dollar of investment cost. The problems of quality of product and regularity of operation have been largely solved by the makers of water-gas machinery, by coke-oven builders and by the contributions of skilled operating men in all classes of gas works. Yet today we find that one of the principal items in cost of gas, whether for city supply or for industrial use, is that of capital charges. There is still much to be done by the chemical engineer in devising more productive and efficient schemes in order that this part of the problem may not remain as serious a one as it now is.

Readers' Views and Comments

"Chem. & Met." as a Text Book

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have a new use for *Chem. & Met.* which is working out pretty well in practice, and that is as a text book. I have a class in industrial and organic chemistry composed of young fellows who work all day in the industry and then come to school five nights a week. They really do come, too; not only is attendance required, but they are interested. Furthermore, each knows more than I do about some one or two things, and it is my job, in part, to even up their general knowledge of chemistry.

There is no one book I can ask them to get which is within the price limit and not too advanced, so I have arranged for them to each take *Chem. & Met.* and every week we go over it. Sometimes articles are assigned, sometimes we take a chance, and, pretty regularly, the price lists are used as a sort of old-fashioned spelling bee, the fellows telling whence things come, how they are made and what they are used for. They are also expected to be able to answer questions on the advertising pages along the same lines. Of course the regular lectures, coming before and after this session with the paper, may or may not hit something in that particular issue, but very often they do, or at any rate some matter which has recently had some notice in the patent lists.

As the year goes on and we get a larger background there is an increasing number of articles which bear on what I have been telling them, and my hope is to have every student able to tell something about all the common chemicals and to read most of the articles with intelligent interest by the time we have finished our course. It seems to be working out that way; at any rate they are coming to see the length, breadth and depth of the knowledge of chemistry, and how each of them fits in.

F. D. CRANE.

Newark Technical School,
Newark, N. J.

Steel at Moderate Temperature

To the Editor of Chemical & Metallurgical Engineering

SIR:—Several articles have recently been published in reference to physical tests on iron and steel at elevated temperatures. An article on "The Blue Brittleness and Aging of Iron" by Dr. Fettweis was published in *Stahl und Eisen* for Jan. 2 and Jan. 9, 1919, which I think is a most valuable contribution to the literature. Dr. Zay Jeffries is the only writer in this country who has made any reference to the work of Dr. Fettweis; at least no other reference has come to my notice. This leads me to believe that this important work has been very largely overlooked.

At the head of the article by Priester and Harder on "Effect of Temperature on the Mechanical and Microscopic Properties of Steel" (*Chem. & Met.*, Jan. 17, 1923, p. 111) this editorial summary appears: "Properties of a low-carbon steel in the blue heat range are inherent to that temperature and are not duplicated when same metal is tested at room temperature after a corresponding tempering." I do not believe this statement holds true. I believe the results can be duplicated when tested at room temperature *provided the metal is cold-worked before or during the tempering.* Fettweis demonstrates this clearly.

That Priester and Harder did not get a higher value at 300 deg. than at room temperature (Fig. 3, p. 12) seems to be due to the "annealing" effect at this temperature overbalancing the "aging" effect, as they started with quenched samples.

At the September, 1922, meeting of the Electrochemical Society a paper was presented by Norman B. Pilling on "Effect of Heat-Treatment on the Hardness and Microstructure of Electrolytically Deposited Iron," and the increase in hardness at 300 deg. C. was ascribed to the decomposition of the iron-hydrogen compound. That the iron is deposited in a strained condition has been clearly demonstrated and I believe the increase in tensile strength at the blue brittle range is to be accounted for in the same way as that noted in iron strained by cold-working and then heated to the blue brittle range.

R. O. GRIFFIS,
Assistant Metallurgist,
American Rolling Mill Co

Middletown, Ohio

Numbering Steels

To the Editor of Chemical & Metallurgical Engineering

SIR:—The editorial pages of *Chem. & Met.* have been the source of so much instruction to me, and I have come to hold them in such high esteem, that I cannot forbear a few words of mild protest regarding the discourse on "Numbering Steels" appearing in your issue of Dec. 27. Having taken an interest in that subject for some time, I read your editorial with considerable eagerness, hoping for the usual clarifying exposition of a difficult topic. Forgive me, therefore, if I confess to a keen disappointment and a feeling that the matter was wound into an unintelligible tangle and dropped there.

You proceed to show that the SAE system, at first logical, has now become arbitrary, because of the constantly increasing complexity of steels offered, but you cite this arbitrary class numbering as an *advantage,* although arbitrary numbering was the very evil which the SAE system was originally designed to avoid! You next lament, Friend Editor, that "a logical code indicating the chemical composition of steels has so far eluded discovery" and observe how much more difficult it would be to devise a code which, in addition, will denote "that physical property" which is desired. Again, you assure us that information on the chemical composition is only incidental, since an ordnance constructor wants not chemical analysis, but a gun tube, with high transverse strength and ductility; and so on. We are then asked how all this is to be got into one code.

The answer, of course, is: It is not. Even if all the properties named were to be got into a code, somebody would come along with a lot more real or fancied properties that could not be coded. Moreover, if none of these gentlemen care about composition, as you intimate, why are modern steel specifications tending more and more to include chemical analysis?

The point of the whole discourse is finally disclosed to be that the only known way to describe a steel is in a detailed specification, and that it does not really matter in the least how the specification is designated. It is added that all of the steels might (for "practical" purposes?) be indistinguishable chemically, good steel being "more than low phosphorus and sulphur."

All of which leaves us just where we started, although a trifle dizzy.

Have the editors of *Chem. & Met.*—so often leaders of progressive thought in affairs technical—really nothing better to offer than persiflage on a subject which has called together a group of engineers, representing perhaps thirty national organizations on a series of conferences? Can you not give your readers some really constructive, helpful, logical and practical suggestions on this important and delicate subject?

Perhaps this code problem seems complex and difficult because we make it so. It is only when we try to "discover" a code system which will express in one neat and compact little symbol all we want to know about a steel, including diverse and sundry physical properties, method of manufacture, its physical state, heat-treatment, and even the purposes for which intended, with or without chemical analysis (all of which have at various times been suggested), that we get into a muddle and reject the idea as impracticable. Of course it is impracticable to expect one symbol to do all that work, for it would then be no longer a symbol, but merely a specification number, and we should have to refer to the specification to get our data.

However, what is really under consideration is "a numbering system for *steels*—not the *properties* of steels. That there is a real need for such a system has already been definitely agreed upon.

When the SAE founded its system, a dozen years ago, it made its symbols express the principal alloying components, carbon, nickel, chromium, etc., and did not try to make the same symbol tell all the physical characteristics which any steel might, under various treatments and circumstances, possess. It recognized the fact that one steel may be made to meet a wide variety of physical specifications by different treatments, and also that a given set of physical properties can be met by a considerable number of different steels appropriately treated. It stuck to chemical analysis for its symbols, and took care of the other properties by means of specifications. The system has been quite successful and very useful. Unfortunately, the SAE code, using numerals only, is not capable of unlimited expansion, and cannot be logically extended to take care of all the useful alloys which are developing. This is admitted. What is needed, therefore, is a truly elastic and comprehensive symbol system for steels, showing the principal components, which can take care of any useful steel now existing or which may exist in the future. Such a code cannot be "discovered," but can and will be developed by logical thought.

The answer seems to be found in an abbreviated chemical formula—that is, a code wherein the important elements are represented by letters corresponding to or suggesting their chemical symbol and the approximate quantities of these important elements are indicated by numerals. Here we have letters and numbers each acting in their true function—letters for names and numerals for amounts. The principles of such a code have already been outlined and shown to be quite practicable. (Universal Steel Code, Knerr & Collins, *Iron Age*, Sept. 1, 1921.) A code along very similar lines (although with some objectionable details) has recently been tentatively issued in Europe by the Standards Committee of the Swiss Association of Engine Builders.

Once having a truly elastic, comprehensive, brief, logical and easily learned and remembered symbol system for *steels*, we can proceed to indicate the physical characteristics desired in any given steel by a specification number, or by an appended symbol, if we so desire. Special chemical characteristics, such as high or low phosphorus and sulphur, etc., may also be indicated, where necessary, without confusion.

Naval Aircraft Factory, Philadelphia, Pa. HORACE C. KNERR.

Importance of Proper Technical Testimony in Patent Suits

To the Editor of Chemical & Metallurgical Engineering

SIR:—In your issue of Jan. 17 under the head of "Patent Notes" there are two pages devoted to a review of the decision of the N. Y. courts in the infringement suit of the Philadelphia Rubber Works Co. vs. the United States Rubber Reclaiming Co. claiming infringement of the Marks patent on the "alkali process" of rubber reclaiming.

It may not be generally known that the Ohio court's decision on the validity of these patents was quite at variance with the New York court's decisions.

The Philadelphia Rubber Co. sued the Portage Rubber Co. of Akron for infringement of the same patents and at about the same time. By expert testimony it was shown that a number of patents had been issued long before on the use of both alkali and acids with various heating methods for reclaiming rubber and that in the Mitchell patent it was claimed that it had been discovered that there was advantage in submitting rubber with reclaiming agents "either acid or alkaline" to heat under pressures comparable to that specified in the claimed process.

It was further shown by expert examination of the file wrapper and contents that the Patent Office had been misled by erroneous statements and affidavits in the case which claimed that all of the sulphur, both free and combined, was removed, thus producing a new product, while admissions of complainants at the trial proved that no combined sulphur was removed by the treatment of vulcanized rubber with 3 per cent caustic soda at 150 lb. steam pressure for 24 hours, which was the claimed process.

Further, it was shown the court that the object of reclaiming was, first, to remove fiber and that acid best removed cotton fiber; second, that the free sulphur should be removed and that this could be done at ordinary pressure by boiling in weak alkalis, a process commonly used to prevent "blooming," and third, that plasticizing was a function of heat and time and was not affected by the chemicals.

Defendants had modified their process so as to remove the fiber first with acid in open tanks and then this was, after removal of acid, treated with alkali at lower pressure and for shorter time than that specified by the patent and that necessary for devulcanizing by its use.

With these facts brought out by expert testimony, the District Court of Northern Ohio decided that the patent was invalid on account of fraud practiced on the Patent Office in claiming the removal of all the sulphur,

but a rehearing was granted because defendants had not alleged this as defense. On the rehearing the defence offered no chemical testimony and the judge decided from the evidence that, at the time of the patent application, there was no way known to determine whethel combined sulphur was in the reclaimed rubber or not. Of course all chemists will see at once that the judge was misled on chemical facts. But he decided that the patent was invalid anyway on account of the anticipation by the cited Mitchell patent.

On appeal to the Circuit Court of Appeals of Ohio in Cincinnati, official cognizance was taken of the fact that in the meantime the New York courts had held the Marks patent valid and infringed, but the court decided that it was not necessary to decide this point, as it was convinced the technical testimony had made it plain that the defendant, Portage Rubber Co., was using a different process from that claimed by the patent in suit and that therefore there was no infringement.

Thus it is seen that in the original home of the "alkali" process the patent was twice declared invalid, while in another state the courts of equal standing on different testimony declared the patent valid and infringed. This shows the necessity of such technical testimony that the judges can perceive the actual chemical principles and practice involved in any patent brought before them. Usually they are ignorant of the chemistry involved, but understand logic and can comprehend any chemical proposition explained logically and lucidly to them.

H. O. CHUTE.
New York City

Accelerated Reactions in Pulsating Gas Currents

To the Editor of Chemical & Metallurgical Engineering

SIR:—In reference to the article "Accelerated Reactions in Pulsating Gaseous Currents," I have no experience with the suggestion therein contained. I do know, however, that the problem of "channeling" is a very serious one in many catalytic gaseous reactions and anything that may be done to obviate the difficulties which so arise would be of very considerable importance in the technology of such processes. I believe that definite information concerning the advantage or otherwise of such pulsating currents might be very readily attained in the study of a well-chosen catalytic gaseous reaction taking place in contact with a solid contact agent. I think it should be possible to determine definitely what improvement might be effected by the pulsating process. And that, perhaps, more readily than in the case of absorption processes mainly discussed in the article.

HUGH S. TAYLOR.
Princeton University,
Princeton, N. J.

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have reread the article on "Accelerated Reactions in Pulsating Gaseous Currents." It seems to me to be a very good article from a standpoint of getting one to consider the possible benefits from pulsating gaseous currents.

However, the question came into my mind two or three times, Does the increased efficiency, due to pulsating gaseous currents, compensate for the increased cost of producing them? Can this article be followed by one giving quantitative figures showing in one or two instances the increased capacity which the authors' claim? For example, they claim increased capacity in absorption towers with pulsating current and that gas producers operate more regularly and with greater output when operating with a pulsating current or blast. Proving these points would be a very valuable thing and some data should be given to support their case.

R. T. HASLAM.
Massachusetts Institute of Technology,
Cambridge, Mass.

An Oil Well in a Graveyard

To the Editor of Chemical & Metallurgical Engineering

SIR:—No doubt you will be surprised to observe the California postmark on this communication, so permit me to explain that the insufferable weather of the metropolitan district induced me to leave my office in charge of my son, Marcus, and set out on a jaunt to the Golden Gate. Yesterday, while on a little excursion to Long Beach, I chanced upon a sight so odd, and one which inspired such humility, that I snapped the photograph which you will find inclosed. An oil well in a graveyard! It is producing, too.

A PRODUCING OIL WELL IN A CEMETERY

I am sure you will understand the irresistible urge that came over me to philosophize on the brevity of this fleeting shadow and the cynical humor of the situation. Evidently, one need no longer be a Pharaoh to "make" the front page. And who shall say that the account of the discovery of Pharaoh's tomb, his mummified remains with his favorite pocket flask and a somewhat moldy but otherwise perfectly preserved pâté de fois gras, his favorite dish, may soon be driven to a less prominent position by a column headed, "300 Barrels a Day of Paraffine Base Crude From Grave of John Doe."

I note that you propose an epitaph in an editorial of your issue of Jan. 3, "Here lies John Doe—Engineer." The spirit of your thought is indeed commendable, but fancy the dismay of John's shade, passing by 500 years later and reading, directly under the Requiescat in pace, —"S. O. Co. of N. Y. Keep off!" As a matter of fact, my guide assured me that no evidence has been found to indicate that the oil was derived from decaying hu-

man remains. But I must close, or you will be waiting my demise in order to stake out a "gusher."

A gruesome subject, Mr. Editor. I believe I will run down to Hollywood this afternoon. MARTIN SEYT.

Dirt in Steel

To the Editor of Chemical & Metallurgical Engineering

SIR:—In a recent issue appeared an editorial on the subject of "dirty steel." There are certain phases of this on which I should like to present another viewpoint. In reading this article there is a tendency in the reader's mind to find a direct condemnation of steel made in large quantities—"tonnage steel" it is termed.

That steel made in smaller quantities may perhaps appear better from a theoretical standpoint or from laboratory examination will not be questioned. There is, however, a decided difference of opinion as to the actual commercial value of such differences as may appear in favor of the smaller lot. When one considers the successful application of "tonnage steel" in tremendous quantity, particularly in the automotive industry, which was directly mentioned, one may hesitate to condemn offhand this material.

It is true that "dirty steel" has been found and that it has caused trouble, but it must be remembered that when such cases have been found they have received exceedingly wide advertising. It is not always remembered that such cases represent an extremely small proportion of the amount in service. Furthermore little mention is made of the large quantities which render excellent service.

In the writer's experience with steel, covering about 15 years, of which 10 was spent in the automotive industry, he has had his share of difficulty with seamy and dirty steel. This, however, represents a very small proportion of the troubles which have occurred in the use of steel and has occurred less and less as practice has improved. Furthermore, the steels made in small quantities with considerable care have by no means lacked representatives which showed this condition.

Much of the condemnation of certain inclusions in steel has arisen from a lack of complete analysis of the factors governing the application of the steel. Many cases of failure which have been stated to be due to inclusions or dirt have been due primarily to faulty design. The effect of a sharp corner or nick is now quite well understood. Tool marks represent a phase of this. When fracture occurs because of tool marks, it is not always a simple matter to demonstrate this, because after it has occurred the mark has disappeared. All steel contains more or less inclusions and if an obscure break occurs it is usually quite a simple matter to find inclusions with which it may be connected. The line of reasoning that the break was not caused by the inclusion but rather followed it along the line of least resistance, being caused by an overload due to the mechanical condition of the steel, requires an intimate knowledge of all the factors which enter in. This example will serve to illustrate the fact that troubles arise frequently for which the condition of the steel is not at all responsible.

The writer is holding no brief for "dirty steel" nor for "tonnage steel" in all cases. There are many cases in which exceeding care is necessary—for example, in tool steel from which costly tools are to be made. This is written to call attention to the fact that "tonnage practice" is not to be condemned in any wholesale way. There may be makers whose practice is such that their steels are marketed in bad condition, but on the other hand it is not at all difficult to select many whose "tonnage steels" are of excellent quality. Competition will do the rest.

The proof of all this does not lie in any laboratory examination of an individual case carried on in a spirit of condemnation tending to locate the causes in the steel. It comes rather from the results of years of use. The greater bulk of forgings, for example, comes from "tonnage steels," yet we are not confronted by any wholesale failures in service. This applies to the automotive industry as well as to industry in general.

There is another factor which seldom enters into a discussion of this situation but which nevertheless has a very direct effect, and that is cost. In dealing with quality in steel there is often a marked tendency to avoid a discussion of this factor, but in spite of this it has a very direct effect in the final analysis.

To illustrate we will assume that the loss due to dirt inclusions in "tonnage steels" is one-tenth of 1 per cent. That this is a high estimate will be generally admitted if all industry is considered. If to eliminate this it becomes necessary to increase the cost of the raw material 50 per cent or perhaps more, it is quite evident that economic pressure will eventually require a simpler solution. If to this is added a doubt that 100 per cent perfection will be gained, there will be lacking the necessary pressure to force a change.

With proper attention to detail in manufacture—for example, in ingot pouring and cropping—there is no reason why "tonnage steels" should not meet "tonnage requirements"; in fact they are doing so. Lack of careful practice in one mill is no reason for wholesale condemnation of all. RALPH H. SHERRY.

Elizabeth, N. J.

Problems in Sodium Sulphide Manufacture

To the Editor of Chemical & Metallurgical Engineering

SIR:—I notice with interest what you say in the Jan. 10 issue about methods of making sodium sulphide. There is no real difficulty in making a high-grade product provided the proper furnace be used and it have proper firing. Under these conditions a fused product with very little remaining sulphate may be obtained in a short time. The real difficulties are twofold: First, the temperature necessary is so high that about 5 per cent of the charge volatilizes. Second, the fused sulphide attacks the furnace lining rapidly and destroys it. I have made hundreds of tons of this material by the processes outlined in your editorial and generally failed to get a product containing less than 4 to 6 per cent sulphate. Moreover, by fusing the materials in an atmosphere free from oxygen, so as to avoid reoxidation of the sulphide and giving a chance to the carbon to deoxidize the charge completely, no difficulty is encountered; neither is the fuel cost excessive, since raw bituminous coal is used in the most economical manner.

A combination of this method with the barium process offers the best possible economy, since the furnaced cake produced as above may then be dissolved in the somewhat dilute barium sulphide wash liquor, which must be evaporated in any event, giving strong solution for the production of crystal or concentrated sulphide. In boiling down the solution for either of these products the waste heat of the furnace may easily be used for the concentration. In these days of high and scarce fuel such economies spell the difference between a profit or a loss. EDWARD HART.

Lafayette College,
Easton, Pa.

Art and Science of Leather Manufacture—III

BY F. L. SEYMOUR-JONES*†

Vegetable Tanning Consists in Treating the Prepared Hides and Skins With Extracts of Suitable Natural Materials, the Procedure Varying Somewhat Empirically With the Nature of the Stock and the Product Desired, as the Actual Mechanism Is Indefinite

THE preliminary wetwork in preparing the skins having been accomplished, the next process is that of tanning proper. It is difficult to find a satisfactory definition of "tannin." Broadly, a tannin is any substance which precipitates gelatin and converts hide into leather; this covers a wide range of organic and inorganic substances.

Vegetable tanning, one of the most ancient methods, is still that most widely practiced, though for many purposes it has been replaced by chrome and its supremacy in other directions is similarly being challenged. No definite cause for the formation and secretion of tannin by plants is known, though many theories have been suggested. Tannins may occur in roots, wood, bark, leaves or fruit, though not necessarily of the same nature in each part. It is very widely distributed in the vegetable kingdom.

VEGETABLE TANNING MATERIALS

Space will permit of only the more important sources of tannin being mentioned. Of barks, the old standard material was that from the oak, *Quercus robur* and other varieties, more particularly *Quercus prinus*, the chestnut oak, in the United States. The bark contains from 4 to 22 per cent of tannin, but 10 per cent may be considered a good average. It is best peeled in the spring, when the sap is rising, and should be stored under cover from rain. Most barks contain about 6 per cent of soluble non-tanning matter (non-tans), which includes a large percentage of sugar. It is therefore unsuitable for the manufacture of tanning extract, owing to the great liability to fermentation. The bark of the American chestnut oak, owing to its comparatively low non-tan content, is free from this defect, and excellent extract is made therefrom.

Oakwood, though containing only 2 to 4 per cent of tannin, is largely used for extract manufacture in Europe. The tannin is different from that in the bark and more nearly resembles that of the chestnut. The chief source of supply is Slavonia, now of the Jugo-Slav State, where the chips and waste lumber are utilized for making an extract of around 26 to 28 per cent tannin content.

One of the most important native American tanning materials of today is the true or Spanish chestnut, *Castanea vesca*. This is a tree of rapid growth, the main source being in and about the Appalachian Mountains. The air dry wood averages about 8 per cent tannin, and the bark, which is little used alone, about the same. Chestnut extract is made from the wood and bark combined as a rule, and will have a tannin content of 36 to 60 per cent. Large quantities are made not only in this country but also in France.

Formerly if not still the most important North American tanning material, the bark of the hemlock fir (*Tsuga canadensis*) is undoubtedly the most characteristic American tannin. The tree is widely distributed over the northern United States and Canada, from Pennsylvania to Alaska. The bark averages 8 to 10 per cent of a reddish tannin. Extract is also made from the hemlock, both solid and liquid varieties finding place in the market.

Other conifers are used to a lesser extent for tannin. The Norway spruce (*Abies excelsa*) is much used in Austria. It contains a large proportion of fermentable sugars, and hence swells well but tans only lightly. The larch (*Larix europæa*) is used somewhat in the British Isles for light leathers, giving a light-colored product of pleasant odor. The Aleppo pine (*Pinus halepensis*), the bark of which contains up to 25 per cent tannin, is largely used along the eastern Mediterranean littoral.

South America provides a largely used material in quebracho. The wood is extremely hard, has a specific gravity of about 1.3, and contains 25 to 28 per cent of a difficultly soluble tannin. The tree grows in scattered groups over much of the Argentine, Chile and Paraguay. Much of the wood is extracted on the ground before export, but part goes to extract plants in this country, Germany, France and England. The difficultly soluble tannin is sometimes rendered more soluble by treatment with alkaline bisulphites or alkalis, which are subsequently neutralized. Such extracts are spoken of as sulphited quebracho. Even the insoluble tannin, however, if suspended in water and agitated with hide, will tan, showing that it is in reality soluble, though with difficulty.

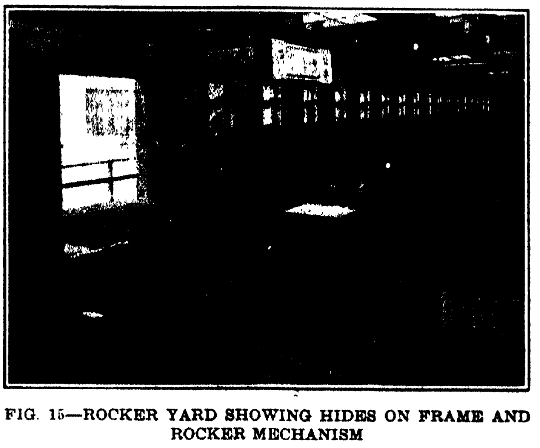

FIG. 15—ROCKER YARD SHOWING HIDES ON FRAME AND ROCKER MECHANISM

*Frank L. Seymour-Jones is the son of Alfred Seymour-Jones, of Wrexham, Wales, who for many years has been one of the foremost tanners of Great Britain and one of the leading scientists of the industry. Frank Seymour-Jones was graduated from the University of Leeds, England, with honors in applied chemistry of leather manufacture, being awarded the Le Blanc medal for special distinction. He now holds the Goldschmidt fellowship at Columbia University, where he is continuing fundamental research on tannery processes.

†Article I of this series appeared in *Chem. & Met.*, vol. 27, No. 23, Dec 6, 1922; Article II in vol. 27, No. 26, Dec. 27, 1922.

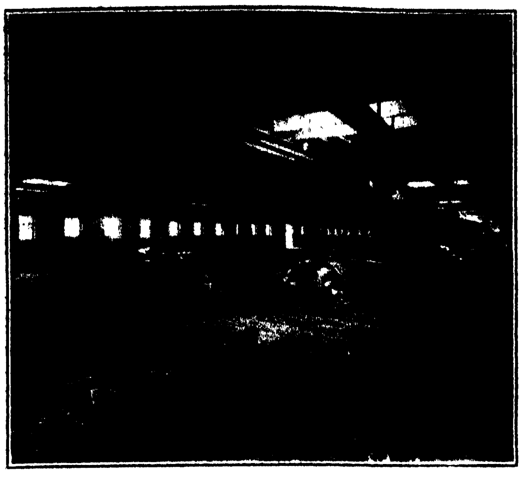

FIG. 16—LAYAWAY YARDS

The acorn cups from the valonia oak (*Quercus aegilops* and other species) form a highly important source of tannin. The small tree is widely spread through western Asia Minor, Greece and the Grecian archipelago, the best quality coming from Smyrna. The tannin content varies from 20 to 40 per cent. The "beard" (the spiky portion surrounding the cup) contains more tannin than the cup proper, and is often sold separately.

Galls occur chiefly on *Quercus infectoria* and other oaks; they contain up to 60 per cent of gallotannin. They are of very little use for tanning, but form the chief source of the tannic acid of commerce and pharmacy.

Sumach is obtained from Sicily (*Rhus coriaria*) and to a lesser extent from Virginia and the Southern States (*Rhus glabra, R. typhina* and other varieties). The leaves and small twigs of the bush are used, dried and ground in a primitive fashion with edge-runners. The tannin content of the Sicilian varieties averages about 25 per cent, that of the American 10 to 18 per cent. Few materials are adulterated more, chiefly with leaves of other and similar plants containing much less tannin; in fact, *Pistacia lentiscus* is imported from Algeria to Sicily for this purpose. Adulteration is easily detected by microscopical examination, with suitable treatment of the leaves. Sumach is chiefly used for light leathers, and gives a light-colored product. It is the best material known for bookbinding leathers, where wear and resistance to gas fumes and city atmosphere are desiderata.

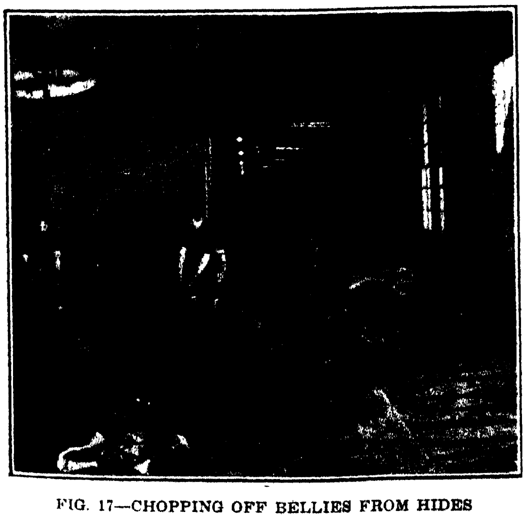

FIG. 17—CHOPPING OFF BELLIES FROM HIDES

Gambier is a solid or pasty extract obtained from the leaves and twigs of an East Indian shrub, *Nauclea* (or *Uncaria*) *gambir*. It is also known as terra japonica and, in common with various other extracts, as catechu. Until recently the manufacture was entirely in native hands and was crude in the extreme. The leaves and twigs are boiled in open pans until a sirupy liquid is obtained; this is roughly strained and poured out to set. It is exported either as paste, roughly covered with sacking, or in dry cubes of about a cubic inch size. The cube gambier contains 50 to 65 per cent tannin, and the pasty block gambier 35 to 40 per cent.

The mangrove grows on almost all marshy tropical coasts and comprises various species of *Rhizophora*. The bark contains 15 to 40 per cent tannin. It is a material of growing importance, and gives a deep red colored leather.

Myrobalans, the unripe fruit of *Terminalia chebula* and other East Indian species, contains 30 to 40 per cent tannin in the nut. The stones and kernels of the nut contain no tannin.

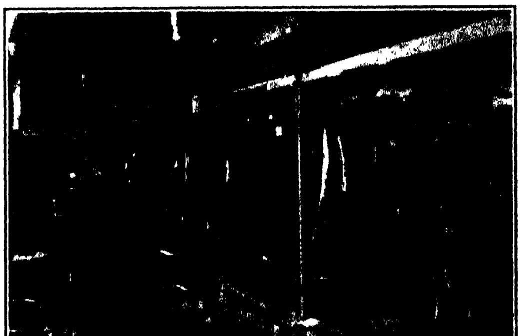

FIG. 18—BLEACHING VATS FOR REMOVING SURFACE TAN

Various kinds of acacias and mimosas are largely used, and those known as wattles are of rapidly growing importance. Indigenous to Australia, they have been transplanted to Natal, where a large and flourishing extract industry now thrives. The tree is of rapid growth and the bark contains up to 50 per cent tannin, according to species, though 30 per cent may be taken as a good average. In recent years it has also been developed in Kenya (British East Africa), where the tree reaches maturity for stripping in as short a time as 5 years. Another variety, *Acacia arabica*, is widely used in India and the Near East under the name "babool." I found it in use in Palestine 4 years ago and it may well have been the material of "one Simon, a tanner."

Divi-divi (*Cæsalpina coriaria*) and algarobilla (*C. brevifolia*), two Central American trees, provide tannin in their seed pods, which contain 40 to 45 per cent.

Among other natural tannins of lesser importance may be mentioned the saw palmetto (*Sabal serrulata*) of Florida, a tannin extract being made from its roots, and canaigre (*Rumex hymenosepalum*), a dock growing

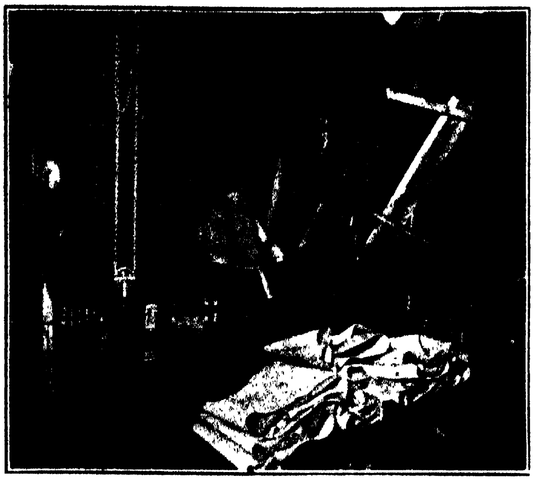

FIG. 19—OIL WHEELS

in Arizona, Mexico and southern California, the air dry roots of which contain 25 to 30 per cent tannin, together with a large quantity of starch.

Sulphite cellulose is obtained by concentrating the waste liquors from the manufacture of wood pulp by the sulphite process. It is not a true tanning material, but has found many applications in tanning, particularly in brightening the color and in filling (giving solidity to) sole leather. One firm markets this product as "spruce" extract. True spruce extract is often sold as "larch" extract.

The chemistry of the tannins is as yet little understood. Emil Fischer succeeded in synthesizing what was at least a stereo-isomer of gallotannin, and which was a penta-m-digalloyl-glucose. Freudenberg is continuing his work, and classifies tannins broadly into (*a*) tannins hydrolyzable with enzymes (tannase and emulsin), in which the benzene nucleus is linked to a larger complex by oxygen atoms, and (*b*) condensed tannins, in which the nuclei are linked by carbon atoms. The first class comprises (1) depsides (esters of phenolcarboxylic acids with each other or with other hydroxy-acids), (2) esters of phenolcarboxylic acids with polyhydric alcohols and sugars (gallotannin type), and (3) glucosides. Of more practical interest to the tanner is the old and rough classification into pyrogallol

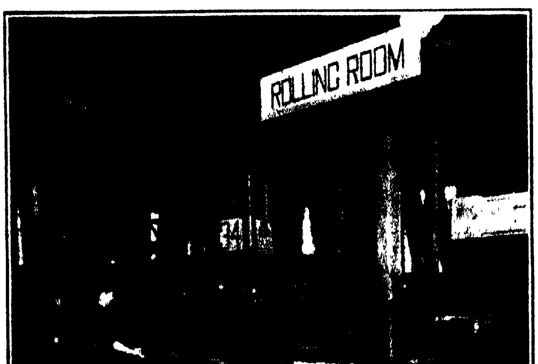

FIG. 20—ROLLING LEATHER FOR FINISH

and catechol tannins, according to their derivation. The pyrogallol tannins yield "bloom" (a deposit of ellagic acid) on fermentation or hydrolysis, while the catechols give insoluble "reds" or phlobaphenes. Some tannins—e.g., oak bark—appear to be of mixed origin, and give the characteristic reactions of both groups. Gallotannin, sumach, oakwood, chestnut, myrobalans, valonia, dividivi and algarobilla belong to the pyrogallol group, and the catechols include pine barks, hemlock, larch, acacias (mimosa, wattle), quebracho, mangrove, canaigre and gambier.

Synthetic tannins or syntans bear no chemical relationship to the natural tannins. The original syntan, Neradol D, was a condensation product of cresol-sulphonic acids with formaldehyde, and this general principle has been widely followed in the overwhelming list of patents granted for the preparation of such substances. Used alone, they are of little value, but in conjunction with natural tannins have found wide applications. They are particularly useful in the preliminary coloring of leather and in the final bleaching or brightening of color.

Extract Manufacture

The grinding of tanning materials prior to leaching varies with the nature of the material and the leaches used. The product must be sufficiently fine to leach

FIG 21—APPLYING POLISH TO GRAIN

easily and completely, yet not so fine as to clog the leaches and cause incomplete extraction of tannin. Various types of mills are employed, with steel blades or teeth to cut and rasp the materials. Disintegrators are widely used. Crushers are used for fruits such as myrobalans. The ground material is conveyed to the leaches by some form of mechanical conveyor—belt or bucket. The heat and dust developed during grinding are very great and cause a large fire hazard. Consequently it is usual, where tanneries grind some of their own materials, to locate the grinding machinery in a building apart from the main factory. Iron from the grinding machinery is very objectionable in the tan liquors, since it forms ink.

The ordinary battery of leaches consist of a series of pits or tubs provided with false bottoms and with an eye in each connecting to the next leach. The extracting water, heated as desired, is passed through these in turn, flowing from one to the next by gravity

FIG. 22—SETTING OUT MACHINE FOR SMOOTHING OUT GRAIN

FIG. 24 ROLLING HEAD MACHINES

or being pumped. The fresh water passes through the nearly spent tan, then on to the next, and through the series to the fresh material. Cold extraction gives a lighter and brighter colored liquor, while hot (not necessarily boiling) water extracts more tannin. The majority of tanning materials yield most tannin at 80 to 90 deg. C., but some, like sumach, canaigre and valonia, extract most at 50 to 60 deg. C.

In extract manufacture and in some tanneries the liquors are concentrated by evaporation, in evaporators of the triple effect or climbing film types. Evaporation is completed in vacuum pans, until the well-stirred liquor is sufficiently sirupy to solidify on cooling. Both solid and liquid extracts are largely made. The former offer economy in transit charges, but are not always so satisfactory in getting back into solution again. Extraction at high temperatures causes a darkening of color of the extract, and where necessary extracts are decolorized by the use of blood albumen, coagulated by heating the liquor or by some other suitable absorbent. Naturally this causes some loss of tannin, but since the leather buyer purchases largely on color, the tanner must demand light-colored extracts from the extract manufacturer.

Tannage proper consists in working the skins through

FIG. 23—JACKING THE HEADS

a series of tan liquors of gradually increasing strength. The strength of tan liquors is usually expressed in degrees barkometer. This instrument is merely a hydrometer, and affords a rough means of gaging the strength of liquors. One deg. Bkr. is equal to 1.001 specific gravity, 10 deg. Bkr. to 1.010 sp.gr., and 100 deg. Bkr. to 1.100 sp.gr., etc.

The materials, liquors and methods used vary according to the class of skins and the nature of product desired. For sole and belting leather, where the product is sold by weight, a heavy tannage is required, while for light leathers, sold by area, a sufficient but not excessive tannage is given.

Tanning Procedure

Taking sheep as typical of light stock, the first process is coloring. The color of the product is largely determined by the first early tannage. The skins are therefore paddled in a weak sumach (or other suitable) liquor, which will insure a light-colored product. Subsequent tannage may be by suspension in pits with periodical handling of the skins or agitation of the liquor, or paddling, or drumming. Naturally the two latter are more rapid, but if too violent loosen the skins out excessively. The strength of the liquors must be increased only gradually. If too strong and astringent liquors are used at first, the grain of the skin becomes drawn and case-hardened, and prevents the further penetration of tannin into the interior of the skin. Many materials are used in tanning, but for the finer classes of leather pyrogallol tannins are preferred, notably sumach, oak bark and wood, chestnut and larch.

The tanned skins are nailed on boards to dry in heated sheds, or may pass through a tunnel drier. They are then wet back and shaved. Shaving consists in reducing the skin to an even thickness by paring off on the flesh side, either by hand with a knife with a turned edge, or by machine, with a rapidly revolving spiral blade roller pressing the skin against a rubber roll. The skins then pass to dyeing and finishing.

Sheepskins are naturally extremely greasy and are therefore usually degreased. This is accomplished either by hydraulic pressing between brass plates after coloring, or by extraction with naphtha after tanning and dyeing, but before finishing. The naphtha is recovered. The grease finds a market for the manu-

facture of stuffing greases and similar products. The fire risk of a spirit degreasing plant is very high, and special precautions have to be taken to prevent any sparking of machinery, even belts being protected by points to avoid electrical sparks.

With heavy leather (sole leather, etc.) the hide commences in the suspenders, a weak but acid liquor, to insure complete neutralization of lime and good plumping, being used to color the leather. They pass to the rockers or handlers, through a series of liquors of increasing tannin content, where the suspended hides are rocked mechanically to insure even tannage. Next they go to the layers or dusters, where the hides (or bends) are placed horizontally in a pit, a layer of ground tan is dusted over the hide, another hide placed on top, and so on until the pit is full. The pit is then filled up with strong liquor. The hides pass through a series of these layaways. When tannage is completed—which may take from 3 to 6 months, although the hides are half tanned in 10 to 14 days—the leather is dipped in warm water to clean it, swabbed over with cod oil, dried, damped back and piled to samm (semi-dry), oiled on the grain, and rolled with a brass roller.

After tannage proper it is usual to fill the leather to get firmness and weight. The sides are dipped or drummed in a strong, hot, neat, tannin extract or sulphite cellulose. They are then bleached, by dipping into hot water, soda, dilute sulphuric acid, and water in turn. They pass through a wringer, and are next loaded. Loading is straight adulteration, necessary to get weight to sell at a competitive price. It cannot be said to affect the wearing quality of the leather adversely, but the deliquescent nature of some of the substances used renders the leather readily water-absorbent, and its harmful nature is obvious. Some countries, notably Australia and Sweden, have taken action to prevent the import of loaded leather. The usual substances are glucose, epsom salts (magnesium sulphate) and barium sulphate. The first two are drummed in with oil, while the last is implanted by alternate dippings in sulphuric acid and barium chloride.

The sequence of operations at the J. H. Ladew Co for tanning and finishing sole leather is illustrated by Figs. 15 to 25. As will be noted in Figs. 15 and 16, the hides are handled in the rocker and layaway yards by means of a monorail hoist. The use of an electric traveling crane for this purpose is shown in Figs. 26 and 27.

Many rapid tannages for sole leather have been tried, usually consisting in drumming the goods in concentrated liquors after a short preliminary coloring in weaker liquors. This is in general unsuitable for sole leather, as it is impossible to get the necessary firmness

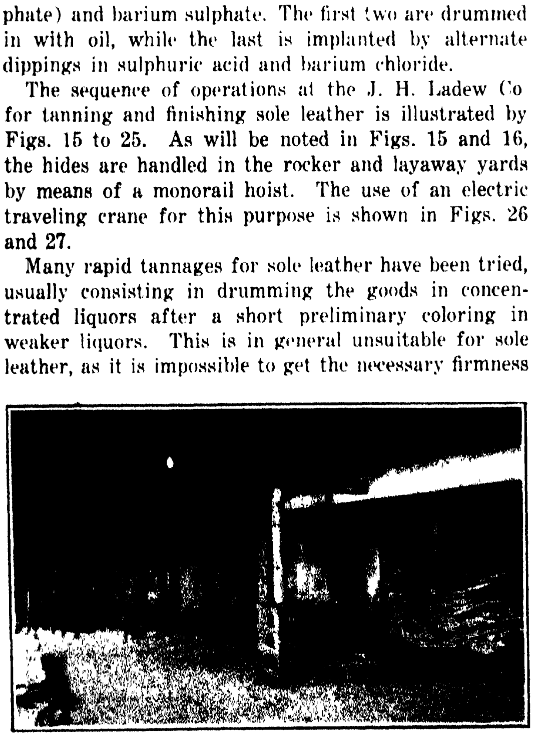

FIG. 25—DRYING LEATHER

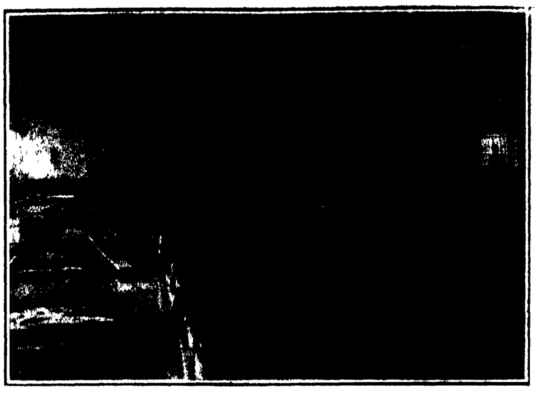

FIG. 26—ROCKER YARD WITH ELECTRIC TRAVELING CRANE

and solidity by a straight drum tannage. Used in conjunction with suspension methods, it has met with some success.

One method of vacuum tanning has achieved some popularity, though not yet employed very extensively—namely, that known as the Nance process. The difficulty in any vacuum tannage is that, for the tan liquor to enter the hide, the pressure must be so reduced that the water in the hide capillaries boils out, leaving a vacuum. This the Nance process accomplishes. The liquors used are then introduced at about 25 deg. C., and rapidly penetrate the hide.

Many materials are used in heavy leather tannage, hemlock, chestnut and chestnut oak extracts being favorites. In the layers, for dusting materials, valonia, algarobilla, and ground bark are used. When pyrogallol tans are employed, the bloom deposited on the grain may either be left on or removed by scouring, according to the type of product required by the buyer.

Belting and other leathers are usually curried—i.e., stuffed with greases to render them waterproof—and then finished. The bloom is scoured off by machine, the hides are skived or shaved and then stuffed. Stuffing is carried out either by hand or in the drum. A suitable mixture of cod oil, tallow and stearine is applied to the damp leather. The stuffed leather is "set out"—i.e., stretched out flat and all wrinkles removed, either by hand or machine. Belting leather is finally stretched by machine. Stuffing is often carried out hot, a temperature of 90 deg. C. or over being used. In this case the leather must be absolutely dry before entering the drum or it will be seriously damaged. In passing it may be remarked that dry leather will stand much higher temperatures than wet, and that chrome-tanned stands heat better than vegetable-tanned. Since the tanner takes days to dry his hides, it is scarcely reasonable to expect to dry a pair of wet boots satisfactorily by a hot radiator in an hour or so.

The choice of materials and their blending to produce the desired effect in any kind of vegetable tanning is an art in itself and also requires knowledge of the constituents. The soluble extract from any tanning material contains a greater or less proportion of non-tans, part of which consists of readily fermentable sugars. These yield acids, which tend to plump the leather. A high tan:non-tan ratio in a material means a highly astringent liquor, such as straight quebracho, while the greater the proportion of non-tans the milder and mellower the liquor. Gambier is an example of a mild material. Even such a highly astringent material as

FIG. 27—LAYAWAY YARD WITH ELECTRIC TRAVELING CRANE

quebracho can be rendered as mild as gambier by addition of suitable non-tans.

Molds are an occasional source of loss in tan liquors. Their action is due to the secretions of an enzyme, tannase, which hydrolyzes certain classes of tannins. At the same time the molds utilize the tannin as a source of carbon nutriment, where other carbonaceous matter is absent.

There are many theories of vegetable tanning, none yet susceptible of exact proof. They range from pure physical adsorption of the tannin by the hide fibers to a definite chemical combination between hide protein and tannin. One very plausible theory holds that the negatively charged tannin particles and the positively charged hide (on the acid side of its isoelectric point) mutually precipitate each other, just as in the mutual precipitation of colloids. Unfortunately for this, it is quite possible to tan hide in an alkaline solution, so it will require some modification. Needless to say, alkaline tanning is entirely impracticable, since large excess of tannin has to be used, though it is definitely fixed by hide powder. One thing is certain—that combination between hide and tannin is slow and not immediate. Freshly tanned hide powder loses its tannin if extracted *wet* with alcohol, but not after drying. The tannin can be easily stripped from *freshly* tanned hide powder with alkalis, but not after the tanned hide powder has been aged for some time. The whole subject is as yet too indefinite to make any detailed statements of value, and it will be necessary to wait until more is known of the chemical nature of tannins and hide before a definite explanation can be adduced.

ACKNOWLEDGMENT

Illustrations for this article were made available through the courtesy of the J. H. Ladew Co., Newark, N. J. (Figs. 16 to 25); *Compressed Air Magazine* (Fig. 15); Pawling & Harnischfeger, Milwaukee, Wis. (Figs. 26 and 27).

(Another article on the art and science of leather manufacture will appear in a subsequent issue.)

Developments and Tendencies in the German Potash Industry*

Stassfurt Giving Way to Hannover and South Harz District—Production and Sale—Government Control—French Competition

BY WILLIAM T. DAUGHERTY
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THE war left to Germany at least one self-contained industry—the potash industry. The pre-war monopoly enjoyed by Germany, broken by the loss of the potash mines in Alsace Lorraine under the peace treaty, is nevertheless not as seriously threatened now as the first signs after the war would have seemed to indicate. The superiority of German deposits i.e., the purer and more abundant deposits of salts and the simultaneous occurrence of carnallite ($KCl.MgCl_2.6H_2O$), sylvanite ($xKCl.yNaCl$), kainite ($K_2SO_4.MgSO_4.MgCl_2.6H_2O$), kieserite ($MgSO_4.H_2O$)—as well as lower costs of production, favors Germany on the world market. Germany's expectation of setting a record of sales in the calendar year 1922—i.e., probably around 1,330,000 tons of potash (K_2O), or 220,000 tons more than in 1913, out of which total 24.8 per cent has been for foreign sales in the first 10 months of 1922 (against 45 to 50 per cent in 1913)—seems to confirm this claim. Energetic plans are in progress to penetrate America and recover Germany's most important pre-war market.

SHIFTING OF PRODUCTION CENTERS

Production centers of the German potash industry are roughly five—namely: (1) The Hannover district, (2) the South Harz district, (3) the Werra (Thuringia) district, (4) the Stassfurt district and (5) the Halle, Mansfeld and Unstrut district, in the order of their approximate production in terms of K_2O in the first 6 months of 1922. In October, 1922, 128 shafts were being actively worked in all Germany, while 83 shafts were idle, according to the "Kaliprüfungsstelle," of Berlin, an official organization, calculating the participation of all German works in total sales.

Rich and abundant supplies of German potash, lying near the surface, or more profitably worked for richer content if lying deeper, permit a variety of choice of location for new works. The shifting, for instance, of production centers within the past year, so that the famous Stassfurt district, which occupied second place in production in 1921, fell to fourth place during the first 6 months of 1922, is proof of the growing importance of the South Harz district.

This shifting of production centers is not necessarily borne out by the number of active shafts in operation, as some shafts in respective districts are worked more intensively than others. In October, 1922, the Hannover district operated the largest number of shafts—namely, 54 shafts out of 79; the South Harz district, 24 out of 33; Stassfurt, 24 out of 43; the Werra, 14 out of 27; Halle, etc., 12 out of 29.

PRODUCTION AND SALES

Production.—Production of all crude salts by districts in the years indicated is shown in Table I.

The potash content from this production is shown in Table II.

*Abstracted from a special report, received Jan. 17, 1923, by Western European Division, Bureau of Foreign and Domestic Commerce, Department of Commerce.

TABLE I—PRODUCTION OF CRUDE POTASH SALTS IN GERMANY, BY DISTRICTS
(In Metric Tons)

District	1913	1920	1921	1922*
Hannover	(Regional	3,508,544	2,912,997	3,812,220
Stassfurt	figures not	2,242,192	1,989,829	2,038,560
South Harz	available	2,005,122	1,746,431	2,283,520
Werra	in 1913)	2,037,862	1,457,128	2,373,960
Halle-Mansfield, etc	"	1,562,385	1,134,794	1,279,160
Totals	11,604,511	11,356,105	9,241,179	11,787,420

* Loosely estimated on the basis of twice the production in the first 6 months of 1922. Total production figures of K_2O can probably be discounted by around 25,000 tons.

TABLE II—PRODUCTION OF POTASH (K_2O) IN GERMANY, BY DISTRICTS
(In Metric Tons)

District	1913	1920	1921	1922
Hannover	(Regional	407,822	334,426	446,620
Stassfurt	figures not	225,454	215,494	215,620
South Harz	available	269,060	231,720	299,080
Werra	"	233,128	170,819	273,160
Halle-Mansfield, Unstrut	"	161,465	114,390	131,080
Totals		1,296,929	1,066,849	1,365,560

TABLE III—TOTAL SALES OF GERMAN POTASH SALTS
(In Metric Tons)

Year	Inland	Foreign	Total
1913	604,283	506,087	1,110,870
1914	537,809	366,179	903,988
1915	567,098	112,779	679,877
1916	721,044	158,932	879,976
1917	871,478	132,893	1,004,371
1918	859,716	141,947	991,663
1919	637,033	174,970	812,003
1920	689,391	234,252	923,643
1921	768,477	152,670	921,147
1922*	997,500	332,500	1,330,000

* Estimated

Sales.—Table III shows the total sales of German potash salts, in terms of K_2O content, to inland and foreign purchasers in the years indicated. It is observed from this table that except for the year 1921 foreign sales have increased progressively in post-war years. Germany's best customer for potash salts in 1913 was the United States, with purchases of 236,884 tons of K_2O; Holland came next, purchasing 43,478 tons, while France bought 33,115 tons. Although foreign sales have decreased in volume in post-war years, the same relative importance of these markets is probably not appreciably changed, as, for instance, figures for 1920 show. In that year the United States bought 83,602 tons of K_2O from Germany; Holland, 54,347 tons; England, 11,414, and France, 1,975, according to figures given by the German Potash Syndicate.

Potash Control in Germany

After various experiments to regulate production and sales of potash extending over a period of about half a century, the German Reichstag passed the so-called federal potash law on May 25, 1910. This law provided that the government, and not the Potash Syndicate, be empowered to fix inland prices for potash. It also took from the syndicate the right to prescribe the amounts of participation of the various concerns (groups) in total sales, and created a so-called "distribution center" (Verteilungsstelle) for this purpose. At the same time, however, an appeal commission was created with power to hear appeals against decisions of the distribution center. The real organization of the Potash Syndicate was not directly affected by this law. This organization was regulated through the members, as well as through the sales agreement. Until the outbreak of the revolution (November, 1918), the organization was not changed.

Socialist parties with majority votes in the Reichstag after the revolution contemplated the socialization of Germany's potash resources. As this proposal was confronted with too many difficulties, another alternative was chosen—namely, the creation of a federal potash council (Reichskalirat) with power to control the German potash industry.

The Federal Potash Council is composed of thirty members, and includes representatives of the potash producers, dealers and wholesale consumers (agriculture and the chemical industry). In addition, three members of the Potash Syndicate are admitted, as well as one expert in potash mining. Employers and labor are represented in equal number in the council.

Along with the council are other bodies, such as the "Kaliprüfungsstelle," already mentioned, and the appeal office. Both of the latter perform the same duty as was written into the law of 1910 for the distribution center and the appeal commission. The potash producers themselves are organized into a sales organization, which is the Potash Syndicate, which alone has the right to sell potash at home and abroad.

Importance of German Monopoly

Until the end of the war Germany had, *de facto*, a potash monopoly. This monopoly was partly broken by the granting of approximately thirteen potash shafts to France in connection with the cession of Alsace-Lorraine. At that time the thirteen shafts were not all in operation, but they were rapidly improved and thrown into competition with German production. Alsatian competition is, however, probably handicapped by the existence of far fewer mines and concentrating plants, as well as a none too great occurrence of sulphate salts. Kieserite ($MgSO_4$), used in Germany in the production of potassium sulphate and potassium-magnesium sulphate, is absent completely from Alsatian deposits.

In order to overcome this handicap, attempts have been made to employ sulphuric acid on potassium chloride, but the production costs are said to be too great to permit profitable competition. The occurrence of clay in Alsatian deposits is said to offer another disadvantage in the most profitable concentration of the raw salts. Freight competition is another factor to be taken into consideration. The distance to nearest harbors—namely, Antwerp and Rotterdam—is greater than from German mines to Bremen and Hamburg.

The German industry is apparently not greatly concerned over the new French competition. French exports of potash to the United States are roughly estimated by German authorities as not exceeding 20 per cent of all sales to our country, but it is claimed that the French are selling at a loss (with possible subsidies), and that competition will diminish, on account of inability to compete with German prices. The contention regarding the subsidy of the French industry cannot be verified here, but it is vigorously denied in official French quarters in Berlin.

Negotiations between Alsatian and German producers have been attempted with a view to agreeing upon a uniform price policy, but without success, and the present prospect is that Germany will probably continue to underbid French producers. If German claims are justified, the German control of the international potash trade appears to be not very seriously affected by the separation of the Alsatian potash mines.

Fundamentals of Rectification

Conditions for Perfect Rectification of Binary Mixtures

The Relations Existing in a Simple Adiabatic Rectifier Are Discussed and the Possibility of Perfect Rectification Is Analyzed—Special Case of Proportionality Latent Heats

BY C. C. VAN NUYS
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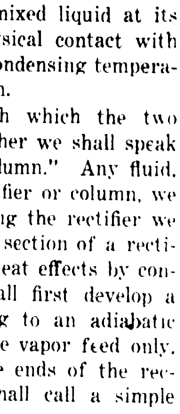
THE term rectification, as commonly used, refers to a variety of operations or processes wherein either evaporation or condensation or both are employed to purify or change the composition of physical mixtures. In the following pages, however, the term is understood in general to refer to the interaction between a continuous stream of a mixed liquid at its boiling temperature in intimate physical contact with a continuous stream of vapor at its condensing temperature flowing in the opposite direction.

The conduit or passages through which the two streams flow in contact with each other we shall speak of collectively as a "rectifier" or "column." Any fluid, liquid or vapor, as it enters the rectifier or column, we shall call a feed, and any fluid leaving the rectifier we shall call a product. Any portion or section of a rectifier which is insulated from outside heat effects by conduction is called adiabatic. We shall first develop a series of general equations applying to an adiabatic rectifier with one liquid feed and one vapor feed only, these two feeds entering at opposite ends of the rectifier. Such an arrangement we shall call a simple rectifier.

EQUATIONS FOR A SIMPLE RECTIFIER

Suppose a continuous stream of a liquid mixture of two components enters the top of a rectifying column wherein for convenience it may be assumed to cascade over a large number of "trays" of the usual form, and suppose that this liquid as it descends is in intimate physical contact with an ascending saturated vapor which enters the rectifying column at the bottom.



Assume that the system is perfectly insulated, and let the fractional composition of the liquid feed in the more condensible component be x_1, and let the mass of liquid entering the column per unit time be M_1. Let the fractional composition in the same component of the vapor feed be y_2 and the mass thereof entering the column per unit time be m_2. Let the composition of the vapor leaving the top of the column be y_1 and the composition of the liquid product leaving the bottom be x_2. Then the following equations must hold in all cases. In these equations m_1 is the mass of vapor leaving the top of the column and M_2 is the mass of liquid leaving the bottom and the unit of mass may be taken either as 1 gram or as 1 gram molecule, or mol. If the mol is the unit of mass, compositions must be taken as molecular compositions—i.e., fractional compositions by volume when the mixture is in a condition approaching that of a perfect gas.

In the first place the total mass of the fluids entering the column must be equal to the total mass of the fluids leaving. Hence,

$$M_1 + m_2 = M_2 + m_1$$

Second, a similar relation holds for the masses of the more readily condensible component—i.e.,

$$x_1M_1 + y_2m_2 = x_2M_2 + y_1m_1$$

Third, the sum of the values of the "total heat" function for all fluids entering the apparatus must equal the same quantity for the fluids leaving—i.e., if I_1 is the total heat per unit mass of the liquid M_1, and I_2 the same quantity for the liquid M_2, and J_1 and J_2 the corresponding quantities for the vapors m_1 and m_2, the following equation holds:

$$I_1M_1 + J_2m_2 = I_2M_2 + J_1m_1$$

From these three equations any three of the four masses, say M_2, m_1, m_2, may each be determined in terms of the total heats I_1, I_2, J_1, J_2 the compositions x_1, y_1, x_2, y_2 and the remaining mass, say M_1.

The "total heats," I_1, I_2, J_1, J_2, are, in all cases, determined by the physical properties of the corresponding fluids and hence cannot be regarded as independent variables. Since we have three equations among the remaining eight "variables," x_1, M_1, x_2, M_2, y_1, m_1, y_2, m_2, we may regard any five of them as independent—i.e., their values may be stipulated or assigned in advance, and then the three remaining are determined by the above equations.

Of the five independent variables, however, among which must be included at least one of the quantities x_1, y_1, x_2, y_2, there is always one composition at least that is determined by conditions in the rectifier of which the above equations take no account. The basis of this statement will appear as we proceed.

Solving our system of equations for M_2, m_1 and m_2, we obtain:

$$M_2 = \frac{(J_1 - I_1)\ (y_2 - y_1) + (J_2 - J_1)\ (x_1 - y_1)}{(J_2 - I_2)\ (y_2 - y_1) + (J_2 - J_1)\ (x_2 - y_2)}\ M_1$$

$$m_1 = \frac{(J_2 - I_1)\ (x_2 - x_1) + (I_2 - I_1)\ (x_2 - y_2)}{(J_2 - I_2)\ (y_2 - y_1) + (J_2 - J_1)\ (x_2 - y_2)}\ M_1$$

$$m_2 = \frac{(J_1 - I_1)\ (x_2 - x_1) + (I_2 - I_1)\ (x_1 - y_1)}{(J_2 - I_2)\ (y_2 - y_1) + (J_2 - J_1)\ (x_2 - y_2)}\ M_1$$

Now in assigning values of the variables x_2 and y_1, these being the compositions of our products, we must take account of certain limitations. For example, it is impossible to produce a liquid M_2 whose composition x_2 differs more widely from the composition y_2 of the vapor m_2 than does the composition of that liquid which would have phase equilibrium with the vapor m_2. That is, the maximum possible value of x_2 is x_{y_2}, the composition of a liquid in phase equilibrium with the vapor y_2. Similarly, the minimum possible value of y_1, the composition of the vapor product, is y_{x_1}, that of the vapor having phase equilibrium with the liquid x_1.

If we assume perfect contact between liquid and vapor

in the column, we may suppose that x_2 and y_1 can attain these values. Then if m_2 be taken as less than the value fixed by the above three equations under these conditions, x_1, y_2 and M_1 being kept constant, the composition y_1 of the vapor leaving the top of the column will still be the composition for phase equilibrium with the incoming liquid, but the composition x_2 at the bottom will decrease—i.e., we shall obtain a liquid product whose composition in the more condensible component is less than that for phase equilibrium with the incoming vapor. If, on the other hand, m_2 be made larger than the value fixed by the three equations just written, the composition x_2 will still be that for phase equilibrium with the incoming vapor y_2, while the composition y_1 of the vapor product will increase—i.e., we shall obtain a vapor whose composition in the more condensible component is greater than for phase equilibrium with the incoming liquid.

The equation for M_2 may be written in the form:

$$\left[J_1 - I_1 + (J_2 - J_1)\frac{x_1 - y_1}{y_2 - y_1}\right]M_1 = \left[J_2 - I_2 + (J_2 - J_1)\frac{x_2 - y_2}{y_2 - y_1}\right]M_2$$

This equation may be regarded as defining equivalence between the liquid M_1 admitted at the top and the liquid M_2 obtained at the bottom.

In the particular case where $x_2 = y_2 = 1$, $x_1 = y_1 = 0$, it takes the form:

$$(J_1 - I_1)\,M_1 = (J_2 - I_2)\,M_2$$

In this case, however, since each one of the fluids M_1, M_2, m_1, m_2, contains only one component, the quantities $J_1 - I_1$ and $J_2 - I_2$ are the latent heats of evaporation in the pure condition of the two components respectively, and the last equation may be written:

$$L_A M_1 = L_B M_2$$

where L_A is the latent heat of the more volatile component and L_B is the latent heat of the more condensible component. For two substances for which $L_A = L_B$, the last equation would become:

$$M_1 = M_2$$

In the equation

$$\left[J_1 - I_1 + (J_2 - J_1)\frac{x_1 - y_1}{y_2 - y_1}\right]M_1 = \left[J_2 - I_2 + (J_2 - J_1)\frac{x_2 - y_2}{y_2 - y_1}\right]M_2$$

we note that each of the quantities $J_1 - I_1$ and $J_2 - I_2$ is the difference between the total heat per unit mass of a liquid mixture and that of the vapor in phase equilibrium with it.

These quantities constitute much the larger part of the respective coefficients of M_1 and M_2, since $J_2 - J_1$ is the difference of the total heat per unit mass of two saturated vapors at the same pressure, and the fractions

$$\frac{x_2 - y_2}{y_2 - y_1},\ \frac{x_1 - y_1}{y_2 - y_1}$$

approach zero as the end products approach 100 per cent purity—that is, as $x_2 = y_2 = 1$, and $x_1 = y_1 = 0$.

In general, whatever the compositions x_1, y_1, x_2, y_2, if it should happen that $J_1 = J_2$ and $I_1 = I_2$ we have:

$$M_2 = M_1$$

and

$$m_1 = m_2 = \frac{x_2 - x_1}{y_2 - y_1}M_1$$

Consider next a level in the column where the composition of the descending liquid is x, x being greater than x_1 and less than x_2, and let the mass of descending liquid passing this level per unit time be M. Let the composition of the ascending vapor at this level be y, and the mass passing per unit time be m. Then it is clear that the composition y cannot be less than the composition of a vapor having phase equilibrium with the descending liquid of composition x.

At this point, however, under the conditions specified, the value of y may be determined as a function of x with the values of x_1, y_1, x_2 and y_2 as constants from the six following equations:

$$\begin{aligned}
M_1 + m_2 &= M_2 + m_1\\
x_1M_1 + y_2m_2 &= x_2M_2 + y_1m_1\\
I_1M_1 + J_2m_2 &= I_2M_2 + J_1M_1\\
M_1 + m &= M + m_1\\
x_1M_1 + ym &= xM + y_1m_1\\
I_1M_1 + Jm &= IM + J_1m_1
\end{aligned}$$

From all these equations all (M, m)'s may be eliminated and thus a relation be obtained between x and y containing the constants I_1, I_2, I, J_1, J_2, J, x_1, y_1, x_2 and y_2. Hence we conclude that if the ratio $x{:}y$ thus determined is everywhere equal to or less than the ratio for phase equilibrium, it is possible for the rectification to be complete or "perfect"—i.e., we can obtain a vapor at the top having phase equilibrium with the incoming liquid and at the same time obtain a liquid at the bottom having phase equilibrium with the incoming vapor. It the ratio between x and y is anywhere greater than that for phase equilibrium, it is impossible for the rectification to be complete unless either some liquid or some vapor be removed at some intermediate level or levels in the column. If the ratio is everywhere less than that for phase equilibrium, then a limited amount of liquid of composition x between x_1 and x_2 or a vapor of composition y between y_1 and y_2 may be added at a point between the top and bottom of the column without changing the composition of the vapor or of the liquid leaving it.

We have found above that the value of m_1 as obtained from the first three equations is:

$$m_1 = \frac{(J_2 - I_2)\,(x_2 - x_1) + (I_2 - I_1)\,(x_2 - y_2)}{(J_2 - I_2)\,(y_2 - y_1) + (J_2 - J_1)\,(x_2 - y_2)}\,M_1$$

Since the same relation holds at an intermediate point in the column, we have

$$m_1 = \frac{(J - I)\,(x - x_1) + (I - I_1)\,(x - y)}{(J - I)\,(y - y_1) + (J - J_1)\,(x - y)}\,M_1$$

Comparing this with the last equation written, we obtain as the necessary relation between the x's and y's in order for perfect rectification to be possible:

$$\frac{(J - I)\,(x - x_1) + (I - I_1)\,(x - y)}{(J - I)\,(y - y_1) + (J - J_1)\,(x - y)} = \frac{(J_2 - I_2)\,(x_2 - x_1) + (I_2 - I_1)\,(x_2 - y_2)}{(J_2 - I_2)\,(y_2 - y_1) + (J_2 - J_1)\,(x_2 - y_2)}$$

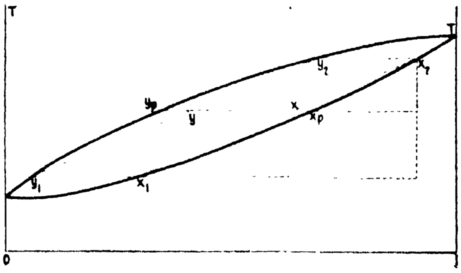
If the ratio $x{:}y$ determined by the last equation in terms of the various constants, x_1, x_2, y_1 and y_2, I, I_1, I_2, J, J_1, J_2, is greater than the ratio for phase equilibrium, the rectification is clearly impossible—i.e., we cannot obtain a vapor at the top having phase equilibrium with the incoming liquid and at the same time obtain a liquid at the bottom having phase equilibrium with the incoming vapor, since it is impossible at any level in the column for ascending vapor and descending liquid to differ in composition more widely than for phase equilibrium. The properties of those binary mixtures for which the ratio $x{:}y$ is everywhere less than the value for phase equilibrium and thus for which perfect recti-

fication, as we have exemplified it, is possible are made evident by considering the T-x diagram.

Consider the special case where $I_1 = I_2 = I$ and $J_1 = J_2 = J$. Under these conditions, the above relation between the x's and y's reduces to:

$$\frac{x - x_1}{y - y_1} = \frac{x_2 - x_1}{y_2 - y_1}$$

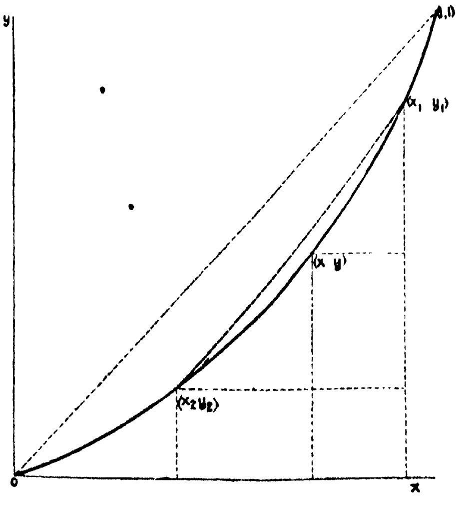
Let the values of the x's and y's be as indicated in the diagram. Then it is clear that if y lies on the straight line connecting y_1 and y_2, x must lie on the straight line connecting x_1 and x_2, since the segments on



each of a system of lines passing through a point intercepted between a system of parallel lines are proportional. Hence, we may conclude that under the assumed condition, $I_1 = I_2 = I$, and $J_1 = J_2 = J$, in order for the rectification to be impossible—i.e., for the difference between x and y to be greater than that for phase equilibrium—the lower boiling point curve must, at some portion of its length, be such that the horizontal distance measured *to the right* from the point x_p on the curve to the point x on the chord drawn from x_1 to x_2 is greater algebraically than is the corresponding quantity measured also to the right for the dew point curve—i.e., such that $x_px > y_py$, both distances being taken positive when measured to the right from the equilibrium curve.

If we confine the discussion to mixtures which do not possess a constant boiling composition between x_1 and x_2, these being the only mixtures for which perfect rectification is possible for all ranges of composition, then it follows from the foregoing result that for perfect rectification to be impossible (i.e., for the difference $x - y$ to be greater than $x_p - y_p$) either the dew point curve must contain inflexions between the points y_1 and y_2 or else the boiling point curve contains inflexions between x_1 and x_2.

If we consider a diagram in which values of x are abscissas and values of y are ordinates, the condition



$$\frac{x_2 - x_1}{y_2 - y_1} = \frac{x - x_1}{y - y_1}$$

implies that the point (x, y) lies on the line connecting the points (x_2, y_2) and (x_1, y_1) and hence between the points (x_1, y_1) and (x_2, y_2), the curve, which must be everywhere below the line defined by the points (0, 0) and (1, 1) contains two or more inflexions. In such a case, even though it would be impossible to obtain perfect rectification with the given end compositions x_1, y_1, x_2, y_2, still it would be possible to obtain perfect rectification if the end compositions were taken closer to 100 per cent purity respectively—i.e., if x_2 and y_2 were taken closer to 1, and x_1 and y_1 closer to zero—since as this condition is approached, it is impossible for (x, y) to lie on the line between (x_1, y_1) and (x_2, y_2) unless $x = y$, this latter being the condition for a constant boiling mixture.

The relation between x and y may be obtained in another form, which will be useful later, by properly changing subscripts in the solutions of our original three equations thus:

$$m = \frac{(J_1 - I_1)\ (x - x_1) + (I - I_1)\ (x_1 - y_1)}{(J - I)\ (y - y_1) + (J - J_1)\ (x - y)}\ M_1$$

and also

$$m = \frac{(J_2 - I_2)\ (x_2 - x) + (I_2 - I)\ (x_2 - y_2)}{(J_2 - I_2)\ (y_2 - y) + (J_2 - J)\ (x_2 - y_2)}\ M$$

but

$$M = \frac{(J_1 - I_1)\ (y - y_1) + (J - J_1)\ (x_1 - y_1)}{(J - I)\ (y - y_1) + (J - J_1)\ (x - y)}\ M_1$$

whence

$$m = \frac{(J_2 - I_2)\ (x_2 - x) + (I_2 - I)\ (x_2 - y_2)}{(J_2 - I_2)\ (y_2 - y) + (J_2 - J)\ (x_2 - y_2)}$$
$$\frac{(J_1 - I_1)\ (y - y_1) + (J - J_1)\ (x_1 - x_1)}{(J - I)\ (y - y_1) + (J - J_1)\ (x - y)}\ M_1$$

Comparing this with the first relation between m and M_1, we obtain

$$\frac{(J_1 - I_1)\ (x - x_1) + (I - I_1)\ (x_1 - y_1)}{(J_1 - I_1)\ (y - y_1) + (J - J_1)\ (x_1 - y_1)} = \frac{(J_2 - I_2)\ (x_2 - x) + (I_2 - I)\ (x_2 - y_2)}{(J_2 - I_2)\ (y_2 - y) + (J_2 - J)\ (x_2 - y_2)}$$

as an alternative form of the x, y relation.

PROPORTIONALITY LATENT HEATS

A particular case of considerable interest is that where we are dealing with two components having unequal latent heats but which have the property that the latent heat of evaporation L at constant pressure of any mixture of the two follows the proportionality law as indicated by the equation:

$$L = L_Bx + L_A\ (1 - x)$$

where x is the composition in the component whose latent heat at that pressure is L_B, the latent heat of the other component being L_A. This equation implies that the heat required to evaporate a given amount of either component present in a mixture under a constant total pressure is the same as it would be in the pure condition at that pressure. If, in addition to this peculiarity, the mixture has the further property that its "total heat" when in the saturated vapor state equals the sum of the total heats that the components therein contained would have if each one were in the saturated condition at that pressure, the above equations are somewhat simplified.

Let J_A be the total heat per unit mass in the satu-

rated state of the more volatile component, and J_B that of the more condensible component. Then, if J is the total heat per unit mass of a mixed saturated vapor of composition x, the property just described is indicated by:

$$J = J_B x + J_A (1 - x)$$

Let I_A and I_B be the corresponding total heats of the pure constituents when each one is liquid at its boiling point. Then the two properties above decribed necessitate that the proportionality law holds also for the total heat I of a mixed liquid at its boiling point—i.e.,

$$I = I_B x + I_A (1 - x)$$

If, now, in the equation we have obtained between M_1 and M_2 we substitute these expressions for the I's and J's, that equation becomes:

$$[(J_B - I_B)x_1 + (J_A - I_A)(1 - x_1)] M_1 = [(J_B - I_B)x_2 + (J_A - I_A)(1 - x_2)] M_2$$

or

$$[L_B x_1 + L_A (1 - x_1)] M_1 = [L_B x_2 + L_A (1 - x_2)] M_2$$

The last equation may be obtained directly by writing, in place of the third of our original equations, one which states that for a mixture having the properties specified the heat required to vaporize the mass of the more volatile component evaporated in the column equals the heat lost by the mass of the more condensible component liquefied at the same time—i.e.,

$$L_B(x_2 M_2 - x_1 M_1) = L_A[(1 - y_1) m_1 - (1 - y_2) m_2]$$

This, if combined with the first two original equations, becomes:

$$[L_B x_1 + L_A(1 - x_1)] M_1 = [L_B x_2 + L_A(1 - x_2)] M_2$$

and solving for m_1 and m_2, we have

$$m_1 = \frac{x_2 - x_1}{y_2 - y_1} \cdot \frac{L_B y_2 + L_A(1 - y_2)}{L_B x_2 + L_A(1 - x_2)} M_1$$

$$m_2 = \frac{x_2 - x_1}{y_2 - y_1} \cdot \frac{L_B y_1 + L_A(1 - y_1)}{L_B x_2 + L_A(1 - x_2)} M_1$$

while the relation between x and y at an intermediate point in the column is:

$$\frac{x - x_1}{y - y_1} \cdot \frac{L_B y + L_A(1 - y)}{L_B x + L_A(1 - x)} = \frac{x_2 - x}{y_2 - y} \cdot \frac{L_B y_2 + L_A(1 - y_2)}{L_B x_2 + L_A(1 - x_2)}$$

or

$$\frac{x - x_1}{y - y_1} \cdot \frac{L_B y_1 + L_A(1 - y_1)}{L_B x_1 + L_A(1 - x_1)} = \frac{x_2 - x}{y_2 - y} \cdot \frac{L_B y_2 + L_A(1 - y_2)}{L_B x_2 + L_A(1 - x_2)}$$

SUMMARY

1. In the above discussion we have developed a set of relations applying to a simple adiabatic rectifier or to any section of an adiabatic rectifier in which no material is admitted or withdrawn at any level except the top and bottom.

2. We have pointed out the limitations necessary to be taken account of in estimating masses and compositions of products obtainable from given masses and compositions of materials entering such a rectifier.

3. We have developed a necessary relation between compositions of liquid and vapor in contact at any level in such a rectifier and have shown for what type of binary mixture "perfect" rectification under these conditions is possible.

4. We have obtained the special form these various relations take for a mixture having the property we have called proportionality latent heat at constant pressure.

To be continued in a subsequent issue.

The Tariff Act of 1922 and the Chemical Industries

An Eminent Economist's Views on the Development of American Manufacture of Dyestuffs and Chemicals and That Industry's Relation to the Tariff

In the last number of *The Quarterly Journal of Economics*, its editor, Prof. F. W. Taussig, contributes a comprehensive chapter on "The Tariff Act of 1922." The former chairman of the United States Tariff Commission has made a piercing analysis of the provisions of this measure, particularly in the relation they bear to economic developments in the industries affected by them. Dr. Taussig's views on the chemical schedule will be read with interest by those who have followed the development of the American chemical industry and its efforts to obtain protective legislation.

AMONG the most hotly debated paragraphs were those fixing the duties on coal-tar products and dyestuffs.

They were closely connected with the administrative provisions of the act. The history of this set of duties makes a long story, and the economic situation is highly complicated. Only a brief sketch is possible here.

THE WAR ARGUMENT

The war argument was used to the limit. Before 1914 the supply of dyestuffs, the most important of the coal-tar products, came almost exclusively from Germany. During the war there had been a great shortage, speculation, advances in prices, a hothouse domestic industry. At its close, the domestic producers were dismayed, and urged their case before Congress and the public with great insistence. On the other hand, the circumstances that there were large-scale combinations in the industry and that the unpopular du Pont concern was among the most important producers aroused suspicion and some hostility.

Regarded from the strictly economic point of view the industry does not seem to be adapted to American ways. In our technical parlance, it lacks a comparative advantage. Its processes are painfully detailed and elaborate, in which highly trained and highly paid labor is applied slowly and carefully to a variety of products. Each one of these products is turned out in small amounts; a possible exception is synthetic indigo, of which there is something like mass production. In the main it is adapted to the German industrial ways and traditions: exact applied science; patient experimenting; a technical staff and its trained technical assistants, to be had at comparatively low salaries and wages; large-scale operations but not mass production.

Some bad things have been said of the tricks of the German dyestuffs producers and merchants, and of the unscrupulousness of their competition. Apparently much of this was true, but hardly more true than of the same industry elsewhere; the business seems to lend itself to the worst features of the competitive system. The United States had not failed before the war to develop some chemical industries without high protection, but these were of a different type from the higher grades of coal-tar products. Here as in other directions the successful American industries are those turning out great quantities of a single product by large-scale methods. My impression is that not lack of aptitude for chemical industries as such, not great scarcity of trained chemists or lack of ability on their part, but the character of the dyestuffs part of the industry mainly explains the pre-war situation. As a matter

of the international division of labor, the people of the United States probably would do well to turn to other things in which they work to better advantage, and get their dyestuffs from Germany. And—to go on with the purely economic aspects of the case—the war stoppage of supply raises the old question whether it is worth while to restrict the advantages of the international division of labor because of a possibility of its sudden disruption.

But quite a different phase of the war argument was urged in this case. The cool economic considerations, not of a sort to receive attention under any circumstances from the dominant party, were quite disregarded because of the stress laid on the chemical industries, and especially on the manufacture of coal-tar products, for the direct service of war. The same plant can be used for making dyestuffs and the like in time of peace, for explosives and for poison gas when war comes. The line of reasoning is similar to that applied in favor of subsidizing a merchant marine: the ships can be used for the ordinary purposes of transportation during peace and can serve as an auxiliary navy or transport system in time of war. The plea is more dramatically effective as regards the coal-tar products: be prepared to make your own explosives and poison gas! It was pushed to the hilt; and in this case once more the general protectionist atmosphere caused it to be welcomed, with little endeavor to ascertain just how far the military needs went, whether each and every kind of coal-tar product had to be bolstered up at home in order to meet these needs.

German Competition

On the other hand, domestic producers were so uncertain of their own position—so impossible was it to say just how much they had to fear from their dreaded German competitors—that they urged at first a complete prohibition, at least for a couple of years. In fact a virtual prohibition had existed since the close of the war through certain administrative regulations, and had been sanctioned by a temporary act of Congress. The proposal for the so-called embargo, however, proved unpopular, and though put in the bill as presented by the Ways and Means Committee to the House, was struck out by the House itself. After long debates in the Senate and with no little vacillation it finally was dropped from the act itself. In its place came some extremely high duties and some general administrative provisions which had no logical connection with the coal-tar products themselves but which nevertheless were expected or hoped to be applied to them.

The new rates of duty are extremely high. In 1916, when the war shortage of dyestuffs aroused attention, duties had been imposed upon dyestuffs of 30 per cent ad valorem plus 5 cents per pound. In the act of 1922 these rates become 40 per cent ad valorem (55 per cent until 1924) plus 7 cents per pound on the intermediate products and 45 per cent ad valorem (60 per cent until 1924) plus 7 cents per pound on the finished coal-tar dyes. The combination of specific and ad valorem duties is used, as it has been so often in the protective acts of recent years, to make sure that both the cheaper and the dearer forms shall be saddled with an effective high duty.

Much more important is the provision that these ad valorem rates shall be assessed, not under the ordinary procedure, but with "American valuation"; not on the basis of foreign market value, but on that of the selling price in the United States of a similar article of domestic production. Of the controversy that centered about American valuation in general more will be said presently. It suffices here to point out that the effective duty is made very much higher by its application and that this special treatment is made obligatory for the coal-tar products, and for them only. Alone in the act they are thus singled out. There are further provisions for the proper labeling and description of these articles, and (elsewhere in the act) for the application of special restrictions for the prevention of the "unfair competition"; provisions which are entirely proper and should serve to meet a real need of combating unscrupulous competition. The rates themselves, to repeat, are extremely high. Both the industrial and the military conditions are so extraordinarily complex as to render the problem quite the most difficult I have encountered in the whole history of tariff legislation. But it is certain that the military excitement caused the protective policy to be applied more rigorously than would have been the case if these two factors had not combined, and more so than is justified by either if taken by itself.

Electron Emission From Thoriated Filaments*

Thoriated tungsten filament is a tungsten filament containing 1 or 2 per cent of thorium, usually in the form of oxide. When such a filament is heated to about 3,500 deg. C., a little of the thorium oxide is changed into metallic thorium. In the meantime, however, any thorium on the surface of the filament evaporates off, leaving only pure tungsten. If the filament temperature is then lowered to about 1,800 deg. C., the thorium gradually wanders or diffuses through the filament, and when it reaches the surface, if the vacuum is very perfect, remains there and gradually forms a layer of thorium atoms which never exceeds a single atom in thickness. The thickness of this film is therefore about 1/100,000,000 of an inch, and yet this film increases the electron emission of the filament more than 100,000 fold.

Of course this film is very sensitive and needs some protection to keep it in good condition. Very slight traces of water vapor or other gases would oxidize and destroy it. This can be avoided by putting in the bulb some substance that will combine with the water before this has a chance to attack the thorium film. Such a substance is metallic magnesium. Furthermore, it is necessary to avoid heating the filament to too high a temperature, for otherwise the film might evaporate off. It is therefore best to operate such filament within a rather narrow range of temperature close to 1,700 deg. C., where the ratio of evaporation is very small and where the temperature is high enough for the thorium gradually to diffuse to the surface and continually repair any damage done by the effect of slight traces of residual gases.

The thoriated tungsten filament opens up many new fields of scientific investigation. By measuring the electron currents, it is possible to determine accurately exactly how much thorium is present on the surface. An amount of thorium corresponding to only 1/1000 of the surface covered with a layer one atom deep is easily measurable in this way. It is possible to knock off a thorium film by bombarding it with positive ions, moving at high velocities, and in this way the true nature of this bombardment can be determined.

*Abstracted from a lecture by Dr. Irving Langmuir at Pittsburgh, Pa., Nov. 28, 1922.

The Magnetic Change A_2 In Silicon and Chromium Steels

It Is Impossible to Rely Upon the Loss of Magnetism to Indicate Proper Hardening Temperatures for These Steels, Since the Carbon Change Point Is at a Higher Temperature Than the Magnetic Change Point

BY HOWARD SCOTT
Associate Physicist, Bureau of Standards

IF A carbon steel is magnetized under high magnetizing force, a marked loss in its magnetism occurs on heating through the temperature where eutectoid cementite goes into solution (Ac_1). In consequence, that transformation of the carbide and iron can be readily detected by magnetic methods such as have been effectively employed in the investigations of Honda and his associates of the Japanese Iron and Steel Research Institute, and outlined in this periodical, March 30, 1921. Commercial advantage is also taken of this phenomenon in some forms of hardening equipment designed to indicate when the steel has reached a hardening temperature by noting its loss of magnetism. However, Ac_2, the magnetic change in the ferrite of certain alloy steels, occurs below Ac_1. The method noted is then inapplicable. Since two important alloying elements in sufficient percentages causes this inversion in the position of the critical points Ac_1 and Ac_2, it is intended to clarify the situation by presenting transformation temperature data on these alloy steels.

It was originally shown by Moore[1] that the magnetic change Ac_2 occurs below Ac_1, the carbon point, in certain chromium steels, while Charpy and Cornu-Thenard[2] found the same to be true for high-silicon steels. The phenomenon has escaped general recognition due to the peculiarities inherent to the method of thermal analysis commonly used in steel testing laboratories. On the differential or time-temperature curves ordinarily recorded, A_2 occurs as an indistinct bulge, lacking the easily recognized features it presents when the same data are plotted by the derived differential or inverse rate methods. To verify this, see the inverse rate heating curve for pure iron given at the left of Fig. 3. The fact is obvious enough when one considers that the inverse rate curves are of the same form as first derivatives of the differential curves.[4] Therefore, a peak or maximum in an inverse rate curve corresponds to a point of maximum slope on the differential curve and this relation must of course be observed if the results from data plotted by one method are to be made comparable with those of the other.

A_2 IN CARBON STEELS

The maximum rate of thermal change identified with the magnetic change A_2 occurs at the same temperature in pure iron and in low-carbon steels, both on heating and on cooling. That is to say, $A_2 = Ac_2 = Ar_2 = 768$ deg. C. When determined by suitable thermal methods,

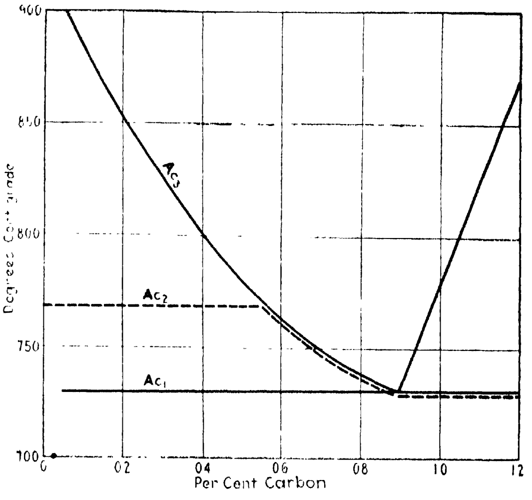


FIG. 1—THE TRANSFORMATIONS Ac_1, Ac_2 AND Ac_3 OF PLAIN CARBON STEELS

it is quite sharp.[5] The accompanying change of magnetization has, however, the peculiar property that it depends on the magnetizing force. With a low magnetizing force A_2 as determined by magnetic methods is very abrupt,[6] but when the magnetizing force is high and approaches saturation the steel begins to lose magnetism before reaching 600 deg. C., the loss continues with increasing rate upon further heating to 768 deg. C. and abruptly reaches a minimum just above this temperature. The temperature of the maximum rate of change of magnetism is, however, independent of the magnetizing force and corresponds to the temperature where the maximum amount of heat is evolved. Thus, notwithstanding the fact that loss of magnetism occurs over a considerable range of temperature, when suitable precautions are taken A_2 can be determined equally well by thermal or magnetic means, and the resulting data will agree.

Now when steels are heated, the pearlitic areas change into austenite at Ac_1. The ferrite plates which formerly existed in the pearlitic materials thus lose their identity, thereby losing whatever magnetism they possessed practically completely. But any excess ferrite left untransformed has the same unit magnetization as pure iron at the same temperature. The total magnetization remaining in low-carbon steels at any temperature between Ac_1 and Ac_2 is then roughly proportional to the amount of free ferrite present, providing the magnetizing force is high. (If the magnetizing force is low, only a very small part of the total change in magnetism occurs at A_1.) Thus, in

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[1]Moore, *J. Iron and Steel Inst.*, vol. 81, p. 268 (1910).

[2]Charpy and Cornu-Thenard, *J. Iron and Steel Inst.*, vol. 1, (1915), p. 276.

[3]Bureau of Standards Scientific Paper 99.

[4]Russell, *J. Iron and Steel Inst.*, vol. 104, p. 261 (1921), plots curves of chromium steels which show the relationship between various methods of plotting.

[5]Burgess and Crowe, Bureau of Standards Scientific Paper 213.

[6]Smith and Guild, *Phil. Trans. Royal Soc.*, vol. 215, p. 177 (1915).

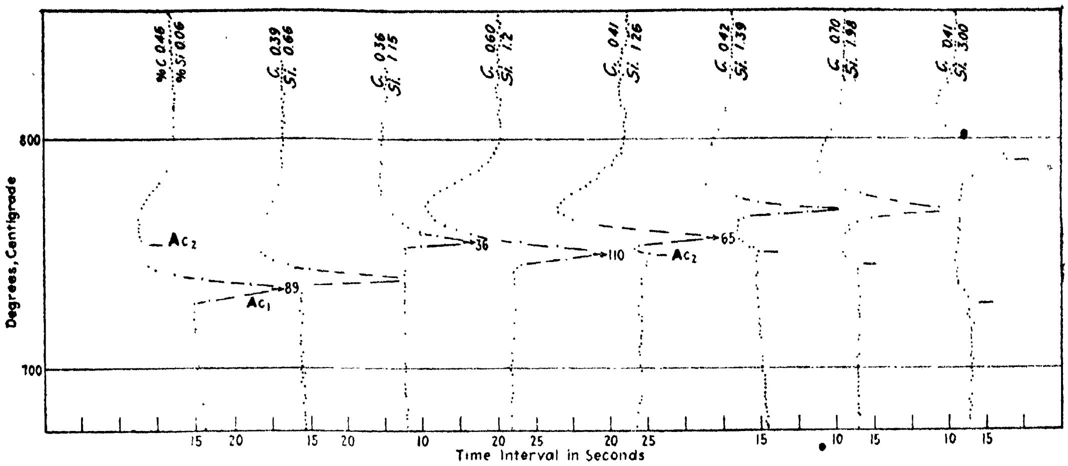


FIG. 2—INVERSE RATE HEATING CURVES OF SILICON STEELS

hypo-eutectoid steels the ferrite undissolved at Ac_1 gradually goes into the austenite solution as the temperature increases, so the total magnetization drops off from two causes—namely, the normal change of unit magnetization and the decrease in the amount of free ferrite through transformation to austenite. If carbon is so low that ferrite is not all dissolved when A_2 is reached, the remaining magnetism then disappears.

These facts regarding the temperature of disappearance of magnetism in steel are represented graphically by the broken line of Fig. 1, in which Ac_1 and Ac_3 are represented by solid lines. The horizontal for A_2 is deflected and continued just below Ac_3, from 0.55 per cent carbon, where it meets Ac_1, to 0.90 per cent carbon. For higher carbon contents Ac_2 is shown just below Ac_1, to indicate that the temperature of disappearance of magnetism actually coincides with the change of pearlite into austenite.

In Table I are given the significant data on silicon and chromium steels taken from inverse rate thermal curves obtained by the method described in Bureau of Standards Scientific Paper 348, and in the American Institute Mining and Metallurgical Engineers' Pyrometry Volume, page 2140. Heating curves for silicon steels are reproduced in Fig. 2 and of chromium steels in Fig. 3, together with comparison curves of a pure iron and a straight carbon steel.

Transformation temperatures are plotted against per cent alloy in Fig. 4 for silicon steels and in Fig. 5 for chromium steels. A_2 plotted in these figures for zero alloy is 768 deg. C., the same as in low-carbon steels. For compositions in which it occurs above Ac_1 the curve is broken; it is thus apparent that the magnet method for determining hardening heats is not directly applicable in silicon or chromium steels containing above 1 and 2½ per cent of alloy respectively.

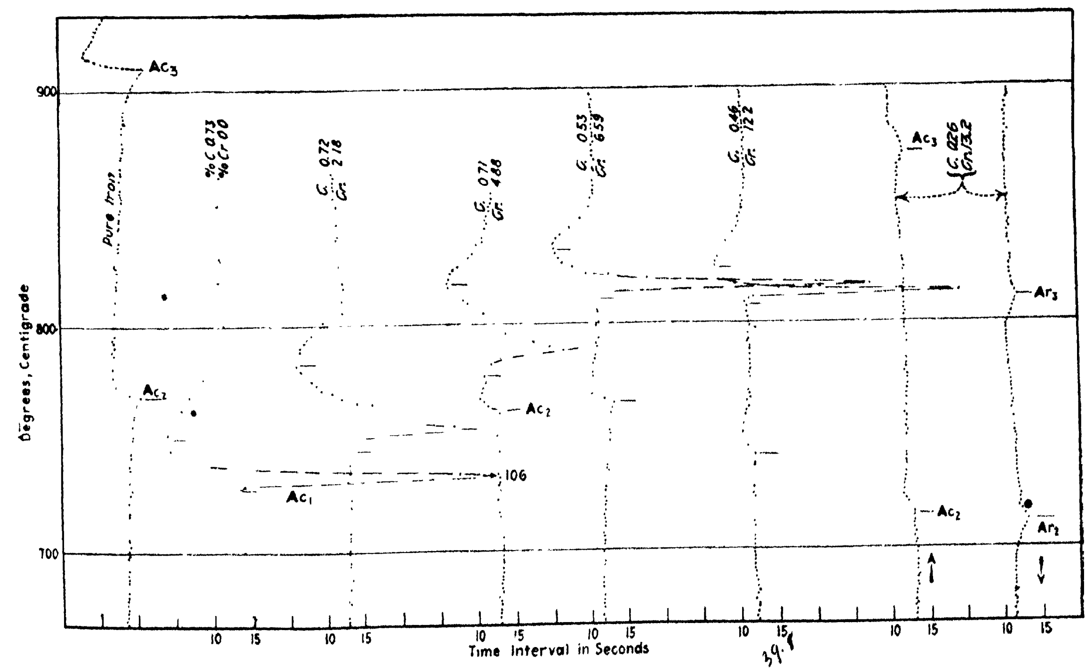


FIG. 3—INVERSE RATE HEATING CURVES OF CHROMIUM STEELS

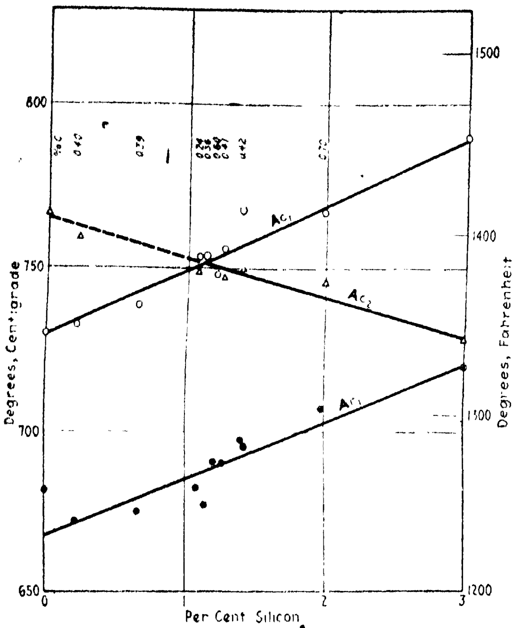


FIG. 4 THE EFFECT OF SILICON ON Ac_1, Ar_1, AND Ac_2 IN STEELS AVERAGING 0.45 PER CENT C AND 0.70 PER CENT Mn

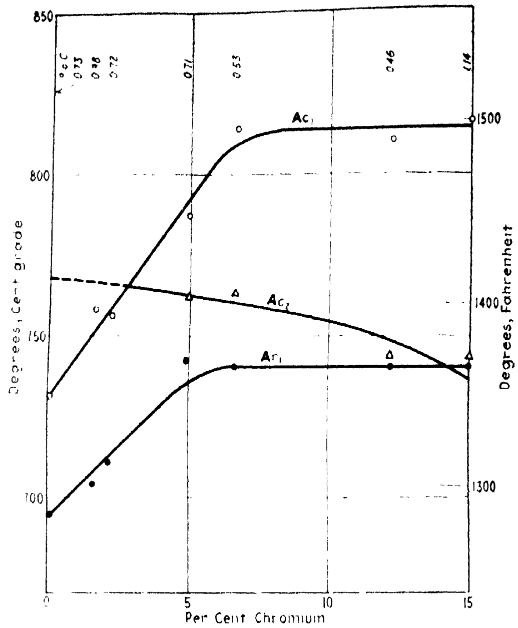


FIG. 5—THE EFFECT OF CHROMIUM ON Ac_1, Ar_1 AND Ac_2 IN STEELS AVERAGING 0.75 PER CENT C AND 0.45 PER CENT Mn

Values of Ac_1 and Ar_1 for zero silicon on Fig. 4 were obtained by interpolation of data on pure iron-carbon manganese alloys to correspond to an analysis of 0.45 per cent C and 0.70 per cent Mn, the average of these elements in the silicon steels. For zero chromium in Fig. 5 are used the values for a carbon steel of near the average carbon and manganese contents of the chromium steels, 0.75 per cent and 0.45 per cent respectively. Curves are drawn to represent the average carbon contents.

The principal effects of silicon are (1) to raise Ac_1 21 deg. C. and Ar_1 18 deg. C. for each per cent addition of silicon up to a content of at least 3 per cent; (2) to reduce the intensity and abruptness of these transformations; and (3) to lower Ac_2 at the rate of 21 deg. C. for each per cent silicon. Consequently Ac_1 and Ac_2 merge at 1.2 per cent silicon, and if the curves be extended above 3 per cent, A_2 would also cross Ar_1. A_2 is lowered at the same rate in pure iron-silicon alloys, according to the magnetic observations of Murakami,[1] until 450 deg. C. is reached for a 17 per cent silicon alloy, the limit of solid solubility, at which temperature it remains for higher silicon contents.

Since there is such close agreement between commercial alloy steels and pure Fe:Si alloys, A_2 is not affected by carbon in the form of cementite in silicon steels (as is equally true in plain carbon steels). These facts do not mean that dissolved carbon has no influence upon A_2 unless thereis a change of solubility at A_2. Moore[2] proves there is not. We know that carbon content has little effect on Ac_2, so these curves of Fig. 4 are probably reliable for the range of carbon contents found in commercial steels.

Data on chromium steels are rather limited, but show clearly the effect of that element in reversing the ordinary relationship of Ac_1 and Ac_2. Chromium does not affect Ac_2 markedly except in the higher alloys, but Ac_1 is raised rapidly up to about 810 deg. C. at 7 per cent chromium, after which the concentration-temperature curve flattens out. Ar_1 is raised in the same manner, but not as rapidly; therefore the lag between transformation A_1 on heating and cooling increases

TABLE I TRANSFORMATION DATA FROM INVERSE RATE CURVES OF SILICON AND CHROMIUM STEELS.

Composition: Per Cent C	Per Cent Mn	Per Cent Si	Per Cent Cr	Heating	Rate of Heating, Deg C Per Sec.	Ac_2 Maximum, Deg C.	Ac_1 Maximum, Deg. C	Maximum Temp. of Heating	Rate of Cooling, Deg. C. per Sec	Ar_2 Maximum, Deg. C.	Ar_1 Maximum, Deg C.
					Silicon Steels						
0 40	0 75	0 22	. .		0 16	759(?)	732	880	0 14	.	672
0 39	0 58	0 66	.	1st	0 19	. .	736	910	0 18		673
0 39	0 58	0 66	. . .	2nd.	0 15	.	740	840	0 14		678
0 24	0 71	1 08	. . .	2nd.	0 09	.	754	960	0 10	748	683
0 24	0 71	1 08	. .	3rd.	0 10		754	960	0 11	750	682
0 36	0 65	1.15		1st	0 27	.	756	940	0 24	.	676
0 36	0 65	1 15		2nd.	0 19	.	752	910	0 16		678
0 60	0 74	1 2		1st.	0 08	.	748	910	0 08	.	690
0 41	0 74	1 26	.	1st.	0 08	749	755	915	0 09		692
0 41	0 74	1 26		2nd.	0 15	743	754	915	0 15	.	683
0 41	0 74	1 26		3rd.	0 10	748	758	915	0 09	.	696
0 42	0.85	1 39		1st.	0 26	751	769		0 23	.	698
0 42	0 85	1 39		2nd.	0 16	750	767	925	0 14	.	696
0 70	0 41	1 98		1st.	0 15	746	767	875	0 15	.	707
0 41	0 86	3 00	.	1st.	0 16	727	790	920	0 15	.	719
					Chromium Steels						
0 73	0 38	0 01	0 0	. . .	0 12	.	731	875	0 14	.	694
0 98	0.32	0 65	1 60	1st.	0 25	. . .	760	965	0 24	. .	702
0 98	0.32	0 65	1 60	2nd.	0 21		756	905	0 19	. .	706
0 72*	0.49	0 19	2 18	1st.	0 14	. . .	753	865	0 15		712
0.72*	0.49	0 19	2 18	1st.	0 13	.	760	870	0 13		709
0 71*	0.34	0.37	4 88	1st.	0 14	762	787	875	0.15		742
0 53	0 70	0 44	6.59	1st.	0 17	764	816	965	0 15		720
0 53	0.70	0.44	6 59	2nd.	0 16	765	812	1,070	0 15		†
0 46	0 67	0.13	12 2	1st.	0 13	745	807	915	0.13		740
0.47	0 67	0 13	12.2	2nd.	0 17	742	812	1,045	0.15		‡
1.14*	0.32	0.25	15.0	1st.	0 14	751	816	905	0 15	. . .	742
1.14*	0.32	0.25	15.0	1st.	0 13	735	815	905	0 14	. . .	737
							Ac_3				Ar_3
0 26*	0.85	0.70	13.2	1st.	0 15	714	871	915	0 17	711	809
0 26*	0 85	0.70	13.2	1st.	0 16	711	879	925	0 15	711	805
0 36	0 38	. . . .	15.8	1st.	0 12	718	852	905	0 12	720	774
0 36	0 38	. .	15 8	2nd	0 12	717	853	905	0 12	721	804

* Previously hardened. †Ar′ = 680, Ar″ = 294. ‡Ar′ = 700, Ar″ = 381

[1] Murakami, Science Reports Tohoku Imperial Univ., vol. 10, No. 2, May, 1921.

with the chromium content up to 7 per cent. The rate at which Ac_1 rises is about half as fast as in the silicon steels, and Ac_2 crosses Ac_1 at 2.5 per cent chromium.

Edwards, Sutton and Oishi[8] have determined the critical ranges of a very complete series of chromium steels, but their values are considerably higher than those given here for equivalent steels. This discrepancy is probably a result of their method of recording data taken from the differential curves. The values for steels within their series are, however, comparable and show that Ac_1 is not affected appreciably by considerable differences in carbon content. The same is true of the observations noted by Russell[4] and of those presented here for carbon contents above about 0.40 per cent. When lower carbon-chromium steels are studied another factor apparently enters.

Data given in Table I for two steels of less than 0.40 per cent C and containing 13.2 and 15.8 per cent chromium respectively show that the upper transformations of these steels occur at a much higher temperature than in similar steels of slightly higher carbon content. The last two curves shown in Fig. 4 are heating and cooling curves of one of these steels. The high temperature, the marked dimunition of intensity and the change in shape of the inflections indicate that the transformation involved is A_3 rather than A_1. This suggests that carbon up to about 0.40 per cent is soluble in ferrite containing high chromium, but there are insufficient data available to verify this. It is, however, significant that Monypenny[9] finds the solubility of carbon in austenite to be greatly decreased by chromium. In consequence, chromium steels containing over about 0.40 per cent carbon and 12 per cent chromium are hypereutectoid, and A_1 only is observed on thermal analysis.

SUMMARY

From a discussion of thermal and magnetization curves, it is noted that $A_2 = Ac_2 = Ar_2$ is a continuous change in the magnetization of ferrite reaching a maximum rate of change at 768 deg. C., just below the temperature of total disappearance of magnetism. In carbon steels this change differs from that in pure iron in degree only, a circumstance which is caused by the transformation of ferrite to austenite within its range.

The critical temperatures Ac_1, Ar_1, and Ac_2 are modified in the following manner:

Ac_1 is raised 21 deg. C. and Ar_1 is raised 18 deg. C. for each per cent silicon added up to at least 3 per cent, while Ac_2 is lowered 21 deg. C. for the same increment.

Chromium raises Ac_1 11 deg. C. and Ar_1 6 deg. C. for each per cent addition up to about 7 per cent, above which they are stationary, but it lowers Ac_2 only in the higher percentages.

Chromium steels containing in excess of 0.40 per cent carbon and 12 per cent chromium are hypereutectoid.

Ac_2 occurs below Ac_1 for silicon contents above 1.2 per cent and chromium contents above 2.5 per cent.

When Ac_2 occurs below Ac_1, the latter change is not detectible by the usual magnetic methods and so equipment depending on the loss of magnetism for indicating the proper hardening temperature cannot function for high silicon and chromium steels.

[8]Edwards, Sutton and Oishi, *J. Iron and Steel Inst.*, vol. 101, p. 403 (1920).

[9]Monypenny, *J. Iron and Steel Inst.*, vol. 101, p. 493 (1920).

Recent Experiments on Chlorine Volatilization

Experiments were made at Bureau of Mines station, Salt Lake City, Utah, on some lead-zinc concentrates for the Kirk-Simon Smelting Co., Harbor City, Calif., in an endeavor to make a separation of lead and zinc. The procedure consists of separating part of the lead as the oxide and part as chloride by the addition of salt, and then a reducing agent was added to make a good grade of zinc oxide from the zinc residue.

Following some volatilization experiments carried on in co-operation with the Chief Consolidated Mining Co., Eureka, Utah, this company erected a semi-commercial plant which includes horizontal Cottrell treaters and a three-compartment bag-house. It was found that treatment of pulped fume with milk of lime would make an acceptable product, containing the values in a concentrated form, and could be sold to the smelters. Experiments made on the electrolytic treatment of fume in a fused bath showed excellent recoveries of the silver, with a good current efficiency.

RECOVERY OF SILVER, LEAD AND COPPER

A good deal of work has been done to determine why it was more difficult to volatilize silver than lead when the two were present in the same ore. It was found that silver chloride formed readily and was quite stable under furnace conditions, but that it required considerable time at high temperature to volatilize even after it was formed. Aeration of the charge reduces this time materially. Vapor pressure of $AgCl$ is low at 1,000 deg.

After testing a variety of ores and looking over former work it seems that the best field for the immediate utilization of the volatilization process lies in lead-zinc separation. It was also found that most of the lead could be separated from the zinc as lead oxide, and many fields for oxide volatilization are now being opened. A good zinc concentrate can be made from many ores which are at the present time too high in lead to have much commercial value, and at the same time the sulphur can be eliminated to save freight.

CHEMISTRY OF THE VOLATILIZATION PROCESS

During the past fiscal year an effort was made by the Bureau of Mines to get some valid fundamental data upon which might be based the chloride volatilization work. Up to this time this work has been divided into four principal divisions: (*a*) A study of the effect of elemental chloride on a zinc carbonate ore. (*b*) Various theoretical calculations of vapor pressure, heats and reactions, and various predictions as to courses of reactions and applicability of various metallic chlorides as chloridizing agents. (*c*) Direct measurement, by a static method, of the vapor pressure of various metallic chlorides. (*d*) The measurement of equilibria in systems consisting of a metallic oxide, metallic chloride, oxygen and chlorine.

Zinc Condensers

In large-scale experiments with the distillation of zinc by the electric current, difficulty has been encountered in the fact that condenser linings made from ordinary refractories break down due to carbon deposition around particles of iron oxide contained in the refractory material. Small-scale experiments are being carried on at the Rolla station of the Bureau of Mines using condensers lined with various iron-free refractories to determine what materials are permissible for this purpose.

Pyrex Glass as a Material for Chemical Plant Construction*

Boro-Silicate Glass Has Already Established a Unique Place for Itself in Chemical Industries and the Possibilities Are Tremendous—Less Than a Year Ago Industrial Pyrex Was Undertaken Seriously—The Progress Made Is Reported in This Paper

By A. E. Marshall
Consulting Chemical Engineer, Baltimore, Md.

Anyone who has undertaken construction work on chemical plants, whether for the manufacture of mineral acids or less corrosive products, will admit that no available material gives satisfactory service under all conditions.

Materials in general use have specific advantages for specific work, and the chemical engineer utilizes a number of different materials in one piece of construction in order to develop maximum durability under varying conditions. Incidentally, durability is in many cases synonymous with resistance to corrosion.

Glass, because of its insolubility in acids, has always found uses in the chemical industry, but its limitations in the way of temperature resistance have restricted the field of application.

Limited Use of Ordinary Glass in Industry

Ordinary glass, if desired to withstand moderate temperature changes, has to be made into shapes with thin walls, and such shapes when thin enough to survive slight heat shocks are much too thin to stand up under ordinary plant usage, or in many cases to survive rough handling during erection.

The desire to make use of the non-corrosive properties of glass has led to its being tried out under a variety of plant operating conditions, but the inherent disadvantages of ordinary glasses so far outweigh the useful features that it is difficult to point to successful applications in plant-scale work except under special circumstances.

I remember making a survey some years ago of materials used in the construction of gas-conveying lines from hydrochloric acid pots and muffles. One plant at the time of my visit was using 15-in. slip joint glass pipes on the pot line. Very good results were being obtained because of the thorough cooling of the gas in its passage through the thin-walled pipes to the absorption tower. Later inquiries indicated rather heavy breakage during the winter months, the cause being ascribed to leakage of melted snow through the roof and onto the pipes, or to the considerable difference in temperature between the atmosphere and the gas inside the pipes.

There was a purely local reason for the use of glass on this line. The chemical plant adjoined a glass factory, and the glass pipes were thin cylinders from the plate glass department.

When wire glass was introduced it seemed to offer decided possibilities to the chemical industry, and it was tried out for various uses without any great measure of success. I was very much interested in sulphuric acid concentrators at that time, and I substituted some wire glass plates for the acid-proof cover slabs on a cascade concentrator. The glass cracked in the course of a few hours and thereafter final collapse was merely dependent on the time required for the acid fume to attack the wire reinforcement.

Other engineers have endeavored to utilize glass in various ways, and where temperature resistance and mechanical strength have not been essential, the material has proved satisfactory. I have in mind, as an instance, the glass-packed Gay-Lussac and absorption towers introduced in England about 1909 by Carmicheal. These towers, usually of square section, are packed with annealed plate glass sheets, set on edge and spaced fairly closely. Each successive layer of packing is placed at right angles to the row below, thus giving excellent surface contact and good gas distribution.

Mention has been made of attempts to use, and the actual use of, ordinary glass in plant construction, because such attempts afford evidence of a desire on the part of the chemical industry to utilize the valuable non-corrosive properties of glass.

Industrial Possibilities of Pyrex Realized in Laboratory Ware

With the introduction of Pyrex as a laboratory material and as a domestic utility in the form of baking ware, the possibilities of using glass in plant construction assumed a more promising outlook. Chemical manufacturers tried out Pyrex baking ware for small-scale chemical operations, drawn Pyrex tubes were used in Hart nitric acid condensers, and many other minor uses were discovered for the standard shapes which were being produced for the laboratory or the home.

In December of last year the author suggested to the Corning Glass Works the desirability of gathering together these sporadic developments and investigating the possibilities of producing a line of Pyrex products designed for the use of the chemical industry. The field appeared promising, and a decision was reached to establish an industrial Pyrex department, the author being retained as consulting engineer.

Before entering into a description of the present state of development, it is necessary to set forth the essential characteristics of Pyrex and the difference in its properties and ordinary glass.

What Pyrex Is

Pyrex is a low-expansion boro-silicate glass of simple chemical composition, containing no metals of the magnesia-lime-zinc group and no heavy metals.

A comparison of the linear expansion coefficients of Pyrex and a number of materials is given in Table I and, as will be seen, Pyrex has a smaller coefficient than porcelain, ordinary glass or any of the usual metals.

The low coefficient of expansion introduces a marked distinction from ordinary glass whether of the lead or lime-soda type.

*Paper presented at the Richmond meeting of the American Institute of Chemical Engineers, Dec. 8, 1922.

TABLE I—LINEAR EXPANSION COEFFICIENTS
(PER DEG. C.)

Pyrex glass	0.0000032
Porcelain	0.0000036
Hard glass	0.0000077
Soft glass	0.0000085
Cast iron	0.0000102
Wrought iron	0.0000119
Portland cement	0.0000120
Copper	0.0000167
Brass (66Cu-34Zn)	0.0000190
Zinc	0.0000258
Lead	0.0000276

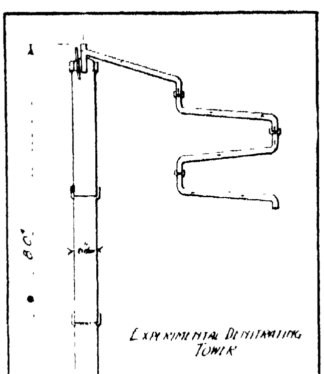
The melting point of glass is not particularly valuable as an engineering consideration, as there is usually a fairly wide range between the initial softening point and final melting point. In the case of Pyrex, the softening point is about 800 deg. C., but the material will soften slightly, especially under pressure, if maintained for a long time above 600 deg. C.

In connection with the softening point it is useful to remember that devitrification, which is a serious factor in the use of some materials, does not affect Pyrex in its working range.

Comparative Acid Resistance of Glasses

Acid resistance is not usually given much thought in the case of glass, the general assumption being that all glasses are equally resistant. Bulletin 107 of the Bureau of Standards gives considerable data on the acid-resisting qualities of Pyrex and other glasses, and is well worth study. Researches have also been conducted in the Corning laboratories on the resistance of Pyrex to perchloric, phosphoric, constant boiling hydrochloric and concentrated sulphuric acids under a variety of conditions.

The action of hydrochloric and sulphuric acid is very slight, constant boiling hydrochloric acid attacking Pyrex at a rate of 0.000006 gram per square centimeter per hour. Concentrated sulphuric acid in 4 hours at the fuming temperature shows an attack of 0.000002 gram per square centimeter per hour. Both figures relate to initial surface attack, as after the lapse of a few hours a state of practical stability is reached.



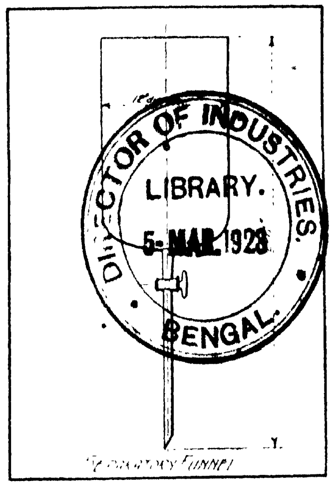
INSTALLED BY THE DU PONT CO.

Work on the coefficient of heat transference is being carried out at Corning, but has not been completed. Preliminary results on the relative efficiencies of Pyrex, porcelain and stoneware indicate Pyrex and porcelain as equal, whereas stoneware shows about one-half the Pyrex value.

It can be said that while Pyrex is superficially a glass, its physical characteristics justify consideration from the engineering standpoint as a special and distinct material adapted to a variety of industrial uses to which ordinary glass cannot be applied.

The Development of Industrial Shapes

Proceeding from a consideration of useful properties to the development of definite industrial shapes, it is obvious that the upper limit of size is a factor of great importance. If the sizes had to be restricted below the usual standards in other materials, then the field of application would also be restricted. It was not practicable to pick out very large pieces and concentrate on them, for the reason that failure in manufacture might be caused by lack of dexterity in handling such large shapes. The history of most plant materials, stoneware, fused silica, high-silicon irons, etc., has been one of gradual enlargement of product. In the case of Pyrex the existing laboratory and domestic shapes could be used as a starting point and a stage selected which would represent useful commercial products without going out to sizes which would call for the introduction of new methods of handling.



ONE OF THE FIRST PIECES OF PYREX INDUSTRIAL EQUIPMENT

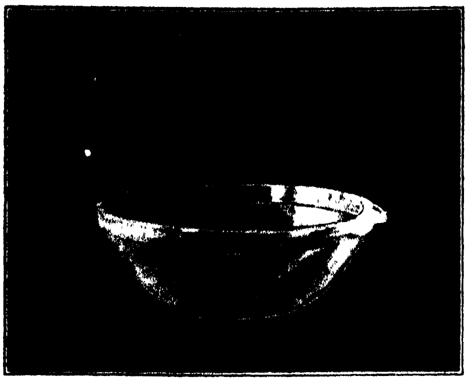
The starting points selected were therefore an 18-in. evaporating dish, a 6-in. bore socket pipe 39 in. over all, and a cylindrical pot 12 in. in diameter by 20 in. high.

It was expected that difficulties would develop in the manufacturing process; but contrary to expectations, production was worked out with nothing more than the usual minor troubles.

With proof that manufacture was possible, it was then necessary to test out the product under working conditions. These tests were made on single pieces in various plants, and following satisfactory reports, distribution was started on a small scale.

The application of these first available shapes brought along a demand for other forms of Pyrex equipment, and as a consequence new items have been added in the last few months, while others are approaching the production stage.

Reference is directed to the 72-liter capacity retorts, designed for distillation and reaction work, various



PYREX DISH, 25 IN DIAMETER AND 30 LITERS CAPACITY

sizes of pots up to 9-gal. capacity, and large separatory funnels of 8-gal. capacity as articles now available.

Pyrex glass is also being produced in sheets 14x18 in., and it is expected that much larger sheets can be made if there is the necessary demand

In addition to the above items a 25 in diameter dish of 30-liter capacity is about ready for distribution. 12-in. socket pipes will follow in a few weeks, and other shapes of equivalent size, such as a drier tray, cascade dishes, etc., will be put in production as soon as a demand is assured.

Incidentally the use of Pyrex in forms developed especially for the chemical industry has created interest in the possibilities of equipment made from Pyrex tubing. Condensing equipment made up of "S" bends, pipe lines with socket or butt joints, and many similar uses are becoming standardized.

A Pyrex Denitrating Tower

An interesting piece of Pyrex equipment was constructed recently for the du Pont company. This was in the form of an experimental denitrating tower 6 in. in diameter by 8 ft. high. All parts, including distributor, inlet and outlet connections, were Pyrex. It is understood that the tower has given satisfactory service, despite rather strenuous conditions

The use of Pyrex in actual plant work has developed some interesting sidelights, not only on applications but on a phase of excessive cost, created by a lack of standardization. This point will be discussed later.

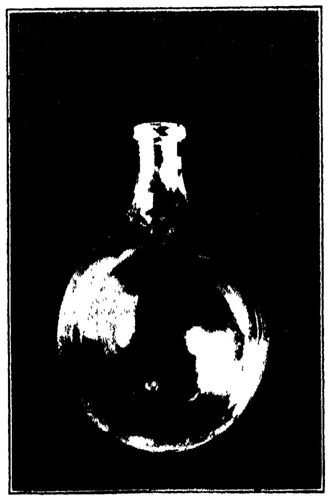
It had been expected by users that there would be a higher handling breakage with Pyrex dishes than with porcelain. Experience has been entirely to the contrary, and the reason apparently lies in the province of psychology. One plant, which is now completely equipped with Pyrex dishes, reports handling breakages as nil, and states that the men treat the dishes as glass, setting them down with care and so obviating breakages through dropping. It has been the experience of every user of Pyrex, irrespective of the shape of the article, that transparency creates care in handling. It is a natural assumption that an opaque object will withstand shocks and that a transparent one will not, so a transparent material which is at least equal to stoneware and porcelain in mechanical strength has a much better chance to survive at the hands of a workman. Transparency has other advantages which are not psychological. The first and most important is that a transparent article cannot have blowholes or other hidden flaws. Even strains can be detected by the use of a special polariscope, this being one of the routine tests to which every piece of Pyrex equipment is subjected in the Corning factory.

Next comes the question of cleanliness. Opaque equipment may or may not be clean, but transparent equipment always supplies its own positive answer on this point. Finally there is the feature of controlling reactions through direct observation.

Advantage of Rapid Process of Fabrication

Another interesting feature which has been brought forward by users is in relation to the process of manufacture. Pyrex is to a certain extent competitive with chemical stoneware. The process of making stoneware is quite lengthy, the time required being about 2 months. Breakage of a special piece of stoneware, provided there is no duplicate in the plant store room or at the stoneware manufacturer's works, means a long delay in starting up after the shut-down. Providing a mold exists for the piece in Pyrex, manufacture can be completed in 3 days as a minimum, although factory conditions might necessitate a delay of a few additional days on account of prior routing of work.

Touching on the phase of excess costs of construction materials, it seems very desirable to emphasize the lack of standardization in the chemical industry. Molds are costly, whether they are intended for stoneware, silica, Pyrex or other materials. The manufacturer of the equipment has to charge up his mold cost to the



A 72-LITER RETORT

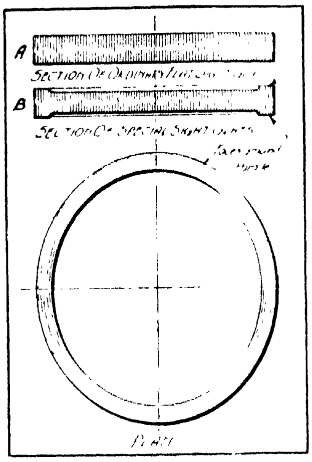
user, and there seems to be too great a demand for "specials"—which may vary only ⅛ in. from a stock mold. Some concerted effort to standardize shapes would cheapen the products, and, of equal importance, would enable producers to carry representative stocks. A striking example of the lack of standardization is shown by the Corning Glass Works list of sight glass molds. Continuous efforts have been made to keep down the number of sizes, but the success can be judged when it is shown that between the range of 2½ in. diameter by ¼ in. thickness to 8½x¾ in. it has been necessary to provide forty-one molds.

In the case of plant equipment, a further effort is being made to work out shapes which will suit a variety of uses, and it is hoped that a full measure of cooperation will be extended by plant managers and engineers, through the use of stock rather than special molds.

The industrial use of Pyrex is spreading into many fields, and while not a strictly chemical application, decided interest attaches to the development by the research laboratories of the Corning Glass Works of Pyrex high-tension insulators.

The generally accepted causes of failure of porcelain high-tension insulators are: (1) change in structure of porcelain with time and absorption of moisture; (2) breakage due to thermal changes; (3) flaws in the porcelain body, causing dielectric and other failures; (4) failure due to expansion of cements used in attaching hardware to the insulator; (5) mechanical weakness. These failures may be generally classified as failure due to the properties of the insulator and failure due to design.

Pyrex glass seems to have ideal properties for an insulator, for it apparently is not subject to any of the intrinsic weaknesses of the porcelain insulator. It does not change in structure, can be inspected for any defects, thus assuring a uniform product, has a sufficiently high dielectric strength, a great resistance to thermal changes (its thermal expansion coefficient being lower than that of porcelain) and in addition is not heated by direct solar radiation as much as porcelain. Consequently if a Pyrex glass insulator could be built free from the design defects of the porcelain, there is no question that it would be a better insulator.



SUGGESTED DESIGN OF PYREX SIGHT GLASS

Fig. 1 shows the construction of the Pyrex insulator. It is evident at a glance that this construction and design gives a cement-free, all-metal and glass insulator and that the design is one of great resistance to tension, as the material of the insulator is largely under compression.

Considerable data have been collected showing the relative properties of Pyrex.

Heating of glass and porcelain insulators by solar radiation shows a rise in temperature above air temperature for a porcelain insulator of 39.5 deg. C., and for a Pyrex insulator of 10.8 deg. C. This is a mean of ten observations in both cases. These data show the increase in temperature due to solar radiation to be 3.65 times as much for the porcelain as it is for the glass. **The glass is transparent and the porcelain absorbs the heat radiation. This proves that in service the glass is not subjected to anything like as severe heat changes as porcelain.**

In a report on dielectric strength tests made by one of the large manufacturers of electrical equipment it was stated that unit No. 1 punctured at 143 kilovolts, unit No. 2 punctured at 160 kilovolts, and unit No. 3 punctured at 140 kilovolts.

"The tests on Pyrex suspension insulators show quite conclusively that the material has good characteristics. The uniformity of electrical puncture is a distinct advantage over porcelain."

It is evident that Pyrex glass has very good dielectric properties, more than ample for the service, as well as being uniform.

Tensile strength tests made by Cornell University, Sibley College, show:

No. 1.	22,600 lb.	No break
No. 2.	23,000 lb.	Pin broke in holding device
No. 3.	19,500 lb.,	Pin broke in holding device, reaction broke insulator
No. 4.	22,750 lb.	Yielding, no break
No. 5.	23,600 lb.	Cracked
No. 6.	20,600 lb.	Click, no break
No. 7.	21,800 lb.	Click, cracked
No. 8.	22,000 lb.	No break
No. 9.	17,000 lb.	Click
	22,500 lb.	Click again, cracked
No. 10.	25,460 lb.,	Broke stud, flange shattered by reaction, head O. K.

Since the better grades of porcelain insulators will not stand over 10,000 lb. load as a maximum, and many break below that, it is evident that the glass insulator has a strength far superior to anything yet developed. This property should allow for longer spans, and in many cases where two strings of porcelain are used in parallel one of Pyrex will be ample to carry the load.

Pyrex glass has a great resistance to water absorption and surface attack, and is therefore durable under long exposures to severe atmospheric conditions, as for instance around chemical plants.

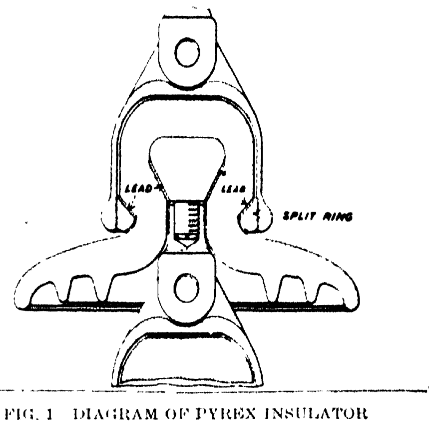


FIG. 1 DIAGRAM OF PYREX INSULATOR

It is probable that glass insulators will not be as attractive to birds and spiders for nesting sites, since they will not have the dark shadows that exist in a string of porcelain insulators.

The chief advantages of the Pyrex insulator are the fact that it does not absorb heat as does porcelain; has no cement in its construction gradually to absorb water and expand, ultimately fracturing the insulator; and has a mechanical strength that will average twice as high as any porcelain insulator yet on the market.

This paper describes in sufficient detail the present status of industrial Pyrex, and carries a suggestion of future possibilities. It is believed that Pyrex will in a short time occupy a definite place along with the other materials used for plant construction. It is not a universal panacea for construction ills, but, like everything else in our practice, it demands thought in its application and care in its use.

European Conditions as I Saw Them*

Deplorable Policy of Feeding the German Masses With Propaganda of Hatred Toward Former Enemies, Particularly the French—Salvation of Germany Depends on Payment of Honest Wages and Sale of German Products at Prices Commensurate With Their Intrinsic Value

By J. S. Negru

As I now pass in review my impressions gained in Germany during my visit there during the summer of 1922, I am compelled to say that the worst which has befallen the German people is not the loss of the war, but the policy of a handful of Germans who keep the remainder of their countrymen practically in complete ignorance of what the outside world has learned about Germany's doings during and after the war.

Although throughout the war, the Germans employed means which alienated for them the consideration which is due to a civilized people, even to this day they know only about their own sufferings and privations, and seem not to have the least idea or thought of what was and is going on elsewhere. Since the war they have been led to believe that the conditions which have been imposed upon them were not imposed as a means to alleviate conditions caused by their acts during the war, but as a concerted plan to destroy them as a people.

For this state of mind, a handful of Germans is responsible. They are the leading industrials of the country, who grew immensely rich during the war, and after the war dreamed of mastering the world's markets. This they have done by feeding the people systematically with hatred propaganda, at the same time compelling them to work for ridiculously low prices and selling for export German products requiring large amounts of manual labor at far below their real value. This procedure did not have the effect which the industrialists expected. Instead, it has resulted in Germany gradually falling in the estimation of other nations, and has created a feeling of distrust which it may take her generations to live down, and thus regain her lost place in the community of nations.

While I was in Germany I stated openly my impressions, as I received them, to practically all Germans with whom I came in contact, hoping by this means, if I were mistaken, to compel them to tell me facts which might lead to nullifying or modifying those impressions. Therefore, the judgment at which I arrived as to actual conditions in Germany is free from any personal bias.

Pride in Germany Before the War

Germany before the war was strong and boastfully conscious of her strength. There was then no visible hatred toward any foreign nation, foreigners were treated with the consideration due to visitors. Her cities were well patrolled and everything was minutely regulated according to the "verboten" dogmas. Her railways were considered the best in the world as to regularity of traffic. She pointed to her intellectuals with almost as much pride as she did to her uniformed defenders of the Vaterland. The results of her researches were made public freely and served as steps in the advancement of human knowledge. Her scientific and technical magazines and books were standard, sought for and studied by all who wished to attain recognition as savants. The degree of Doctor obtained in German schools and German universities was the open sesame to the fraternity of the learned. The German students were the coming leaders and were aware of their importance. Her factories were busy and the workmen imbued with the spirit of the then real meaning of the label "Made in Germany," which was the production of goods which competed honestly as to quality and price with those of other industrial countries. Her workmen were contented and received what was considered a fair return for their labor. Business ethics were summarized in the term "Ein Mann ein Wort" (a man's word). In brief, Germany was a great country, but even then she was suffering from an illness which accompanies the exalted belief in self-importance—namely, she was conceited and became so to such an extent as finally to consider herself as the anointed for dispensing to the rest of the world the blessings of Kultur.

The Germany of today is sick with the sickness of hatred. Economic war, wailing notes, conferences, blaming others are like patent medicines; the medicine Germany needs is just plain honesty toward herself and others.

Hate, far more than anything else, is now corroding

DISTINGUO ALLEMAND

— Après Petersdorf Hamborn, après Hamborn Gleiwitz! Il faut que cela cesse..
— Mais, Mylord, pourquoi vous fâcheriez-vous? Il n'y a jamais d'Anglais « accidenté »,

*This is the seventh of a series of articles by Mr. Negru on this subject. The preceding articles appeared in the issues of Oct. 18, Oct. 25, Nov. 8, Nov. 15, Nov. 22 and Nov. 29. This article was written in September, 1922.

the German people. They have made out of it a new religion, "Hatredism," if I may use this expression, which they worship with fervor. France conveniently personifies the mortal enemy of their good god Kultur, hence it is on France that all Germany's imprecations are heaped. The leaders in Germany well know that others, in particular England, were and are just as mortal enemies of their type of Kultur, but it would not do to use them all at the same time, as the masses of worshippers might then be confused as to which was which; hence the superficial tolerance for the non-French.

The accompanying cartoon "German Distinction," by Louis Raemaekers, taken from the April 16, 1922, issue of *Le Soir*, Brussels, illustrates better than words could do the idea which the Germans have of tolerance. The caption reads:

ENGLAND — After Petersdorf Hamborn, after Hamborn Gleiwitz! This must stop.

GERMANY — But, my lord, why are you offended? There are never any English casualties.

This refers to the occurrence when French soldiers were killed and wounded by the explosion of concealed ammunition.

Hatred of French Is Bred Systematically

The Germans have a league for the protection of the German Kultur (Liga zum Schutze der deutschen Kultur). I had heard something about the activities of this league and of its itinerant exhibition, giving a series of graphical and statistical descriptions of what the peace treaty meant to Germany. I had an opportunity to visit this exhibition in Berlin, which was the forty-second city in which it was held since it was conceived.

If ever there was an efficient means of arousing fanatic hatred, this kind of exhibition can surely claim first prize. It was unilateral and partisan, showing effects only and absolutely no trace of causes. The walls of the halls were covered with a series of tables, twenty-eight of them the subject of Wilson's fourteen points, the others dealing with Germany's lost colonies, lost German territory, loss of minerals and agriculture, payment for reparations and so on. In the main hall, a raving anti-French denunciator and agitator was addressing the audience, which looked like a congregation of raptured fanatics.

The masterful poster for this exhibition is here reproduced. Can there be any more suggestive picture resembling a huge antediluvian animal with a heavy body and a diminutive head? It is entitled "The Chained Germany."

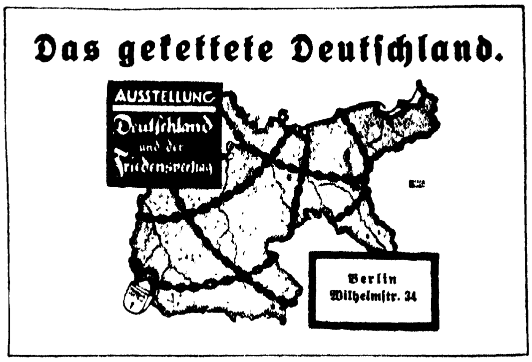
I am a believer in free speech, free press and the like. I have nothing to say against the exhibition, the speaker, and the audience. The exhibition is a business proposition, the speaker surely a hireling and the audience consisted of grown-ups, so all was what might be expected in any constitutional country.

But where I am compelled to draw the line is that in the morning preceding the day on which I visited the exhibition I saw a large group of girls about 14 years of age, accompanied by their teachers, waiting on the street and in the yard of 34 Wilhelmstrasse for the doors to open. I learned afterward that the forenoons were reserved for school children and their teachers. It is criminal to poison the minds of children with such exhibitions as these, especially when the parents of these children are exploited to the extent that they receive only the very minimum-for-existence wages, at the time of which I write on the average of about $2 per week. Would it not be far healthier for all concerned that instead of such exhibitions there should be in the German press honest accounts as to what really becomes of German work? Also, why it is possible that a workman receives only about $2 per week, when the intrinsic value of the product of his work is even more than before the war, when he received at least $6 per week. This is the condition which is the very cause of Germany's present plight.

Meeting a Locksmith in the Tiergarten

This steady feeding of hate, which is so very conspicuous in every place which I visited in Germany, has embittered even the minds of their scientists. During a conversation with B., a leader in metallography, he used a language of hatred strikingly similar to that which I heard from S., a plain locksmith in a tent in the Berlin Tiergarten.

The meeting with B. was at my request, but that with S. was accidental and deserves to be related more in detail. It was on a Sunday afternoon. After a long promenade in the Tiergarten, I entered a tent show, paid the entrance fee, 6.20 marks (about 2 cents), sat down at a table and ordered black coffee. A few moments later a couple took their places at the same table, and also ordered coffee. When this was brought, the man



looked in disgust at the small pots of coffee and cups the size of demi-demi-tasse, if I may use that expression. He evidently expected to receive the large cups of coffee that I well remember in such places in the years gone by, especially since while waiting for the coffee the couple had taken out the sandwiches which they had brought with them for their lunch. When he learned that the price was 12 marks (about 4 cents) per pot, he started to argue with the waiter that it was too dear, and on learning that the price of beer was 7 marks, ordered the waiter to take the coffee back and bring them two glasses of beer instead.

This gave me opportunity to start a conversation which lasted about two hours and a half. I learned that he was a locksmith, earning 600 marks a week (about $2). The entrance fee to the tent (6.20 marks each for himself and wife) plus the 12 marks for coffee, making a total of, say, 11 cents, was too much for them, as with this sum they could have purchased meat and bread for a good dinner. It furnished the pretext for a series of imprecations against the French and why an honest German workingman cannot afford even once in a while an enjoyable outing on a May day Sunday afternoon. The burden of his song was that the French

are the masters of Germany and squeeze out of her every drop of the proceeds of her work, etc. Needless to say, he believed that it was so.

Cannot the German intellectuals see that the ever-exaggerated accusations against the French and others are driving the German masses to the fixed idea of a savage crazed with hatred? Can they not think of what might happen if these men were at last to learn that their work has served in reality to enrich a few Germans and to alienate the good will of the rest of the world, because of the very abnormal low selling prices of the products of their work?

It will not be long before the German masses will learn that huge sums are being placed by German industrials in foreign countries and that the payments already made for reparations are a small proportion only of the German annual productive wealth.

I may cite here the following which was printed in *Le Matin* of Paris, under the heading "Stinnes offers to Jugoslavia a Loan of $100,000,000:"

> Belgrad, 8 May, 1922—*Novosti* of Belgrad, the governmental organ, announces that a financial consortium, behind which is the famous Hugo Stinnes, has lately offered to the Jugoslavian Government a loan of $100,000,000 for the construction of new railways from the interior of the country to the Adriatic ports.

What Germany needs now more than ever is not to hear hate, read hate and think hate, but to have her workingmen get wages commensurate with the true value of their work and sell her products at honest prices.

Other articles by Mr. Negru on this subject will be published in subsequent issues.

Legal Notes

BY WELLINGTON GUSTIN

Where Combination of Old Elements Is Patentable

The Circuit Court of Appeals of the United States at St. Louis has affirmed the judgment of the District Court in a suit brought by the Laclede Christy Clay Products Co. against the City of St. Louis and has denied a rehearing on the matter. (280 Federal, 93.)

SUSPENDED ARCH CONSTRUCTION ANTICIPATED

Suit was brought by the Laclede Christy Clay Products Co. against the city for infringement of a patent, known as the Girtamer patent, No. 986,455, claims 1 to 3. This patent covers claims for a furnace arch having parallel I-beams on which are brackets from which tile are suspended by a tongue and groove arrangement. The court found there was not only anticipation by prior patent issued to Stimmel, No. 944 296, and to Green and Gent, No. 676,606, and to Poppenhusen, No. 783,132, in the use of more than one transverse support; but also the question whether two (or more) I-beams (or girders of other form) should be used as called for in the three patents rather than one as called for in Girtamer's first patent, No. 910,809, was a question answered by mechanical suggestion when it is desired to make the arch longer. Again, the court said there was nothing new in the patent in suit, for Girtamer's first patent has the grooved tile fitting into lateral extensions of pendent portions of the brackets. Even this point is identical with Green and Gent's patent.

USE OF SEVERAL PARTS INSTEAD OF ONE TO PRODUCE SAME RESULT NOT INVENTION

It was contended that Girtamer's first patent called for one transverse I-beam which supported integral brackets extending rearward and forward over the length of the arch, while the structure disclosed in his second patent, which calls for two I-beams spaced apart, with brackets in three separate pieces, one extending forward from the front I-beam, one extending rearward from the rear I-beam, and one between the two, demonstrate inventive genius in devising a means of lengthening the arch. But a plurality of transverse supports was disclosed in prior patents, and Girtamer lengthened the arch in the same way by using two beams instead of one. The court says that was anticipated if patentable, though it thought this was wholly within mechanical suggestion.

"Ordinarily, the making of two or more parts out of a thing that had before been used in one part, and using the separate parts to serve the purpose that had been served before the division is not invention," says the court.

WHEN COMBINATION OF OLD ELEMENTS IS PATENTABLE

"However, where a discovery embodies co-acting elements, although they be old, yet, if when brought together in a way not theretofore known, they produce by their interaction a new and useful result, the combination is patentable. (Regent Mfg. Co. vs. Penn. Elec. Mfg. Co., 57 C. C. A., 334); and if one of the elements in the combination be removed or changed so that their interaction is then in another way (in obedience to a different co-operative law), there is nevertheless invention, although the same result is attained, for in that case a different idea of means expresses the discovery, and the new is not an equivalent of the old."

But it further says that whether the change or rearrangement of those elements has, in their co-action, produced the old result in a different way is always a question of fact in any particular case. In the case at bar the court failed to find that the change produced the old result in any different manner. The three elements in combination, whether the brackets be integral or in three parts, were utilized for the same purpose, and perform the same functions in the same way and produce the same result for which they were used in other prior patents.

Fatigue Resistance of Dirty Metal

During the war a series of fifty steels was made by H. W. Gillett of the Bureau of Mines having the rarer metals as principal alloying elements. These steels are now being tested for endurance to repeated bending, especially in the hardened condition. It was found that non-metallic inclusions have a very detrimental effect on such specimens, and an independent investigation on this subject is being planned. The effect on repeated bending tests, of various amounts of lead in wrought brass, and of various amounts of copper oxide in copper is to be studied. This particular phase of the problem was brought up by W. R. Webster, of the Bridgeport Brass Co., as being of importance in itself as well as in its bearing on the general problem.

Book Reviews

Sampling and Analysis of Coal, Coke and Byproducts. Methods of the Chemists of the United States Steel Corporation. Second edition. Published by the Carnegie Steel Co., Bureau of Instruction, Pittsburgh. 184 pages, including many illustrations. Price, $3 (cash with order)

While this book now appears as a second edition, it is virtually a new work, for the old material has been rewritten and revised and many new methods and tests not covered in the former edition are included in the new. In fact the new book is more than double the size of the first edition. The scope and purpose of the work are splendidly given in the preface to this new edition, as follows:

"The first edition of Methods for the Sampling and Analysis of Coal, Coke and Byproducts has served very usefully the purpose for which it was intended. However, the rapid gowth of the byproduct coke industry in this country during the comparatively brief interval since the preparation of the original pamphlet has brought about many changes in byproduct laboratory practice. This consideration led to a decision to rewrite the text, so that the methods described therein could be brought up to date. Accordingly, a committee composed of chief chemists from the largest coal and coke laboratories of the various constituent companies of the United States Steel Corporation was appointed to co-operate in carrying out the work to that end.

"In addition to revising the pamphlet so as to describe the most recent methods employed in coal and byproduct laboratories, it has been deemed advisable to add several new features, among the most important of which are physical tests on coal and coke, the fusibility of ash, and methods for determining sulphur according to the way it exists in coal."

Very frequently industrial plants find it difficult to determine what methods should be used in the laboratory in order to get the most significant commercial results. In the field of coal and coke this has not been as widely true as in some other industries, for there have been standard methods for many of the determinations commonly used, fixed by joint action of the American Chemical Society and the American Society for Testing Materials. Nevertheless it is of great interest to have clearly set forth the methods employed in a large group of laboratories such as those of the Steel Corporation. This work will, therefore, be widely appreciated even by those whose needs are generally met by these standard procedures fixed by societies' committee action and in many cases this work will fill the many gaps still remaining in these standard procedures.

The work should be widely useful in coke-oven plants and in gas works. In fact it promises to be quite as valuable to the gas-works chemist as any other volume, for the methods are given in a clean-cut, understandable style that leaves little opportunity for misunderstanding by the analyst. In this respect the work is worthy of particular commendation, so many of the earlier tests have inextricably mixed discussion of theory, statement of laboratory procedure and incidental comment on interpretation of results. The present volume avoids this complication very happily. It is just exactly what it purports to be, a set of fixed and definite instructions for the laboratory man to follow unincumbered by extraneous discussion which more often than not leads to confusion.

In the teaching of chemical engineering, especially for courses in gas and fuel analysis, this work should also be widely useful. Teachers will do well to include in their course of instruction a clear understanding of such methods as are given, for the student upon graduation will be better able to use the results of a laboratory test if he has had clearly brought to his attention the difference in significance between these tried and proved methods, used with success on a large scale, and the heterogeneous mass of test procedures that accumulate in our literature as the "half-baked" product of small laboratories that lack the vision and commercial experience to get the best results.

R. S. McBride.

Synopsis of Recent Chemical & Metallurgical Literature

Citric Acid and Citrate of Lime

The Department of Agriculture in its Circular 232 entitled "By-Products From Citrus Fruits" by E. M. Chace, gives the following recommended methods for making citrate of lime and citric acid. In this circular it is also suggested that those interested may be able to get additional information from the Laboratory of Fruit and Vegetable Chemistry, 148 South Anderson Street, Los Angeles, Calif.

Citrate of Lime

Boil the juice expressed from lemons or limes with large-grained infusorial earth, in the proportion of from 5 to 10 pounds of the earth to 100 gallons of juice. Separate the infusorial earth and coagulated material from the juice by filtration, bring the juice to boiling again, and neutralize it with ordinary lime or very pure ground limestone. Filter the precipitated calcium citrate, and wash it once or twice with boiling water. If citrate of lime is the end product desired, filter it, dry it thoroughly, and pack in waterproof packages.

Citric Acid

If citric acid is the end product desired, thoroughly mix the calcium citrate with water, in the proportion of 1 to 10 parts, and add an equivalent part of sulphuric acid. Separate the calcium sulphate from the dilute citric acid solution by filtration. Evaporate the filtrate in vacuo, and allow it to crystallize. Redissolve the first crystals, which usually are not of commercial grade, filter them through boneblack, and recrystallize. Mother liquors may be returned to be worked over again with a fresh batch of juice, or they can be repurified by recrystallization.

The main problem in the manufacture of citric acid is to secure a satisfactory container for evaporating the dilute citric acid solution. Wood is the most satisfactory material wherever it can be used. Enamel lined vacuum pans or pans constructed of Monel metal are most favored by those who are manufacturing citric acid on a large scale.

Treatment of Rock-Drill Steel

Messrs. Foley, Clayton and Burnholz will present a "Review of Present Status of Drill Steel Breakage and Heat-Treatment" to the American Institute of Mining and Metallurgical Engineers in February. From an inspection of operations at sixty mines in the Western states, it was found that six had once had pyrometers on their heating furnaces, but five had discarded them. The trouble appeared to be due to small furnaces. In order to get out more drill bits, they were either withdrawn before attaining furnace temperature, or the furnace was greatly overheated. In any case, the pyrometer was useless. Sometimes Le Chatelier optical pyrometers were used to sight upon the hot tip as it rested on the edge of the quenching tank. Under these circumstances, the reading may be within 100 deg. of correct. Magnets are extensively used. A badly overheated bit—where the heat creeps back along the shank—will ordinarily be placed under a faucet to cool before quenching the top. The operator evidently knows that steel should not be quenched from too high a temperature, but does not know that an overheated steel is damaged beyond cure by mere heat-treatment.

Furnace atmospheres are always oxidizing; bits are usually quenched cold in water and not drawn. Under such circumstances the first few blows mushroom the soft cutting edge of a decarbonized bit—if the carbon remains, the very brittle edge is spalled against the hard rock. Either of these tools has about the same life—they work continually in a dulled state. There are so few parallels of this practice of using quenched high-carbon steels to resist impact that one can only speculate upon the advantages to be gained by giving the steel a correct microstructure.

In ten of the mines visited the drills were quenched from the hammer. Thus the finishing temperature varied, also the end strokes given by the smith are always quite light. Consequently the drills would be expected to have quite variable but in general quite large grain size. Even when the steel was

reheated for hardening, it was heated not nearly as far back as it was in the forging heat. In quenching, only ½ to 1 in. of the end is immersed in the water; apparently the heat back of the end is relied upon to creep forward and give the necessary draw.

Variable as is this practice, it is constancy itself compared with the heat-treatment of the shank end. The result is a shank having a Brinell hardness anywhere from 250 to 700. That end of the rod should be hard enough to resist mushrooming, and yet not hard enough to chip itself or the hammer piston. Apparently anything from 250 to 700 Brinell satisfies these requirements, because little or no complaint is heard about breakages there.

Lignite Chars

A new member of the fuel family in Germany has been given the name "grudekoks," which means "embers coke." For some time in the United States we have been hunting for a suitable name for the material that remains after subjecting lignite to a heating process in order to drive off most of the moisture and volatile matter. O. P. Hood, chief mechanical engineer for the Bureau of Mines, the author of an article on grudekoks in a recent issue of *Coal Age*, suggests that the term "lignite char" might be taken as the American equivalent of the German product.

In order to improve lignite as a fuel, it is desirable that a large proportion of its water, from 25 to 40 per cent, be driven off in order to concentrate the fuel values sufficient to warrant transportation and to make a stable product. With the water removed, there remain the ash and about equal parts of volatile matter and fixed carbon. The volatile matter may be more valuable as a source of by-products than as a raw fuel, and also if partly removed the resulting char is mechanically stronger. This material, here called lignite char, is very similar in composition to a Pennsylvania semi-anthracite, but physically it is quite different. In expelling the moisture from lignite the material breaks up into very small pieces.

The material is gray black; it is clean to handle and does not deteriorate in heating value on exposure.

In central Germany the brown coal deposits contain a similar material which when subjected to low-temperature distillation yields a high percentage of tar. It appears in the brown coal bed as lighter colored layers, which are mined separately from the darker material. This lighter colored brown coal is subjected to low-temperature distillation in a circular kiln of simple construction, the resulting char being considered as a byproduct, since the main objective in this process is the paraffine contained in the tar.

No attempt has been made in Germany to briquet this material, since the Germans have found an acceptable way of burning the fine char direct without further processing.

Recent Chemical & Metallurgical Patents

American Patents Issued Jan. 16, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem & Met.* readers. They will be studied later by *Chem & Met.'s* staff and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,442,031—Oil Burning Furnace. G C Adams, California.

1,442,089—Chemical Fireproof Paint. Peter Oosterhouse, Richmond, Mich

1,442,301—Electrical Precipitation of Particles From Gases. W A Sheek; assigned to International Precipitation Co. of Los Angeles, Calif

1,442,304—Apparatus for Treating Material. A R Spencer and W J. Plews, Cleveland.

1,442,317—Recovery of Constituents of Waste Liquor. C. T Whittier; assigned to Royal Baking Powder Co

1,442,318—Preparation of Dry Granular Calcium Acid Phosphate. C T Whittier; assigned to Royal Baking Powder Co

1,442,319—Compressor. E Wilson; assigned to Wilson Eng. Co., St Louis.

1,442,330—Cooling and Refrigerating Solution. N A. DuBois, Massachusetts.

1,442,339-340-341—Albuminous Animal Waste, etc. P Hildebrandt Germany, assigned to Chemical Foundation

1,442,386—Glycols. G O Curme and C O Young, Pittsburgh, assigned to Carbon & Carbide Co

1,442,406—Anhydrite as Source of Substance Which Sets in Presence of Water. R Hennicke; assigned to Kalwerke Salzdefurth A G

1,442,413—Refractory. Z Ollson; part assigned to A R Oppenheim.

1,442,414—Bringing Gases Into Contact With Liquids. W. H Rose, Jersey City.

1,442,420—Reactive Composition. L. H. Baekeland, assigned to Baekelite Corporation.

1,442,485—Production of Fine Powders. W. K. Lewis; assigned to Goodyear Tire & Rubber Co., Akron

1,442,491—Method of Chlorination. J. B. Marvin, Saranac Lake, N. Y.

1,442,494—Treatment of Liquid Waste Containing Combined Carbon. J. E Plimstead, assigned to Jessup & Moore Paper Co, Philadelphia.

1,442,520—Purification Isopropyl Ether. H E. Buc; assigned to Standard Development Co of Delaware

1,442,619—Treating Air. A B Lamb, Washington, D C

1,442,631—Products Made With Cellulose Derivatives. L G Richardson, assigned to American Cellulose & Chemical Manufacturing Co, Ltd., New York City

1,442,743—Process for Making Phenyl Glycerine. C J Strosacker, assigned to Dow Chemical Co., Midland, Mich

1,442,773—Crystalline Product. H A Richmond and R MacDonald; assigned to General Abrasive Co, Niagara Falls

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D C

Extraction of Vanadium, Uranium and Radium From Certain Ores—W. F. Bleecker, of Boulder, Colo., has assigned to the Tungsten Products Co., of Boulder, Colo., the following patent. It has to do with the separation of vanadium, radium, uranium and other compounds from various ores. The process consists first of grinding up the ore to about 20 mesh, adding 50 per cent its weight of sodium carbonate and treating the paste so formed in an autoclave at about 90 lb. pressure at 150 deg. C. temperature. The resulting liquors contain the sulphate obtained by the decomposition of barium and radium sulphate, as well as uranium and vanadium compounds. These are at once filtered off and evaporated in some suitable manner. The barium-radium compounds are separated by means of hydrochloric acid. (1,438,357. Dec. 12, 1922.)

Separation of Chloracetones—When isopropyl alcohol is chlorinated at a temperature of about 65 deg. C., the liquid products of the reaction separate into two layers: a heavy lower layer containing chiefly chlorinated acetones and a supernatant layer containing chlorinated acetones in solution. The chlorinated products consist of dichloracetone (asymmetric), trichloracetone (such as 1.3.3), tetrachloracetone (symmetric), and pentachloracetone. It has been found that the components of such a mixture can be separated by extracting the mixture with water, thereby forming an aqueous solution principally of the tri- and tetra-chloracetones, separating the aqueous solution from the residue, "salting out" the chloracetones from the solution, fractionating the separated chloracetones, extracting the residue above mentioned with an aqueous solution of $NaHSO_3$, thereby dissolving the dichloracetone and, finally, decomposing the solution of dichloracetone to remove this compound from the mixture. (1,436,950. Hyym E. Buc, assignor, by mesne assignments, to the Standard Development Co. of New York. Nov. 28, 1922.)

Guanidine Nitrate—Tenney L. Davis, of Sommerville, Mass., has been granted a patent on a process for the preparation of guanidine nitrate from dicyandiamide, which he claims will give practically double the yield of the present process, involving the intermediate formation of guanylurea. Dicyandiamide and ammonium nitrate, in such proportions that there are present two molecules of ammonium nitrate for each molecule of dicyandiamide, are heated to 160 deg. C. in an autoclave for two to six hours. The dicyandiamide first combines with one molecule of ammonium nitrate to form biguanide nitrate, and upon further heating at a proper tem-

perature, the biguanide nitrate combines with the other molecule of ammonium nitrate to form two molecules of guanidine nitrate. (1,440,063. Dec. 26, 1922.)

Perchlorate Explosives — Numerous attempts have been made to produce an explosive more powerful than or equally as powerful as dynamite, yet possessing superior qualities with respect to stability, economy, resistance to freezing or physiological effect—nitroglycerine headache. Among the proposed substitutes for nitroglycerine dynamite may be mentioned the mixtures of chlorates, sodium or potassium, with resins, gums and nitro-aromatic compounds and mixtures of inorganic nitrates with resins or nitro-aromatic compounds. In general, however, the substitutes have not met with favor because of the low initial sensitiveness and of the tendency of the powder to become hard. Russell M. Cook, of Tamaqua, Pa., has patented an explosive which he claims combines the desirable properties of perchlorate explosives and nitroglycerine dynamite, yet eliminates the undesirable properties of both. A number of formulas are given in the patent disclosure. One example consists of 30 per cent ammonium perchlorate, 7 per cent manganese dioxide, 36 per cent sodium nitrate, 24 per cent TNT, 2 per cent nitroglycerine and tetranitro diglycerine, and 1 per cent chalk.

The purpose of the explosive liquid organic nitrate is to raise the propagation sensitiveness of the perchlorate explosives, so that they compare more favorably in this respect with dynamite, and can be successfully used in special cases in which at present only the more sensitive nitroglycerine dynamite can be applied. The patentee claims that the sensitiveness of the explosive compound is not affected by age. Patent 1,440,768, by the same patentee, covers the use of sodium or potassium perchlorate instead of the ammonium salt. (1,440,767. Jan 2, 1923.)

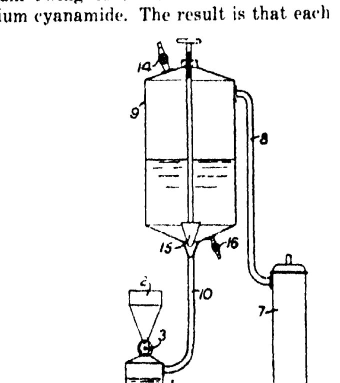
Iodine Compound—Rezso Benko, of Budapest, Hungary, has taken out a patent on a substance which he assumes to be gelatine-hexamethylene-tetramine-di-iodine for which he claims some novel properties. It is said that a solution of the compound is considerably less poisonous than iodine and will, on being introduced into the body by injection, deposit almost its total content of iodine. The substance is made by heating a solution of an albuminoid or a neutralized product of decomposition of an alubuminoid, such as gelatose, with hexamethylene-tetramine-di-iodine, filtering the solution and evaporating to dryness in a vacuum. The compound is said to be readily soluble in water and in glycerine, with a slightly yellow color, forming a yellow precipitate with silver nitrate and giving free iodine with acids. (1,440,813. Jan. 2, 1923.)

Dyeing Cellulose Acetate—The use of trisodium phosphate for the treatment of cellulose acetate artificial silk to render it permeable to dyeing solutions is covered by patent granted to Edouard Paul Sisley of Lyon, France, assigned to Société Chimique des Usines du Rhone of Paris. In an example the artificial silk is slowly agitated for three-quarters of an hour to one hour in a bath containing 25 grams of crystallized dibasic phosphate of sodium and 5 cc. of caustic soda solution 36 deg. Bé. The bath is maintained between 60 and 70 deg. C. during the whole operation. The silk is then thoroughly washed and dried, the loss of weight being 6 per cent. A process can be applied to pure cellulose acetate fabrics or to mixed fabrics, such as cellulose acetate silks and natural silks, or cellulose acetate silk and wool. (1,440,501. Jan. 2, 1923.)

British Patents

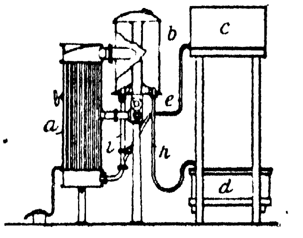
For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England

Cyanamide— In the production of solutions of free cyanamide by gradually adding calcium cyanamide to a circulating body of water or cyanamide solution into which carbon dioxide is admitted, the process is carried out in such a way that the quantity of liquid between the points where the calcium cyanamide and carbon dioxide respectively are supplied is constant and small compared with the total quantity of liquid, notwithstanding the increase in bulk owing to the addition of the calcium cyanamide. The result is that each



addition of calcium cyanamide is only a short time in the liquid before reaching the carbonic acid, and only a small proportion of the liquid is alkaline. Calcium cyanamide is fed from a hopper 2 by a valve 3 into a small tank 1, from which the liquor passes to a pumping device 5 containing a centrifugal wing wheel 11 and mixing vanes 12. Carbonic acid is supplied by a pump 13 and is mixed with the liquid in the apparatus 5. The liquor then passes through a pipe 6 to a cooler 7 if necessary, and thence by a pipe 8 to a large tank 9, which is capable of accommodating the increase in the bulk of the circulating liquor. From the tank 9 the liquor is passed by a valve 15 and pipe 10 to the tank 1. The pipe 8 is preferably tangential to the tank 9 so as to facilitate the escape of gas, which is led off by a pipe 14. The finished solution is withdrawn at 16. (Br. Pat. 186,020. Wargons Aktiebolag and J. H. Lidholm, Wargon, Sweden. Nov. 8, 1922.)

Distillation and Evaporation—In apparatus for evaporating and distilling liquids in which the liquid passes upward through the tubes of a calandria *a* to a vapor-separating chamber *b*, a part of the concentrated liquid flows from the chamber *b* by a pipe *h* to a tank *d*, and the other portion of the concentrated liquid is returned by a pipe *i* to the base of the calandria together with fresh liquid from a tank *c*



and pipe *e*. Part of the vapor evolved in the chamber *b* may be forced by an injector, fan or pump into the space surrounding the tubes of the calandria to serve as heating agent. The apparatus may be used under pressure or vacuum and as an element of a multiple-effect apparatus. In a modified form of apparatus, the end boxes of the calandria are divided by partitions to give the liquid a longer travel, and the fresh liquid is preheated by heat exchange with the concentrated liquor and also with the condensate from the calandria, which may also be used to wash out the tubes of the calandria. The apparatus may be used for the recovery of benzene from oils and greases. (Br. Pat. 185,873. J. L. Ferguson, Glasgow. Nov. 8, 1922.)

Coke—In the production of smokeless fuel and coke, a blend is made of two coals or of coal and coke, semi-coke or ore so that the resinic content of the blend is not less than 5 per cent but preferably not less than 8 per cent of the weight of the blend. This blend is heated to a temperature not exceeding 500 deg. C. or to a temperature of from 50 to 100 deg. C. above the minimum temperature at which the resinic matter is destroyed. To increase the contraction of the blend, the volatiles evolved between 350 and 400 deg. C. should be below 7.5 per cent. Blended coals may be treated as described in specification 175,888—that is, first preheated and then heated to 500 deg. C. and the product subsequently carbonized at 900 to 1,000 deg. C. The products of the process described in specification 164,104 may form part of the blend. (Br. Pat. 186,085. S. R. Illingworth, Brynfedwen, Radyr, Glamorgan. Nov. 15, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Arsenic Report Regarded as Too Optimistic

Consideration of Findings of Department of Agriculture Arouses Feeling That Government's Expert Is Prejudiced—Federal Trade Commission to Investigate

STUDY of the arsenic report submitted to the Senate on Jan. 18 by the Secretary of Agriculture leads many chemical specialists to believe that the findings are more optimistic than the situation warrants. The general reaction, and this is supported by letters reaching members of Congress from persons acquainted with the situation, seems to be that the main object of the report was to depress the price of calcium arsenate, or at least check possible advances. It is pointed out that this would be the natural attitude on the part of B. R. Coad, who undoubtedly is responsible for the principal economic deductions in the report. Mr. Coad is in charge of the laboratory which the Department of Agriculture maintains at Tallulah, La. This laboratory was located in the heart of the cotton belt for the specific purpose of studying methods of boll weevil control. It was there that the adaptability of calcium arsenate to that purpose was demonstrated.

THINK COAD PREJUDICED

After having worked out the most promising method ever devised for boll weevil control, Mr. Coad is certain to be keenly disappointed by the interference with its application by the increase in price and lack of the poison. The belief is expressed that, without intending to do so, he has reported on the situation in a way which, to say the least, would not be an additional reason for a further advance in prices.

It also is declared that Mr. Coad's estimate of the demand up to May 1, 1923, is absurdly low. This is particularly the case, it is said, in estimating the requirements for glass manufacture and for the manufacture of lead arsenate. Issue also is taken with his estimate of 3,500,000 tons as being the annual requirement for calcium arsenate.

Many are of the opinion that the demand for white arsenic will increase much more rapidly than its production and that the shortage a year hence will be much more acute than it is today. It is pointed out that the increase in production in the United States will be slow. The output at the smelters can be calculated very closely. Inquiries into the possibilities of production on the part of the Salt Lake Insecticide Co. developed the fact that its production, which will begin about Feb. 1, will not exceed 15 tons a day for a considerable period and while that output eventually can be increased, there is no immediate prospect for the large production in that quarter which some have predicted.

There has been some suggestion that the flexible tariff be applied to calcium arsenate, which is dutiable at 25 per cent ad valorem. In that connection it is pointed out that the manufacturers will not oppose such action, but that it would have very little practical effect, since it would be unprofitable to pay freight on the lime. Arsenic itself is on the free list. All are agreed, however, that the situation cannot be helped materially by imports. The greatest promise for the future lies in Mexico, where it is believed that additional recoveries of arsenic can be secured.

TRADE COMMISSION WILL INVESTIGATE

Without discussion, the Senate approved a resolution offered by Senator Fletcher of Florida providing that the Federal Trade Commission "investigate and report the facts relating to any alleged violations of the anti-trust acts by the manufacturers of, or dealers in, calcium arsenate." Such of the government's specialists who have looked into the calcium arsenate situation, however, are convinced that it is the shortage rather than speculation or combination which is responsible for the enhancement of the price.

On the heels of this resolution, Senator Harris of Georgia introduced a bill to amend the 1922 tariff act so as to place calcium arsenate on the free list. The commodity is not mentioned specifically in the tariff act, but the Customs Division of the Tariff Commission agree that calcium arsenate is dutiable as a chemical salt at 25 per cent ad valorem under paragraph 5 of the act.

Because it is the principal ingredient of calcium arsenate, white arsenic was put on the free list, Senator Harris said, and the evident intention of Congress was that calcium arsenate should be free.

Dr. Miller Reese Hutchison, managing director of the national campaign for boll weevil control of the American Cotton Association, in a letter to the New York *Journal of Commerce* denies that he intends to engage in the manufacture of calcium arsenate. He claims that the efforts of the association are directed toward developing, first, an ample supply of calcium arsenate at a reasonable price; second, an organization to insure that this substance is available to the farmer and to conduct research looking toward improved methods of application and improved insecticides.

Mention is made of the sources from which Dr. Hutchison previously intimated that calcium arsenate could be obtained as follows:

"The publicity that has been laudably given this campaign for the control of the boll weevil has brought out some very interesting and heretofore unknown and unconsidered resources. Among them are several processes for the manufacture of calcium arsenate, which do not require the white arsenic of commerce. It is from such sources that the tonnage, in excess of that pronounced available by governmental and other agencies, will be secured."

COUNTERVAILING DUTIES ANNOUNCED

Instructions for the assessment of countervailing duties on imports of calcium acetate were issued to collectors of customs on Jan. 23 by the Treasury.

The Treasury listed the duties imposed on calcium acetate in various countries as follows: Belgium, free; Germany, 1 gold mark per 100 kilos; Hong Kong, free; Japan, 0.41 gold yen per 100 kin; Mexico, 0.07 gold peso per kilo, plus additional surtaxes amounting to 12 per cent of the duty; Netherlands, free; Norway, free; Panama, 15 per cent ad valorem; Sweden, acetate of lime, raw or purified, 0.03 gold crown per kilo; United Kingdom, 11⅓ per cent ad valorem.

5,000 Research Problems Concern Agriculture

More than 5,000 research projects are under way at the agricultural experiment stations throughout the country, it is announced by the Department of Agriculture. They include many problems involved in fertilizer requirements, the study of soils, the control of pests and other work which requires the application of chemistry.

Meat Packers Perfect Development Plans

Establishment of a national institution combining broad educational, research and trade association facilities is assured for the meat packing business, according to an announcement by the Institute of American Meat Packers in the name of Thomas E. Wilson, of Chicago, chairman of the organization's "development plan commission." Mr. Wilson's statement, in part, follows:

Sufficient funds now have been subscribed by the meat packers of America to begin actual development of the Institute plan. This plan provides for the ultimate development at Chicago of a comb ned educational institution, research institute, trade association and industrial museum.

Approximately $150,000 has now been subscribed by the meat packers of the United States to cover the necessary surveys and initial developments during a 3-year period. These special subscriptions are entirely in addition to the regular revenues received by the Institute for carrying on its present educational and trade activities.

Systematic instruction will be provided for men already engaged in the industry as well as for men intending to enter the industry. The packers of the United States have authorized the creation forthwith of a bureau of industrial education and the engagement of an educator of distinct on in this field to direct it. A thorough-going survey of the educational possibilities and difficulties of the American meat-packing industry will be made, and future provision for instruction—respecting both methods and kinds—will be shaped largely by the results of the survey.

Similarly a bureau of scientific research will be established at once and a competent director of standing engaged. A survey of the scientific problem of the industry will be made. It is believed that much duplication of research can be eliminated and that many research projects can be undertaken which would be too costly or of too general benefit to justify their prosecution by an individual company. It is believed that co-operative research will effect many savings and solve many scientific problems of the industry on which information is now incomplete. Nor is it believed that such a plan will interfere with the research work done by individual companies in their respective plants and laboratories.

In the same way provision has been made for creating without delay a bureau of packinghouse practice and research. This bureau, directed by an expert on packinghouse operations, will function in furtherance of purposes similar to those just mentioned.

Development of the plan will mean the creation of an institution which combines with the research and technical educational facilities of Continental industrial institutes the trade activities and exposition features of American business associations.

Engineers Urge Study of Gold and Silver Situation

That more than mining engineers are interested in legislation proposing to study the situation which will overtake silver mining when the Pittman act expires is indicated by a communication received by the Senate Committee on Mines and Mining from the Federated American Engineering Societies. The Committee on Mines and Mining is considering legislation proposing to set up a Congressional committee, along the lines of the Committee on Agricultural Inquiry, to study the silver and possibly the gold situation. The letter from the Federated Societies reads as follows:

"Engineers in all branches of the profession are much interested in the welfare of the metal-mining industry and in the activities which depend directly and indirectly upon that industry. For that reason, the Federated American Engineering Societies wishes to urge on your committee the advisability of a careful study of the problems which this nation is facing as a result of the handicaps which surround the production of gold and which soon will envelop the production of silver.

"Since these matters concern many more activities than those immediately involved, the engineers of the country are much interested in seeing the entire subject illuminated as much as possible.

"This organization, therefore, urges that your committee report favorably some such legislation as is now before you and asks that no effort be spared to secure the enactment of the bill at this session of Congress."

European Conditions to Be Discussed at Joint Meeting

A joint meeting of the four chemical societies having sections in New York City will be held in Rumford Hall, Friday, Feb. 9, under the auspices of the American Electrochemical Society. W. S. Landis, chief technologist of the American Cyanamid Co., will be the principal speaker, his subject being "European Conditions," a discussion of impressions received on his recent trip abroad.

J. S. Negru, managing editor of *Chem. & Met.*, will lead the discussion.

C.W.S. Corrosion Report Delayed

Recent announcement in *Chem. & Met.* of the report prepared by the Chemical Warfare Service on "Corrosion of Metals and Materials by Acids and Alkalis" has resulted in a large number of requests for this report to the Washington office of C.W.S. That Service regrets that there has been a temporary delay in supply of this document and that it is impossible at once to comply with the requests which have been made. However, it is hoped that an ample supply may be prepared and made available for distribution in the near future, at which time those who have requested it will be supplied.

Mining Engineers to Meet in February

Three Days Devoted to Technical Sessions at 127th Meeting

The 127th meeting of the American Institute of Mining and Metallurgical Engineers will occur at the Engineering Societies Building, New York, Feb. 19 to 22, 1923. A summary of activities interesting to metallurgists is shown below:

MONDAY, FEB. 19

2 p.m.—Session on Breakage and Heat-Treatment of Drill Steel.

2 p.m.—Session on metallurgy; considering heap leaching, zinc electrolytes, pyritic smelting, and gold recovery.

4 p.m.—Second annual lecture of Institute of Metals; "Solid Solutions," by Walter Rosenhain.

8 p.m.—Smoker.

TUESDAY, FEB. 20

2 p.m. Institute of Metals.

"Nature of Solid Solutions," by Edgar C. Bain.

"Cored Crystals and Metallic Compounds," by Edgar C. Bain.

"Some Observations on Occurrence of Iron and Steel in Aluminum," by E. H. Dix, Jr.

"Polishing Aluminum and Its Alloys for Metallographic Study," by E. H. Dix, Jr.

"Density and Expansivity of Aluminum-Silicon Alloys From 20 to 1,000 Deg. C.," by J. S. D. Edwards.

"Practical Spectrographic Analysis," by W. F. Meggers, C. C. Kiess, F. J. Stimson.

8 p.m.—Motion pictures and dance.

WEDNESDAY, FEB. 21

9.30 a.m.—Session on Iron and Steel.

"Continued Discussion on Physics of Steel," by W. R. Webster.

"Specifications for Foundry Pig Iron," by Richard Moldenke.

"Influence of Temperature, Time and Rate of Cooling on Physical Properties of Carbon Steels," by H. M. Howe, F. B. Foley and J. H. Winlock.

2 p.m.—Discussion on Technical Education.

2 p.m.—Institute of Metals Division.

"Occurrence, Chemistry and Uses of Selenium and Tellurium," by Victor Lenher.

"Determination of Gases in Metals," by Harold L. Simons.

"Study of Bearing Metals," by C. H. Bierbaum. (Illustrated.)

"Tests on High-Tin Bearing Metals," by P. W. Priestley.

"Bright Annealing of Copper Wire," by P. E. Demmler.

"Thermal Conductivity of Some Industrial Alloys," by H. M. Williams.

2 p.m.—Iron and Steel Session.

"Deterioration of Malleable in the Hot Dip Galvanizing Process," by W. R. Bean.

"Heating and Cooling Curves of Large Ingots," by F. E. Bash.

"Possibilities in Application of Colloid Chemistry to Production of Clean Steel," by H. W. Gillett.

"Low-Temperature Brittleness in Silicon Steels," by Norman B. Pilling.

6:45 p.m.—Annual dinner.

THURSDAY, FEB. 22

Excursion to American Brass Co.'s plants at Ansonia, Conn.

Long-Expected Exposition Report Appears

Salesmen's Association Suggests Plans to Improve Annual Chemical Show Which It Is Hoped Will Appease Everybody

FOR THE PAST three months a committee of the Salesmen's Association of the American Chemical Industry has been considering possibilities and plans for a new departure in the conduct of the Chemical Exposition. During and immediately after the last exposition—which was the eighth annual affair of the kind—considerable sentiment was voiced in disapproval of the present management. It was noised about that an opportunity to be of genuine service to the industry was being sacrificed to commercialism and that the price demanded of exhibitors was greatly in excess of the benefits they derived from their displays.

At the height of the dissatisfaction, the plan of holding a co-operative exposition designed to interest and attract representatives of the chemical industry rather than manufacturers of equipment was proposed by Adriaan Nagelvoort, who purposed to conduct such an effort in 1923. This program enlisted the interest of many in the industry, while others felt that the management of such a spectacle should be left to a private company which had the necessary experience and facilities.

The Salesmen's Association, in an attempt to weigh the merits of the opposing plans and decide on a course which would be of maximum benefit to the industry, appointed the committee whose report has just been completed. Briefly, the Salesmen express the belief that the exposition should be continued, presumably by the old management, with special and intensive efforts to improve its quality and to work with representatives of the industry for the ultimate good of the latter.

Extracts From Report

Extracts from the report follow:

This report presents a plan for getting more tangible results. It records also definite accomplishments towards putting this plan into effect. The committee agrees that in its fundamentals this plan is sound and practical; its details are purposely left flexible.

Elements Necessary to Success

To make the exposition a truly national chemical meeting and market place, a congress of scientific trade and consuming associations must be held and so guarantee the attendance of many desirable visitors.

To carry on the logical purpose of educational work to the public, students and chemical consumers a constructive, consecutive program must be worked out.

To accomplish this end the management of future expositions must work closely in co-operation with the industry. Policy must be guided and plans controlled by what the industry, as a whole, believes is for the common good, and this control is just and proper because the support of the industry is virtually a franchise creating a monopoly in chemical shows. Even a private corporation conducting the exposition must fairly share the profits with the industry.

The attendance problem can best be solved by holding a congress of chemical and consuming industries. A common program, to avoid conflicts, can provide common entertainment features with one gigantic chemical industry banquet. The meetings of the participating associations would have to be a new and special type, devoid of routine business and paper reading, designed as get-together gatherings to discuss one or two big fundamental problems of broad interest.

Exposition Co. Contributes $5,000

At the instance of your committee the directors of the International Exposition Co. voted Jan. 15 to turn over to the advisory committee 5 per cent of the gross receipts of the coming Ninth Chemical Exposition. This sum, which Mr. Payne estimates at not less than $5,000, is to be spent by the advisory committee for the common good of the industry, on educational and other work in connection with the exposition.

The question of better representation for the executive and sales departments of the industry upon the exposition's advisory committee has been taken up with their chairman, Dr. Charles H. Herty.

Dr. Herty has invited your committee to meet with the advisory committee in order to confer on the new personnel of the advisory committee and to lay before them suggestions and offers of co-operation which we have received from many associations, firms, colleges and individuals in response to our questionnaire which was the subject of our preliminary report.

Naglevoort Withdraws 1923 Plans

After further consultation with your committee, Mr. Nagelvoort has agreed to withdraw definitely his tentative plans for a co-operative show in 1923. He takes the liberal view that the measure of co-operation with the industry which the International Exposition Co. offer should be tried fairly, and for the common good desires not to put the least obstacle in the way of hearty, united co-operation. We commend his attitude and indorse the sentiments he expresses.

While this report has been in preparation most of the feeling on the subject has died out and the report is not likely to arouse any great enthusiasm. Cooler heads in the industry look for a Chemical Exposition in 1923 much like its predecessors, although it seems probable that the late controversies will serve as a word to the wise.

Program of Joint Safety Engineering Meeting Announced

The need for and use of national codes relating to safety in the operation and maintenance of elevators and in building construction are the two principal subjects on the program of the joint meeting of the Engineering Section of the National Safety Council and the American Society of Safety Engineers called for Friday, Feb. 16, in the Engineering Societies Building, New York City.

The different phases of elevator safety will be discussed by D. L. Lindquist, chief engineer, Otis Elevator Co.; M. H. Christopherson, deputy commissioner, New York State Department of Labor; C. B. Connelley, commissioner, Pennsylvania Department of Labor and Industry; C. W. Old, vice-president, Shur-Loc Elevator Safety Co., Inc., New York; C. W. Bassett, associate engineer, Elevator Supplies Co., Hoboken, N. J.

George T. Fonda, chairman of the Engineering Section of the National Safety Council and a member of the firm of Fonda-Tolsted, Inc., Washington, D. C., will preside at the afternoon meeting on the proposed national building code. Those who will lead the discussion are: Ira H. Wilson, chairman, United States Department of Commerce; Sidney J. Williams, chief engineer, National Safety Council; and a representative of the New York State Industrial Commission. The motion picture "Paying the Price," depicting the dangers in neglecting minor injuries, will be presented by A. D. Risteen, director of technical research, Travelers Insurance Company.

The public safety problem of adequate control will be considered at an evening session. Richard E. Enright, New York City Police Commissioner; H. K. Maples, field secretary, American Automobile Association; David Van Schaack, Aetna Life Insurance Co., and others will discuss the subject.

British Interests Investigate Canada as Site for Paper Mill

Another striking evidence of the intention of prominent British firms to locate branches in the overseas dominions came to light recently with the arrival of the Empress of France at a Canadian eastern port, with a party of civil engineers representing the famous shipbuilding firm of Armstrong-Whitworth of Newcastle-on-Tyne. The immediate object of the party is to investigate the prospects of locating a pulp and paper plant in Newfoundland, presumably at Port aux Basques. In addition to this, however, the information was given out that coincidental with this development in Newfoundland it is the intention of the Armstrong-Whitworth interests to investigate similar prospects in the Province of Quebec, to which end arrangements have already been made for the reorganization of the company's Canadian headquarters at Montreal.

Dye Makers and Importers Reach Impasse

Difficulty Lies in Defining Competitive Products Entitled to Higher Duties Under American Valuation

Committees representing dye manufacturers, importers, manufacturing importers and consumers met at the U. S. Appraiser's Stores in New York City, Jan. 25, for the purpose of assisting in drafting rules and regulations to govern the appraisement of imported dyes. Special Deputy Appraiser John Donnelly, who presided, declared that the primary purpose of the meeting was to consider tentative lists of non-competitive dyes which under the new tariff are entitled to entry at comparatively low rates of duty. Thomas L. Doherty, customs adviser of the Synthetic Organic Chemical Manufacturers Association, reported that the dye makers were not willing to prepare lists of competitive or non-competitive colors until the customs authorities indicated how they were going to interpret that part of the tariff law which provides that "any coal-tar product shall be considered similar to or competitive with any imported coal-tar product which accomplishes results substantially equal to those accomplished by the domestic product when used in substantially the same manner."

Appraiser Donnelly said that the American manufacturers had been given the same opportunity as the importers to prepare their lists and in view of the fact that they had thus failed to coöperate with him, he declared the meeting adjourned. The rules and regulations, he said, would be worked out by the customs authorities in consultation, with the importers, consumers and manufacturing importers.

Dr. Herty's Views

In explaining to *Chem. & Met.'s* representative the stand which the manufacturer's had taken, Dr. Charles H. Herty, president of the producers' association, pointed out the difficulties involved in defining the term "competitive," particularly from the manufacturer's viewpoint. "The importer," he said, "has nothing to lose and everything to gain in preparing his lists. If he includes a domestic made product among his non-competitive dyes, the only one to suffer would be the American maker. On the other hand, if the manufacturers put a color on the non-competitive list and later found that a domestic producer had already spent a large sum of money in developing the product, his entire investment might be wiped out by a single large importation."

Whether two dyes are competitive or not should be decided on the basis of degrees or respects in which the products are similar, according to Dr. Herty. Thus if the appraiser were to agree that dyes are competitive when they are similar in respect to color, or fastness, or chemical composition, or method of application, etc., it would be comparatively easy to prepare such a list.

A.C.S. President Will Visit Thirty-Two Sections

Announcement is made of the itinerary of E. C. Franklin, newly elected president of the American Chemical Society, in his speaking trip over the country. Prof. Franklin will speak in the following cities on the dates noted:

Los Angeles, Calif.,	March 16
Houston, Texas,	March 19
New Orleans, La.,	March 21
Nashville, Tenn.,	March 22
St. Louis, Mo.,	March 24
Pittsburgh, Pa.,	March 26
Morgantown, W. Va.,	March 27
Maryland,	March 29
Boston, Mass.,	April 9
New York, N. Y.,	April 11
Philadelphia, Pa.,	April 12
New Jersey,	April 13
Lehigh Valley,	April 14
Rochester, N. Y.,	April 16
Syracuse, N. Y.,	April 17
Cornell, N. Y.	April 18-19
Buffalo, N. Y.,	April 21
Akron, Ohio	April 23
Cleveland, Ohio,	April 24
Detroit, Mich.,	April 25
Ann Arbor, Mich.,	April 26
Midland, Mich.,	April 27
East Lansing, Mich.,	April 30
Notre Dame, Ind.,	May 1
Lafayette, Ind.,	May 2
Urbana, Ill.,	May 4
Evanston, Ill.,	May 7
Milwaukee, Wis.,	May 8
Madison, Wis.,	May 9
Iowa City, Iowa,	May 11
Ames, Iowa,	May 14
Minnesota, Minneapolis and St. Paul,	May 16-17

Professor Franklin's talk before most of the sections on this occasion will be "The Ammonia System of Compounds—Experimentally Illustrated."

Conduct Research on Kerosene Fuels

The research laboratories of Carnegie Institute of Technology, Pittsburgh, have undertaken experiments to determine the relative efficiency of kerosenes and oxidized kerosenes as fuels. In accordance with the policy of the Institute to link up its educational facilities with modern industry, the department of chemical engineering has been conducting a series of tests to determine the relative merits of various oils as usable fuels. The completion of this important work should go a long way toward solving the problem of oil conservation, by the possible development of a new fuel.

According to a report by J. H. James, head of the department conducting the experiments, oxidized kerosenes cause less "knocking" than straight kerosene when used in a kerosene engine. The tests also showed that oxidized kerosenes have approximately the same power development as ordinary kerosene, in spite of the fact that their thermal value is one-eighth less. Dr. James attributes the efficiency of the oxidized kerosenes to the better "clean up" in the combustion of these partially oxidized fuels.

The success of the experimental work at Carnegie at this stage gives promise that oxidized kerosene, which is manufactured by catalytic oxidation from low-grade petroleum, may become a useful fuel in the future. Its properties may cause it to be used industrially in kerosene engines or blended with gasoline for use in gasoline engines.

Midgley Awarded 1923 Nichols Medal

Work on Gaseous Detonation and Anti-Knock Compounds Wins Award of American Chemical Society

The Nichols medal, awarded each year by the American Chemical Society to the author of the most exceptionally meritorious paper published during the year in the society's journals, has been awarded to Thomas Midgley, Jr., of the General Motors Corporation. Mr. Midgley's remarkable work in the development of anti-knock compounds for internal combustion engines is too well known to require elaboration here. The medal will be presented on March 9 by C. A. Browne, chairman of the New York Section, as Dr. Nichols, who was asked to make the presentation, will be in California at that time.

Wilder D. Bancroft, of Cornell, will also speak at this meeting, on Midgley and various aspects of his work. Mr. Midgley will review the effects of anti-knock compounds on gaseous detonation and then emphasize the fact that to all intents and purposes the anti-knock property is a new property of matter which can be truly ascribed to one element in the compound and that the groups bonded to this atom modify its behavior. His remarks will be illustrated with slides and be accompanied by experiments.

Industrial Alcohol Situation Improved, Says Doran

The industrial alcohol situation is in far better condition as regards denaturing of the product and its use illegally as liquor than it was a year ago, according to J. M. Doran, head of the industrial alcohol division of the prohibition unit, while reports to the division indicate that the legitimate industry is enjoying a period of prosperity with plants running to capacity.

Newspaper reports which were current shortly after the first of the year to the effect that much of the illicit liquor supply was due to industrial alcohol being misused were grossly exaggerated, according to Dr. Doran, who declared that the basis probably was a series of arrests and several suspensions of permits to consumers. These developments were the result of long work by the prohibition unit, Dr. Doran declared, and not connected with an influx of liquor during the holidays.

Conditions Under Control

The unit has been successful in cleaning out a number of fraudulent permitees who were securing industrial alcohol on the plea of need for manufacturing purposes but in reality for illegal use, Dr. Doran asserted, and has had close co-operation with industrial alcohol producers in this effort.

"From the prohibition standpoint, conditions a year ago were alarming but are now well under control," said Dr. Doran. "Progress has been surprisingly satisfactory and I never felt better about the situation than now."

Ceramic Society to Hold Silver Jubilee in Pittsburgh

Plans for General Session, Divisional Meetings and Plant Visits Reflect Endeavor to Surpass All Previous Efforts

Since the publication in our last issue of the program of the refractories division for the American Ceramic Society meeting at Pittsburgh, Feb. 12 to 16, announcement has been made of plans for the other divisional meetings, the general session and plant visits. The meeting will open with a general business and technical session in the ballroom of the William Penn Hotel, Monday, Feb. 12. That evening will be devoted to a banquet in honor of charter members. Industrial divisions will meet Tuesday and Wednesday at the Fort Pitt Hotel. Plant visits will be made Thursday and Friday. During the entire week an exhibition of ceramic products will be held at the Fort Pitt Hotel.

Although the program is still incomplete, the following excerpts will indicate the effort which is being exerted to make this meeting the best ever held

GENERAL BUSINESS AND TECHNICAL SESSION

Presidential address, Frank H Riddle

Research—Its Relation to a Manufacturing Executive, B. E. Sallsbury.

Theory and Practice in Refractories, J D Ramsey

The Art of Manufacture and the Manufacture of Art, Charles F Binns

The Industrial Benefits From Co-operation in Research Through the Enamel Division, DeWitt F Riess.

International Critical Tables of Numerical Data of Physics, Chemistry and Technology, E. W. Washburn

A Simple Method of Measuring Color, A E. O. Munsell

ENAMEL DIVISION

A Cause of the "Specking" of Ground Coat Enamels, R. R. Danielson and T. D Hartshorn.

Sand Blasting of Cast Iron for Enameling Purposes, F. G. Jaeger

Relative Action of Acids on Enamels, E P. Poste

The Intermittent Type of Gas-Fired Enameling Furnaces, H. H. Clark.

A Study of Some Substitutes for Tin Oxide and Their Effect on Opacity, R R Danielson and M. K. Frehafer.

Zirconia in Enamels, W. F. Wenning.

Some Relations Between the "Fit" and the Mechanical and Chemical Properties of Enameled Ware, R. R. Danielson and B T Sweely.

The Use of Bentonite for Suspending Enamels, M. E. Manson.

There will also be discussions on fuels and furnaces for enameling, use of silicon carbide refractories for enameling furnace muffles, transparent enamels, single coat gray enameled ware

HEAVY CLAY PRODUCTS DIVISION

Experiences With Dutch Kilns, Roy A Horning.

Construction Features of Importance to Clay Plants, T W. Garve.

Wastes That Should Be Eliminated in Heavy Clay Products Manufacturing, M. W Blair

A Recent Installation of a Harrop Car Tunnel Kiln, Frank M. Hartford

Automatic Stoker for Firing Heavy Clay Products Kilns, John Martin

Some Calculations Involved in the Drying of Clay Wares, Hewitt Wilson.

GLASS DIVISION

Better Gas—Better Combustion—Better Begin, W. B. Chapman

The Resistance of Soda Lime Glass to Water, L. A. Palmer.

A Study of the Tendency of Glass to Take Up Moisture, K. L. Ford.

The Advisability of Pure Research on Glass in American Universities, Alexander Silverman.

Res'stance of Soda Lime Glass to Water, A E. Williams.

Cold Clean Artificial Gas and a Discussion of the General Properties of Gaseous Fuels, A. E. Blake.

Furnaces for the Melting of Glass in the Laboratory, A. E. Badger and C. D. Spencer.

A Skiagraphic Study of Fabricated Glass Articles, C. D. Spencer and A. E Badger.

Glass Wool Heat Insulation in Europe, Arthur D. Saborsky.

A Study of the Origin and Cause of Stones in Glass, Herbert E Insley

Results of Mechanical Tests on Window Plate and Rolled Sheet Glass, Arthur E. Williams.

Tensile Strength of Glass, J. T. Littleton

TERRA COTTA DIVISION

Mold Shop Practices, T. A. Klinefelter.

Monograph of Ceramic Literature on Terra Cotta Subjects, Hewitt Wilson.

A Study of a Group of Slip Clays of the United States, Paul E Cox and Mark A Taylor.

Various Materials Used for Patching Terra Cotta, C. W. Hill.

Tests Used for Barytes in Terra Cotta Work, W. L Howatt

Scheduling in Terra Cotta Plant, Pensyl Mawby.

A Group of Slip Clays of the United States, Paul E Cox and Mark A Taylor.

Magnesium Chloride Cements, C R. Hill, Dow Chemical Co

WHITE WARES DIVISION

A Better Design for a Jug Mold Clinch, Paul E. Cox

A Study of Plasticity with Practical Potters' Methods, Paul E. Cox and D. A Moulton

Recent Developments in Control and Operation of Modern Kilns, T A. Jeffrey, L E Jeffrey and T. R. Harrison.

Further Studies of Porcelain Glazes Maturing at High Temperatures, Robert Twells, Jr.

Preliminary Experiments in Use of American Ball Clays in General Ware Bodies, F K. Pence

Heat Distribution of the Updraft Kiln, Albert V. Bleininger.

Colloquium on Feldspar, led by Edward Schramm

Colloquium on Saggers, led by Walter A. Hull

ART DIVISION

Papers on subjects outlined as chapters of a book on modern pottery practice will form a large part of the Art Division program. In addition, however there will be numerous papers on related topics

PLANT VISITS

Plants to be visited have been divided into seven groups, members having a choice of four trips (1 to 4 below) on Thursday, Feb. 15, and three trips on Friday, Feb. 16.

Trip 1—Fallston Fire Clay Co., Fallston, Pa.; H. C. Fry Glass Co., Beaver Falls Art Tile Co., Mayer China Co., all at Beaver Falls, Pa.

Trip 2—American Window Glass Co., Arnold; Allegheny Plate Glass Co., Glassmere; Heidenkamp Plate Glass Co., Springdale.

Trip 3—Standard Sanitary Mfg. Co., Pittsburgh Clay Pot Co., U. S. Glass Co., Willets Co., Woods-Lloyd Co., Mellon Institute.

Trip 4—Clairton plant, Carnegie Steel Co.; Donora plant and zinc works of American Steel & Wire Co.

Trip 5—East Liverpool district. Homer Laughlin China Co., Golding & Son, plant 1; Hall China Co., R. Thomas & Sons Co.

Trip 6—National Works, National Tube Co., McKeesport; Harbison-Walker Refractories Co., Hays; by-product ovens, Jones & Laughlin Steel Co., Hazelwood.

Trip 7—Westinghouse Electric & Mfg. Co., Universal Portland Cement Co., Universal, or High Voltage Insulator Co., Derry.

Personal

C. F. BLUE, president and director of the Carbon Steel Co., Pittsburgh, Pa., has resigned.

C. D. GARRETSON, general manager and director of the Electric Hose & Rubber Co., Wilmington, Del., has been elected president of the company, succeeding GEORGE S. CAPELLE, who becomes chairman of the board of directors. Mr. Garretson has been connected with the company for 19 years.

R. S. GOSROW of Chicago has been engaged as electrometallurgist for the Manitoba Power Co., Ltd., and the Winnipeg Electric Railway Co., Winnipeg, Man.

BENJAMIN G. LAMME, chief engineer of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., was the recipient of the Joseph Sullivant medal from the Ohio State University, Jan. 12, his alma mater, which he received for notable engineering achievements.

A. M. MADDOCK, an official of Thomas Maddock's Sons Co., Trenton, N. J., manufacturer of sanitary ware, gave an interesting illustrated address on the subject of "Early Pottery and Its Development" before the Men's Association of the First Presbyterian Church, Trenton, Jan. 15.

CHARLES PIEZ, president of the Link-Belt Co., Chicago, addressed the annual meeting of the Engineers' Society of Western Pennsylvania, Pittsburgh, Jan. 22, on "Some Problems of the Day."

C. J. RAMSBURG, vice-president of the Koppers Co., Pittsburgh, addressed the Cleveland Section of the American Chemical Society, Jan. 26, on "Coke."

Dr. OWEN L. SHINN, professor of applied chemistry, University of Pennsylvania, will supervise a course of ten lectures on chemistry for the instruction of salesmen, to be given under the direction of the Chemical Club of Philadelphia, Pa.

L. J. TROESTEL, a member of the Bureau of Chemistry, dust explosion staff, has resigned to accept the position of chief chemist of the American Refractories Co. at the Joliet, Ill., plant. Mr. Troestel leaves Washington about the middle of February to assume his new work in Joliet.

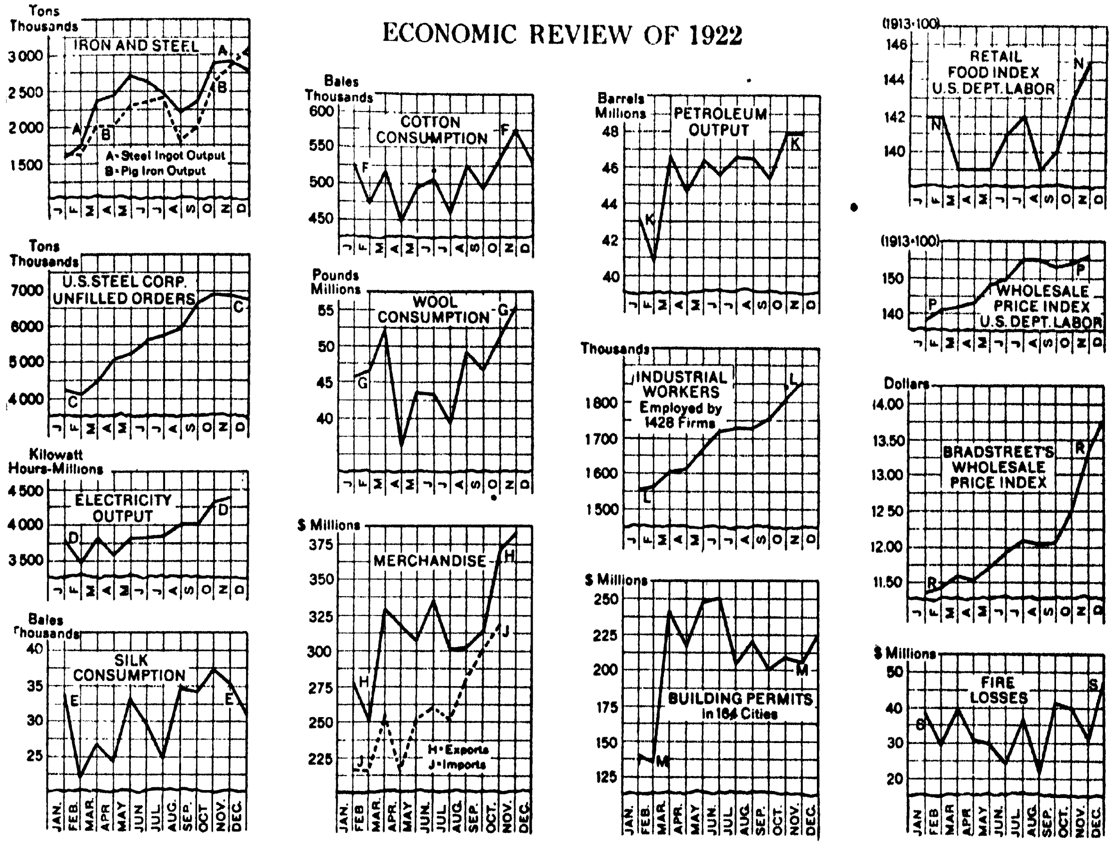
R. C. WELLS spoke before the Chemical Society of Washington on Jan. 11, presenting his address as retiring president, on the subject, "Chemistry of the Sea."

The American Chemical Society, Louisville Section, has elected the following officers: C. E. BALES, chemist of Louisville Fire Brick Works, president; T. J. BOSMAN, of the Federal Chemical Co., vice-president; C. E. GEIGER, of the Louisville Testing Laboratory, secretary-treasurer, and A. W. HOMBERGER, of the University of Louisville, councilor.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers



THE TREND OF PRODUCTION AND CONSUMPTION DURING 1922 *Copyrighted by Irving Bank, New York*

Economic Review of 1922

Summary of Production, Consumption and Prices in the Country's Basic Industries

STATISTICAL evidence is now available definitely to confirm the earlier predictions that 1922 was a year of business expansion. Practically all of the great basic industries showed astonishing improvement during the 12 months ended Dec. 31, 1922. Not only has the volume of output measurably increased, but sales and prices have bettered considerably. Of the sixteen economic factors which form the basis of a business review of 1922, published in the January bulletin of the Irving Bank (see accompanying tables and charts) fifteen showed improvement in December (or last available month), as compared with the beginning of the year. Silk consumption alone was less in December than in January. The improvement ranged between 0.19 per cent in the case of cotton consumption and 87.5 in the output of pig iron.

Action and Reaction in Business

Readjustments Will Continue Until Overexpansion Period Is Balanced —Babson Predicts Possibilities of Early Reaction

According to the cyclic theory of business, action and reaction must be approximately equal—in other words, depression in business must be followed by compensating activity, and *vice versa*. With this theory in mind, it is of interest to consider the question which is so often heard of late: Are we approaching a period of inflation? It would appear the present period of readjustment must be continued until it has compensated for the preceding period of overexpansion. Boom times will not come again until the reaction from the orgy of 1920 is completed.

In forecasting the trend in the commodity situation during 1923, the statistical organization headed by Roger Babson has recently stated that there are possibilities, at least, for an early reaction and a temporary setback in present activity. The statement is as follows:

"The main points in the commodity situation for 1923 are (1) The upward swing will lose momentum, reaching a peak in early 1923; (2) There is a strong possibility of a reaction before

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	175.15
Last week	174.21
January, 1922	144
January, 1921	181
January, 1920	242
April, 1918 (high)	•286
April, 1921 (low)	140

As cottonseed oil continued to rise in price it has favorably affected the index number, which showed a gain during the week of practically one point. The strength shown by caustic potash and the carbonate was sufficient to offset the effects of lower prices for caustic soda and acetic acid.

TABLE I—STATISTICS OF PRODUCTION, CONSUMPTION AND PRICES IN BASIC INDUSTRIES

	Steel Ingots, Output (Tons)	Pig Iron Output (Tons)	Unfilled Orders U. S. Steel End of Month (Tons)	Electricity Output Kw Hr. (Thousands)	Silk Consumption (Bales)	Cotton Consumption (Bales)	Wool Consumption (Thousands of Lbs.)	Merchandise Exports (Thousands of Dollars)
Jan.	1,593,482	1,644,951	4,241,678	3,805,748	33,842	526,552	45,711	$278,848
Feb.	1,745,022	1,629,991	4,141,069	3,467,846	22,107	473,073	46,492	250,620
Mar.	2,370,751	2,035,920	4,494,148	3,820,812	26,651	518,450	52,361	330,327
Apr	2,444,513	2,072,114	5,096,917	3,596,520	24,247	446,843	36,048	318,462
May	2,711,141	2,306,679	5,254,228	3,823,591	33,284	495,674	43,602	307,569
June	2,634,477	2,361,028	5,635,531	3,835,430	29,529	507,869	43,519	335,117
July	2,487,104	2,405,365	5,776,161	3,871,324	24 996	458,875	39,332	301,250
Aug.	2,214,582	1,816,170	5,950,105	4,074,908	34,772	527,404	49,128	301,805
Sept	2,373,779	2,033,720	6,691,607	4,049,204	34,212	495,344	46,777	313,093
Oct.	2,872,415	2,637,844	6,902 287	4,329,906	37,471	533,950	51,176	370,720
Nov	2,889,297	2,849,703	6,840,242	4,398,595	35,467	577,561	55,362	383,000
Dec	2,779,890	3,086,298	6,745 703		31 042	527,945		

	Merchandise Imports (Thousands of Dollars)	Petroleum Output (Thousands of Bbl)	[illegible]	Building Permits (164 Cities)	U. S. Dept. of Labor Retail Food Price Index	U. S. Dept. of Labor Wholesale Price Index	Bradstreet's Wholesale Price Index First of Month	Fire Losses (Thousands of Dollars)
Jan.	$217,185	43,141	1,556,507	$140,517,763	142	138	$11.3725	$38,663
Feb	215,743	40,814	1,565,401	135,452,009	142	141	11 4190	29,304
Mar	256,178	46,634	1,604,959	241,460,369	139	142	11 6001	39,911
Apr	217,023	44,635	1,616,834	217,171,601	139	143	11 5317	31,010
May.	252,817	46,456	1 668 988	247,722,281	139	148	11 7044	29,869
June	260,461	45,559	1,722,371	250,172 411	141	150	11 9039	24,103
July	251,773	46,593	1,729,805	205,244,105	142	155	12 1069	36,668
Aug	281,412	46,521	1,728,424	220,456,973	139	155	12 0688	21,580
Sept	301,000	45,291	1,757,092	200,588,817	140	153	12 0793	41,515
Oct.	319,000	47,885	1,809,959	209,070,208	143	154	12 5039	40,065
Nov	.	47,889	1,854,612	206,345,905	145	156	13 3482	30,776
Dec	.			224,859,090*			13 7835	47,426

* 153 Cities

the year is over; (3) The average price of commodities for the year will be higher than in 1922. Index numbers during the next few months may be somewhat higher, but this prospect does not justify heavy buying. We are in a very sensitive period. Purchases in most cases should be limited to the early part of this year. Only those products that are relatively low should be bought from the long-swing standpoint."

Potash Salts and Imported Chemicals Advance in New York Market

Most Chemical Prices Are Firmly Maintained, Although the Demand Is Not Up to Manufacturers' Expectations—Lead Pigments Advance With Metal

NEW YORK, Jan. 29, 1923.

THE European disturbances are already reflected in the New York market and practically all imported chemicals are in a much firmer position than a week ago. In addition the negotiations of the German potash syndicate have tended to direct interest toward the potash salts. As a result caustic potash, the carbonate, permanganate and perchlorate are being quoted at higher prices on the spot market and stocks are none too plentiful.

Arsenic continues to be scarce and prices are correspondingly high. Caustic soda recorded a fractional decline for export, due presumably to competition from England. Imported lots of barium chloride were slightly lower on spot. Bichromates were in moderate demand, with supplies limited. Sal ammoniac was quite difficult to locate in round lots and holders are firm in their belief that prices are due for a sharp advance.

All lead pigments recorded increases due to the sharp rise in the metal. Standard, dry, white lead was quoted at 9¾c. per lb., in casks, carload basis. Formaldehyde, oxalic acid, bleaching powder, nitrite of soda and prussiate of potash continued along moderate active lines, with practically no change of importance recorded. Camphor was quoted lower, due to recent heavy arrivals from Japan.

HIGH-SPOTS IN THE MARKET

Arsenic—Several fair-sized sales were reported at 15½c. per lb. Nearby shipments were quoted at 15@15½c. per lb.

Barium Chloride—A few lots of imported material were offered somewhat lower on spot at $90 per ton. The general range, however, was around $95@$100 per ton. The demand continued moderately active.

Carbonate of Potash—Leading sellers quoted higher prices on all grades of imported goods. The 80-85 per cent calcined on spot sold at 6c. per lb., with the 96-98 per cent at 7½c. per lb.

Caustic Potash—Higher quotations for 88-92 per cent imported were recorded. Demand continues very active with large interests quoting as high as 7¾c. per lb. The general range is around 7@7½c. per lb.

Caustic Soda—There has been very little demand for export and prices were lower around $3.40@$3.50 per 100 lb., f.a.s. Spot goods for domestic consumption was quite limited, with odd lots sold at $3.75 per 100 lb., ex-store. Contracts at the works remained unchanged.

Chlorate of Potash—Spot quotations remained very firm in sympathy with the general strength of other potassium salts. Importers named 7½c. per lb. for crystal and powdered, with domestic figures around 8½c. per lb.

Permanganate of Potash—Prices on spot are sharply higher, due to the scarcity of supplies and strong demand. Several holders of odd lots named 17½c. per lb. for U.S.P. goods. The general range was around 17½c. per lb.

Prussiate of Soda—Some holders reported sales at fractionally higher levels, while others were still quoting 18½c. per lb. The general range was 18½@19c. per lb. Shipments from abroad were much firmer, with 20c. per lb. the lowest price c.i.f. N. Y., duty paid.

Silicate of Soda—Large producers quoted lower prices on 60 deg. material, with $2 per 100 lb., f.o.b works, carload basis heard as the regular quotation. The 40 deg. test remained around 80c. per 100 lb., f.o.b. works. The demand was merely routine.

Camphor—Large dealers reported lower prices on spot goods, due to the heavy arrivals from the Orient. Several transactions were recorded around 86c. per lb., with the range around 86@87c. per lb.

VEGETABLE OILS

Linseed Oil—The spot market held quite firm, with several large crushers practically sold up for January shipment. January oil held around 90c. per gal., carload basis, in barrels. Forward shipments were somewhat easier, with March quoted at 85c. per gal., in barrels, carload lots.

Castor Oil—There was very little change in prices recorded during the interval, although the market showed a very firm appearance. Producers quoted AA grade at 12¾c. per lb., with No. 3 at 12½c. per lb., carload lots, in barrels.

China Wood Oil—The spot market ruled quite firm and prices were advanced to 18c. per lb., a new high level for the past year. Supplies abroad were reported quite scarce and leading dealers are looking forward to a much higher market. March-April-May shipments from China were quoted at 15c. per lb.

Coconut Oil—Although demand was rather dormant, prices ruled steady throughout the week. Ceylon type oil held around 8¾c. per lb., sellers' tanks, prompt shipment. Spot oil in barrels was quoted around 9¾c. per lb.

Soya Bean Oil—A fair-sized tonnage of crude material was reported sold at 10⅝c. per lb., tanks, f.o.b New York. Spot oil in tanks was quoted around 10½c. per lb. The general inquiry was only moderate.

More Activity With Firmer Market at St. Louis

Very Few Price Declines as Volume of Trading Shows Material Increase—Glycerine Market Unsettled

ST. LOUIS, Mo., Jan. 24, 1923.

Since our last report a material increase in the volume of business transacted is to be reported and future prospects are very encouraging. Prices generally are firm. The European disturbances will undoubtedly reflect upon the American market and bring about higher prices.

ALKALIS HOLDING WELL

Conditions in the alkali market are very firm and prices are still holding well. The volume of business is good with a chance of increasing from now on. *Caustic soda* in 5-drum lots is being quoted at \$3.90 per 100 lb. for the solid and \$4.25 for the flake, delivered buyer's door *Soda ash*, 58 per cent light in 5-bag lots can be had at \$2.10 per 100 lb., with the regular differential of 20c. for barrels over bags. Carload business goes at about \$1.85 per 100 lb. *Sodium bicarbonate* in small lots from 3 to 5 bbl. is going strong at \$2.40 per 100 lb., and some sales are being made as high as \$2.50. *Sal soda* has not held its own with the other alkalis and the volume of sales is not as large as could be expected. However, it is expected that sal soda will be higher soon.

GENERAL AND SPECIAL CHEMICALS

Trading in heavy *mineral acids* is exceptionally good, also showing a material increase in volume and the market is much firmer. Stocks of *citric acid* are in good volume, but the demand only along quiet lines. *Oxalic acid* manages to hold its own. *Ammonia water* 26 deg. is showing some improvement and a very satisfactory business is being done. *White arsenic* continues to be very scarce. The demand for *carbon bisulphide* continues to improve and a very nice business is reported on this article. *Copperas* is moving in a routine manner and the market remains unchanged, with supplies somewhat easier. *Glycerine* is very unsettled and apparently no one knows just what the market is. Prices range from 17½@18½c. lb. Contracts are being made at various prices and spot goods also are being sold at various prices. A settled market is now in sight. *Lead acetate* has advanced recently, but the demand is rather quiet; however, this article should show more activity very soon. *Sulphur* is moving along in rather a routine manner. The volume of sales is only moderate and prices are not over strong. Sales are beginning to pick up slightly, but are not yet what they should be. *Zinc spelter*, while quiet, is still moving in fair volume. This also is the case with *zinc dust*. Both have been very firm and a change in price is not looked for very soon. *Zinc sulphate* is in very good demand and quoted in carload lots at 3¼c. f.o.b. St. Louis, and less than carload lots at 3¾c. f.o.b. St. Louis.

OILS AND PAINT MATERIALS

Castor oil has taken a very stiff increase and has now reached 14c. a lb. in drums. It may go higher and manufacturers are frank to admit that the market is tending that way. *Turpentine* has again gone skyrocketing and touched \$1.67 per gal. in single barrels and \$1.61 in 5-bbl. lots—quite an increase from when we last reported. *Linseed oil* is holding firm and the demand is very good. Higher prices are almost inevitable and users are purchasing as much as possible while prices remain at the present level.

Paint grinders are optimistic for the coming season and are buying freely. Several carloads of dry-earth colors have been purchased for shipment via New Orleans.

Buoyant Tendency Seen in Steel Market

Infrequent Price Advances Noted as General Activity Shows Marked Increase

PITTSBURGH, Jan. 26, 1923.

The general tone of the steel market has further improved in the past week. There has been continuous improvement since early in December. The market has indeed now come to display a buoyant tendency, since there is now a liberal sprinkling of price advances, whereas in November the average mill would probably have been well satisfied with a guarantee of continuance of the prices then existing, some of which were being shaded not infrequently.

MANY PRICE ADVANCES

Hoops, formerly quotable at a range of 2.75@2.90c. according to gage and other conditions, are now at 2.90c. as minimum, with some unattractive orders going as high as 3.25c. For a time there were sales, to particularly favorite buyers, at 2.60c. and even 2.50c.

Technically, merchant steel bars are quotable at 2@2.10c., but the 2c. price seems to be for rather late and uncertain delivery or to apply on special contracts, as for steel involved in large fabricated steel contracts. In November the top of the market was 2c., with various concessions.

Wrought-iron pipe has been advanced four to six points, according to size, on black, and two points extra on galvanized, while double extra strong is advanced six to ten points, uniformly on black and galvanized.

The National Tube Co. has issued a new list on welded steel boiler tubes, dated Jan. 23, decreasing discounts by three points on all sizes except 1¾ in., which is unchanged. The new basing discount is 48 per cent on less than carloads, making 52 per cent on carloads. The advance is followed by all independents. Producers have been well sold up for some time past.

An advance in merchant steel pipe and oil country goods is expected at any time and in some quarters is regarded as overdue, considering the sold up condition of mills and the pressure for deliveries.

The American Steel & Wire Co., while not following the recent advance of independent mills of \$2 a ton on plain wire and 10c. a keg on nails, has adopted new extras, annealing plain wire being \$3 a ton extra, while the basis for galvanizing is increased from 50c. to 60c. a hundred pounds on the base gages and additional advances are made for other gages.

An important point in the general price situation is that the United States Steel Corporation is participating in the price advances, though not in all cases. Until recently it appeared to be the general policy of the corporation to avoid any advance at all.

Independent sheet mills are now sold up much better than they were at the beginning of December, several being very well filled to April 1, beyond which date they are indisposed to obligate themselves. The advance recently predicted is likely to occur for second quarter, and will probably be \$3 a ton, to 3.50c. for black sheets and 4.50c. for galvanized sheets. The Steel Corporation is not a feature in this situation, since it is already sold up into June at the prices ruling for months past.

COKE AND PIG IRON

Since about the first of the year the common expectation has been that arrangements would be made removing the possibility of a bituminous coal strike April 1. The actual agreement has been signed in the past week. In December the prevailing opinion was that there would be a mining suspension, and part of the steel demand then running was supposed to be an anticipation of that mining suspension. The altered condition, however, does not seem to have affected steel demand adversely.

The Connellsville coke market has not weakened on account of the change in labor outlook, prices being sustained largely by there being a continued scattered demand for heating coke, amounting to a fair volume altogether, with occasional inquiry from blast furnaces on account of delayed deliveries on contracts. The market is \$8@\$8.25 on furnace coke and \$9.25@\$9.50 on foundry coke, with a possibility that \$8.50 might have to be paid, in an emergency, for the best furnace coke.

The pig iron market continues decidedly sluggish, on the whole, as to new buying, but furnaces seem to be fairly well sold up, while consumers are taking full deliveries and in some cases endeavoring to anticipate. Consumers are evidently in expectation that prices are much more likely to be lower than higher in the near future, on the ground that coke can hardly avoid declining. The market is quotable at \$27.50 for bessemer, \$25@\$26 for basic and \$27@\$28 for foundry, f.o.b. valley furnaces, freight to Pittsburgh being \$1.77.

Current Prices in the New York Market

FOR CHEMICALS, OILS AND ALLIED PRODUCTS

Although these prices are for the spot market in New York City, a special effort has been made to report the American manufacturer's quotations whenever available In many instances these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported and resale stocks are reported when of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb	$0 39 - $0 41
Acetone, drums	lb	.21 - .21½
Acid, acetic, 28%, bbl	100 lb	3 25 - 3 50
Acetic, 56%, bbl	100 lb.	6 50 - 6 75
Glacial, 99½%, carboys	100 lb.	12 00 - 12 50
Boric, crystals, bbl...	lb	.11½ - .11¾
Boric, powder, bbl.	lb.	.11 - .11¼
Citric, kegs	lb	.49 - .50
Formic, 85%	lb.	.18 - .19
Gallic, tech	lb.	.45 - .50
Hydrochloric, 18° tanks,	100 lb	.80 - 1 00
Hydrofluoric, 52%, carboys	lb.	.12 - .12½
Lactic, 44%, tech., light, bbl	lb.	.11 - .11½
22% tech., light, bbl	lb.	.05 - .05½
Muriatic, 20°, tanks,	100 lb.	1.00 - 1 10
Nitric, 36°, carboys	lb.	.04½ - .05
Nitric, 42°, carboys	lb.	.06 - .06½
Oleum, 20%, tanks	ton	17.00 - 18 00
Oxalic, crystals, bbl	lb.	.12½ - .13
Phosphoric, 50% carboys	lb.	.08 - .09
Pyrogallic, resublimed	lb.	1 50 - 1 60
Sulphuric, 60°, tanks	ton	9 00 - 10 00
Sulphuric, 60°, drums	ton	12 00 - 14.00
Sulphuric, 66°, tanks	ton	14 50 - 15 00
Sulphuric, 66° drums	ton	19 00 - 20 00
Tannic, U.S.P., bbl	lb.	.65 - .70
Tannic, tech, bbl	lb.	.40 - .45
Tartaric, imp. crys, bbl	lb.	.30½ - .31
Tartaric, imp, powd, bbl.	lb.	.31 - .32
Tartaric, domestic, bbl	lb	... - .32
Tungstic, per lb. of WO	lb.	1 00 - 1 20
Alcohol, butyl, drums	gal.	.18 - .23
Alcohol ethyl (Cologne spirit), bbl	gal.	4.75 - 4 95
Alcohol, methyl (see Methanol)		
Alcohol, denatured, 188 proof No. 1	gal.	.39 - .41
Alum, ammonia, lump, bbl	lb.	.03½ - .03¾
Potash, lump, bbl	lb.	.03½ - .03¾
Chrome, lump, potash, bbl.	lb.	.05 - .05½
Aluminum sulphate, com., bags	100 lb.	1.50 - 1 65
Iron free bags	lb.	.02½ - .02¾
Aqua ammonia, 26°, drums	lb.	.06¾ - .07½
Ammonia, anhydrous, cyl	lb.	.30 - .30½
Ammonium carbonate, powd casks	lb.	.09 - .09½
Ammonium nitrate, tech., casks	lb.	.10 - .11
Amyl acetate tech, drums	gal.	2.80 - 3 05
Arsenic, white, powd, bbl	lb	.15½ - .15¾
Arsenic, red, powd., kegs	lb.	.13 - .13½
Barium carbonate, bbl	ton	75 00 - 77 00
Barium chloride, bbl.	ton	90 00 - 100 00
Barium dioxide, drums	lb.	.18 - .18½
Barium nitrate, casks		.08½ - .08¾
Barium sulphate, bbl.	lb	.04 - .04½
Blanc fixe, dry, bbl	lb	.04 - .04½
Blanc fixe, pulp, bbl.	ton	45.00 - 55 00
Bleaching powder, f.o.b. wks, drums	100 lb.	2 00 - 2 50
Resale drums	100 lb.	2 25 - 2 50
Borax, bbl	lb	.05½ - .05¾
Bromine, cases	lb.	.27 - .28
Calcium acetate, bags	100 lb.	3 50 - 3 60
Calcium carbide, drums	lb	.04½ - .04¾
Calcium chloride, fused, drums	ton	22 00 - 23 00
Gran. drums	lb.	.01½ - .01¾
Calcium phosphate, mono, bbl.	lb.	.06½ - .07
Camphor, cases	lb.	.86 - .88
Carbon bisulphide, drums	lb.	.07 - .07½
Carbon tetrachloride, drums	lb.	.10 - .10½
Chalk, precip domestic, light, bbl	lb.	.04½ - .04¾
Domestic, heavy, bbl.	lb.	.03½ - .03¾
Imported, light, bbl	lb.	.04½ - .05
Chlorine, liquid, cylinders	lb.	.06 - .06½
Chloroform, tech, drums.	lb.	.35 - .38
Cobalt oxide, bbl	lb.	2 10 - 2 25
Copperas, bulk, f.o.b. wks	ton	20 00 - 22 00
Copper carbonate, bbl	lb.	.20 - .20½
Copper cyanide, drums	lb.	.50 - .55
Copper sulphate, crys, bbl	100 lb.	6.00 - 6 25
Cream of tartar, bbl	lb.	.25 - .26
Dextrine, corn, bags	100 lb.	3.25 - 3.50
Epsom salt, dom., tech, bbl.	100 lb.	2.10 - 2.25
Epsom salt, imp., tech., bags	100 lb.	1.10 - 1.25
Epsom salt, U.S.P., dom., bbl.	100 lb.	2.50 - 2.75
Ether, U.S.P., drums	lb.	.13 - .15
Ethyl acetate, com., 85%, drums	gal.	.80 - .85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 - 1.00
Formaldehyde, 40%, bbl	lb.	.16 - .16½
Fullers earth, f.o.b. mines	net ton	$16 00 - $17 00
Fullers earth—imp, powd	net ton	30 00 - 32 00
Fusel oil, ref, drums	gal	3 55 - 4 05
Fusel oil, crude, drums	gal	2 30 - 2 40
Glaubers salt, wks, bags	100 lb	1 20 - 1.40
Glaubers salt, imp, bags	100 lb.	1 00 - 1 25
Glycerine, c p, drums extra	lb	.18½ - .19
Glycerine, dynamite, drums	lb.	.17 - .17½
Iodine, resublimed	lb.	4.50 - 4.60
Iron oxide, red, casks	lb.	.12 - .18
Lead		
White, basic cabonate, dry, casks	lb.	.09½ - .10
White in oil, kegs	lb.	.12 - .13½
Red, dry, casks	lb.	.11½ - .11¾
Red, in oil, kegs	lb.	.13 - .14½
Lead acetate, white crys, bbl.	lb.	.13 - .13½
Lead arsenate, powd, bbl.	lb.	.21 - .22
Lime-Hydrated, bbl	per ton	16.80 - 17 00
Lime, Lump, bbl	280 lb	3 63 - 3.65
Litharge, comm., casks	lb.	.09½ - .10
Lithophone, bbl	lb.	.06½ - .07
Magnesium carb., tech., bags	lb	.07 - .07½
Methanol, 95%, bbl	gal.	1.23 - 1 25
Methanol, 97%, bbl	gal.	1 25 - 1 27
Nickel salt, double, bbl...	lb.	.10 - .10½
Nickel salts, single, bbl.	lb.	.11 - .11½
Phosgene		.60 - .75
Phosphorus, red, cases	lb.	.35 - .40
Phosphorus, yellow, cases	lb.	.30 - .35
Potassium bichromate, casks	lb.	.10 - .10½
Potassium bromide, gran., bbl	lb.	.20 - .27
Potassium carbonate, 80-85%, calcined, casks	lb.	.06 - .06¼
Potassium chlorate, powd	lb.	.07½ - .08
Potassium cyanide, drums	lb.	.47 - .80
Potassium hydroxide (caustic potash) drums	100 lb.	7.25 - 7 50
Potassium iodide, cases.	lb.	3.60 - 3 70
Potassium nitrate, bbl	lb.	.06½ - .07
Potassium permanganate, drums	lb.	.17½ - .18
Potassium prussiate, red, casks	lb.	.85 - .90
Potassium prussiate, yellow, casks	lb.	.38 - .39
Salammoniac, white, gran., casks	lb.	.06½ - .06¾
Gray, gran, casks	lb	.08 - .08½
Salsoda, bbl	100 lb.	1 20 - 1 40
Salt cake (bulk)	ton	25 00 - 27.00
Soda ash, light, 58% flat, bags, contract	100 lb.	1.60 - 1.67
Soda ash, light, basis, 48%, bags, contract, f.o.b wks	100 lb.	1.20 - 1.30
Soda ash, light, 58%, flat, bags, resale	100 lb.	1.75 - 1.80
Soda ash, dense, bags, contract, basis 48%	100 lb.	1.17½ - 1.20
Soda ash, dense, in bags, resale	100 lb.	1 85 - 1.90
Soda, caustic, 76%, solid, drums, f.a.s.	100 lb.	3 40 - 3 60
Soda, caustic, 76%, solid, drums, contract	100 lb.	3 35 - 3.40
Soda, caustic, basis 60%, wks, contract	100 lb.	2 50 - 2.60
Soda, caustic, ground and flake, contracts	100 lb.	3 80 - 3 90
Soda, caustic, ground and flake, resale	100 lb.	4 00 - 4.15
Sodium acetate, works, bags	lb.	.06½ - .07½
Sodium bicarbonate, bbl	100 lb.	1.75 - 1.85
Sodium bichromate, casks	lb.	.07½ - .08
Sodium bisulphate (niter cake)	ton	6.00 - 7.00
Sodium bisulphite, powd., U.S.P., bbl	lb.	.04½ - .04¾
Sodium chlorate, kegs	lb.	.06½ - .07
Sodium chloride	long ton	12 00 - 13.00
Sodium cyanide, cases	lb.	.19 - .23
Sodium fluoride, bbl	lb.	.09 - .10
Sodium hyposulphite, bbl.	lb.	.03 - .03½
Sodium nitrite, casks	lb.	.08½ - .09
Sodium peroxide, powd, cases	lb.	.28 - .30
Sodium phosphate, dibasic, bbl.	lb.	.03½ - .04
Sodium prussiate, yel. drums	lb.	.19 - .19½
Sodium silicate (40°, drums)	100 lb.	.80 - 1.15
Sodium silicate (60°, drums)	100 lb.	2.00 - 2.25
Sodium sulphide, fused, 60-62% drums	lb.	.04½ - .04¾
Sodium sulphite, crys., bbl	lb.	.03½ - .03¾
Strontium nitrate, powd., bbl.	lb.	.09½ - .10¼
Sulphur chloride, yel drums	lb.	.04½ - .05
Sulphur, crude	ton	18.00 - 20.00
Sulphur dioxide, liquid, cyl.	lb.	.08 - .08
Sulphur, flour, bbl	100 lb.	2.50 - 3.15
Sulphur, roll, bbl	100 lb.	2.15 - 2.20
Talc—imported, bags	ton	$30 00 - $40 00
Talc—domestic powd., bags	ton	18 00 - 25 00
Tin bichloride, bbl	lb	.11 - .11½
Tin oxide, bbl	lb.	.45 - .47
Zinc carbonate, bags	lb.	.14 - .14½
Zinc chloride, gran, bbl	lb.	.07 - .07½
Zinc cyanide, drums	lb.	.42 - .44
Zinc oxide, XX, bbl	lb.	.07½ - .08
Zinc sulphate, bbl	100 lb.	2.75 - 3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl	lb	$ 95 - $1.00
Alpha-naphthol, ref, bbl	lb.	1.05 - 1.10
Alpha-naphthylamine, bbl	lb.	.28 - .30
Aniline oil, drums	lb.	.16½ - .17
Aniline salts, bbl	lb.	.24 - .25
Anthracene, 80%, drums	lb.	.75 - 1.00
Anthracene, 80%, imp., drums, duty paid	lb.	.65 - .70
Anthraquinone, 25%, paste, drums	lb.	.70 - .75
Benzaldehyde U.S.P., carboys	lb.	1.35 - 1.40
Benzene, pure, water-white, tanks and drums	gal.	.30 - .35
Benzene, 90%, drums	gal.	.26 - .32
Benzene, 90%, drums, resale	gal.	.32 - .34
Benzidine base, bbl.	lb.	.85 - .90
Benzidine sulphate, bbl	lb.	.75 - .80
Benzoic acid, U.S.P., kegs	lb.	.72 - .75
Benzoate of soda, U.S.P., bbl.	lb.	.57 - .65
Benzyl chloride, 95-97%, ref., drums	lb.	.25 - .27
Benzyl chloride, tech, drums	lb.	.20 - .23
Beta-naphthol, subl., bbl	lb.	.55 - .60
Beta-naphthol, tech, bbl	lb.	.25 - .26
Beta-naphthylamine, tech.	lb.	1.00 - 1.25
Carbazol, bbl	lb.	.75 - .90
Cresol, U.S.P., drums	lb.	.26 - .28
Ortho-cresol, drums	lb.	.24 - .26
Cresylic acid, 97%, resale, drums	gal.	1.25 - 1.30
95-97%, drums, resale	gal	1 25 - 1 30
Dichlorbenzene, drums	lb	.07 - .09
Diethylaniline, drums	lb	.50 - .60
Dimethylaniline, drums	lb	.39 - .41
Dinitrobenzene, bbl	lb	.20 - .22
Dinitroclorbenzene, bbl	lb.	.22 - .23
Dinitronaphthalene, bbl.	lb.	.30 - .32
Dinitrophenol, bbl	lb.	.35 - .40
Dinitrotoluene, bbl	lb.	.22 - .24
Dip oil, 25%, drums	gal	.25 - .30
Diphenylamine, bbl.	lb.	.54 - .55
H-acid, bbl	lb.	.75 - .80
Meta-phenylenediamine, bbl.	lb.	.95 - 1.00
Michlers ketone, bbl	lb.	3.50 - 3.75
Monochlorbenzene, drums	lb.	.08 - .10
Monoethylaniline, drums	lb	.95 - 1.10
Naphthalene, crushed, bbl	lb	.05½ - .06
Naphthalene, flake, bbl.	lb.	.06 - .06½
Naphthalene, balls, bbl	lb.	.07 - .07½
Naphthionate of soda, bbl	lb.	.58 - .65
Naphthionic acid, crude, bbl.	lb.	.60 - .65
Nitrobenzene, drums	lb	.10 - .12
Nitro-naphthalene, bbl	lb.	.30 - .35
Nitro-toluene, drums	lb.	.15 - .17
N-W acid, bbl	lb.	1 20 - 1.30
Ortho-amidophenol, kegs	lb.	2 30 - 2.35
Ortho-dichlorbenzene, drums	lb.	.17 - .20
Ortho-nitrophenol, bbl.	lb	.90 - .92
Ortho-nitrotoluene, drums.	lb.	.12½ - .14
Ortho-toluidine, bbl	lb.	.14 - .16
Para-amidophenol, base, kegs	lb.	1 25 - 1.30
Para-amidophenol, HCl, kegs	lb.	1.30 - 1.35
Para-dichlorbenzene, bbl	lb.	.17 - .20
Paranitraniline, bbl	lb.	.75 - .80
Para-nitrotoluene, bbl.	lb.	.55 - .65
Para-phenylenediamine, bbl.	lb.	1.50 - 1.55
Para-toluidine, bbl	lb.	.85 - .90
Phthalic anhydride, bbl.	lb	.35 - .38
Phenol, U.S.P., drums	lb	.35 - .37
Picric acid, bbl.	lb.	.20 - .22
Pyridine, dom., drums	gal	nominal
Pyridine, imp., drums	gal	3 00 - 3.10
Resorcinol, tech., kegs	lb.	1 50 - 1.55
Resorcinol, pure, kegs	lb	2.00 - 2.10
R-salt, bbl	lb.	.55 - .60
Salicylic acid, tech, bbl	lb.	.40 - .42
Salicylic acid, U.S.P., bbl	lb.	.45 - .47
Solvent naphtha, water-white, drums	gal.	.37 - .40
Crude, drums	gal.	.22 - .24
Sulphanilic acid, crude, bbl	lb.	.20 - .22
Thiocarbanilide, kegs	lb.	.35 - .38
Toluidine, kegs	lb.	1.20 - 1.30
Toluidine, mixed, kegs	lb.	.30 - .35
Toluene, tank cars	gal.	.35 - .37
Toluene, drums	gal.	.40 - .43
Xylidines drums	lb.	.40 - .45
Xylene, pure, drums	gal.	.45 - .50
Xylene, com., drums	gal.	.40 - .42
Xylene, com., tanks	gal.	.30 - ......

Naval Stores

Rosin B-D, bbl.	280 lb.	$6.15 - .
Rosin E-I, bbl.	280 lb.	6.30 - .
Rosin K-N, bbl.	280 lb.	6.50 - $6 75
Rosin W.G.-W.W., bbl.	280 lb.	7.75 - 8 25
Wood rosin, bbl.	280 lb.	6 25 - .
Turpentine, spirits of, bbl.	gal.	1 51 - 1 52
Wood, steam dist., bbl.	gal.	1.35 - .
Wood, dest. dist., bbl.	gal.	1.25 - .
Pine tar pitch, bbl	200 lb.	. . . - 6 00
Tar, kiln burned, bbl.	500 lb.	. . . - 12 50
Retort tar, bbl.	500 lb.	. . . - 11 00
Rosin oil, first run, bbl	gal.	43 -
Rosin oil, second run, bbl.	gal	.47 -
Rosin oil, third run, bbl.	gal.	.53 -
Pine oil, steam dist.	gal	. . . - .90
Pine oil, pure, dest. dist.	gal.	. . . - .85
Pine tar oil, ref.	gal.	. . . - .46
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal.	. . . - .35
Pine tar oil, double ref., bbl.	gal.	. . . - .75
Pine tar, ref., thin, bbl	gal.	. . . - .25
Pinewood creosote, ref., bbl	gal.	. . . - .52

Vegetable Oils

Castor oil, No. 3, bbl.	lb	$ 12¼ - $ 12½
Castor oil, AA, bbl.	lb.	.12½ - 13
Chinawood oil, bbl.	lb.	.17 - 17½
Coconut oil, Ceylon, bbl.	lb.	.09½ - 10
Coconut oil, Cochin, bbl	lb.	.10 - 10½
Corn oil, crude, bbl	lb.	.11½ - 11¾
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.10 -
Summer yellow, bbl.	lb.	.12½ - 12¾
Winter yellow, bbl.	lb.	.13 - 13½
Linseed oil, raw, car lots, bbl.	gal.	.90 - 91
Raw, tank cars (dom.)	gal.	.86 - 87
Boiled, 5-bbl. lots (dom.)	gal.	.95 - 96
Olive oil, denatured, bbl.	gal	1.10 - 1 15
Palm, Lagos, casks	lb	08 - 08½
Palm kernel, bbl	lb.	08½ - 09
Peanut oil, crude, tanks (mill)	lb.	.13½ - 14
Peanut oil, refined, bbl.	lb.	16 - 16½
Rapeseed oil, refined, bbl.	gal	86 - 87
Rapeseed oil, blown, bbl.	gal	90 - 91
Soya bean (Manchurian), bbl.	lb.	.11½ - . .
Tank, f.o.b. Pacific coast.	lb.	09½ - . . .

Fish Oils

Menhaden, light pressed, bbl.	gal	$0 60 -
White bleached, bbl.	gal	64 - 65
Blown, bbl.	gal.	68 - 69
Whale No. 1 crude, tanks, coast	lb.	.06 - 06½

Dye & Tanning Materials

Divi-divi, bags	ton	$38 00 - $39 00
Fustic, sticks	ton	30 00 - 35 00
Fustic, chips, bags	lb.	04 - 05
Logwood, sticks	ton	28 00 - 30 00
Logwood, chips, bags.	lb	02½ - 03½
Sumac, leaves, Sicily, bags.	ton	65 00 -
Sumac, ground, bags.	ton	55 00 - 60 00
Sumac, domestic, bags	ton	35 00 -
Tapioca flour, bags.	lb	.03½ - 05

EXTRACTS

Archil, conc., bbl.	lb.	$0 17 - $0 18
Chestnut, 25% tannin, tanks.	lb.	.02 - 03
Divi-divi, 25% tannin, bbl.	lb.	04 - 05
Fustic, crystals, bbl.	lb.	.20 - 22
Fustic, liquid, 42°, bbl	lb.	.08 - 09
Gambier, liq., 25% tannin, bbl.	lb.	.08 - 09
Hematine crys., bbl	lb.	.14 - 18
Hemlock, 25% tannin, bbl	lb.	.04 - 05
Hypernic, solid, drums	lb.	.24 - 26
Hypernic, liquid, 51°, bbl.	lb.	.14 - .17
Logwood, crys., bbl.	lb.	.19 - .20
Logwood, liq., 51°, bbl.	lb.	.09 - 10
Quebracho, solid, 65% tannin, bbl.	lb.	.04¼ - .05
Sumac, dom., 51°, bbl.	lb.	.06½ - .07

Waxes

Bayberry, bbl.	lb.	$0.28 - $0.30
Beeswax, refined, dark, bags.	lb.	.30 - 32
Beeswax, refined, light, bags.	lb.	.34 - 35
Beeswax, pure white, cases.	lb.	.40 - 41
Candelilla, bags	lb.	.34 - 35
Carnauba, No. 1, bags.	lb.	38 - 40
No. 2, North Country, bags	lb.	23½ - 24
No. 3, North Country, bags	lb.	17½ - 18
Japan, cases	lb.	15 - 15½
Montan, crude, bags.	lb.	.03½ - 04
Paraffine, crude, match, 105-110 m.p.	lb.	.04 - 04½
Crude, scale 124-126 m.p., bags	lb.	.02½ - .02¾
Ref., 118-120 m.p., bags.	lb.	.03½ - .03¾
Ref., 125 m.p., bags.	lb.	.03½ - .03¾
Ref., 128-130 m.p., bags.	lb.	.04 - .04¼
Ref., 133-135 m.p., bags.	lb.	.04½ - .04¾
Ref., 135-137 m.p., bags.	lb.	05 - .05¼
Stearic acid, sgle pressed, bags	lb.	10 - .10¼
Double pressed, bags.	lb.	.10½ - 10¾
Triple pressed, bags	lb.	.11 - 11¼

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb.	$3.20 - $3.25
F.a.s. double bags	100 lb.	3.60 - 3.75
Blood, dried, bulk	unit	4.60 - . . .
Bone, raw, 3 and 50, ground	ton	30.00 - 35.00
Fish scrap, dom., dried, wks.	unit	5.00 - 5.10
Nitrate of soda, bags	100 lb.	2.60 - 2.65
Tankage, high grade, f.o.b. Chicago	unit	4.70 - 4.80

Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$3.50 - $4.00
Tennessee, 78-80%	ton	7.00 - 8.00
Potassium muriate, 80%, bags	ton	35.55 - 38.25
Potassium sulphate, bags	unit	1.00 - . . . .

Crude Rubber

Para—Upriver fine	lb.	$0.34½ - $0.35
Upriver coarse	lb	.28½ - .28¾
Upriver caucho ball	lb	.29½ - .30
Plantation—First latex crepe	lb.	35½ - .35¾
Ribbed smoked sheets	lb.	35½ - .35¾
Brown crepe, thin, clean	lb	.31 - .32
Amber crepe No. 1	lb	.31 - .32

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh ton	$450 00 - $550.00
Asbestos, shingle, f.o.b., Quebec	sh ton	60 00 - 80 00
Asbestos, cement, f.o.b., Quebec	sh ton	15 00 - 17.00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	16 00 - 20.00
Barytes, grd., off-color, f.o.b. mills bulk.	net ton	13 00 21.00
Barytes, floated, f.o.b. St Louis, bbl.	net ton	24.00 - 28.00
Barytes, crude f.o.b. mines, bulk	net ton	8.00 - 9.00
Casein, bbl., tech.	lb.	12 - .14
China clay (kaolin) crude, f.o.b. Ga.	net ton	7.00 - 9 00
Washed, f.o.b. Ga.	net ton	8 00 - 9.00
Powd., f.o.b. Ga.	net ton	14 00 - 20.00
Crude f.o.b. Va.	net ton	8 00 - 12 00
Ground, f.o.b. Va.	net ton	13 00 20 00
Imp., lump, bulk	net ton	14 00 - 20.00
Imp., powd.	net ton	40 00 - 45 00
Feldspar, No. 1 pottery	long ton	6 00 7 00
No. 2 pottery	long ton	5 00 - 5 50
No. 1 soap	long ton	7 00 - 7 50
No. 1 Canadian, f.o.b. mill	long ton	20 00 - 21 00
Graphite, Ceylon, lump, first quality, bbl	lb	.05 - 05½
Ceylon, chip, bbl.	lb.	.04 - .04½
High grade amorphous crude	ton	35 00 - 50.00
Gum arabic, amber, sorts, bags	lb	15 - 16
Gum tragacanth, sorts, bags	lb	50 - .60
No. 1, bags	lb.	1 75 - 1.80
Kieselguhr, f.o.b. Cal.	ton	40 00 - 42 00
F.o.b. N.Y.	ton	50 00 55 00
Magnesite, crude, f.o.b. Cal	ton	14 00 - 15 00
Pumice stone, imp., casks	lb	03 05½
Dom., lump, bbl.	lb	05 - 05½
Dom., ground, bbl	lb	06 - 07
Shellac, orange fine, bags	lb.	84 - 85
Orange superfine, bags.	lb	86 - 87
A. C. garnet, bags	lb.	81 - 82
T. N., bags	lb	82 - 83
Silica, glass sand, f.o.b. Ind	ton	2 00 - 2 50
Silica, sand blast, f.o.b. Ind	ton	2 50 5.00
Silica, amorphous, 250-mesh, f.o.b. Ill.	ton	17 00 - 17 50
Silica, bldg. sand, f.o.b. Pa	ton	2 00 - 2.75
Soapstone, coarse, f.o.b. Vt., bags	ton	7 00 - 8 00
Talc, 200 mesh, f.o.b., Vt., bags	ton	6.50 - 9 00
Talc, 200 mesh, f.o.b. Ga., bags	ton	7.00 - 9 00
Talc, 200 mesh, f.o.b. Los Angeles, bags	ton	16 00 - 20.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	ton	$45–50
Chrome brick, f.o.b. Eastern shipping points	ton	50–52
Chrome cement, 40-50% Cr_2O_3	ton	23–27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23 00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	40–46
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	36–41
Magnesite brick, 9-in straight (f.o.b. wks.)	ton	65–68
9-in arches, wedges and keys	ton	80-85
Scraps and splits	ton	85
Silica brick, 9-in sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9-in sizes, f.o.b. Birmingham district	1,000	48-50
F.o.b. Mt. Union, Pa	1,000	42–44
Silicon carbide refract. brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N.Y.	ton	$200.00 - $225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11 - .11½
4-6% C.	lb.	.11½ - .12
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	105.00 - 107.50
Spiegeleisen, 19-21% Mn.	gr. ton	35.00 - 37.00
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb.	1.90 - 2.15
Ferrosilicon, 10-15%	gr. ton	38.00 - 40.00
50%	gr. ton	80.00 - 85.00
75%	gr. ton	150.00 - 160.00
Ferrotungsten, 70-80%, per lb. of W	lb.	$0.90 - $0.95
Ferro-uranium, 35-50% of U, per lb. of U	lb.	6.00 - . . . . . .
Ferrovanadium, 30-40%, per lb. of V	lb.	3.50 - 4.00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$6.50 - $8 75
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22 00 23.00
C.i.f. Atlantic seaboard	ton	18 50 - 19 00
Coke, fdry., f.o.b. ovens	ton	9 25 - 9 50
Coke, furnace, f.o.b. ovens	ton	8.00 - 8.50
Fluorspar, gravel, f.o.b. mines, New Mexico	ton	17 50 - . . .
Fluorspar, No. 2 Lump—Ky. & Ill. mines	ton	25 00 . . . .
Ilmenite, 52% TiO_2	lb	.01½ - .01¾
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.30 - . . . . . .
Manganese ore, chemical (MnO_2)	ton	75 00 - 80.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N.Y.	lb	.70 - .75
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb	.06 - .08
Pyrites, Span., fines, c.i.f. Atl. seaport	unit	11½ - .12
Pyrites, Span., furnace size, c.i.f. Atl. seaport	unit	.11½ - .12
Pyrites, dom. fines, f.o.b. mines, Ga.	unit	Nominal
Rutile, 95% TiO_2	lb.	.12 - . . . . .
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.00 - 8.50
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	7.50 - 8.00
Uranium ore (carnotite) per lb. of U_3O_8	lb	3.50 - 3.75
Uranium oxide, 96% per lb U_3O_8	lb	2.25 - 2.50
Vanadium pentoxide, 99%	lb	12.00 - 14.00
Vanadium ore, per lb V_2O_5	lb.	1 00 - . . .
Zircon, washed, iron free, f.o.b. Pablo, Fla	lb.	.04½ - .13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	14.75
Aluminum, 98 to 99%	23.00
Antimony, wholesale, Chinese and Japanese	6.85-7.00
Nickel, ordinary (ingot)	28–30
Nickel, electrolytic	29-30
Nickel, electrolytic, resale	25-27
Nickel, ingot and shot, resale	36.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	40.00
Lead, New York, spot	8 00
Lead, E. St. Louis, spot	7.90–8.00
Zinc, spot, New York	7.00
Zinc, spot, E. St. Louis	6.65

OTHER METALS

Silver (commercial)	oz	$0.67¼
Cadmium	lb.	1.15
Bismuth (500 lb lots).	lb.	2.50
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99%	lb.	1.00@1.05
Platinum	oz	110.00
Iridium	oz.	250 00@275.00
Palladium.	oz.	65.00@ 70.00
Mercury	75 lb.	72.50

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.75
Copper bottoms	30.75
Copper rods	20.50
High brass wire	19.50
High brass rods	17.00
Low brass wire	21.10
Low brass rods	22.00
Brazed brass tubing	24 25
Brazed bronze tubing	29.00
Seamless copper tubing	25 25
Seamless high brass tubing	23.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.30@11.50
Copper, heavy and wire	11 25@11.50
Copper, light and bottoms.	9.25@ 9.50
Lead, heavy	5.75@ 6.00
Lead, tea	3.50@ 3.75
Brass, heavy	6.25@ 6.40
Brass, light	5.35@ 5.75
No. 1 yellow brass turnings	6.30@ 6.50
Zinc	3.50@ 4.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.14	$3.14
Soft steel bars	3.04	3.04
Soft steel bar shapes	3.04	3.04
Soft steel bands	3.84	3.84
Plates, ¼ to 1 in. thick	3.14	3.14

Industrial

Financial. Construction and Manufacturers' News

Construction and Operation

Alabama

MOBILE—The Great Southern Roofing Co., recently organized with a capital of $125,000, has leased a local building for the establishment of a new plant for the manufacture of composition roofing specialties. A power house and new tank storage building will be constructed. T. J. Larkin is president.

SHEFFIELD—Samuel W. Kendall, Meridian, Miss., is completing the organization of a company to construct and operate a cement manufacturing plant in this section. The Kelley quarry property, near the government's nitrate plant No. 2, has been acquired and work will soon be commenced on the initial units, with total capacity of about 2,000 bbl. per day. It is also proposed to install a limekiln, which will be ready for service at an early date. The cement plant unit will be completed early in July. The works are estimated to cost close to $100,000, including machinery.

Arkansas

EL DORADO—The Evans-Thwing Refining Co., 624 Finance Bldg., Kansas City, Mo., is completing plans and will soon commence the construction of a new oil refinery on site selected at El Dorado, estimated to cost about $500,000, including machinery. The general contract for the structural work has been awarded to the George H. Siedhoff Construction Co., Wichita, Kan.

California

LOS ANGELES—The California Flax Seed Products Co. has awarded a contract to the Austin Co., Pacific Electric Bldg., for the erection of a new 1-story plant 75x100 ft., on 26th St., near Santa Fe Ave., estimated to cost approximately $18,000.

OAKLAND—The California Salt Co., Mills Bldg., San Francisco, has tentative plans under consideration for the rebuilding of the portion of its plant on San Francisco Bay, near Oakland, destroyed by fire, Jan. 14, with loss approximating $300,000, including equipment.

WALNUT CREEK—The Pacific Cellulose Co. will establish a chemical plant in connection with its proposed new local mills for the manufacture of artificial silk. The former works of the Diablo Glove Co. has been secured, with a 6-acre tract of land for the erection of additional buildings. Dr. C. A. Schwartz is vice-president, and E. A. Schwartz secretary and treasurer.

SAN FRANCISCO—The Standard Oil Co., 200 Bush St., is planning for the construction of a new storage and distributing plant on the North Beach, foot of Jones St., with initial capacity of 30,000 bbl.

Connecticut

WATERBURY—The American Brass Co. has awarded a contract to the Tracy Brothers Co., Waterbury, for the erection of a new 3-story building at its plant, 80x100 ft.

Georgia

ATLANTA—The Union Seed & Oil Co., Mason Ave., has plans under way for the rebuilding of the portion of its plant, destroyed by fire, Jan. 14, with loss of about $15,000.

Idaho

COEUR D'ALENE—The Independence Lead Mines, Ltd., is considering plans for the erection of a new mill at its properties, with initial capacity of about 100 tons per day. R. M. Atwater, Jr., is company engineer in charge. Harry B. Kingsbury is president.

Illinois

STERLING—The Black Silk Stove Polish Co. is completing plans and will soon take bids for the erection of a new plant, 3-story, 128x130 ft., estimated to cost approximately $80,000. Ashby Ashby & Schulze, West Jackson Blvd., Chicago, are architects. L. K. Wynn is president.

CHICAGO—Bauer & Black, 2500 South Dearborn St., chemists and drug manufacturers, have purchased property on 26th St., between Dearborn and Federal Sts., for a total consideration of $110,000, and will use the site for extensions in their plant. The proposed factory will approximate 100x100 ft.

CHICAGO—The Chicago Fiber Box Co., recently organized, has leased space in the building at 833 Rees St. for a term of years, for the establishment of a new plant.

Indiana

SEYMOUR—The Silverstone Stucco & Plaster Products Co., 220 Indiana Pythian Bldg., Indianapolis, recently organized, has commissioned Merrit, Harrison & Turnock, 500 Board of Trade Bldg., Indianapolis, to prepare plans for its proposed new plant to be erected at Seymour, for the manufacture of stucco and plaster products. The main structure will be 1-story, 50x96 ft. John R. Briggs is president.

Iowa

WATERLOO—The Rath Packing Co., Sycamore and Elm Sts., has revised plans in preparation for the erection of a new building at its plant for the manufacture of fertilizer products. Henschien & McLaren, 1637 Prairie Ave., Chicago, Ill., are architects. J. W. Rath is president.

MADISON—The Hinde & Dauch Paper Co., Sandusky, O., contemplates the erection of a new mill at the foot of Occidental St., for the manufacture of paperboard products.

Kansas

WICHITA—The Western Glass Co., 531 North Market St., has plans in preparation for the erection of a new 2-story and basement building 75x100 ft., on North Market St., to cost about $35,000. Edward Forsbloom, Sedgwick Bldg., is architect.

Kentucky

LEXINGTON—The Red Top Coal Co., recently organized, is planning for the establishment of a new local plant for the manufacture of smokeless powder to be used for blasting service in connection with its coal-mining operations.

OWENSBURG—Bolger & Medley are considering plans for the erection of a new local plant for the manufacture of brick and tile products.

Louisiana

BOGALUSA—The Bogalusa Paper Co. has plans in progress for the erection of an addition to its plant, to include 5 new buildings, with machine department, 55x300 ft.; finishing department, 150x150 ft.; beater department, 96x140 ft., general mill, 60x80 ft.; and generator building, 95x140 ft. The structures will be used for the manufacture of kraft papers, increasing the output from 90 to 125 tons per day. The plant, exclusive of machinery, will cost about $350,000, with equipment installation estimated to cost about $600,000 additional. James L. Carey, 208 North Laramie Ave., Chicago, Ill., is engineer.

MONROE—The Gulf Carbon Co., Baltimore, Md., recently organized under Maryland laws with a capital of $250,000, has plans under way for the erection of a new plant at Monroe, where a site of about 3 acres of land has been purchased. It is purposed to provide equipment for a daily output of about 8,000 lb. The plant is estimated to cost close to $200,000, with machinery. William A. Gillespie, Union Trust Bldg., Baltimore, is secretary and treasurer.

Maryland

LAUREL—The Lapsey & Brothers Co., 30 South Hanover St., Baltimore, will install a special mechanical drying department at its proposed new plant at Laurel, for treating and drying of painted shade cloth. A mechanical painting works will also be provided. The complete equipment installation is estimated to cost about $100,000.

BALTIMORE—The Continental Roofing & Mfg. Co., recently organized, has acquired the factory of the McHenry-Millhouse Mfg. Co., for the establishment of a new plant for the manufacture of coal-tar and composition roofing products. Thomas M. Riangard heads the company.

Massachusetts

WATERTOWN—The Hood Rubber Co., Nichols Ave., manufacturer of tires and other rubber products, has awarded a contract to the Aberthaw Construction Co., 27 School St., Boston, for the erection of a 3-story addition to its plant, totaling about 9,600 sq.ft. in area. F. C. Hood is general manager.

HOLYOKE—The Chemical Paper Mfg. Co. has acquired the local mill of the United States Envelope Co., and will use the property for extensions in its present works on Jackson St. The United States company will remove the machinery now at the factory to its plants in other cities.

Michigan

DETROIT—The Codde Brass & Aluminum Mfg. Co., care of Robert Finn, 622 McKerchey Bldg., has awarded a contract to Alfred R. Yops, 3072 Maybury Ave., for the erection of a new 1-story foundry, 50x110 ft., estimated to cost about $15,000.

SAGINAW—The United States Graphite Co. has preliminary plans in progress for the erection of a new 1-story plant on Holland St. Cowles & Mutscheller, Chase Bldg., are architects. Harry C. Woodruff is vice-president.

PLYMOUTH—The Lee Foundry & Machine Co., 120 Mill St., manufacturer of iron and steel castings, has commissioned Christian W. Brandt, 1114 Kresge Bldg., Detroit, architect, to prepare plans for a 1-story foundry addition, to cost $30,000.

Minnesota

ST. CHARLES—The Minnesota Gold Mining Co. will take bids early in February for the erection of a new 1-story ore reduction plant at Elba, near St. Charles, to cost about $125,000, including machinery. A. Miles Bean, Denver, Colo., is engineer. E. M. Gainey is secretary.

Missouri

KANSAS CITY—The Kansas City Gas Co., a subsidiary of the United Gas Improvement Co., Broad and Arch Sts., Philadelphia, Pa., is considering the erection of a new 1- and 2-story addition to its artificial gas plant.

New Jersey

TRENTON—The Trenton Potteries Co., North Clinton St., manufacturer of sanitary ware, has commenced the erection of a new addition at the plant of its Equitable Pottery, Lalor and Hancock Sts., to cost approximately $100,000. It will consist of a pressing shop, drying department, and kiln room, 70x110 ft. William A. Klemann, 1st National Bank Bldg., is architect.

New York

LAUREL HILL—The Nichols Copper Co., 25 Broad St., New York, has filed plans for the immediate construction of a 3-story addition to its plant at Laurel Hill, L. I., 41x57 ft., estimated to cost about $25,000.

ROCHESTER—The Dominion Feldspar Corp., has completed plans and will commence the erection of a new grinding mill, 63x104 ft., at its plant at the Genesee Dock, foot of Boxart St.

North Carolina

CHARLOTTE—The J. B. Davis Concrete Products Co., 901 Davidson St., is planning for the construction of a new plant, 50x150 ft., for the manufacture of septic tanks and other concrete products. The equipment installation will comprise mixers, molds and kindred apparatus. J. B. Davis is president.

Ohio

AKRON—The National Sulphur Co., 80 Maiden Lane, New York, has plans in progress for the erection of an addition to its new plant at North Akron, soon to be placed in operation. It will cost about $75,000, including equipment. The company is removing its former works at Bayonne, N. J., to the new location.

ASHLAND—The Faultless Rubber Co. has awarded a contract to the Camp Construction Co., 520 Newman Stern Bldg., Cleveland, for the erection of a 1- and 2-story

addition to its plant, to be used for general rubber and acid service, 46x135 ft. The Osborn Engineering Co., 2848 Prospect Ave., South, Cleveland, is engineer.

Oklahoma

HOCKERVILLE—The St. Louis Smelting & Refining Co. has work in progress on 2 new concentration plants, one to be located near the Ontario lead smelter and the other on the H. E. Ambo property. The mills are estimated to cost in excess of $175,000

TULSA—The Peer Oil Corp is being organized with a capital of $5,000,000 and 1,000,000 shares of common stock, no par value, to take over and merge the Kansas & Gulf Co., 332 South Michigan Ave, Chicago, Ill., the Monarch Oil & Refining Co and the Southern Petroleum Co The new corporation will operate properties and refineries in Oklahoma, Arkansas, Kansas, Louisiana and Texas, and plans for extensive increase in production The present gasoline plants have a rated capacity of 10,000 gal. per day

WYNNEWOOD—The Texas-Pacific Coal & Oil Co, Fort Worth, Tex, will commence the immediate erection of a new oil-refining plant on local site, estimated to cost close to $1,000,000, including machinery

MIAMI—The Chanute Smelter Co., Joplin, Mo., is said to have closed negotiations for an extensive tract of local lead and zinc properties, totaling about 5,000 acres. Development will be commenced at an early date. A plant is projected

Oregon

HUNTINGTON—The Columbia Cement Co Concord Bldg Portland, has plans nearing completion for the erection of a new cement-manufacturing plant on local site, estimated to cost in excess of $500,000, including machinery The company is operating with a capital of $2,000,000

Pennsylvania

HELLAM—A. J Hershey, Hartman Bldg, York, Pa., is having plans prepared for the construction of a new 1-story clay reduction plant on site near Hellam, to be 30x60 ft., estimated to cost about $20,000 John Crowe, Hartman Bldg., York, is architect

PHILADELPHIA—The Garrett-Buchanan Co., 18 South 6th St, manufacturer of paper products, has filed plans for the erection of a new building at its plant to cost about $55,000

MIDLAND—The Crucible Steel Co of America, Oliver Bldg., Pittsburgh, is completing plans for the erection of a new 1-story liquid purification plant at its Midland works, estimated to cost $60,000. The Koppers Co, Union Arcade, Pittsburgh, is engineer.

READING—The Philadelphia & Reading Railroad Co, Reading Terminal, Philadelphia, has commenced the erection of a new oil storage and distributing plant at Reading, with capacity of about 200,000 gal It will be 75x150 ft., and is expected to be ready for the equipment installation early in the spring.

South Carolina

MANNING—The Manning Oil Mill has been acquired by F. D. Hunter and associates. The new owners plan extensions.

Texas

ROCKDALE—The Austin Petroleum Co., Inc., Austin, will soon commence the installation of additional equipment at its local oil refinery for general increase in production. W. H. McClanahan is secretary and manager.

BEAUMONT—The Atlantic Refining Co., 3144 Passyunk Ave., Philadelphia, Pa., has acquired a tract of land of about 500 acres on the Neches River, and plans to use the site for a new oil-refining plant.

HARLINGEN—The Rio Grande Tire & Rubber Co. has commenced the erection of a new local plant for the manufacture of automobile tires and other rubber products. It is estimated to cost close to $50,000.

STAMFORD—The Chickasha Cotton Oil Co., Chickasha, Okla., has preliminary plans under way for the erection of a new oil mill at Stamford, to cost approximately $150,000, including machinery.

TEXAS CITY—The Pierce Oil Co., is planning for extensions in its local plant to cost close to $20,000. A. W. Grant is superintendent.

BRECKENRIDGE—The Central Gasoline Producing Co. is planning for the immediate rebuilding of the portion of its local refining plant recently destroyed by fire with loss of about $32,000.

Industrial Developments

PAPER—The International Paper Co., New York, has increased production at its different mills to a normal basis, with a schedule of close to 1,900 tons output per day, or at the annual rate of 580,000 tons of newsprint. During 1922 the total production was 422,809 tons. The company has advanced the wages of skilled employees at the mills, averaging about 30 per cent of the total working forces, from 6 to 7 per cent over the previous wage level. About 900 operatives are affected.

The paper mills at Holyoke, Mass., giving employment to from 5,500 to 6 000 workers, have advanced the wage scale from 5 to 8 cents an hour, depending upon occupation The increase became effective Jan 15

The Uncas Paperboard Co, Norwich, Conn, recently organized, has commenced operations in a remodeled portion of its new local mill, formerly the plant of the Ironsides Board Corp, idle for about 1½ years past Additional improvements will be made at the mill.

CERAMIC—The International Brick Co, El Paso, Tex., is advancing production at its plant and is now running on a basis of 80,000 brick and tile per day, as compared with a previous output of 70,000 daily. The working force has been materially increased A large part of the output is for Arizona work.

The Crescent China Co., Niles, O., is completing the erection of a new plant at Alliance, O., and plans for early operations

The P Bannon Pipe Co., Louisville, Ky, is maintaining regular operations at its plant, with normal working force, and is said to have orders on hand to insure production on this schedule for some time to come

The Acme Brick Co., Denton, Tex, has resumed production at its plant and plans to develop capacity at an early date. Additional machinery will be installed to provide for a maximum output of about 60,000 bricks per day A. B Kelley is general manager

Kiln placers in the potteries in the East Liverpool, O, district, including plants at East Liverpool, and Wellsville, O, and at Chester and Newell, W. Va, recently out on strike, have returned to their work. The men were recently granted a wage advance of 7 per cent, and have now asked that pottery companies defray one-half the wages of the "pin boy," who is a member of each pottery crew, and paid by the kiln placers The request has been refused.

The Vallejo Brick Co Vallejo, Calif., is operating at capacity at its plant, and has plans under way for extensive additions for increased output. It is purposed to create a fund of about $100,000 for the expansion.

Workers in the sanitary ware branch of the pottery industry at Trenton, N. J., are still out on strike, although the plants are filling the positions with other men. About 5 000 men and women are now said to be idle

The Glenwood Shale Brick Co, Erie, Pa., is maintaining capacity production at its plant, and expects to continue on this basis throughout the winter season.

RUBBER—The Fiske Rubber Co., Chicopee Falls, Mass, is advancing production at its different plants, and practically capacity output is now operative. The works, in addition to the local mill, include the factories at Springfield, Mass., Pawtucket, R. I., and Milwaukee, Wis., with present daily output of 24,500 casings and 32,500 tubes.

The Dunlop Tire & Rubber Co., River Rd, Buffalo, N. Y., is making ready for initial production at its local mill and will make an expenditure of approximately $750,000 for the installation of necessary equipment and improvements in present machinery. It is expected to give employment to a working force of about 5,000 persons, and to advance this at the rate of 150 employees a month for a number of months to come. It is expected to develop an output of 2,500 tires per day. Edwin B. Germain is president.

The Miller Rubber Co., Akron, O., manufacturer of automobile tires, has opened a new plant, recently completed, to be used for the manufacture of rubber gloves. The company is resuming this line of production after a discontinuance since 1920.

The Goodyear Tire & Rubber Co., Akron, O., has refused the demand of employees at the plant for a wage advance of 15 per cent. The company has increased the wage scale 7½ per cent since last July.

IRON AND STEEL—The Colorado Fuel & Iron Co., Denver, Colo., with mills at Pueblo, Colo., is arranging to blow in 4 additional furnaces at its plant in the Silver City, N. M., district at an early date.

The Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., a subsidiary of the United States Steel Corp., is breaking all previous production records for pig iron at its furnaces. During December a total of 81,000 tons was produced.

The Youngstown Sheet & Tube Co., Youngstown, O, is planning to blow in an additional blast furnace at its plant at an early date. The company has recently resumed at a number of sheet mills.

The present steel mill capacity in the Niles, O, district, is now about 88 per cent of normal A total of 45 of the 51 mills are in active production.

The N. & G Taylor Co., Cumberland, Md, manufacturer of tin and terne plate, is maintaining regular production at its local mills, with close to normal working force

The Gulf States Steel Co, Birmingham, Ala, is developing maximum production, with its ingot mill at capacity and finishing mills now on double turn.

The Reading Iron Co., Reading, Pa., has recently advanced the wages of puddlers at its mills to $9 80 a ton, as compared with a previous scale of $8 80 a ton. A proportionate advance has also been made in the tonnage rates of other material. Common labor has been increased from 30 to 33 cents an hour. A total of 6,000 men are affected by the change, which became operative Jan. 15

MISCELLANEOUS—The Great Texas Oil & Refining Co, Breckenridge, Tex., is planning for the early operation of its new oil refinery on local site, now nearing completion. The plant will have a capacity for handling 5,000 bbl. of crude oil per day, with refining facilities for producing 500 bbl. of lubricating oils and other petroleum byproducts daily. It will represent an investment of close to $1,000,000.

The Electric Hose & Rubber Co., Wilmington, Del, manufacturer of heavy rubber hose for air brake and other service, has adopted a night shift at its plant, in addition to regular day operations. The company is said to have orders on hand to insure this basis of output for about 6 months to come.

The Hudsondale Ochre Works, Hudsondale, Pa., is increasing production at its plant, and has recently added a night shift in addition to the regular day force.

The National Enameling & Stamping Co., New York, is operating its metal plants in the Baltimore, Md., district at practically full capacity, and will continue on this schedule for an indefinite period.

The Lancaster Foundry Co., Lancaster, Pa, manufacturer of iron and steel castings, has resumed production at its plant after a shut down since early last July. Employment will be given to about 75 operatives.

Capital Increases, etc.

THE DIAMOND CRYSTAL SALT CO., St. Clair, Mich., has filed notice of increase in capital from $1,500,000 to $2,050,000.

THE SUPERIOR GUANO CO., 4th Ave. and Clinton St., Baltimore, Md., manufacturer of fertilizer products, has arranged for an increase in capital from $100,000 to $250,000.

THE SOUTHWESTERN COTTON OIL CO., Oklahoma City, Okla., has arranged for an increase in capital from $100,000 to $500,000, for proposed expansion.

THE HEGLER ZINC CO., Danville, Ill., has filed notice of increase in capital from $380,000 to $2,000,000, for expansion.

THE AMERICAN GLUE CO., 121 Beverly St, Boston, Mass., is disposing of a note issue of $2,500,000, a portion of the proceeds to be used for expansion and additions to working capital.

THE BUCK GLASS CO., Fort Ave. and Orange St., Baltimore, Md., has arranged for an increase in capital from $150,000 to $250,000.

THE AMERICAN HARD RUBBER CO., 11 Mercer St., New York, N. Y., has filed notice of increase in capital from $5,000,000 to $7,500,000.

THE CLIPPERT BRICK CO., Springwells, Mich., has increased its capital from $100,000 to $700,000, for general expansion.

THE HAMMERMILL PAPER CO., Erie, Pa., is disposing of a preferred stock issue of $3,000,000, a portion of the proceeds to be used for additional working capital.

THE LEHIGH PORTLAND CEMENT CO., Allentown, Pa., has arranged for an increase in capital from $18,000,000 to $25,000,000.

New Publications

PAMPHLETS, ETC.

THE BUSINESS LAW JOURNAL is the title of a new monthly publication, which will contain the current important commercial decisions of the state and federal courts. Each issue will present 50 to 60 such decisions. Each decision will be set forth at sufficient length to explain the facts, the question presented, the court's conclusion, and the reasoning upon which the same is based. The following is a partial list of the subjects under which the decisions will group themselves: Corporations, insurance, sales, contracts, railroads, banking, negotiable paper, mortgages, bankruptcy, brokers, taxation, mining, workmen's compensation, and the decisions of the Federal Trade Commission dealing with unfair competition. Each issue will also contain articles dealing with practical problems of commercial law and recent legislation affecting business. The magazine is intended for the use of business men, manufacturers, bankers, accountants, credit men, etc. Its object is to keep them in touch with the current business decisions, especially those in which a loss has been unnecessarily sustained. The editor will be John Edson Brady, who since 1910 has been editor of the *Banking Law Journal*. The magazine is published by the Business Law Journal Co., 71 Murray St., New York City. The subscription price is $8 per year.

THE UNITED STATES PUBLIC HEALTH SERVICE, Treasury Department, has issued Reprint 748 on "Physiological Effects of Exposure to Low Concentrations of Carbon Monoxide," by R. R. Sayers, F. V. Meriwether and W. P. Yant; Reprint 770, "Dermatosis Following the Use of Cutting Oils and Lubricating Compounds," by William J. McConnell, and Reprint 786, on "The Effect of Gasoline Fumes on Dispensary Attendance and Output in a Group of Workers," by Octavius M. Spencer.

THE DOMINION BUREAU OF STATISTICS, Ottawa, Canada, has issued a booklet on "Chemical and Allied Products—1919 and 1920" and "Coal Statistics for Canada" for the calendar years 1919, 1920 and 1921.

THE DIVISION OF ENGINEERING of the National Research Council has just issued a booklet giving much information about its organization, work and personnel. The National Research Council is a co-operative organization of American societies and scientific men concerned with the physical, mathematical and biological sciences, and the applications to human welfare through the agricultural, engineering and medical arts. Approximately eighty societies are included. The main offices of the Council are at 1701 Massachusetts Ave., Washington, D. C., pending the completion of its permanent building near the Lincoln Memorial. The Division of Engineering has offices in the Engineering Societies Building, 29 West 39th St., New York, to facilitate co-operation with the engineering societies and the Engineering Foundation.

NEW U. S. GEOLOGICAL SURVEY PUBLICATIONS: I: 16, Secondary Metals in 1921, by J. P. Dunlop (Mineral Resources of the U. S., 1921, Part 1), published Oct. 17, 1922; I:17, Gold Silver, Copper Lead and Zinc in California and Oregon in 1921, by Charles G. Yale (Mineral Resources of the U. S., 1921, Part 1), published Oct. 23, 1922; I:20, Gold, Silver, Copper, Lead and Zinc in Montana in 1921, by C. N. Gerry (Mineral Resources of the U. S., 1921, Part 1), published Nov. 17, 1922; II 34, Coke and Byproducts in 1919-1920, by R. S. McBride and F. G. Tyron (Mineral Resources of the U. S., 1920, Part II), published Oct. 18, 1922; II:35, Manufactured Gas and Byproducts in 1920, by R. S. McBride (Mineral Resources of the U. S., 1920, Part II), published Dec. 12, 1922.

NEW BUREAU OF STANDARDS PUBLICATIONS: Circ. 24, Publications of the Bureau of Standards; Circ. 86, U. S. Govt. Specification for Turpentine; Circ. 102, Specification of Composite Vehicle for Thinning Semipaste Paints When the Use of Straight Linseed Oil Is Not Justified; Circ. 134, Specification for Fire-Extinguishing Liquid (Carbon Tetrachloride Base); Circ. 135, Caustic Magnesia Cement; Scien. Paper 444, Practical Spectrographic Analysis, by W. F. Meggers, C. C. Kiess and F. J. Stimson; Scien. Paper 448, Decarburization of Ferrochromium by Hydrogen, by Louis Jordan and F. E. Swindells; Scien. Paper 452, Structure of Martensitic Carbon Steels and Changes in Microstructure Which Occur Upon Tempering, by Henry S. Rawdon and Samuel Epstein; Scien. Paper 453, Preparation and Properties of Pure Iron Alloys by Robert P. Neville and John R. Cain; Scien. Paper 457, Gases in Metals: 1. The Determination of Combined Nitrogen in Iron and Steel and the Change in Form of Nitrogen by Heat-Treatment, by Louis Jordan and F. E. Swindells; Tech. Paper 218, Results of Some Compression Tests of Structural Steel Angles, by A. H. Stang and L. R. Strickenberg; Tech. Paper 219, Effect of Temperature, Deformation and Rate of Loading on the Tensile Properties of Low-Carbon Steel Below the Thermal Critical Range, by H. J. French; Tech. Paper 222, Relative Usefulness of Gases of Different Heating Value and Adjustments of Burners for Changes in Heating Value and Specific Gravity, by Walter M. Berry, I. V. Brumbaugh, J. H. Eiseman, G. F. Moulton and G. B. Shawn; Tech. Paper 223, Reclamation of Used Petroleum Lubricating Oils, by Winslow H. Herschel and A. H. Anderson.

Industrial Notes

THE HAZARD ADVERTISING CORP., 7 East 42nd St., New York City, announces that H. Gardner McKerrow, formerly advertising manager of the National Aniline & Chemical Co., has recently joined the organization. Mr. McKerrow's long experience in the textile and chemical industries has given him an understanding of processes and methods that will enable the Hazard agency, which specializes on technical accounts, to extend its service for technical clients.

F. J. Low recently resigned as vice-president of the agency with which he was associated for more than 6 years and has organized an advertising agency under the name of F. J. Low Co., Inc., with offices at 15 West 44th St., New York City. Mr. Low was for many years advertising manager of H. W. Johns-Manville Co. and has also been associated with the advertising of the Chicago Fuse Mfg. Co., American Steam Gauge & Valve Mfg. Co., the Schaeffer & Budenberg Corp., Sarco Co., Inc., and other concerns in the technical field.

STEWART-THILL Co. is the new name of the Walter L. Flower Co. of St. Louis, district representative of the Conveyors Corp. of America, Chicago. The personnel of the organization remains the same and offices will be continued at 312 8th St., St. Louis.

The directors of GIFFORD-WOOD Co., Hudson, N. Y., at a recent meeting appointed Joseph A. Boucher to the position of sales manager.

THE AIR REDUCTION SALES Co., New York City, has consolidated its executive offices at 120 Broadway and 160 Fifth Ave., which will now be located at 342 Madison Ave., New York City.

E. M. RHOADS, president and treasurer of the Sanitary Co. of America, has disposed of his controlling interest in that company and resigned from the management on Jan. 5, 1923. A number of the former officers of the Sanitary Co. of America, together with factory superintendents, etc., are associated in the building of a soil pipe plant at Boyertown, Pa., to be known as the Eastern Foundry Co. The personnel of this latter company is as follows: E. M. Rhoads, president; B. W. Frederick, vice-president; Grant P. Bechtel, secretary and assistant treasurer; Daniel G. Burkert, assistant secretary and purchasing agent, and Harry R. Trout, general superintendent.

TOCH BROTHERS have moved their executive and sales offices to 110 East 42nd St., New York.

THE COMBUSTION ENGINEERING CORP., New York, announces the acquisition of the Quinn Oil Burner & Torch Co. W. R. Quinn, former president of the Quinn Oil Burner & Torch Co., has become associated with the Combustion Engineering Corp. as manager of its fuel oil department.

THE CHAIN BELT Co., Milwaukee, Wis., announces the appointment of Fitch S. Bosworth as manager of the Chicago office, effective Jan. 1, 1923. Mr. Bosworth has been in charge of the Chain Belt Co.'s St. Louis office for the last 3 years and has specialized on chain and conveying engineering problems. With him will be associated Raymond X. Raymond, who for several years has been connected with the export sales department in Milwaukee. Thomas F. Scannell, formerly of the Chicago office, has been placed in charge of the St. Louis office.

THE JERSEY CITY WELDING SHOP of the Metal & Thermit Corp., in addition to its present facilities for undertaking Thermit welding repairs, has also been recently equipped for making welds on lighter sections by means of the oxy-acetylene and electric processes. This service will be of particular value in cases where large production work is desired. Work can be called for and delivered by truck. This policy of equipping welding shops with the additional welding facilities, as described above, will later be extended to the other welding plants.

THE OXWELD ACETYLENE Co., Newark, N. J., announces that its Western department, formerly located at 1077 Mission St., San Francisco, has recently moved to larger quarters in the same block. Leo Romney is manager.

THE DODGE SALES & ENGINEERING Co., Mishawaka, Ind., which has for the past 8 years been operating as the selling subsidiary of the Dodge Manufacturing Co. and Dodge Steel Pulley Corporation, has now been consolidated with the parent company, Dodge Manufacturing Corp., which was organized and began business last July. The Dodge Manufacturing Corp. at that time took over the two long-established manufacturing concerns, Dodge Manufacturing Co., organized in 1880 and Dodge Steel Pulley Corp., organized in 1917 as the successor of the Oneida Steel Pulley Co., which began the manufacture of steel pulleys in 1900. Since July, 1922, the manufacture of Dodge, Oneida and Keystone power transmission appliances and Dodge heavy oil engines has been conducted by the Dodge Manufacturing Corp. The distribution of Dodge products, which has heretofore been done under the name of the Dodge Sales & Engineering Co., will hereafter be conducted by the sales department of the Dodge Manufacturing Corp., with Duncan J. Campbell, general sales manager, in charge, and John A. Beynon assistant general sales manager.

Coming Meetings and Events

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual convention in Norfolk, Va., May 7 to 9.

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York.

AMERICAN FOUNDRYMEN'S ASSOCIATION will hold a meeting in Cleveland, O., April 28 to May 4.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its annual meeting in New York City during the week of Feb. 19, 1923.

AMERICAN SOCIETY FOR STEEL TREATING will hold its winter sectional meeting in the City Club, Chicago, Feb. 8 and 9, 1923.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL FOREIGN TRADE COUNCIL will hold its annual conference April 25, 26 and 27, 1923, in New Orleans, La.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

A PAPER INDUSTRIES EXPOSITION will be held in Grand Central Palace, New York City, during the week of April 9, 1923, by the International Exposition Co.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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Bootlegging Is Developing The Fine Art of Smuggling

CONTEMPORARY philosophers, particularly those of a thirsty inclination, have often said that prohibition is responsible for making the United States a nation of criminals. In view of the widespread violation of the Eighteenth Amendment, we have never been disposed to controvert their argument. Recently, however, a prominent manufacturer of fine chemicals has called our attention to another phase of the prohibition problem that seems to carry with it a serious menace to certain of our chemical industries.

When an industry grows to tremendous proportions, byproducts often become sources of unexpected profit. Now, as bootlegging has gradually reached the stage of big business, it is perhaps natural that it should develop some profitable sidelines. One of these is smuggling, and along the coast lines and international borders an illicit traffic of no mean proportions has been developed within the past few years. It was recently stated in Congress, on no less authority than that of the State Department, that from the little islands of the Bahamas alone over 1,200,000 gallons of liquor is annually smuggled into the United States. As this traffic became established on such a large scale, and with comparative ease, it was not unnatural that the bootlegger should reach out for a profitable expansion of his business. With the same equipment that was required to bring in 50 or 100 cases of a material as bulky as liquor, he found that he could handle thousands of dollars worth of expensive drugs, pharmaceuticals or fine perfumes. To be sure, the risk was a little greater, the penalties considerably more severe, but probably these dangers served merely to add zest to the bootlegger's game.

Our manufacturing friend tells us that as a result of this diversion the country is being flooded with smuggled drugs—salvarsan being a particularly prominent example. Much the same condition also exists in the case of high-priced synthetics used by the perfumers and extract manufacturers. And, too, the dope and narcotic traffic continues without abatement.

That these clandestine importations threaten the very existence of American industries is obvious. Just what the domestic manufacturer can do to prevent them, however, is not so clear. He can insist on better enforcement, and can and should aid the federal authorities in ferreting out information regarding the origin and source of material believed to have been illegally imported. He should not lose sight of the fact, too, that under section 516 of the new tariff law the American producer for the first time in history has been given the privilege of appealing to the customs authorities for information regarding classification and appraisement of competitive imported products. This is one very definite way in which the attention of the government can be centered on imports of questionable origin. In time, other procedures will doubtless suggest themselves, but it behooves the chemical industries to take immediate steps to put an end to this disastrous phase of the bootlegger's activity.

Pearly Gates For the Unregenerate

IN the last October number of our French contemporary *Chimie et Industrie*, MM. CLÉMENT and REVIÈRE announce their achievement of synthetic mother-of-pearl. The pearl oyster, it appears, secretes an albumenoid material called "conchyoline," which contains calcium carbonate and water, and the authors found that when calcium carbonate is precipitated in a colloidal medium under certain conditions, it forms a network of particles which displays the optical phenomena of a grating. Salts of other metals show similar but less pleasing effects owing apparently to the finer grain of the calcium carbonate.

We confess to a sense of shock about this invention. We didn't mind the corrugated domestic rainbows brought out on so-called Tiffany glass years ago. But this is different. We went to Sunday School with diligence and learned our lessons to the end that we might eventually march in triumph through gates of just such pearly splendor, get an equipment of wings and a harp, and proceed to enjoy ourselves with a definite quality of distinction. Now along come these two Frenchmen with their precipitated calcium carbonate, and before we know it some movie magnate from Hollywood who never went to Sunday School will set up a "palatial residence" across the way, and in front of it will be the very pearly gates of our young desire—and no brimstone pit at the left entrance for our dearest enemies. It's too bad.

Beyond the Control Of the Directors

AT THE general meeting of the stockholders of the Magadi Soda Co., Ltd., held in London on Dec. 11 last, S. SAMUEL, the chairman of the board, said that "the very unsatisfactory position of the company had been brought about by causes beyond the control of the directors. Production had been hindered throughout by the failing of machinery and the fixing of the rate of exchange at 2 shillings to the rupee."

This brings up a very interesting question. Was the failure of the machinery wholly beyond the control of the directors? We admit the rate of exchange was. Suppose the accounts had not been properly kept and at the annual meeting they would have been unable to

tell what their assets and liabilities were. Would that have been "beyond the control of the directors"? It would not, and yet directors are not chosen because they are expert accountants. Suppose they had neglected to make sales, although there was a good market. They would have been to blame, and yet they were not all chosen because they were alkali salesmen. Then why was it beyond their control if the machinery they bought was improperly designed or improperly chosen? The decision to purchase certain equipment is just as much a part of their business as is keeping accounts and selling their product.

Later in the report we read that "the defects of the new bucket-dredger which had been sent to Magadi had now been made good and the dredger had been restarted; in a few weeks there would be a minimum production of soda at the rate of 100,000 tons a year." Why wouldn't the bucket-dredger work when it was set up? Evidently because it was improperly designed for the work in hand. Maybe a member of the board who doesn't know anything of technology bought it from an officer of a machinery company who knows nothing of soda production.

The chairman of the board made an error that is even more common in this country than it is in England—namely, that ignorance of technology is excusable among the directors of a manufacturing corporation. In point of fact the board of a corporation is a unit. No one man can know everything. To have a consultant on call will not solve the problem, because those who are not properly informed do not know when to send for him. It is just as important to have a competent technologist among their number, to avoid such mistakes as this, as it is to have men who can read a balance sheet. Then these mistakes will not be "beyond the power" of directors. The condition will be within their control and the errors will be avoided.

Growing More And More Helpless

CONGRESSMAN RAINEY of Illinois declares that there are now on the federal payroll and on state and municipal payrolls, and pensioners and others who are maintained by taxes, about 3,350,000 men and women. That would indicate that 15,000,000 persons in the United States live on taxes collected from their fellow citizens. There are only 30,000,000 of us engaged in productive labor. Therefore every two persons so engaged support besides their own families at least one man, woman or child by the taxes they pay. If they don't pay it in taxes they pay it in rents or other living expenses.

In 1897 there were 167 federal deputies, agents, etc.; in 1907 there were 3,000, and in 1922 there were over 30,000 federal deputies, agents and inspectors on the government payroll. Within the last 65 years federal taxes have increased from 46 cents to $30 per capita. The latest plan for adding to the tax burden is to collect the British debt on the best possible terms and then blow in the whole four or five billions on a soldiers' bonus.

What are we going to do about it?

No matter what we think as individuals, these plans may go through. Politicians respond to what they think is public opinion, and this noise to which they are obedient does not contain as yet any intimation that taxes raise rents and living expenses. The noise demands that commissioners be appointed to examine into and control nearly everything there is. The politicians obey.

When this government was organized there was THOMAS JEFFERSON, who held that the people should manage their own affairs and that we should have as little government as possible. ALEXANDER HAMILTON, on the other hand, upheld the idea of a strong central government to control affairs. Both were philosophers and thoughtful men. We have discarded JEFFERSON and followed HAMILTON, which might have been well enough if we had only kept our wits about us. But we followed thoughtlessly. We demanded government control of anything and everything until now it has become a burden. As an example, the Bureau of Indian Affairs supports between 5,000 and 6,000 employees to look after 200,000 Indians, and the Indians are suffering from lack of intelligent and conscientious attention. Nevertheless this same bureau asks for an appropriation of $13,000,000 for the coming year. The government is fairly choked with just such abnormal growths on various parts of its system.

Some day the pendulum is bound to swing back for the same reason that a rocket that goes up must come down. We as a people shall grow tired of the infernal cost of so much government. The noise will say so, and the politicians will proceed to cut and slash. They will not do so intelligently, because it is the habit of politicians to address themselves to window-dressing rather than to look ahead beyond the next election. So we would better prepare to manage our own affairs without government support. This simpler and less expensive and less helpful and less meddlesome government may be slow in coming, but it is bound to arrive some day. It will be wise for us to consider our situation beforehand.

Smoke Damage And Chimney Height

ON page 1220 of our issue of Dec. 20, 1922, we published a brief abstract of a decision on a smoke suit dating back to 1917, in which the plaintiff was given a judgment for some damage incurred while the flue system of the St. Louis Smelting & Refining Co. was under reconstruction. Unfortunately, however, the caption of the note stated that "Doubling Height of Smelter Stack Causes Fume Damage."

Our readers will doubtless recognize in this one of the slips and errors which happen to any organization of mere humans. Those interested in smoke have followed our very full accounts appearing during the last 5 years of investigations on that problem. These researches have established so clearly as to be beyond reasonable doubt that no crop damage results from SO_2 fumigation except when definitely known concentrations are exceeded for definitely known times and under optimum conditions of sunlight and humidity. In other words, sulphur is successfully eliminated from a smelter system by correct dilution of the flue gases into the surrounding atmosphere before the smoke stream touches the ground. It is self-evident that this dilution increases with the temperature of the gases and the elevation at which they are discharged.

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The Raging Battle Of the Oil Titans

THE greatest legal struggle in the history of American industry is now going on in an effort to decide what is what and who is who in the oil-cracking business. Hundreds of millions of dollars are involved, a money value with which there are few comparisons. Tales of Captain KIDD'S treasure chests or even stories of the fortunes of modern bootleggers would have to be put through at least a seven-stage radio amplifier to be heard in this battle of the oil Titans. We are now producing annually about six billion gallons of gasoline in this country. Imagine the great, green depth of Niagara Falls roaring away for about 45 minutes and one may perhaps visualize our annual gasoline production. The proportion of "cracked" to straight-run gasoline made from the crudes is rapidly approaching a one-to-one ratio. Fuel oil passed through an efficient cracking plant is enhanced in value about 6 cents per gallon.

Why the big fuss? Simply because the elements of oil cracking, heavier hydrocarbons to lighter ones, were discovered when present-day graybeards were living in "The Days of Real Sport" with Skinnay and the Pup. Coupled with the general situation is a crippled, sadly underpaid Patent Office. That gasoline was produced in substantial quantities by the old-fashioned cracking processes was reported by Prof. C. F. CHANDLER away back in the pre-bicycle age. And we moderns know too that a very large part of what is now included in the gasoline or motor fuel fraction was formerly run into the kerosene fraction. True the yield of gasoline is increased and its quality is improved by distilling or cracking under pressure, but KREY, DEWAR and REDWOOD and others developed processes of this sort back in the lower Pleistocene. And now, too, interested people are discovering that fossil apparatus discovered in the chalk cliffs of Bayonne and other points can be operated so as to produce gasoline. Furthermore, it is rumored that some of the curious markings on papyri carefully preserved at the Patent Office have been made to blossom, like Japanese pith flowers, into working drawings of gasoline-cracking apparatus.

To one who is not a Jack-be-nimble lawyer, and not gazing into a crystal, several things appear to stand out as real. Somebody must have had to dynamite away a deal of conservatism and start the thing going—show that marketable cracked gasoline could be manufactured in a big American way, and at a cozy profit. It seems to us that this was WILLIAM M. BURTON. To a casual reader of the daily papers it appears that Burton stills have been known to blow up when you didn't want them to. We understand that one of the big troubles has been the formation or carbon or coke. We are told that many forms of apparatus have been built, some with the tubes running north and others west, but the carbon deposits just the same. Then somebody discovered that if the oil is heated hot enough and then passed into a receiver, insulated so not to lose the heat, the cracking proceeds for some time and most of the coke forms and is deposited in this insulated chamber, removed from the heating surfaces. It seems that this principle is made use of by CROSS and by DUBBS.

The legal struggle has settled down to four or five major contestants, each with an impressive rosary of patents. In the meantime, conditions in the industry have become such that it is practically imperative for a refiner to "crack" or be cracked. The freedom of the whole industry is, to a large degree, at stake. If the courts should hold that one or two of the earlier live patents, now in litigation, are basic, then the whole industry will have to pay tribute. Ten cents per barrel of stock treated is the royalty proposed by one concern.

It seems likely, at least we hope, that out of this great polygonal debate will come a clarification of our patent law, the establishment of new precedents as to what is patentable matter. We have noted the recent decision, after appeal, in the case of the Saybolt patents for absorbing gasoline vapor under pressure from natural gas, that the said process and patents merely set forth certain simple and widely understood principles of physics. How long will American industries tolerate \$2,000 patent examiners to grind out confusion for the \$15,000 judges, to the delectation of the \$50,000 lawyers and the despair of those who pay for it all?

Awaiting Operating Data On the Colloid Mill

ABOUT 30 months ago the first article on the colloid mill was published by its inventor, Dr. HERMAN PLAUSON. From this and subsequent articles we have built up our present conception of a grinding mechanism that has attracted world-wide attention. The idea seems to be to subject a substance suspended in liquid to the extreme disintegrative action of teeth set on a cylinder which rotates at high speed and drives the particles against stationary teeth set on a concentric shell. The cylinder is designed to operate at very high speed, claims having been made of an attained peripheral speed of 650 ft. per second and a possible speed of over 3,000 ft. per second. This is the so-called impact type mill, which, together with the friction type mill, was described in detail in our issue for Jan. 10.

There seems nothing impossible in the conception of such disintegration. To anyone who has worked with dye pastes or other substances where fine subdivision is essential, a mechanical disintegrator is conceivable. But the stumbling blocks in the way of complete optimism regarding its utility are incidental to the terrific speed that is necessary. First, there is the wear and tear of heavy work at high speed. Of course in a machine like the Sharples supercentrifugal we have speeds which the colloid mill probably would not reach; but the supercentrifugal has a relatively light cylinder rotating in air, while the colloid mill must have a heavier cylinder operating in a liquid. If the mill is used to make actual or near colloidal solutions, the liquid would often be viscous. As a matter of fact, in terms of 1,000 r.p.m., any liquid is viscous. Then the mechanical details of construction of such a mill on a commercial scale offer a formidable problem. Of course it is not impossible, but it presents such difficulty as to make commercial success almost a greater achievement than the invention itself. Finally, after the mill has been made a mechanical possibility, the high operating cost for power and the replacement cost of worn parts due to heavy wear and tear present operating difficulties that suggest a distinct economic handicap.

So far there are no existing data on the operation of the mill and they are being awaited with interest. The difficulties outlined here are not regarded as insuperable; they merely indicate the very definite engineering problem that must be solved before the mill can be a success.

tell what their assets and liabilities were. Would that have been "beyond the control of the directors"? It would not, and yet directors are not chosen because they are expert accountants. Suppose they had neglected to make sales, although there was a good market. They would have been to blame, and yet they were not all chosen because they were alkali salesmen. Then why was it beyond their control if the machinery they bought was improperly designed or improperly chosen? The decision to purchase certain equipment is just as much a part of their business as is keeping accounts and selling their product.

Later in the report we read that "the defects of the new bucket-dredger which had been sent to Magadi had now been made good and the dredger had been restarted; in a few weeks there would be a minimum production of soda at the rate of 100,000 tons a year." Why wouldn't the bucket-dredger work when it was set up? Evidently because it was improperly designed for the work in hand. Maybe a member of the board who doesn't know anything of technology bought it from an officer of a machinery company who knows nothing of soda production.

The chairman of the board made an error that is even more common in this country than it is in England—namely, that ignorance of technology is excusable among the directors of a manufacturing corporation. In point of fact the board of a corporation is a unit. No one man can know everything. To have a consultant on call will not solve the problem, because those who are not properly informed do not know when to send for him. It is just as important to have a competent technologist among their number, to avoid such mistakes as this, as it is to have men who can read a balance sheet. Then these mistakes will not be "beyond the power" of directors. The condition will be within their control and the errors will be avoided.

Growing More And More Helpless

CONGRESSMAN RAINEY of Illinois declares that there are now on the federal payroll and on state and municipal payrolls, and pensioners and others who are maintained by taxes, about 3,350,000 men and women. That would indicate that 15,000,000 persons in the United States live on taxes collected from their fellow citizens. There are only 30,000,000 of us engaged in productive labor. Therefore every two persons so engaged support besides their own families at least one man, woman or child by the taxes they pay. If they don't pay it in taxes they pay it in rents or other living expenses.

In 1897 there were 167 federal deputies, agents, etc.; in 1907 there were 3,000, and in 1922 there were over 30,000 federal deputies, agents and inspectors on the government payroll. Within the last 65 years federal taxes have increased from 46 cents to $30 per capita. The latest plan for adding to the tax burden is to collect the British debt on the best possible terms and then blow in the whole four or five billions on a soldiers' bonus.

What are we going to do about it?

No matter what we think as individuals, these plans may go through. Politicians respond to what they think is public opinion, and this noise to which they are obedient does not contain as yet any intimation that taxes raise rents and living expenses. The noise demands that commissioners be appointed to examine into and control nearly everything there is. The politicians obey.

When this government was organized there was THOMAS JEFFERSON, who held that the people should manage their own affairs and that we should have as little government as possible. ALEXANDER HAMILTON, on the other hand, upheld the idea of a strong central government to control affairs. Both were philosophers and thoughtful men. We have discarded JEFFERSON and followed HAMILTON, which might have been well enough if we had only kept our wits about us. But we followed thoughtlessly. We demanded government control of anything and everything until now it has become a burden. As an example, the Bureau of Indian Affairs supports between 5,000 and 6,000 employees to look after 200,000 Indians, and the Indians are suffering from lack of intelligent and conscientious attention. Nevertheless this same bureau asks for an appropriation of $13,000,000 for the coming year. The government is fairly choked with just such abnormal growths on various parts of its system.

Some day the pendulum is bound to swing back for the same reason that a rocket that goes up must come down. We as a people shall grow tired of the infernal cost of so much government. The noise will say so, and the politicians will proceed to cut and slash. They will not do so intelligently, because it is the habit of politicians to address themselves to window-dressing rather than to look ahead beyond the next election. So we would better prepare to manage our own affairs without government support. This simpler and less expensive and less helpful and less meddlesome government may be slow in coming, but it is bound to arrive some day. It will be wise for us to consider our situation beforehand.

Smoke Damage And Chimney Height

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A Protest

To the Editor of Chemical & Metallurgical Engineering

SIR:—The American nation is, I am told, specially courteous to women. I take it therefore for granted that you will publish in full this letter.

Friends have put before me pages 776 and 777 of your journal for Oct. 18, 1922, and I am assured that your paper has a wide circulation among American engineers and chemists. To my great astonishment my cartoon which appeared in the *Fliegende Blätter* has been reprinted without my permission and has been explained at the same time in a way which excels the misrepresentations disseminated during the world war in the Northcliffe and other press of the former enemies of Germany. The following explanation of my satirical cartoon may suffice:

The *Fliegende Blätter* is an entirely non-political paper, which ridicules and condemns human weakness of every kind. Vox populi means the voice and judgment of the masses in *all* countries of the world. Nowadays people are generally not guided by leaders of a supernormal intellect, intelligence and very high qualification, but in the first instance the mind of the masses is dependent on the press, the influence of which is increasing everywhere.

The fallacy of human leaders is proved by the downfall of Woodrow Wilson in your country and Lloyd George in England, not to speak of the German leaders in 1914 to 1918. The press leading the masses is imbued with phrases and catchwords. The owners and governors of the press are rarely guided by ideals, but mostly by egoistic thoughts. The masses are like a flock of sheep (*Hammelherde*), who follow the guide-wether (*Leithammel*). In a great many countries the "Leithammel" of the press are "wolves in sheep's clothing," who feed the sheep with phrases and catchwords. This, my general impression of *all* countries, was pictured in my cartoon. I regret that such long interpretation is necessary to prove that the author of your article has not understood the proper meaning of the word "vox populi" and of my cartoon and that a journal of your position and reputation has published such wrong judgment of my country without consideration of the true state of affairs in *all* countries.

KÄTHE OLSHAUSEN-SCHÖNBERGER.

Munich, Germany.

EDITOR'S NOTE: We gladly grant space for our correspondent's explanation. Our interpretation of the cartoon still seems particularly fitting to conditions in Germany, where the masses have been exploited by a few industrialists.

Numbering of Steel

To the Editor of Chemical & Metallurgical Engineering

SIR:—It is curious how variously a piece of writing can be viewed. Your editorial of Dec. 27 leaves one of your correspondents dizzy from your persiflage, while to some others of us it appears to be a sensible constructive review of the situation.

The question of numbering or codifying steels is of considerable importance. But if it is to be discussed intelligently, every proponent of a numbering system should start by stating quite definitely the purposes to be served by the system.

To my mind there are two main spheres of usefulness for a numbering system:

(1) A manufacturer who makes machine parts and purchases semi-finished steel bars, blooms, etc., of various grades and desires to give each grade of steel a designation so that it may be readily recognized and referred to, to the end that the correct steel shall be selected and used for each part to be manufactured.

(2) A designer wishes to use on his drawings a simple notation which shall show the kind of steel to be used for each part.

These two applications are to a certain extent overlapping and in practice will be subject to many minor variations and developments. They do, however, show the essential characteristics required of any useful system of designating steels. Both uses lead eventually to the purchasing agent, and in this fact lies the necessity that the numbering system to be really useful must be perfectly definite. Suppose that under a system applied to our No. 1 purpose, the stock of a given steel is running low and the stock clerk requisitions 100 bars 4 in. square by 10 ft. long of XYX steel. The designation XYX is sufficient and satisfactory if it enables the clerk in the purchasing department to fill out as a matter of simple routine a request for bids or an order which will indicate without further question the steel required. To my mind this can be done only by having the symbol XYX represent a complete and definite specification. A symbol which merely indicates the general proportions of the principal elements is useless to the purchasing agent. To place his order intelligently he must have an open-or-shut specification on which he can accept or reject without argument.

Similarly for our No. 2 purpose. To fulfill the designer's needs the designation on the drawing must leave no doubt as to the properties of the finished piece. These must be so clearly expressed that it becomes a routine matter to select the raw material and to choose the processes it is to undergo to give the desired results. Again the symbol designating the steel must lead to a complete specification.

It is evident that for semi-finished material (our purpose No. 1) the numbering will in most cases lead only to a specification as to chemical composition, while for finished parts (our purpose No. 2) the specification must usually cover physical properties with some indication as to the chemical composition, but in both cases the numbering to be of practical value must give a concrete, definite account of the steel it describes.

LAWFORD H. FRY.

Standard Steel Works Co.
Burnham, Pa.

Studies on Graphite Crucibles

In order to investigate the crucible-making properties of American graphites as compared to foreign graphites, seven sets of crucibles, six to the set, were made by the Vesuvius Crucible Co., according to a formula furnished by the Ceramic station of the Bureau of Mines.

In arriving at this formula, the bond clays were varied and the Ceylon graphite kept constant. Crucibles made from the most promising mixes were tested in steel-melting practice at the Lockport, N. Y., plant of the Simonds Manufacturing Co. Some of the crucibles gave ten melts before failure, which is considered excellent practice.

Using the most promising mix of bond clays and graphite obtained in the above-mentioned tests, seven sets of crucibles were made up using seven different graphites and are now awaiting test. The graphites used were Ceylon, Madagascar, Alabama, New York, Montana, Texas and Canadian.

How "Asbestos-Protected Metal" Was Developed Commecially*

The Early Stages of Development and the Peculiar Problems Which Had to Be Solved Before the Product Became a Commercial Success—The Process of Manufacture—Some Still Unsolved Problems

BY J. H. YOUNG
Senior Industrial Fellow, Mellon Institute of Industrial Research, University of Pittsburgh, Pittsburgh, Pa.

THERE are two fundamental problems with which man has had to contend since time prehistoric. Man's first duty has been to provide food and his second to provide shelter. Accordingly, the general subject "building materials" is not one which is impressive by its newness; it is one which has been with us always and that always will remain. However, with the advent of the modern factory and chemical industry, there have come some novel phases of the subject which are of interest to the chemical engineer.

As a rule, the chemical engineer has busied himself with chemical processes and equipment and has given but little attention to the selection of the proper building materials to house his industry. This constructional task has been left to the architect; and although this specialist has conscientiously done his best and, as a rule, has made wise selections of his materials, his training does not fit him for meeting the many problems connected with the proper housing of the various and highly diversified chemical industries, without advice from those who should be peculiarly well qualified to render such aid—namely, the chemical engineers. In times past this advice has been neither sought nor offered. As one result, buildings containing much lead in their structures have been erected to house industries in which high concentrations of acetic acid prevail in the atmosphere. Concrete, copper, aluminum, zinc and steel —in fact, all building material—have limitations and have been used under conditions for which they are not adapted. Therefore the chemical engineer may quite profitably study the materials available for his buildings as well as those used in its equipment.

During the development and expansion of the steel industry corrugated steel sheets, either the so-called black-iron or the galvanized iron sheets, have come into very wide use as a roofing and siding material on industrial buildings. The comparatively short life of these sheets has led to the development of a number of useful roofing and siding materials for industrial buildings, each of which nevertheless leaves something to be desired. In other words, the perfect roofing and siding material is yet to be evolved. Among the comparatively new roofing and siding materials which have been developed is the so-called asbestos-protected metal and it is particularly with this product that this paper deals.

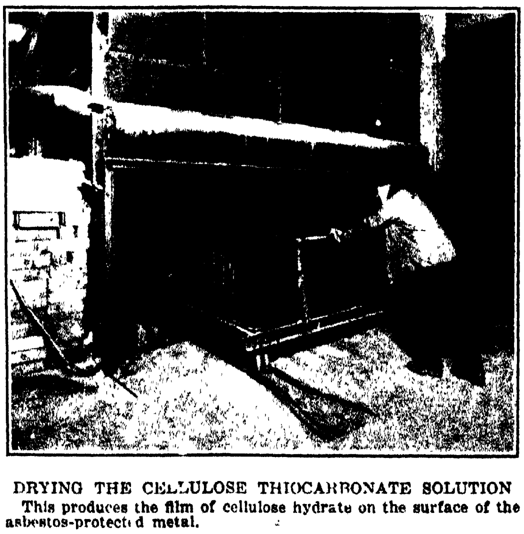
EARLY STORY OF ASBESTOS-PROTECTED METAL

The early history of many American industries teems with tales of struggles against great odds. The surviving manufacturers usually owe final success to the courage, faith and active optimism of a single individual who has never recognized defeat when he encountered it. Such has been the case with the asbestos-protected metal industry. Starting in 1905, at Canton, Mass., with an idea that a steel sheet could be protected from corrosion by dipping it in molten asphalt and then pressing a layer of asbestos felt on each side of the coated steel to protect the asphalt, H. H. Robertson stuck by his idea through thick and thin, and there was considerable thin until the present product was evolved.

As may readily be imagined, the original product was a failure, the asbestos felt rapidly washing from the sheet upon exposure and collecting in the roof gutters or on the ground. To overcome this difficulty, the asbestos felt was saturated with a waterproofing mixture, of which chinawood oil was the principal ingredient. The resultant product was considerable improvement over the original material and really gave pretty good service. However, the edges and ends of the steel sheet were unprotected, and this resulted in a weakness which was finally overcome by folding the felt over the edges of the steel.

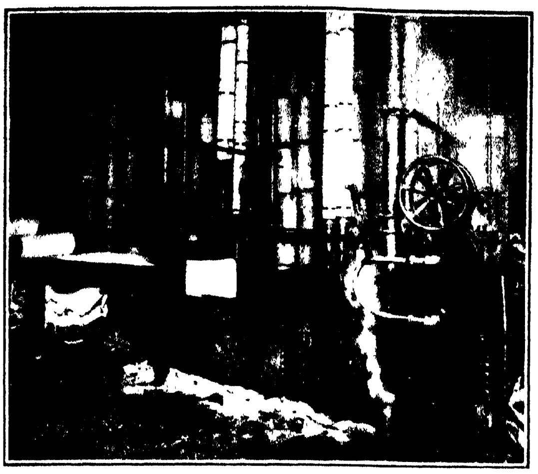
Commercial success was not achieved until 1909, when the late Dr. E. T. Newsome developed new machinery which made it possible to manufacture a product consisting of a sheet steel core covered with asphalt and wrapped in asbestos felt saturated with a waterproofing agent. This product of 1909 won commercial success, but although it had sufficient merit to warrant its sale, it was considered to be a long way from perfection. It may be added, though, that there are a number of installations of this 1909 product which still are serviceable.

Recognizing that improvements were possible in its product, the manufacturing company adopted the policy, which has since been adhered to, of utilizing a part of its resources each year in development work. As a result of the researches carried out during the period 1909-1916, the present product was worked out and pro-



DRYING THE CELLULOSE THIOCARBONATE SOLUTION
This produces the film of cellulose hydrate on the surface of the asbestos-protected metal.

*Paper presented at the Richmond meeting of the American Institute of Chemical Engineers, Dec. 6-9, 1922.



SATURATING ASBESTOS FELT

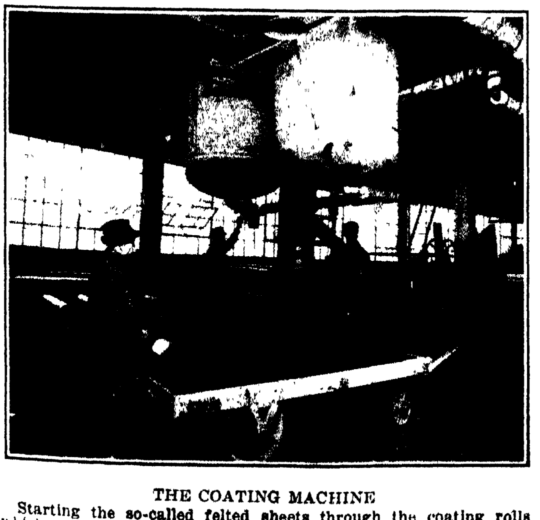
duced in 1916. This product differs from that of 1909 in that asphalt is used to saturate the asbestos felt and the felt layer itself is protected by a bituminous coating which retards the drying and hardening of the bituminous layers beneath, thus increasing greatly its weather-resisting properties.

The orignal asbestos-protected metal was made in Canton, Mass. In 1911 the company moved to Beaver Falls, Pa., and in 1916 the present factory at Ambridge, Pa., was occupied. Factories in Canada and England were then added.

What Is Required of Roofing and Siding Materials

Before taking up in detail the discussion of asbestos-protected metal, it is appropriate to present an opinion respecting the requisite essentials in the perfect roofing and siding material. When a roofing and siding material is referred to, there is meant the type represented, for instance, by corrugated galvanized iron which is used to cover the so-called skeleton type building.

It is believed that the perfect roofing and siding material, in order to meet various and complex requirements of roofing service, should have the following characteristics: (1) It should have strength; (2) it should be resistant to weathering; (3) it should be light in

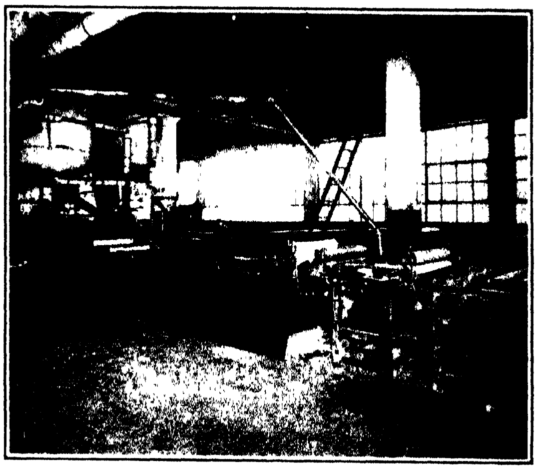


THE COATING MACHINE
Starting the so-called felted sheets through the coating rolls which put on the weatherproofing coat.

weight; (4) it should be adaptable to buildings of standard design; (5) it should have a low fire hazard; (6) it should have a low thermal conductivity; (7) it should be capable of conforming to any color scheme required; and finally (8) it should have a reasonable first cost and a low per year cost.

Since steel is the basis of asbestos-protected metal, the strength requirement is well taken care of. By choosing steel of the proper gage, it may be made to span successfully any purlin spacing ordinarily used. The weight of asbestos-protected metal is approximately 1.3 times the weight of galvanized iron. Being similar in form, strength and weight to ordinary corrugated steel roofing, it will span with a wide margin of safety all standard purlin spacings, and may be worked into flashings and other standard shapes. It is easily adaptable to the general run of mill buildings without the necessity of designing the buildings to meet any limitations of the roofing material.

In order to get a better idea of the durability of this product, it is necessary to describe the various protective coatings used over the steel and the methods of applying them. The first and most important bituminous coating is applied by pulling the clean steel sheet

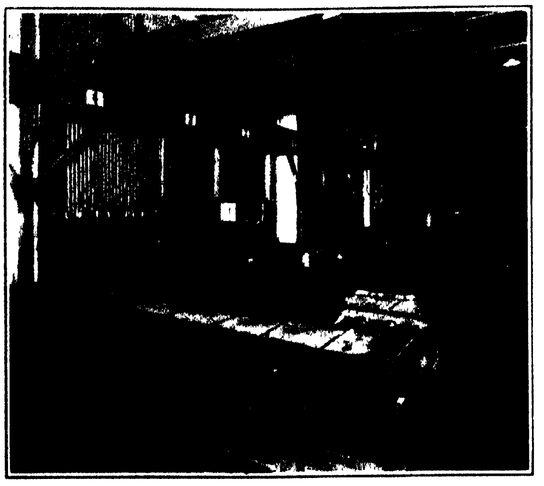


THE OTHER SIDE OF THE COATING MACHINE
Showing cooling tank for cooling the asphalt coating and the tank for applying the solution of cellulose thiocarbonate.

through a vat of the asphalt maintained at a temperature of 350 deg. F. The viscosity of the asphalt at this temperature is such that a uniform coating weighing about 16 lb. per square (100 sq.ft.) is put on the steel. As the coated steel emerges from this tank, asbestos felt, previously saturated with asphalt, is pressed on to both sides and folded around the edges of the steel, thus completely sealing it. The next operation consists of running the so-called felted sheets through coating rolls, which apply the top waterproofing coat. The coating rolls operate at a temperature of about 425 deg. F. The whole process is one in which no solvents are used, the asphalts being applied in a melted condition.

The asphalt used directly on the steel is an air-blown petroleum asphalt having a low susceptibility factor, being soft and adhesive at low temperatures, yet not flowing at temperatures reached on roofs, even in the tropics. It contains practically no mineral matter and is chemically quite inert, particularly toward acids and slightly less so toward alkalis.

The saturant for the asbestos felt is also an air-blown



FEEDING STEEL SHEETS INTO THE FELTING MACHINE

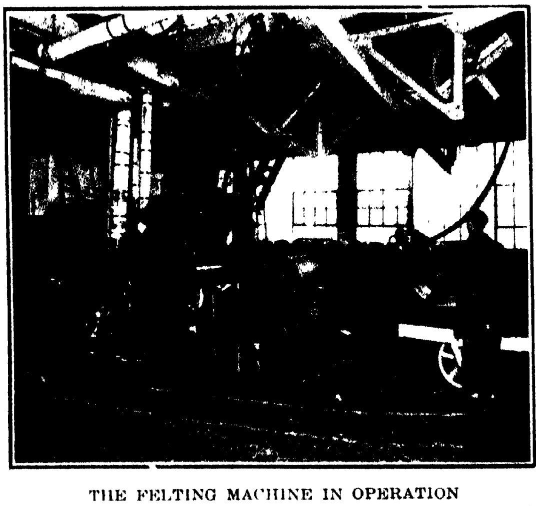
asphalt of the asphalt-base petroleum type, and it is also quite inert chemically.

The top or weather-proofing coating is a compounded bitumen, being of the so-called stearin pitch type. It is similar in composition to the best baking japan bases and withstands weathering conditions very well.

It is clear, then, that there are three layers, each of which is of bituminous composition and is of substantial thickness. The chemical nature of these compositions is such that they will resist a wide range of chemical conditions. Asphalt will resist the chemical action of a wider range of chemicals than any other commercial adhesive known at present. A study of the performance of the product under actual service conditions of all sorts and in all climates show that it is a relatively durable building material.

Fire Hazard and Corrosion

Regarding the fire hazard, since each square of metal has approximately 36 lb. of asphalt on it and since asphalt is combustible, there is a certain fire hazard involved in the use of the material. Where used on a roof, the hazard is of little consequence, because of the fact that burning embers and the like, falling on such a



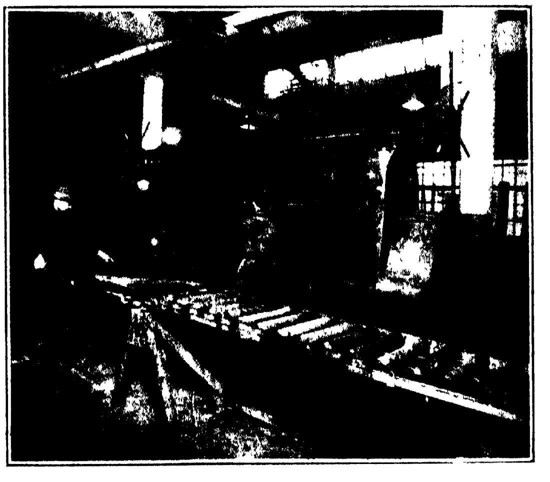
THE FELTING MACHINE IN OPERATION

The steel sheets travel through hot asphalt and upward through combining rolls which press asbestos felt onto both sides of the steel sheet and fold the edges of the felt around the steel, forming a continuous web.

roof, will fail to produce a spreading fire. In other words, the asphalt has such a low combustion rate that the heat is dissipated upward too rapidly to keep the film burning and the fire is localized at the spot where the ember falls. In case of a side wall a fair-sized fire at the base may ignite the coating, and the coating under favorable conditions will continue to burn upward until the roof is reached; but the damage done consists of the loss of the protection to the steel sheets, which may still give some service if painted.

While the fire hazard of a roofing and siding material is an important factor to be considered, it is interesting to note that the loss from so-called slow burning or corrosion is several times as large each year as the loss from fire. One gains much food for thought in looking over the long list of so-called fireproof buildings which have burned each year. Truly the fire hazard is important, but the corrosion hazard is of equal if not greater importance.

In general, it is quite important to have a roofing and siding material with a low thermal conductivity, because a building housed with such material is heated with less



THE CORRUGATING MACHINE

expense in the winter and is cooler in the summer and also because it transmits sound less readily, as a rule. Asphalt is among the very best non-conductors of heat, and it is safe to say that the material under consideration is as poor a conductor of heat as any material of equal thickness used for roofing and siding purposes. Its deficiency lies in the fact that it is not very thick; but in actual practice it compares very favorably with ¼ in. pine wood in so far as heat loss is concerned.

The Problem of Color

Coming now to the subject of painting or producing various color effects on or with it, it is confessed that, outside of dark colors, such as maroon, dark green and brown, it has been impossible to produce colors satisfactorily, either by painting or by incorporating pigments in its outside coating. White or light-colored drying oil paints or enamels, when used over bituminous surfaces, become discolored by dissolving the dark bituminous coating; then, too, the paint films tend to distort the underlying bituminous material, producing an effect commonly termed "alligatoring." If a priming coat of shellac or other similar gum is applied to a bituminous surface, a drying oil paint may then be put on without becoming discolored, but, upon exposure, cracking and

"alligatoring" take place. For interior finishes a fairly satisfactory result is obtained by the shellac priming-coat method, provided either a cold-water paint or a drying-oil paint is used over the shellac. A Manila copal spirit varnish may also be used as a priming coat. A cellulose nitrate lacquer has been developed in which alcohol is the principal component of the solvent. This lacquer is satisfactory as a priming material, and with aluminum or bronze powder it will produce a satisfactory light- and heat-reflecting finish that weathers fairly well, without cracking or distorting the coating. It may be seen that, although it is possible to produce several light color effects, they are all more or less of the makeshift variety. It is true, however, that on the vast majority of buildings of the type covered by similar materials dark colors are not objectionable; indeed, they are often preferred.

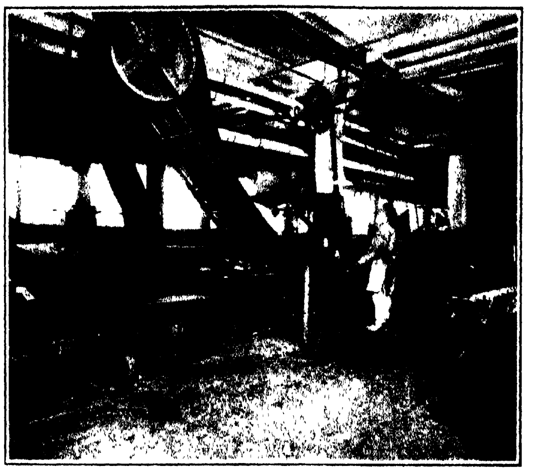
Taking up finally the factor of cost, it may be said that asbestos-protected metal compares very favorably in first cost and in per year costs with material used for the same purpose. Erected, it costs from one and one-half to two times as much as painted galvanized iron; but on a per year basis the cost will average very much below that of painted galvanized iron, when its low maintenance cost is considered.

Summarizing the characteristics of asbestos-protected metal, it may be stated that it is strong, durable, adaptable and light in weight, and has a fairly low thermal conductivity. It has a certain fire hazard, and is not capable of being painted satisfactorily with drying-oil paints. It has a relatively low first cost and a low per year cost.

Some Research Problems, Solved and Unsolved

In the development of any industry it is natural to expect a variety of problems to arise, and often they come from quarters least expected and at most inopportune times. One such problem appeared when the present type of asbestos-protected metal was first marketed. It was found that, even though a very high melting-point asphalt had been used as the top weatherproof coating, the sheets, when piled flat and shipped to southern and even northern points, would stick together firmly. All sorts of fine powders were used as surfacing materials to attempt to eliminate the difficulty, but with little success. The research finally developed a viscose solution which could be used to coat the sheets, and this worked successfully. As you are reminded, viscose is the term applied to solutions of cellulose thiocarbonate. Heretofore, these solutions have been used largely to produce artificial silk. To prepare viscose, cellulose in the form of cotton or wood pulp is treated with caustic soda and carbon bisulphide under proper conditions to form a water-soluble compound. Viscose, when heated or treated with salt or acid solutions, decomposes to form a so-called regenerated cellulose. This regenerated cellulose has lost its fibrous structure and is clear.

By running sheets through solutions of viscose, they become coated therewith. The sheets then are dried at a temperature of about 120 deg. F., which results in the decomposition of the viscose to form cellulose hydrate. Inasmuch as the viscose on the sheets is in the form of a thin film, the regenrated cellulose hydrate produced is in the form of a thin colorless film, which completely covers the surface of the asphalt. This film prevents contact of bituminous surfaces where the sheets are piled and, as a result, the sheets do not stick together.



CUTTING THE CONTINUOUS WEB INTO INDIVIDUAL SHEETS

Another problem which has received quite a little research attention has been the fire hazard of the product. This problem has finally been solved and the product has been accepted as equal to steel sheets as a fire risk in factories by insurance companies interested in fire risks of factory buildings. This result has been obtained by using asphalt containing hexachlorinated naphthalene as the saturant for the asbestos felt. It is found that, when this procedure has been followed and the sheet is exposed to a fire, the non-combustible vapors of the chlorinated naphthalene dilute the vapors of the asphalt to such an extent that the whole will not support combustion and consequently a fire is localized in so far as the sheets are concerned.

There is in addition the problem of painting bituminous surfaces, and, as has been pointed out, its solution is not yet at hand. One very interesting development has been that of coating such surfaces with various metals to form adherent and coherent films. This may be accomplished either by depositing a thin layer of metal on the surface of the asphalt electrolytically or by spraying molten metal thereon. Although this work is very much in the developmental stage, hopes are entertained for its successful future. The product of this procedure may be varied so as to meet different chemical conditions—for example, the lead-coated product will undoubtedly give excellent service under conditions in which oxides of sulphur are the corrosive agents. The zinc-coated product is of pleasing appearance, and any of the metallized surfaces may be painted over satisfactorily with any drying-oil paint. Such products are easily handled, stored and shipped, and are admirably adapted to tropical use. Another interesting product results from the use of granulated slate or minerals of different colors as an outside surfacing material to produce different color effects.

In conclusion, emphasis is put on the fact that the future development of industries is going to be more and more along chemical lines. In fact, the large manufacturing centers are becoming large chemical laboratories. The building materials of the future must successfully withstand these widely various chemical conditions and the development of such building materials is a problem of prime importance to the chemical engineer. It is hoped therefore that this paper will serve to stimulate his interest in the general subject.

How Can Financiers Prevent Industrial Overexpansion?

The Closer Co-operation of the Engineer and the Financial Man Is Suggested as a Practical Solution to This Problem

BY IVAR J. MOLTKE-HANSEN
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THE enormous development of the world's productive capacity in many chemical and electrochemical industries spells ruin to a great many undertakings and heavy losses to banks and shareholders. Is anybody responsible for this result? Who gave the starting signal for this wild rush of capital investment in these special lines? Of course, these industries are not the only ones to suffer from an overdevelopment after the war—for instance, in shipping one sees a similar overproduction of carrying capacity.

The common reasons of these great efforts are easily established and universally familiar: the war, the call for independence of each country or group of countries in the production of important commodities and finally much easily earned money, which called for investment. Yet ought not a great deal of this investment in impossible enterprises to have been avoided? I do not now deal with imperfect construction in certain of these war-time industries, nor with the recklessness in placing contracts for construction, which led to absurd wages for manual labor in many instances. What I want to get at is the fundamental relationship among bankers, promoters of industrial schemes and the engineering fraternity.

THE OLD CRY, "LACK OF TECHNICAL CONTACT"

It appears that this all-important relationship is very casual and has been very little cultivated in most countries till now, with a few exceptions. Bankers have as a rule very little insight into the chemical and allied industries and can hardly be expected to have this special knowledge. Promoters are too often without any special practice and knowledge of actual working conditions in the industries which they propose to establish and still less in their commercial aspects. But even when such knowledge exists the interests of promoters lead to an overemphasis of the optimistic sides of a proposed undertaking. The neutral and well-informed body of college and university professors and first-rate consulting engineers is either not called in at all or only too late and with a very restricted field of action. They are perhaps requested to express themselves on the strictly technical aspect or in a case of arbitration between a company and its technical leaders or advisers and in cases of patent questions and the like.

But the evil lies, in my opinion, at the very root of things. There is insufficient control at the very beginning or even before the beginning of *new industries*. Banking concerns, interested in company promotion or in lending money to industries, ought to have a much more thorough grasp on the whole situation than is now generally the case before committing themselves to industrial schemes. I should not have raised these questions merely to criticise existing conditions if I did not think there was a remedy for the evil. The salvation lies in a competent engineering department on logical and well-defined lines in every banking concern dealing with promotion work. Here and there one may hear of advisory engineers being appointed by one or the other bank. But comparatively seldom is the position of considerable importance.

Of all the various engineering departments of commercial banks which have come to my notice, there is one in a big Belgian bank which seems nearly perfection. I am not entitled to make its organization known publicly, but may say that it corresponds to the technical department of a big industrial enterprise. An adequate, well-equipped personnel under an experienced manager is able to cover those fields in which the bank is interested. An adequate technical library with scientific and technical periodicals and other branches of service necessary to a proper investigation of technological projects has also been established. The industrial clients of the bank are carefully watched as long as the bank takes an interest in them. The technical and financial control is serious and concerns itself with no other intention than to secure the safe development into fuller independence of the concerns in question, the degree of patronage being graded according to the needs of each case individually. The financial management of the bank is very well satisfied with the operation of its technical department, which after a short time became self-supporting through a system of modest working charges on services rendered to the various industries dependent on it.

TANGIBLE RESULTS OF A REAL SYSTEM

Such an organization secures fair treatment all around. Promoters will have confidence in submitting their propositions to such an impartial body; investors will know that an invitation to subscribe to a new company, whose working plans have been approved by his bank's technical service, offers the maximum safety.

The bank management will feel that no diversity of interests exists between the technical report of its own engineers and the policy of the bank and finally that the bank enters into no engagement with shut eyes as to what the undertaking may ultimately lead to in regard to capital outlay. The sad results in many countries of the war and post-war activity in promotion or extensions prove too well that in this field ignorance is not bliss. Any bank adopting the policy of full technical and commercial research of any industrial proposition put before it by its trained staff of experts will certainly in the end find that knowledge is power.

A conversation I had with my late friend Prof. Joseph W. Richards in September, 1921, on these questions made me believe that also in America things might be improved in this respect: the important and neglected rational relationship between the engineer and the banker. And to sum up my impressions and the experiences which have come to my knowledge: Much of the financial disaster from overproduction capacity after the war might have been avoided, had the banks and the financiers had at their disposal a well-established, technical service forming an integral part of their business outfit, somewhat on the lines indicated in the Belgian bank.

Drastic examples may be called in to witness the truth of this observation, which on reflection may seem so obvious to many as to be compared with the famous egg of Columbus. Yet it is one thing to admit the truth of a statement, another to conquer the inertia of long-established neglect and reliance on the rule-of-thumb methods. **The vital need of the hour calls for more exact businesslike and scientific treatment of the problems of the right relationship among capital, industrial initiative and engineering.**

The Resolution of Petroleum Emulsions

By Harold V. Dodd
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The factors controlling the stability of emulsions in general have been thoroughly studied during the last 20 years, and the results of these studies were admirably presented and reviewed in some recent articles.[1] In this paper, therefore, the discussion of the theory of emulsification will be very brief.

Substances Soluble in Both Phases Are Found to Be Effective Agents for Breaking Down Crude Oil Emulsions, Providing Very Small Amounts of Acid Such as Sulphuric Are Also Introduced. The Mutually Soluble Substances, of Which Phenol Proved the Most Satisfactory of Those Tested, Conveys the Acid Through the Enveloping Oil to the Dispersed Water. It Has Also Been Found Advantageous to Use a Certain Amount of Heat During the Reaction

The Two Classes of Emulsifying Agents

A stable emulsion between two immiscible liquids is possible only in the presence of a third substance, the emulsifying agent, which collects at the interface and forms there a coherent film. There are two kinds of emulsifying agents—namely, those that are apparently soluble in one phase of the emulsion, and those that are insoluble. Investigation has shown that the apparently soluble emulsifying agents are actually colloids. The insoluble emulsifying agents are finely divided solids that have the property of collecting at the interface between the two liquids.

The only difference in the behavior of the two classes of emulsifying agents is that the colloids lower the interfacial tension, and it is generally supposed that the insoluble emulsifying agents do not. Lowering of interfacial tension undoubtedly promotes emulsification, but is not essential. The essential property of an emulsifying agent is its tendency to collect at the interface and form a coherent film, which prevents coalescence of the globules of the dispersed phase. If the emulsifying agent is water-soluble (a hydrophile colloid), or is more readily wet by water than by oil, the aqueous phase will be external; if it is oil-soluble (a hydrophobe colloid), or is more readily wet by oil, the oil phase will be external.

It has been claimed that ions adsorbed upon the globules of the dispersed phase will act as emulsifying agents, but there seems to be no satisfactory evidence that a true emulsion has ever been produced without the presence of a solid or colloidal emulsifying agent. There is no doubt, however, that the static charge on the globules of the dispersed phase, whether due to ion adsorption or to other causes that are not thoroughly understood, often increases the stability of an emulsion to a considerable extent.

The Emulsifying Agent in Petroleum

All crude petroleum emulsions are of the water-in-oil type, and we, therefore, know that the emulsifying agent must be some oil-soluble colloid, or some finely divided, insoluble solid that is more readily wet by oil than by water. Crude petroleum contains heavy hydrocarbons, such as asphalt, asphaltenes, etc., which are probably present in colloidal solution and could reasonably be expected to act as emulsifying agents.

Sherrick[2] suggests the importance of these asphalt-like bodies in the formation of petroleum emulsions, but since not all asphalt base oils emulsify easily, he thinks these colloidal substances are not, alone, effective as emulsifying agents, but must first be adsorbed upon hydrated earthy material, which is thus changed from a water-soluble to an oil-soluble colloid. This does not seem probable, because the conditions cited by him as favorable for the formation of such a colloid are not likely to have been of wide occurrence, and also because many emulsions contain little or no earthy material.

Furthermore, such an assumption is not necessary—the nature of the solution of the asphalt-like bodies in the crude oil probably depends upon the ratio of light fractions to lubricating fractions, and consequently the tendency to emulsify should be expected to vary; as the dispersion approaches that of true solution the tendency to emulsify should be expected to decrease. In every case that has come to the writer's attention, dilution with gasoline has made the emulsion more difficult to break. This indicates that the degree of dispersion of the asphalt-like bodies is more favorable for emulsification in light fractions than in heavy.

Asphalt in Oil-Field Emulsions

To test the effectiveness of asphalt as an emulsifying agent, the writer prepared some emulsions of distilled water dispersed in gasoline solutions of asphalt of various concentrations. The asphalt used was a refined product sold by the Standard Oil Co. of California under the name of "asphaltum cement." The emulsions were prepared by placing 50 cc. of water and 100 cc. of asphalt solution in 500-cc. graduated cylinders and agitating for 2 minutes by means of a 1½-in. propeller revolving at 3,500 r.p.m. When the concentration of asphalt in gasoline was 0.05 per cent by weight, no emulsion was produced; when the concentration was 0.1 per cent, 20 cc. of water was emulsified; when the concentration was 0.2 per cent or more, all of the water was emulsified.

These emulsions settled to the bottom of the excess gasoline within a short time and formed a compact, brown mass. They stood in the laboratory for 3 weeks, and at the end of that time none of them showed any tendency to break. Their extreme stability was shown by the fact that when a 25-cc. sample was shaken with 75 cc. of clean gasoline and the mixture centrifuged for 5 minutes, the same compact emulsion, slightly lighter in color, was thrown down instead of water. This procedure was repeated several times on the same sample with no results other than some change in color. An emulsion similar in appearance and similar in reaction to this test was obtained from an oil-field emulsion by diluting with gasoline and centrifuging.

Crude petroleum is said to contain traces of saponifiable organic acids. If this is a fact, it is reasonable

[1] Emulsification Symposium: *J. Ind. Eng. Chem.*, vol. 13 (1921), pp. 1008-1017, 1116-1123.

[2] *J. Ind. Eng. Chem.*, vol. 12 (1920), p. 133; vol. 13 (1921), p. 1010.

to expect oil-soluble soaps, which might act as emulsifying agents, but the amount of these would be so small, if present at all, that they may be neglected.

It is quite apparent that asphalt-like bodies, under certain conditions of solution, are very effective emulsifying agents. Since they are present in considerable amounts in all Western crude oil, it is safe to assume that they are responsible for the oil-field emulsions.

Breaking Emulsions Chemically

There are two antagonistic forces at the interface between the phases of an emulsion—namely, (1) surface tension, which tends to cause coalescence, and (2) the coherence of the film of emulsifying agent, which tends to resist coalescence. The stability of an emulsion depends upon the relative magnitudes of these opposing forces. If the coherence of the film of emulsifying agent is so great that surface tension is unable to rupture it, the emulsion is permanent. Thus it is evident that there are two general methods by which the stability of an emulsion may be decreased—first, by an attack upon the emulsifying agent, and second, by increasing the surface tension at the interface.

Chemically, the attack upon the emulsifying agent may be made by destroying it, or by converting it into an ineffective form. The ideal method, of course, is to destroy it and thus give surface tension, however small, an unrestricted opportunity to cause coalescence, but this is frequently impossible or impracticable. To convert the emulsifying agent into an ineffective form, a substance may be added that dissolves it and thus removes it from the interface; or one that flocculates it to such an extent that a coherent film is no longer formed; or one that tends to form the reverse type of emulsion—a counter-colloid.

In most, if not all, emulsions there is an electric charge upon the globules of the dispersed phase. According to Sir Oliver Lodge[3] an electric charge on a drop causes a slight distending force which tends to diminish surface tension; this tendency is vastly increased as the drop grows smaller, because surface tension varies inversely as the simple diameter of the drop, while the electric tension varies inversely as the fourth power of the diameter; hence, when a certain minimum size is reached, the two opposing tendencies become equal and the drop behaves as if flat. Lewis[4] used this idea as a basis for a theory of emulsification which, while seeming to fit the facts in many ways, does not seem capable of proof.[5] It is safe, however, to assume that the electric charge upon a globule of the dispersed phase of an emulsion materially reduces surface tension, and that if the charge is large (probably due to adsorbed ions of electrolytes in solution in the water) it may contribute to the stability of the emulsion to a considerable extent. In some such cases the neutralization of the electric charge results in the increase of surface tension to such an extent that the film of emulsifying agent is no longer able to prevent coalescence.

In many emulsions a marked lowering of surface tension is due to an inherent property of the emulsifying agent, and it can be increased only by destroying or modifying the latter. In view of the foregoing it becomes increasingly apparent that in order to control intelligently the breaking of an emulsion it is necessary first to determine the nature and properties of the emulsifying agent.

Previous Work on Petroleum Emulsions

In the case of crude petroleum emulsions, the emulsifying agent (asphalt) cannot be destroyed. Hydrophile (water-soluble) colloids that are strongly interfacial should, however, render it ineffective, because of their tendency to form emulsions of the reverse type. Considerable success appears to have been attained with this class of compound[6] in the mid-continental fields, but it is far from a universal remedy. The great difficulty lies in conveying the aqueous solution of the colloid through the enveloping oil to the dispersed water, which it must reach in order to be effective. As far as known, this method has not proved successful on emulsions from California fields. The latest development along this line is the "oil-soluble" hydrophile colloid.[7] This should be more effective.

While experimenting upon an emulsion from a Texas field Sherrick[8] found that the water globules carry a negative electric charge and that the water can be precipitated by neutralizing this charge. He also found that the efficiencies of acids in neutralizing the charge are directly proportional to their hydrogen ion concentration—thus, in order of efficiency: hydrochloric, sulphuric, acetic acids—and that other electrolytes with strongly adsorbed positive ions also neutralized the charge and precipitated the water, notably ferric chloride and ferric nitrate. He also reported that the extent to which the negative ion is adsorbed simultaneously with the positive ion is of considerable importance.

Early Experiments

The first work done on petroleum emulsions by the writer was an attempt to repeat some of Sherrick's experiments, using an emulsion from the Midway-Sunset field of California. It was easy to prove that the water globules carry a negative charge. When a sample of the emulsion was put into a U-tube and a direct current of 250 volts impressed upon it by means of an electrode in each arm, the arm containing the positive electrode became black, and the one containing the negative electrode became lighter brown in color than formerly. On the positive side the negative water globules had migrated to the electrode, leaving the pure black oil against the glass; on the negative side the water globules were repelled to the glass, where their increased concentration resulted in the lighter brown color.

When the acids were tried, it was found that their order of efficiency was the reverse of that found by Sherrick, and that considerable heat and time were necessary in all cases. Sulphuric acid combined with the oil and, therefore, would not work at all. Hydrochloric acid in high concentrations caused some precipitation of water. Acetic acid precipitated the water most completely, in the least time and with the least amount of heat.

Ferric chloride and ferric nitrate solutions were merely incorporated in the emulsion. Some other salts, such as ferric sulphate and calcium chloride, caused some minor coalescence of the water globules after long heat-treatment. On the whole the action of electrolytes

[3]"Modern Views of Electricity."

[4]*Z. Kolloid.*, vol. 5 (1909), p. 91.

[5]Bancroft, *J. Phys. Chem.*, vol. 16 (1912), p. 210.

[6]Notably a chemical sold under the trade name of "Tret-O-Lite." This preparation was not tested in this laboratory because the manufacturers refused to send a sample for that purpose.

[7]Ayres, E. E., *J. Ind. Eng. Chem.*, vol. 13 (1921), p. 1011.

[8]*J. Ind. Eng. Chem.*, vol. 12 (1920), p. 133.

alone, on California emulsions, was not sufficient to encourage further investigation.

However, it was later found that if a substance that is soluble in both phases of the emulsion is added with the acids, the efficiencies of the latter are as found by Sherrick. The use of this class of substances as an aid in the resolution of crude petroleum emulsions is the principal subject of this paper.

Selection of Oil-Soluble Substances

Since the asphalt film around the water globules behaves as if it is, to all intents and purposes, insoluble in both phases, it was decided to conduct a search for some oil-soluble substance small amounts of which would destroy, or at least greatly modify, this film and thus permit the water globules to coalesce. In the preliminary experiments it happened that of the first three tried, one was practically insoluble in water, one slightly soluble and the third soluble to a considerable extent. The results seemed to be in proportion to this solubility, and therefore the series in the following table was tried in order to determine if any such generalization could be made.

In each case 2 cc. of the substance was added to 20 cc. of emulsion containing 25.6 per cent of water by volume, in a 100-cc. centrifuge tube, and heated to 45 deg. C. Each tube was then shaken by hand for 1 minute, and then kept at a temperature of 45 deg. C. for 3 hours. After this period it was centrifuged for 5 minutes by means of an electric centrifuge, and the amount of water thrown down noted.

Chemical	Solubility in 100 cc. Water, Grams	Water Precipitated, cc.
Carbon tetrachloride	0.08	0.0
Amyl nitrite	1 2	0 1
Fusel oil	3.0	4 8
Aniline	3.5	5.0
Butyl and propyl alcohols (mixed)	5.0	5.0
Ethyl acetate	8.6	0 5
Acetone	All proportions	1 5
Butyric acid	All proportions	6.0

The solubilities given above for amyl nitrite, fusel oil and the butyl-propyl alcohol mixture are rough determinations made in this laboratory, but are sufficiently accurate for the purpose. It is quite apparent that the effect of oil-soluble substances cannot be predicted by their solubility in water alone; other properties are also important—probably, chiefly, the extent to which they will mix with asphalt, and the presence of a strongly adsorbed positive ion. It was concluded, however, that no oil-soluble substance is likely to have a marked tendency to aid in the breaking of an emulsion unless it is also water-soluble to a considerable degree. This conclusion in regard to mutual solubility has been proved sound by the results of all experiments later performed.

Acidified Mutually Soluble Substances Effective

It will be remembered that of the acids tried upon this emulsion, acetic was decidedly the most effective—it is undoubtedly somewhat soluble in the oil. The action of butyric acid, which is miscible in all proportions with both phases, is rapid and complete. This led to the idea of conveying a readily adsorbed positive ion through the enveloping oil to the water globules by means of a mutually soluble substance. The first application of this idea was made with acidified fusel oil.

In the following tests 100 cc. of emulsion was treated with 5 cc. of acetic acid and fusel oil in the various proportions shown in the following table. The mixtures were placed in 500-cc. graduated cylinders, agitated for 2 minutes by means of a 1½-in. propeller revolving at 3,500 r.p.m., and then heated to 45 deg. C. for 24 hours on a steam radiator. After 24 hours the condition of the emulsion in each case was noted.

Chem. Mixture 5 cc. Acid	Fusel Oil	Results
5	0	Emulsion slightly darker in color.
4	1	Green-black color; perceptible coalescence of water into globules at bottom of cyliner.
3	2	Same as above, but globules of water very much larger—up to 1/16 in. diameter.
2	3	In addition to very large globules, some water precipitated.
1	4	Practically complete precipitation of water.
0	5	Emulsion slightly darker in color.

Untreated petroleum emulsion is chocolate-brown in color. When the water globules coalesce to macroscopic size, the color changes to black. Thus a color change is an accurate indication of a change in degree of dispersion of the water.

This experiment showed that a small amount of acetic acid in the presence of a mutually soluble substance is far more effective in breaking petroleum emulsions than either chemical alone. Similar experiments, in which the actions of acetic, hydrochloric and sulphuric acids were compared, resulted in concurrence with Sherrick's conclusion that acids that ionize readily are most effective.

Tests With Phenol

A search was made among the organic compounds for mutually soluble substances, with the hope that something cheap, and effective in minute amounts, would be found. Phenol proved to be the most suitable substance encountered. The following standard manipulation was adopted for its thorough testing.

The Emulsion—The emulsion used in these tests was obtained from the General Petroleum Corporation, Taft, Calif. The gravity was 19 deg. Bé. and the emulsion contained 35 per cent of water by volume—thus each sample of 150 cc. contained 52.5 cc. water.

Sample—150 cc. of emulsion in a 500-cc. graduated cylinder.

Chemicals—As indicated in the tables of results.

Heat—50 deg. C. in a water bath for 1 hour before the addition of the chemicals and agitation, and for 2 hours after. The heat was turned off at the end of this period, but the samples were left in the water bath while it was cooling. A circular tank 2 ft. in diameter and 8 in. deep, filled with water to depth of 6 in., was used for the water bath.

Agitation—Two minutes with a 1½-in. propeller, revolving at 3,500 r.p.m., unless otherwise stated in the table.

Twenty-four Hours After Agitation—The samples were heated in the water bath to 50 deg. C. The purpose of this heating was to make the oil more fluid so that it could be handled with a pipette readily, but it also undoubtedly had some effect upon the emulsion. Then the top 50 cc. of each sample was withdrawn with a pipette, diluted with 50 cc. of gasoline, and centrifuged for 5 minutes to determine the water content of this layer. Part of the water often came down as an emulsion, therefore both free water and emulsion were recorded. (Column No. 1 in the tables which follow.) The remainder of the sample was slowly stirred with a glass rod, and the amount of free water in the bottom of the cylinder noted. (Column No. 2.) The purpose of the stirring was to cause the large globules of free water to coalesce and settle.

Constant Factor—When there was a constant factor other than those already stated, it is stated at the top of the table.

Color Change—The untreated emulsion is brown and the clean oil is black. Experience has shown that a darkening of color indicates coalescence of the water globules.

The phenol used in all the experiments was made liquid by the addition of 15 per cent of water.

TABLE I—EXPERIMENTS HAVING AS A CONSTANT FACTOR—1 CC. PHENOL

Variable Factor	1 Top 50 cc. Water cc.	1 Top 50 cc. Emulsion, cc.	2 Free Water in Cylinder cc.	Color Change
H_2SO_4, 4	0	0.05	55*	Black
H_2SO_4, 3	0	.05	55*	Black
H_2SO_4, 2	0	0	55*	Black
H_2SO_4, 1	trace	2	52*	Black
H_2SO_4, 0 5	0	18	53*	Black
H_2SO_4, 0 4	0	15	52*	Black
H_2SO_4, 0 3	0	1	50*	Black
H_2SO_4, 0 2	0	05	45*	Black
H_2SO_4, 0 1	2	2 3	0†	Black
H_2SO_4, 0 1	.5	1 3	0‡	Black

* Water acid to litmus paper

† Water obtained by centrifuging a sample of oil from the bottom of the cylinder had a very slight alkaline reaction

‡ Water obtained by centrifuging was very slightly acid to litmus paper

TABLE II—EXPERIMENTS HAVING AS A CONSTANT FACTOR—0 02 CC. H_2SO_4

Variable Factor cc	1 Top 50 cc Water, cc	1 Top 50 cc Emulsion, cc	2 Free Water in Cylinder cc	Color Change
Phenol, 1 0	0	0 5	50	Black
Phenol, 0 75	trace		50	Black
Phenol, 0 50	trace		5	Black
Phenol, 0 25	0	17 5	0	Very slight

TABLE III—EXPERIMENTS HAVING AS A CONSTANT FACTOR—0 5 CC. PHENOL

Variable Factor, cc	1 Top 50 cc Water, cc	1 Top 50 cc Emul., cc	2 Free Water In Cylinder, cc	Color Change
H_2SO_2, 0 2	trace		trace	Black
H_2SO_4, 0 4	trace		40	Black
H_2SO_4, 0 6	trace		48	Black
H_2SO_4, 0 8	trace		50	Black
Experiments having as a constant factor 0 25 cc phenol				
H_2SO_4 0 2	0	20 0	0	Black
H_2SO_4 0.4	0	5 5	0	Black
H_2SO_4 0 6	trace		15	Black
H_2SO_4 0.8	trace		15	Black

TABLE IV—RESULTS OF TREATING SLUDGE WITH PHENOL AND ACID

Variable Factor, cc.	1 Top 50 cc Water, cc	1 Top 50 cc Emul., cc	2 Free Water In Cylinder, cc	Color Change
Phenol, 0 75; H_2SO_4, 0 3	0	0	5	Black
Phenol, 0 75; H_2SO_4, 0 6	0	0	45	Black
Phenol, 1 0; H_2SO_4, 0 3	0	0	47	Black
Phenol, 1 0; H_2SO_4, 0.6	0	0	50	Black

It is quite apparent from the results tabulated in Table I that the emulsified water was alkaline and that enough acid was required to make it distinctly, but not necessarily strongly, acid.

Having determined the minimum amount of sulphuric acid that would give good results, the tests reported in Table II were made to see to what extent the amount of phenol could be cut down.

Thus the minimum amount of chemicals that could be used and still get good results was 0.75 cc. of phenol plus 0.2 cc. of sulphuric acid to 150 cc. of emulsion. This is an incomparably smaller amount than is necessary when acid alone is used, and the time and heat necessary are also much less.

The rapid increase in the amount of acid necessary to produce a separation when the amount of phenol used was cut down is shown in Table III.

The heavier oil fractions were removed from a quantity of emulsion by diluting with gasoline and centrifuging. This resulted in a "sludge" containing about the same amount of water (35 per cent) as the original emulsion, but differing from it in that the water was suspended in impure gasoline instead of in crude petroleum. Table IV shows the results obtained when some of this sludge was treated with phenol and acid in the

TABLE V—TESTS WITH KEROSENE ACID SLUDGE

Variable Factor, cc.	1 Top 50 cc. Water, cc.	1 Top 50 cc. Emul., cc.	2 Free Water In Cylinder, cc.	Color Change
Sludge, 5 0	trace		50	Black
Sludge, 4 0	trace		43	Black
Sludge, 3 0	trace		43	Black
Sludge, 2 0	trace		43	Black
Sludge, 1 0	trace		25	Black
Sludge, 0 5	No apparent change in emulsion.			

usual manner. It will be noted that it does not respond to treatment as readily as ordinary petroleum emulsion. This tends to substantiate the opinion expressed earlier in this paper, that the efficiency of asphalt as an emulsifying agent probably depends upon the nature of the oil in which it is dissolved.

Acid Sludge Studies

Refinery acid sludge is a complex byproduct obtained when petroleum distillates are purified with sulphuric acid. Besides acid, it is said to contain aromatic compounds and other organic substances some of which might be expected to be soluble both in oil and in water. It was therefore decided to test this sludge. Kerosene acid sludge was used.

In all cases the free water that settled out was acid to methyl orange; when only 1 cc. of sludge was used, this acidity was very slight. In all cases, except the last, the oil was tested for acidity (after the free water had settled out) and found to be acid to methyl orange. The test was made by shaking distilled water with the oil, and then centrifuging the water out and testing it with methyl orange.

By titration with a standardized solution of sodium hydroxide, 1 cc. of the sludge was found to be equivalent in acidity to 0.4 cc. of sulphuric acid. It is apparent from the results shown in Table V that something besides the acidity of the sludge is active in precipitating the water from the emulsion; an equivalent amount of sulphuric acid will not produce comparable results unless phenol is also present. This probably is due to the mutually soluble substances in the sludge. When the content of this class of compounds was increased by the addition of varying amounts of phenol, it was found, as shown in the tables to follow, that the acid sludge could be reduced to an amount roughly equivalent in acidity to the minimum effective amount of sulphuric acid.

TABLE VI—ACID SLUDGE EXPERIMENT USING VARYING PROPORTIONS OF PHENOL

Variable Factor, cc	1 Top 50 cc Water, cc	1 Top 50 cc Emul., cc	2 Free Water In Cylinder, cc	Color Change
Constant Factor—0 75 cc Phenol				
Sludge, 2 0	0	0	50*	Black†
Sludge, 1 5	trace		50*	Black†
Sludge, 1 0	trace		50*	Black†
Sludge, 0 5	trace		50*	Black†
Sludge, 0 4	trace		50*	Black†
Sludge, 0 3	trace		40*	Black†
Sludge, 0 2	trace		10‡	Black†
Constant Factor—0 50 cc Phenol				
Sludge, 2 0	0	0	50*	Black†
Sludge, 1 5	trace		50*	Black†
Sludge, 1 0	trace		50*	Black†
Sludge, 0 5	trace		47*	Black†
Constant Factor 0 25 cc Phenol				
Sludge, 2 0	trace		50*	Black†
Sludge, 1 5	trace		50*	Black†
Sludge, 1 0	trace		50*	Black†
Sludge, 0.5	trace		30*	Black†

* Water was acid to methyl orange

† Oil was acid to methyl orange.

‡ Water was neutral to methyl orange.

It was later found that all emulsions do not respond to this treatment with equal readiness. Another shipment, presumably from the same well, was found to require a higher temperature, and, when phenol and sulphuric acid were used, a considerable increase in the amounts of the reagents. It was therefore concluded that each emulsion is an individual problem from the standpoint of this method of treatment.

A Theory of Explanation

The explanation of the breaking of petroleum emulsions by mutually soluble substances is not clear. At first sight the decrease in interfacial tension due to their presence would seem likely to promote, rather than prevent, emulsification, but this effect apparently is of small importance compared with others tending to decrease stability. When a mutually soluble substance is used alone, a comparatively large amount is necessary to have any apparent effect upon the stability of an emulsion; the results, if any, are undoubtedly due largely to the solvent effect upon the asphalt films around the water globules. When acid is also present, the amount of mutually soluble substance necessary to cause coalescence is often so small that it is not reasonable to attribute the result to solvent effect. It is entirely reasonable, however, to assume that the mutually soluble substance conveys the acid through the enveloping oil to the dispersed water; and that, having come in contact with the water, the H ion of the acid neutralizes the negative charges thereon and thus establishes conditions favorable for coalescence.

If this view is sound it is reasonable to suppose that other electrolytes with strongly adsorbed positive ions can be substituted for the acids, provided such electrolytes are soluble in the mutually soluble substance. This was not tried.

The further investigation of the mutual solubility idea was carried out with sulphur dioxide gas. The latter, being an acid gas that is soluble both in water and in some of the fractions of crude oil,[9] should break an emulsion if enough of it could be forced to stay in solution while the emulsion is being heated. Considerable success was attained in breaking petroleum emulsions when small samples in test tubes were saturated with the gas under from 5 to 10 lb. pressure for 1 hour, and then heated to 50 deg. C. When large samples were used, the results proved unsatisfactory.

Conclusions

There are two antagonistic forces at the interface between the phases of an emulsion—namely, interfacial tension, which tends to cause coalescence, and the coherence of the film of emulsifying agent, which tends to resist coalescence. The stability of an emulsion depends upon the relative magnitudes of these opposing forces.

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The emulsifying agent in petroleum is probably asphalt. The coherence of the film of asphalt depends to a considerable extent upon the nature of the oil—an excess of light fractions seeming to promote the formation of a coherent film.

The dispersed water globules of a petroleum emulsion carry negative charges which decrease the surface tension at the interface. When these charges are neutralized, surface tension at the interface is increased to such an extent that the films of asphalt are no longer able to prevent coalescence, and the emulsion breaks.

Petroleum emulsions may be broken in this manner by the use of electrolytes having strongly adsorbed positive ions, provided the electrolytes can be conveyed through the enveloping oil to the dispersed water. Ordinarily this can be done only with extreme difficulty when electrolytes alone are used, and even then only when the latter are present in excessive amounts.

Petroleum emulsions can be broken readily by means of very small amounts of acid if a small amount of a substance that is soluble in both phases is also introduced. The mutually soluble substance conveys the acid through the enveloping oil to the dispersed water.

Any mutually soluble substance should be expected to act in this manner. Of those tested, phenol is the most satisfactory. Kerosene acid-sludge contains mutually soluble substances, but not in sufficient quantity to be very effective. When a small amount of phenol is added to kerosene acid-sludge, the mixture is more effective for breaking emulsions than phenol and acid.

A certain amount of heat is necessary when using this method.

The amount of acid necessary is very small. It is not known whether enough is left in the oil to injure pipe lines and equipment or not.

Acknowledgment

These experiments were carried on under the direction of Prof. Theodore J. Hoover of the department of mining and metallurgy, Stanford University, whose valuable suggestions, as well as those of Prof. S. W. Young, professor of physical chemistry, are gratefully acknowledged.

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Sulphuric Acid From Ferric Sulphate

Sulphuric dioxide may be used to oxidize ferrous iron when making a leaching solution to contain both sulphuric acid and ferric iron. This solution can be used as a leaching agent for the recovery of copper from oxidized ore or sulphide ores, or a mixture of these ores. SO_2 accelerates the oxidation of ferrous iron and the percentage of SO_2 present affects the rapidity with which the ferric iron breaks down for the formation of sulphuric acid. The Bureau of Mines station at Tucson, Ariz., has found that when the concentration of the SO_2 entering or bubbling through the solution containing ferrous iron is less than ½ of 1 per cent, the formation of ferric iron proceeds more rapidly than does the breaking down of the ferric iron to form sulphuric acid. Under these conditions, it is practical to change all of the ferrous iron to ferric iron with the formation of some sulphuric acid. As the percentage of SO_2 in the entering gas increases, more of the ferric iron is broken down, so that a concentration of SO_2 can be obtained which will effect a complete reduction of all the ferric iron to ferrous iron with production of a corresponding amount of sulphuric acid. By suitably controlling the concentration of the SO_2 in the gas applied to the operation, the proportion of ferric sulphate to sulphuric acid in the final solution may be varied according to the requirements of any particular case. The rapidity of the oxidation is directly proportional to the volume of gas. Maximum oxidation is obtained in neutral solution. Reaction is retarded in the presence of free acid.

Contraction and Shrinkage During Casting*

BY ROBERT J. ANDERSON
Metallurgist, U. S. Bureau of Mines

LITTLE information has been published relating to accurate measurements of the linear contraction of the non-ferrous casting alloys and the total contraction in volume of alloys on passing from the liquid to the solid state. In foundry practice, patterns are usually made on the basis of a general figure for linear contraction of a given class of alloys—for example, aluminum alloys, brasses or bronzes—irrespective of the alloy employed. For instance, in making light aluminum alloy castings a general figure of 0.156 in. per foot is employed as the pattern allowance, although measurements by the Bureau of Mines show that in forty alloys the range was from about 0.05 to 1.80 per cent.

When a metal or alloy is cooled from the liquid state at any temperature to the solid state at any temperature — say to room temperature — its diminution in volume is the algebraic sum of three separate contractions — namely, (1) in cooling from any temperature in the liquid state to the freezing point; (2) in passing from the liquid state at the freezing point to the solid state at the melting point; and (3) in cooling from the solid state at the melting point to any lower temperature. These three contractions in volume have been termed respectively, (1) the liquid shrinkage, (2) the solidification shrinkage, and (3) the solid shrinkage. Reliable data as to the contraction of the various metals on passing from the liquid state to the solid state are scant, but on the basis that practically every well-defined property of the elements is a function of their symbol weights, it may be deduced that the contraction in volume of the metals is a periodic function of their atomic weights.

DEFINITION OF TERMS

The liquid shrinkage may be considered to be the amount of contraction in volume of a metal or alloy in the liquid state on cooling from any temperature in the liquid state to the freezing point. The greater the temperature interval through which the metal cools —that is, the higher the initial temperature of the melt—the greater the liquid shrinkage. The liquid shrinkage of a metal or alloy, therefore, is not a definite numerical value; but it varies with the temperature interval of cooling. Thus the weight of metal that can be poured into a mold at a higher temperature is less than at a lower temperature.

The solidification shrinkage may be defined as the contraction in volume of a metal or alloy on passing from the liquid state at the freezing point to the solid state at the melting point. Where an alloy solidifies over a freezing range, the solidification shrinkage is the contraction in volume which occurs from the beginning to the end of freezing. The actual amount of the solidification shrinkage varies considerably for different metals and alloys, and it may be markedly affected by the presence of impurities. So far as is known, bismuth and silicon are the only metals that expand on solidification, but a number of alloys expand; and some show expansions on cooling from liquid to solid, although the total volume change is a decrease.

*Extracted from "Reports of Investigations," Serial 2410, November, 1922.

The solid shrinkage is the contraction in volume of a metal or alloy on cooling from the solid state at the melting point to any lower temperature—usually the ordinary temperature—and it may be determined over any solid temperature range by experimental measurements or by calculation from the formula for expansivity. Ordinarily, in foundry practice, the solid shrinkage may be regarded as the contraction in volume on cooling from solid metal at the melting point to about room temperature. The thermal expansivity is the reciprocal of the solid linear contraction.

The linear contraction of a metal or alloy is the diminution of length that takes place in a casting on cooling in a mold. The terms linear contraction and pattern maker's shrinkage are synonymous. Turner states that the shrinkage may be defined as the difference between the length of a casting and that of the pattern from which it was produced—that is, it is the difference in volume between the fluid metal in the mold and the resultant casting at the ordinary temperature. Shrinkage in this sense, therefore, does not take into account the various stages of contraction, arrest or expansion which may occur in an alloy; but represents the final volume change. In experimental measurements, the linear contraction may be most readily determined by measuring the diminution in length of a bar cast from a pattern of definite length. It may be expressed in percentage diminution in length, in inch per foot, or in terms of the patternmaker's shrinkage scale.

PATTERNMAKER'S SHRINKAGE

In pattern practice for light aluminum alloy castings, the usual allowance for the shrinkage is $\frac{5}{32}$ in. per foot (0.156 in., or 1.30 per cent); and if a casting is to be 1 ft. long, then the pattern is made 1 ft. and $\frac{5}{32}$ in. in length. According to Keep (and his version of the matter is accepted also by Turner and others), the general understanding is that the shrinkage of a casting is the difference in length (or any other linear dimension) between the casting and the pattern from which it was made; or rather between it and the mold in which it was cast. Thus, the general figure for the shrinkage of gray cast iron is $\frac{1}{8}$ in. per foot, and the pattern maker, in taking measurements for the different dimensions of a pattern, uses a "shrink rule" which is $\frac{1}{8}$ in. longer than the standard foot-rule which is used to measure the castings.

West, however, calls "shrinkage" the decrease in volume in the liquid state, which requires feeding in casting practice and applies the term "contraction" to the decrease in volume which takes place after solidification. Also, according to McWilliam and Longmuir, "technically, 'shrinkage' refers to the gradual lessening in volume of the fluid metal as it approaches the solidification point at which 'shrinkage' ceases and contraction commences, the latter being understood to refer to the lessening in length or in volume of the solid metal." Hailstone states that "liquid contraction" is the local contraction which takes place in the heavy part of a casting when the outside skin of that casting has solidified. He states also that "solid contraction" is the natural contraction which metals undergo when passing from the hot to the cold condition; solid contraction is also known as shrinkage. The arbitrary terminology applied by West and others to contraction in the liquid and solid states seems to be based on nothing rational, and the writer prefers the terminology of Keep and Turner, which is technically correct.

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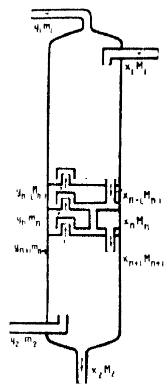
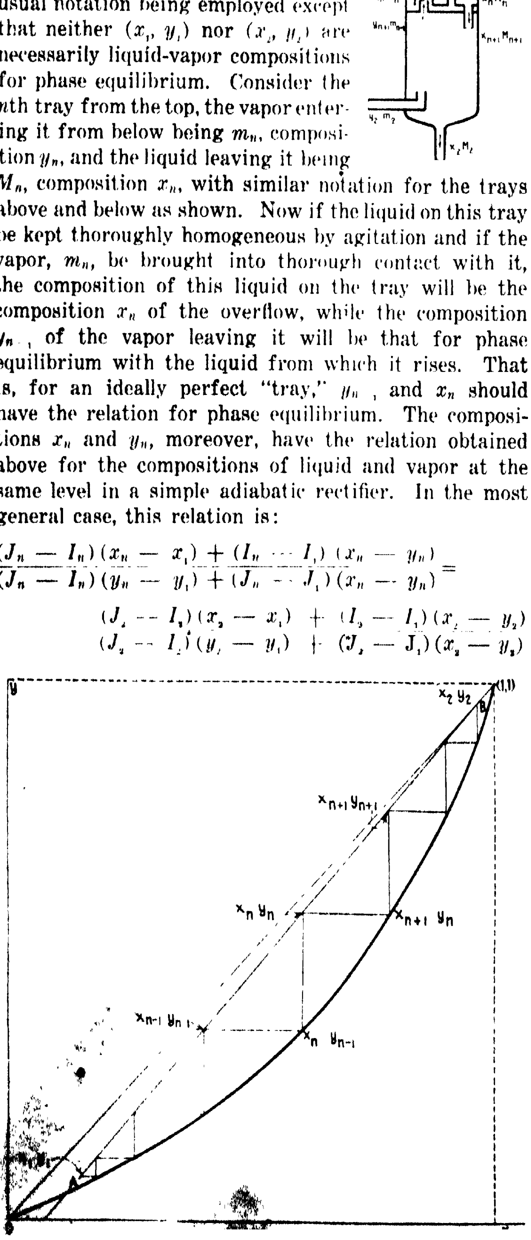
The problem, just considered, as to the actual conditions at the bottom of a rectifier has an intimate connection with that of the conditions existing in a rectifier containing a finite number of so-called "trays," or liquid reservoirs such as commonly employed. In all the above theory we have assumed perfect contact at every level between descending liquid and ascending vapor, and for perfect rectification we assumed that at the top and also at the bottom the liquid and vapor in contact were in phase equilibrium, although the equations we have written must be satisfied independently of phase relations. In a rectifier, however, containing a finite number of trays, there are certain limitations that must be taken account of.



Consider a rectifier as shown in the diagram where the only liquid entering it is admitted at the top, our usual notation being employed except that neither (x_1, y_1) nor (x_2, y_2) are necessarily liquid-vapor compositions for phase equilibrium. Consider the nth tray from the top, the vapor entering it from below being m_n, composition y_n, and the liquid leaving it being M_n, composition x_n, with similar notation for the trays above and below as shown. Now if the liquid on this tray be kept thoroughly homogeneous by agitation and if the vapor, m_n, be brought into thorough contact with it, the composition of this liquid on the tray will be the composition x_n of the overflow, while the composition y_{n-1} of the vapor leaving it will be that for phase equilibrium with the liquid from which it rises. That is, for an ideally perfect "tray," y_{n-1} and x_n should have the relation for phase equilibrium. The compositions x_n and y_n, moreover, have the relation obtained above for the compositions of liquid and vapor at the same level in a simple adiabatic rectifier. In the most general case, this relation is:

$$\frac{(J_n - I_n)(x_n - x_1) + (I_n - I_1)(x_n - y_n)}{(J_n - I_n)(y_n - y_1) + (J_n - J_1)(x_n - y_n)} = \frac{(J_2 - I_1)(x_2 - x_1) + (I_2 - I_1)(x_2 - y_2)}{(J_2 - I_2)(y_2 - y_1) + (J_2 - J_1)(x_2 - y_2)}$$



With specified values of the end compositions, x_1, y_1, x_2, y_2, the above equation, with x_n, y_n considered as variables, determines a plain curve connecting the two points (x_1, y_1) and (x_2, y_2) on the x, y diagram. The values of I_n and J_n at the various points (x_n, y_n) would be determined by the physical properties of the mixture dealt with.

For a mixture whose latent heats at constant pressure follows the proportionality relation discussed above, the equation just written is somewhat simplified, as we have seen, while for equal latent heats of the pure constituents it is the equation of a straight line connecting the points (x_1, y_1) and (x_2, y_2).

In the diagram let 0-(1,1) represent the equilibrium curve, while AB represents the locus of the above equation between x_n and y_n. Then with the values of the end compositions, (x_1, y_1) and (x_2, y_2) as shown, it may be seen that the minimum possible number of trays is equal to the number of segments into which the line AB has been divided by the various points (x_n, y_n) . . .

The diagram shows that if either of the two points (x_1, y_1) or (x_2, y_2) is located on the equilibrium curve, 0-(1,1)—i.e., if at either end we assume phase equilibrium between descending liquid and ascending vapor, the number of "trays" required will be infinite, as we should expect.

Continuation of this series of articles will be published in a subsequent issue.

Suggested Research Problems in Eletrochemistry

The American Electrochemical Society has issued a booklet of suggestions to authors, embodying some of the standards set by the society for papers presented before its meetings.

The following list of research problems is suggested as fruitful subjects for future papers:

Electrolytic Deposition of Brasses and Bronzes.
Hydrogen Potential Measurements of Aqueous Electrolytes.
Electrochemistry of Concentrated Solutions.
Electrolytic Production of Organic Compounds.
New Uses for Chlorine and Caustic.
Electrolytic Production of Lithium Hydrate.
Studies of the Properties of the Alkaline Earth Alloys.
Effect of Impurities in the Electrolysis of Fused Magnesium Salts.
The Electrochemistry of Gaseous Conduction.
Electrical Conductivity of Metals and Alloys Above Melting Point.
Stability of the Metal Carbides at Elevated Temperatures.
Revised Melting Point Determination of Refractory Oxides, Pure and Commercial.
Stability of the Metal Silicides at Elevated Temperatures.
Energy Losses in Electric Furnaces.
Gaseous Reduction of Metal Compounds.
Equilibria Studies in Electric Steel Furnaces.
Putties and Cements Used in Electrochemical Industries.
Electrical Porcelain.
Dielectric Constants of Mineral Oils.
Dielectric Constant vs. Composition of Glasses.
Dissociation of Compounds in the Beck Arc.
New Uses for Iodine; the Electrolytic Production of Iodine Compounds.
The Electrolytic Corrosion of Alloys.
The Fixation of Atmospheric Nitrogen.
Electrochemical Problems Relating to the Soil.
The Electric Stimulation of Plant Growth.
Electrolytic Dissociation in Non-Aqueous Electrolytes.
Catalytic Phenomena in Electrolytic Reactions.
Physical Properties of Elements and Materials at Electric Arc Temperatures.
The Occlusion of Gases by Metals at Electric Furnace Temperatures.
Electric Conductivity of Flames.

Properties of Wood in Paper Making*

The Effect of Physical and Chemical Properties of the Wood on Economy and Quality, Particularly in the Sulphite Process

BY BJARNE JOHNSEN and H. N. LEE

THE suitability of any kind of wood for paper making is determined by its physical and chemical characteristics. Very resinous woods, like the pines, are not suitable for the sulphite process, but make an excellent raw material for the sulphate or kraft process. Soda pulp from poplar is used in certain papers such as book papers on account of the short, bulky fiber, but cannot be used for papers where strength is required. It is not the intention of this paper to discuss the value of the various species of wood for all different pulping processes and for the different grades of paper. This discussion will deal chiefly with the most important pulpwoods, spruce and balsam, and their use in the sulphite process, which is by far the most important chemical process. However, much of the data given may be equally well applied to other woods and other processes.

In discussing the properties of wood for paper making there are two chief considerations—economy and quality. Wood is ordinarily purchased on the cord basis and the consumption of wood is recorded on the cord basis. It is customary to express the yield of pulp in terms of cords used per ton of pulp, but while the enormous variations in this figure in different mills may, to a great extent, be accounted for in the different methods used in the manufacturing process, it is not possible so to explain the great variations which are experienced in any one mill. These variations can be explained only when the actual value of the cord based on the physical and chemical properties of the wood are known.

MEASUREMENT OF CORD WOOD

Considering first the physical properties, it is known that a very large variation can exist in the amount of solid wood in the cord. According to Sterns[1], the theoretical solid content of the cord is always the same provided the logs are all of the same diameter. In this case the theoretical solid content is 90.69 per cent (116.1 cu.ft.). If the logs differ in diameter, the solid content will be greater and will increase as the ratio of the largest diameter to the smallest increases. However, in actual measurements he found no cords contained over 80 per cent (102.4 cu.ft.) solid wood. He also found that the average solid volume per cord of 32-in. wood, based on careful volumetric measurement of 34 cords, logs from 4 to 16 in. diameter, to be, before barking, 93.97 cu.ft., after barking 83.36 cu.ft.

TABLE I—CUBIC FEET PER CORD

	Graves[2]		Winslow and Thalen[3]			
Length	Over 5.5 In. Diameter at Small End	2.5 to 5.5 In. Diameter at Small End	Mixed	Straight	Crooked	Knotty
30 in.	90.5	83.9	87.2		..	
4 ft	88.9	82.4	85.7	92	82	74
8 ft	83.8	77.2	80.5	82	75	50

TABLE II—SOLID CONTENT OF WOODS FROM MINNESOTA AND QUEBEC

	Average Que.	Average Minn.	Maximum Que.	Maximum Minn.	Minimum Que.	Minimum Minn.
Number of logs per cord	67	115	102	156	36	86
Average diameter inches, per cord	7.31	5.67	10.56	6.50	5.96	4.95
Cubic feet solid material per cord	88.58	85.68	99.52	91.72	69.79	77.82

Our own measurements on two very different kinds of wood, one coming from northeastern Quebec and the other from Minnesota, based on 32 cords of each class of wood, are given in Table II.

The Quebec wood was peeled, the Minnesota wood not peeled; therefore the actual wood in the latter was about 12.5 per cent less, or an average of about 75 cu.ft. per cord. The greatest variation in the amount of solid wood was due to poor packing, which in turn was frequently due to crooked or poorly trimmed logs. The figures appear to show conclusively that wood of larger average diameter, which means a mixture of small, medium and large diameters, results in more actual solid wood per cord than wood of small average diameter.

In most cases investigators have found that the larger the average diameter the greater the solid content, but Sterns found just the reverse. He believes the discrepancy may be explained by the fact that he measured 32-in. wood, while the others, in general, measured 4-ft. or 8-ft. wood. It is certainly true that the effect of crookedness of logs is greater in long logs than in short ones and it is possible that in very short logs the effect of crookedness might be comparatively small. Moreover, large diameter logs are more likely to be straight than are those of small diameter.

It has been shown in the foregoing that the actual value of a cord of wood for production of pulp, or in other words the solid wood in a cord, may be influenced by several factors and may vary considerably. To secure reliable figures from which to determine yield, as well as to handle the purchase of wood in the most efficient manner, it is quite apparent that accurate measurement of the wood is necessary.

DENSITY AND RATE OF GROWTH

The value of a given volume of solid wood for pulp is determined by the dry weight of the wood. This is dependent on the density of the wood. This varies not only with the species but also within the same species according to the conditions of growth.

Our investigations show in balsam as well as in spruce, and the same may probably be applied to other coniferous woods, that slow growth wood is more dense than rapid growth wood. The figures for logs 6 in. in diameter are given in Table III.

Moreover, as is shown in Table IV by Kress, Wells and Edwards[4], there is considerable variation in the average density of different species of wood.

Results of tests by the authors are given in Table V.

From these data it is apparent that spruce has, on the average, 15 to 20 per cent greater density than balsam fir. Here again, as in the case of cord wood measure, are opportunities for large variations in the possible yields from cords of wood composed of more than one species or even composed of the same species of different rates of growths.

*A paper read at the annual meeting of the Technical Section of the Canadian Pulp and Paper Association, Montreal, Jan. 24 to 25, 1923.

[1]R. W. Sterns (unpublished data), Abitibi Power & Paper Co., Canada.

[2]H. S. Graves, "Forest Mensuration" John Wiley & Sons, N. Y.

[3]Winslow & Thalen, "The Purchase of Pulpwood," *Paper*, Oct. 4, 1916.

[4]Kress, Wells and Edwards, "The Suitability of Various Species of American Woods for Pulp and Paper Production," *Paper*, vol. 24, pp. 914-22, 1919.

TABLE III—EFFECT OF RATE OF GROWTH ON DENSITY

	Rings, Per In	Weight, Cu Ft Dry Green Wood
Quebec spruce	18.5	27.6
	4.5	20.2
Minnesota spruce	17.4	28.0
	5.7	22.4
Quebec balsam	19.7	27.2
	4.3	18.7
Minnesota balsam	10.3	22.6
	6.4	17.8

TABLE IV—DENSITY OF DIFFERENT WOODS

	Average Weight Of 1 Cu Ft of Dry Green Wood
Black spruce (*Picea mariana*)	23
White sprice (*Picea canadensis*)	24
Balsam fir (*Abies balsamea*)	21
Hemlock (*Tsuca canadensis*)	24
Jack pine (*Pinus divaricata*)	24
Aspen (*Populus tremuloides*)	23

TABLE V—RATE OF GROWTH AND DENSITY OF CANADIAN WOODS

	Average Weight Of 1 Cu.Ft of Dry Green Wood	Rings per In
N. E. Quebec spruce	25.2	12.8
S. W. Ontario spruce	25.6	11.5
N. E. Quebec balsam	20.8	9.1
S. W. Ontario balsam	20.4	8.2

Chemical Composition

Another factor which influences the possible yield, even when the foregoing factors are eliminated, is the chemical composition of the wood. The most important characteristic is the cellulose content. The data on this subject from different sources are not always comparable, because the various investigators have not used the same methods in making their determinations. The relative cellulose content of certain kinds of wood, based on a comparatively small number of tests is given by Johnsen and Hovey[5] in Table VI.

TABLE VI—CELLULOSE CALCULATED AS PER CENT OF OVEN DRY WOOD

White spruce	56.48
Black spruce	50.64
Red spruce	52.95
Balsam fir	51.60
Jack pine	49.24
Hemlock	48.70
Aspen	57.52

Even within the same species it has been shown that the cellulose content varies. Johnsen and Hovey found in balsam fir that rapid growth (low density) wood contained 50.35 per cent cellulose, while slow growth (high density) wood contained 52.85 per cent cellulose. Thorbjornson[6] gives the following figures for Swedish spruce, determined from different parts of the same log:

Specific Gravity	Per Cent Cellulose
0.382	53.4
0.425	57.3
0.446	58.5

As far as the two most important pulpwoods—spruce and balsam fir—are concerned it is safe to say that spruce has a slightly higher cellulose content than balsam fir. According to these data the yield which may be expected from a given volume of solid wood will be greater with woods of high density for two reasons, (1) the greater actual weight of wood substance, (2) the somewhat greater cellulose content by weight.

[5]Johnsen and Hovey, "The Estimation of Cellulose in Wood," *Pulp and Paper Magazine*, Jan. 31, 1918.

[6]B. Thorbjornson, "Nagra synpunkter betraffande sulfitkokning" (Some Observations Regarding Sulphite Cooking), *Svensk Pap. Tid.*, p. 196, 1922.

The influence of the cellulose content on yield is much more marked when wood of different degrees of soundness are compared. It has been found by Acree[7] that the cellulose content may be decreased by as much as 28 per cent. Similar results have been obtained by J. L. Parsons[8]. While in general decay decreases the cellulose content, Parsons found that decay caused by *Trametes pini Brot.* resulted in an increase in cellulose content of 15 per cent with a decrease in lignin of 30 per cent.

Another serious result of decay is a decrease in the density of the wood. Sutermeister[9] found spruce wood which was thoroughly affected by rot but which was still quite hard and firm weighed less than 18 lb. per cubic foot of dry wood, while sound spruce weighed more than 22 lb.

Relation to the Manufacturing Process

Factors thus far considered have a bearing upon the value of the cord, particularly with regard to economy. In the following, the importance which knowledge of these factors and other factors have in the manufacturing process and on the final product will be discussed.

It is obvious that the variations in the solid content of the cord, due to the conditions of piling of wood, dimensions of logs, crookedness, and trimming, have a very great effect on the cost of production. However, these variations are eliminated as soon as the wood is in form of chips and therefore do not directly affect the capacity of the mill or the quality of the product.

Knowledge of the density of the wood is of much greater importance because it directly affects the yield and, as a result, the economy in several ways:

(1) Dense wood gives a greater weight of wood per cord.

(2) Dense wood gives a slightly higher cellulose content per unit of weight.

(3) Dense wood, consequently, increases the digester capacity, which allows (*a*) a longer cooking time at lower temperature, which results in (*b*) increased yield and a better quality of product.

These points are illustrated by the results given in Table VII obtained by experimental cooks on a semi-commercial scale.

TABLE VII—SEMI-WORKS EXPERIMENTAL COOKS

	Balsam	Spruce
Weight of absolutely dry chips from cord of peeled wood, lb	2,036	2,580
Weight of chips in digester, absolutely dry, lb	268	323
Bleach consumption, per cent	17.2	15.5
Yield of bleached pulp, per cent dry wood used	42.79	43.65
Yield bleached pulp for equal volume digester charges, lb	115	141
Absolutely dry pulp per cord peeled wood, lb	871	1,126

TABLE VIII—EXPERIMENTAL PLANT COOKS

	Month *A*	Month *B*
Weight cu ft wet chips when absolutely dry, lb	15	8.64
Absolutely dry pulp, per cu.ft digester space, lb.	3.56	3.91
Yield absolutely dry pulp, per cent of dry wood	43.7	45.2
Screenings (dry), per cent of total pulp	3.00	2.03
Cooking time, hours	12	12.5
Bleach consumption, per cent	12.7	12.0
Slowness of unbleached pulp	91.0	27.1
Strength of unbleached pulp	92	93

Actual mill data, using two different classes of wood (average figures per month) are given in Table VIII.

These experimental and mill data show how the density of the wood affects the value of a cord and the capacity of the cooking equipment.

[7]S. F. Acree, "Destruction of Wood and Pulp by Fungi and Bacteria," *Pulp and Paper Magazine*, July, 17, 1918.

[8]J. L. Parsons, unpublished data, Hammermill Paper Co., U. S. A.

[9]E. Sutermeister, "The Use of Rotten and Stained Wood for Making Sulphite Pulp," *Pulp and Paper Magazine*, June 22, 1922.

Another factor which affects the digester capacity is the moisture content of the chips. The higher the moisture content of the chips the heavier the chips will be and consequently the better will the chips pack in the digester. Thorbjornson[8] has shown that by using chips with an average moisture content of about 20 per cent in place of chips with a moisture content of about 40 per cent the capacity of the digester is reduced 9.5 per cent.

EFFECT OF DECAY ON YIELD

It has already been stated that the variation in cellulose content with sound wood is not great, but when rotten wood is used the cellulose content becomes a very important factor. The yield by weight, based on a number of experimental cooks, with the soda process, is shown by Sutermeister[10] to be about 30 per cent for rotten poplar wood as compared with about 41 per cent for sound poplar. For birch an even greater reduction in yield was found. Sutermeister[9], using the sulphite process with spruce wood, shows that the yield by weight is higher with rotten wood than with sound wood, but his conclusions do not seem entirely justified when it is considered that the two resulting pulps were not cooked down to anywhere near the same degree of purity; the sound wood yielding a pulp with only 0.6 per cent screenings and requiring only 17 per cent bleach, while the pulp resulting from the rotten wood had 6.6 per cent screenings and required over 30 per cent bleach. There is no reason to believe that decayed wood should give a higher yield by weight than sound wood, except in cases where the fungus has caused an increase in the cellulose content, as referred to in the case of *Trametes pini Brot.* This shows how necessary it is in investigations of this kind to specify the kind of fungus which has caused the decay of the wood, and also to compare resulting pulps on the basis of the same degree of purity. All of our experimental and mill data have shown a decided decrease in yield by weight when rotten wood is used. Also Bates[11] found a reduction in yield by weight in large-scale experiments.

Large mechanical losses will occur if wood is decayed. Kress[12] gives the following figures for loss in chipping:

	Per Cent Loss in Screening [illegible]-In. Chips
Nearly sound white spruce	5.62
Infected white spruce	13.22
Infected white spruce	15.60
Badly rotted white spruce	17.02

If wood is decayed, and especially if it is saprotten, a considerable loss also occurs in barking.

EFFECT OF DECAY ON QUALITY

The effect of decayed wood upon the quality of the pulp is not clearly evident in Sutermeister's and Bates' reports. According to Bates there is no reduction in the strength of the pulp, but his tests were made on unbeaten pulp and the difference would hardly show up at this stage, particularly when the wood is only partly decayed. Sutermeister[9] found a decided decrease in strength of pulp in the case of the rotten wood cooked by the sulphite process. With the soda process he found an increase in the strength of pulp from partly decayed birch wood, after beating in a pebble mill, while he found it impossible to make sheets of beaten soda pulp obtained from very rotten wood. Our own tests show that decayed wood has a decided influence on the beating quality as well as on the strength of the resulting pulp. Pulp obtained from rotten wood hydrates more rapidly when beaten, and with the hydration the strength increases. However, the maximum strength of the pulp is reached at an earlier stage in the beating process, after which point the strength decreases rapidly.

Such has been found to be the case, not only in experimental tests, but also in ordinary mill experience. Monthly figures from mill operation show that when a large percentage of wood was used which had been stored for 2 or 3 years and therefore was more or less affected by fungus, the strength of the pulp was considerably lower and the slowness considerably higher than when comparatively new, sound wood which came from the same locality was used. This was the case in spite of the fact that the cooking process was adjusted so as to protect the fiber of the more or less decayed wood as much as possible.

The deleterious effect of decayed wood used in the ground-wood process has been thoroughly investigated and described by Kress, Humphrey and Richards[13], and Bates[14].

SEASONING

With a raw material which may be stored for a long period before it is used in the manufacturing process, it is of interest to know what effect seasoning has upon its value. It is evident that if wood is stored so that it will deteriorate from decay its value will gradually decrease. If, however, wood is stored under proper conditions, unfavorable for the growth of fungi and so that the wood may dry out, its value for pulp will increase. As Schwalbe[15] has stated, green wood, because it is less resistant to the cooking process, gives a lower yield than seasoned wood, but he has found it possible to increase the yield from green wood materially by giving it a milder treatment. It has also been found in mill operation that seasoned wood gives a higher yield and a stronger fiber than green wood. During the period of storage the moisture content of the wood decreases, which is an advantage, since the moisture in the chips results in a direct dilution of the cooking liquor. However, if the wood is too dry, the penetration of the acid is much slower and more time is required to bring the digester up to the desired temperature and pressure, necessitating either a longer total cooking time or a higher temperature. Schwalbe found that the penetration period of very dry wood could be materially decreased by pretreating the chips with steam or with waste liquor.

Another objection to the use of green wood is the difficulty which is experienced in the manufacturing process due to pitch. It is generally known that the troublesome pitch-forming substances in the wood decrease during storage.

The most important of the factors which influence the consumption of wood per ton of pulp or the yield of pulp per cord, the density and soundness, are also the factors which influence the quality the most. In most cases the low-density wood and the infected wood

[10] E. Sutermeister, "Decay of Pulp Wood and Its Effect in the Soda Process," *Pulp and Paper Magazine*, July 14, 1921.

[11] J. S. Bates, "Sulphite Tests of Average Wood, Infected Wood and Chipper Sawdust," *Pulp and Paper Magazine*, June 9, 1921.

[12] O. Kress, "Progress in the Study of Wood and Wood Pulp Infection and Decay," *Paper Industry*, January, 1921.

[13] Kress, Humphrey and Richards, "Some Observations of the Deterioration of Wood and Wood Pulps," *Paper Industry*, October, 1919.

[14] J. S. Bates, Grinding Tests of Average, Infected and Sound Pulpwood," *Pulp and Paper Magazine*, June 30, 1921.

[15] C. G. Schwalbe "Holzzellstoffkochung, inbesondere die Sulfitzellstoffkochung," (Pulp Cooking, with Special Reference to Sulphite), *Zellstoff u. Papier*, April 1, 1921

are cooked in mixture with sound wood of high density and the cooking process is adjusted to the sound wood. All the undesirable effects of low-density wood and decayed wood are therefore experienced—low yield, low strength and high slowness. If, however, the wood could be sorted according to its qualities, soundness, density, seasoning, etc., it would be possible to adjust the cooking process to some extent for the various grades. To maintain the production of the mill with low-density wood and with decayed wood the cooking time must be shortened by using a higher temperature. With this kind of wood high temperatures should be avoided.

It is, in many cases, possible to do so by shortening the penetration period of the cooking process, because wood of low density and decayed wood are more rapidly penetrated by the acid. A few experiments were made in order to determine how the penetration is affected by these factors. The results, which were obtained by placing disks of wood in a small digester with cooking acid of 6.18 per cent total SO_2 and 1.03 per cent combined SO_2, and bringing the temperature gradually up to 100 deg. C. in 2½ hours, keeping the temperature at this point for ½ hour, give an indication of the comparative penetrability.

TABLE IX. PENETRATION RATIO BASED ON SLOW GROWTH SPRUCE EQUAL TO 100

	Rings Per In.	Wt. Per Cu.Ft.	Penetration Ratio
Slow spruce	28	28.6	100
Rapid spruce	9	23.2	180
Slow balsam	58	22.2	215
Rapid balsam	7	18.6	350
Spruce partly decayed by *Lenzites sepiaria*		22.0	900
Spruce badly decayed by *Trametes pini*		14.0	1,500

The question of proper methods of storing pulpwood has been often discussed. It will only be mentioned here that best seasoning conditions allowing a minimum amount of decay are secured when logs are peeled or barked and then stored in such a way that good circulation of air is always maintained throughout the piles.

It has been attempted in this discussion to point out some of the important factors which influence the economy and quality in the production of pulp and paper from wood, with the object of drawing more attention to this most important raw material. It is hoped that the pointing out of the factors which so greatly influence yield and quality will result in the establishment of methods of measuring and testing wood which will be of great value in the intelligent purchase and handling of wood and which will explain variations in yield and quality hitherto not full accounted for.

Attendance at Engineering Schools

The United States Bureau of Education has obtained the following figures for attendance at engineering schools for the current year. A few of the smaller engineering schools have not reported:

Attendance for 1921-22	
Freshmen and sophomores	32,178
Juniors	11,446
Seniors	8,520
Corresponding enrollment for 1922-23	
Freshmen and sophomores	29,952
Juniors	10,383
Seniors	9,571
Total for 1921-22	52,144
Total for 1922-23	49,906
Decrease for the current year	2,238

It seems that the engineering schools have reached their maximum attendance for the present. This attendance is probably limited by the schools' facilities.

Manufacture of Soap in 1921

The Department of Commerce announces that reports made to the Bureau of Census show that production by establishments engaged primarily in the manufacture of soap amounted to $240,116,000 in 1921, as compared with $316,740,000 in 1919, a decrease of 24.2 per cent in value of products. In addition soap products to the value of $21,140,000 were produced in 1919 by establishments classified in other industries; corresponding figures for 1921 are not yet available.

The statistics for 1921 and 1919 are summarized in the following statement. The figures for 1921 are preliminary and subject to such change and correction as may be found necessary upon further examination of the original reports.

	1921*	1919*	Per Cent of Decrease
Number of establishments	283	279	...
Persons engaged	23,022	28,919	20.4
Proprietors and firm members	103	183	43.7
Salaried employees	6,361	8,300	23.4
Wage earners (average number)	16,558	20,436	19.0
Salaries and wages	$32,566,000	$35,400,000	8.0
Salaries	13,701,000	14,172,000	3.3
Wages	18,865,000	21,228,000	11.1
Paid for contract work	614,000	640,000	4.0
Cost of materials	150,356,000	238,519,000	37.0
Value of products	240,116,000	316,740,000	24.2
Value added by manufacture †	89,760,000	78,221,000	14.8‡

* Statistics for establishments having production valued at less than $5,000 are not included in the figures for 1921. 69 establishments of this class reported 34 wage earners and products aggregating $181,800 in value. For 1919, however, data for 69 establishments of this class, reporting 32 wage earners and products valued at $130,100, are included in the figures with exception of the item "number of establishments." † Denotes increase. ‡ Value of products less cost of materials.

Detailed statistics of products for the years 1921 and 1919 are given in the following table, though figures for soap and associated products produced as subsidiary products by establishments in other industries, aggregating $21,140,000 in 1919, are not at present available for 1921; hence all items are not actually comparable.

	1921	1919
Total value	*	$337,880,000
The soap industry	$240,116,000	$316,740,000
Subsidiary soap products from other industries	*	21,140,000
Hard soaps:	Soap industry only	All industries
Quantity, lb	1,741,002,000	1,855,257,000
Tallow, foots and olein soaps	903,258,000	1,072,390,000
Toilet soap	195,347,000	179,350,000
Dye soap	1,319,000	21,710,000
Soap chips	143,915,000	181,837,000
Other hard soaps	497,163,000	399,970,000
Value	$163,041,000	$227,051,000
Powdered soaps		
Quantity, pounds	576,270,000	466,536,000
Abrasive	198,087,000	.
Non-abrasive	378,183,000	.
Value	$29,144,000	†
Liquid soap:		
Pounds	5,965,000	10,033,000
Value	$768,000	$1,255,000
Soft soap:		
Pounds	50,756,000	74,463,000
Value	$2,313,000	$3,925,000
Special soap articles		
Pounds	26,183,000	36,302,000
Value	$2,269,000	$3,568,000
Glycerin		
Crude, for sale		
Pounds	19,710,000	18,228,000
Value	$1,912,000	$2,433,000
Refined, for sale		
Pounds	39,307,000	47,377,000
Value	$6,088,000	$11,461,000
Stearin:		
Pounds	3,223,000	3,140,000
Value	$316,000	$825,000
Candle pitch		
Pounds	5,958,000	5,211,000
Value	$92,000	$91,000
Candles		
Pounds	4,359,000	5,483,000
Value	$327,000	$819,00
Red oil (commercial olein acid):		
Gallons	930,000	433,000
Value	$416,000	$476,000
Perfumes and toilet preparations:		
Value	$15,115,000	$12,635,000
All other products	$18,315,000	$73,290,000

* Figures not yet available. † Included above with value of hard soaps.

X-Ray Examination of Steel Castings

It Is Possible to Locate $\frac{1}{16}$-In. Flaws in Steel 3 In. Thick With a 30-Minute Exposure From Commercial X-Ray Tubes—Correspondingly Smaller Defects Can Be Likewise Revealed in Thinner Sections

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THE X-ray examination of castings promises to become one of the important methods of testing in foundry practice. It is important to know within what limits the method is applicable and to know the factors that determine those limits. Experiments recently conducted at Watertown Arsenal have been concerned with the practical limits and working equations in metal radiography.

Probably an impression is general that the utility of the X-ray in revealing hidden defects is quite limited, owing to the relative opacity of metal. While it is easy to radiograph a man's pelvis, measuring perhaps 12 in. side to side, a "twenty-two" bullet produces a dense shadow. Therefore we find *Chemical & Metallurgical Engineering* stating in an editorial (Feb. 15, 1922) entitled "X-Ray for Routine Testing" that the enormous difficulties seem to limit the use of radiography to moderate sections of metals of low atomic weight. Furthermore, Circular 113 of the Bureau of Standards, on "Structure and Related Properties of Metals," states that "an examination by means of X-rays is often of value if the specimen is not too large. . . . Specimens of steel to be examined by this means should not exceed ½ in. in thickness."

In contradistinction to these accepted limitations, we have found at Watertown Arsenal that the limit of penetrability based on 30-minute exposure with commercial apparatus is approximately 3 in. of steel! Anticipating the subject somewhat, Figs. 1, 2 and 3 show what has been done with relatively heavy castings to be made for air bombs. The pattern was made up and an experimental casting poured. This was sent in to the laboratory for radiographing before the risers were cut off. Fig. 1 shows the casting as we received it; it weighed about 400 lb. Radiographs were made through various points marked in chalk on the casting and prints of these, properly indicated, were furnished to the foundry. No defects of importance appeared except in the section through the nose. Fig. 2 is a print of a film placed horizontally inside the shell and exposed to rays traveling along the axis of the casting through slightly over 2 in. of metal. The three dark areas are shadows of the columnar risers. It was obvious that the risers were not feeding properly, and a change in the design of these remedied the difficulty. The casting was later cut up for study, and Fig. 3 is a photograph showing some of the holes represented by the spots shown on Fig. 2.

FIG. 1—400-LB. AIR BOMB CASTING TO BE RADIOGRAPHED

It may be objected that the information given by the X-ray might have been found by merely sawing up the casting. Even so, *complete* information is given by the X-ray far quicker and cheaper. It is no small matter to cut up heavy steel sections. Furthermore, the X-ray is of especial value in assuring oneself than an unsawed casting is sound in its vital parts. Thus sample castings are completely radiographed at the arsenal to make sure they are free from internal defects.

The questions that naturally come up for solution are: How should the exposure vary with the thickness? What is the limiting thickness of metal that may be radiographed with existing apparatus? What is the magnitude of the faults which gives certain markings on the plate? What is the limiting size of fault that may be detected under practical conditions?

With regard to the first question, How should the exposure vary with the thickness? It is possible to develop certain mathematical equations showing the relationships between the several variables involved. This work is outlined in the appendix. Practical application of theory is hampered by the fact that fluorescent screens are ordinarily

FIG. 2—RADIOGRAPH OF NOSE, SHOWING MANY BLOWHOLES. REDUCED ONE HALF

used to intensify the direct effect of the ray, and these screens deteriorate with use. Thus a photographic plate or film—which is covered by an emulsion sensitive to X-ray impact as well as to light rays—is covered front and rear by a screen impregnated with salts which visibly glow when struck by X-rays. Thus the photographic effect recorded is that due to the direct action of the rays plus that due to the fluorescence of the screens. The latter effect may amount to fifteen times the former.

In order to get experimental curves showing relation of exposure to thickness, an echelon was made of eight pieces of transformer iron 0.03 in. thick and differing in length by ½-in. steps; the pile varied from 0.03 to 0.24 in. thick, by eight equal steps. A number of steel strips 8 in. long and of various thicknesses were then prepared, stacked up

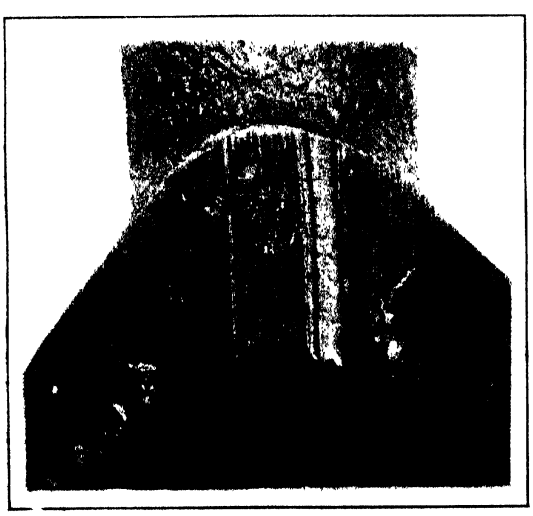


FIG. 3—CONDITION OF NOSE WHEN SAWED APART. CASTING IS 2 INCHES THICK

and the echelon placed on top of the pile, whereupon the whole was radiographed. Patterson "cleanable" intensifying screens were used. These screens were new and had their maximum sensitiveness. A series of negatives was made at varying times—other conditions being constant—and one picked out which showed clear or nearly clear under the thick end of the echelon and a regular graduation of density under the other steps. One film was selected and step 4 of this was arbitrarily taken as a standard for judging other negatives. Then a series of films was taken through piles of different height, and all of them were compared with the standard. The thickness of steel plus the thickness of transformer iron under the step that exactly matched the standard density was plotted against the corresponding "exposure." ("Exposure" means time of exposure multiplied by the current flowing through the Coolidge tube.)

Results of individual determinations are shown by dots on Fig. 4. As shown, two series of negatives were made, one when 100 kv. potential was impressed on the Coolidge tube, and the other under 195 kv. Curves *A* and *B* are figured according to the theory, with constants so chosen as to fit the observed values as closely as possible. A family of similar curves is also drawn,

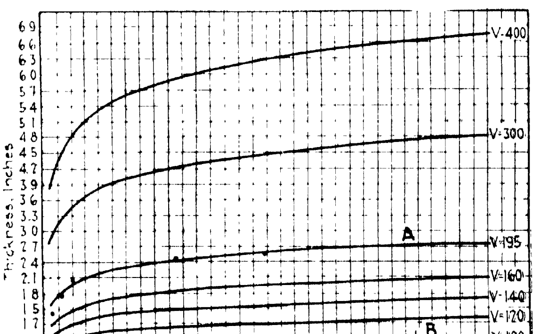


FIG. 4—RELATION BETWEEN THICKNESS OF STEEL PENETRATED, TIME OF EXPOSURE AND VOLTAGE AND CURRENT THROUGH X-RAY TUBE

checked by experiment on voltages up to 230 kv., and assumed by extrapolation for higher.

The curves shown in Fig. 4 are practical working curves and are used in our laboratory as a guide to the necessary exposure for a given specimen. Actual exposures are plotted rather than logarithm of exposure because of greater convenience in use. The tube which we use can be operated at 200 kv., then consuming 7 milliamperes of current. In order to get any work done it is necessary to limit the time for making a negative to 30 minutes. The "exposure" therefore is 30 minutes × 60 seconds × 7 milliamperes, or 12,600 milliampere-seconds. Running up the vertical ordinate corresponding to 12,600 to slightly above the curve marked V-195 gives a valve of 2.9 in. for the limit of penetrability at a distance of 17 in. from the target.

In practice we have radiographed 3.1 in. of steel with the film at a distance of 13 in. from the target, and the film was somewhat more dense than the standard used above.[1] Hence it is probable that 2.9 in. is

[1]Since the above was written we have penetrated 4.1 in. of steel, but under cond'tions of varying voltage so that it was not possible to check the equation.

fairly conservative. With a 300-kv. tube the curve indicates that we would be able to penetrate about 4.8 in. of steel, and with a 400-kv. about 6.8 in. of steel, using the same exposure (12,600).

Such tubes are needed. One of the difficulties today in metal radiography is the limitation of possible penetration. Greater penetration may be had either by increasing the transmitted radiation or by increasing the sensitiveness of the film system. To aid in the latter respects screens will undoubtedly be improved. Bulbs must be improved to take a higher potential rather than a heavier current. This fact is illustrated in Fig. 4. If we double the power consumption in a 195-kv. tube by doubling the current, we double the "exposure." But for long exposures the increase in penetration is very small indeed—the curve flattens out almost to horizontal. If, however, we double the power consumed in the bulb by doubling the potential (200 kv. to 400 kv.), the current remaining the same, we change the thickness that can be radiographed in the same exposure (12,600) from 2.9 to 6.7 in., a gain of 3.8 in.

SIZE OF CAVITIES WHICH CAN BE DETECTED

To determine the magnitude of a fault it is necessary to consider the area of the image and its relative density. If the cavity is sufficiently large, as compared to the focal spot in the X-ray tube—and sufficiently close to the film, so that definite, unblurred outlines occur, the image will be a scenographic projection of the fault. This is illustrated in diagram *D* of Fig. 5. Under these conditions, if the cavity is roughly spherical, this projection will be related to the section through the fault parallel to the film by the laws of geometry. The area of the section may be calculated from the area of the image, the distances from the target to the flaw, the distance from the target to the film, and the inclination of the film to the axis of the X-ray beam through the flaw. If the cavity is not spherical and its major diameter is inclined to the axis of the X-ray beam through the cavity, the area of a section of the cavity usually cannot be found from the area of the image given on one film. If the fault is small in comparison to the area of the focal spot in the Coolidge tube, the cavity acts like the aperture of a pinhole camera.

FIG. 6 IMAGE OF TUNGSTEN TARGET OF COOLIDGE TUBE TAKEN THROUGH A PINHOLE IN A LEAD SHEET

The "image" appearing on the developed film is the image of the focal spot of the target rather than the image of the flaw. This pinhole image depends upon the variables that would affect the image in a pinhole camera—viz., the relative distances of the film and target from the hole, the area of the hole and the area of the focal spot of the target. For cavities small enough a true image of the focal spot would occur. Such an exposure is shown in Fig. 6. This is a very sharp view of the whole target—it shows the focal spot from which most of the X-rays emanate, together with the outlines of the target and some of the supporting stem, all of which is excited to emit resonance radiation.[2]

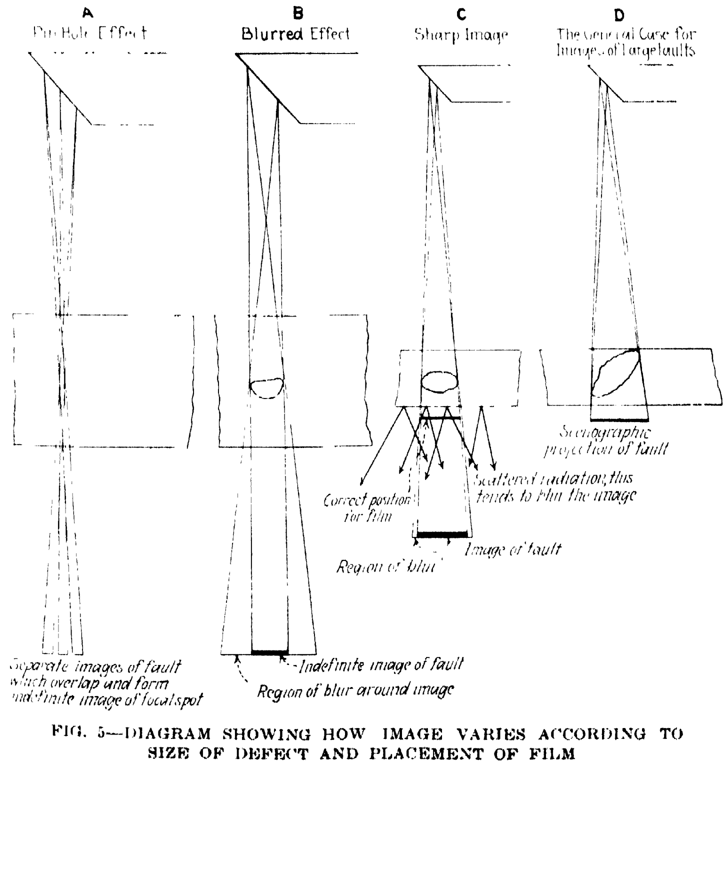


FIG. 5—DIAGRAM SHOWING HOW IMAGE VARIES ACCORDING TO SIZE OF DEFECT AND PLACEMENT OF FILM

Images produced by somewhat larger cavities would be indefinite, as shown in sketch *A* in Fig. 5. For still larger cavities the outlines of the fault would begin to appear (sketch *B*), and for cavities sufficiently large the image would present the sharply defined outline of the projection of the cavity (sketch *C*). In the case of the pure pinhole image the area of the section of the fault could not be calculated; where the outline of the cavity appears it is possible to calculate the area in some cases as outlined above. In practice most of the types of images sketched in Fig. 5 appear, sometimes all on one negative. However, a pure pinhole image of the focal spot such as shown in Fig. 6 has not been surely identified in practical exposures on steel castings.

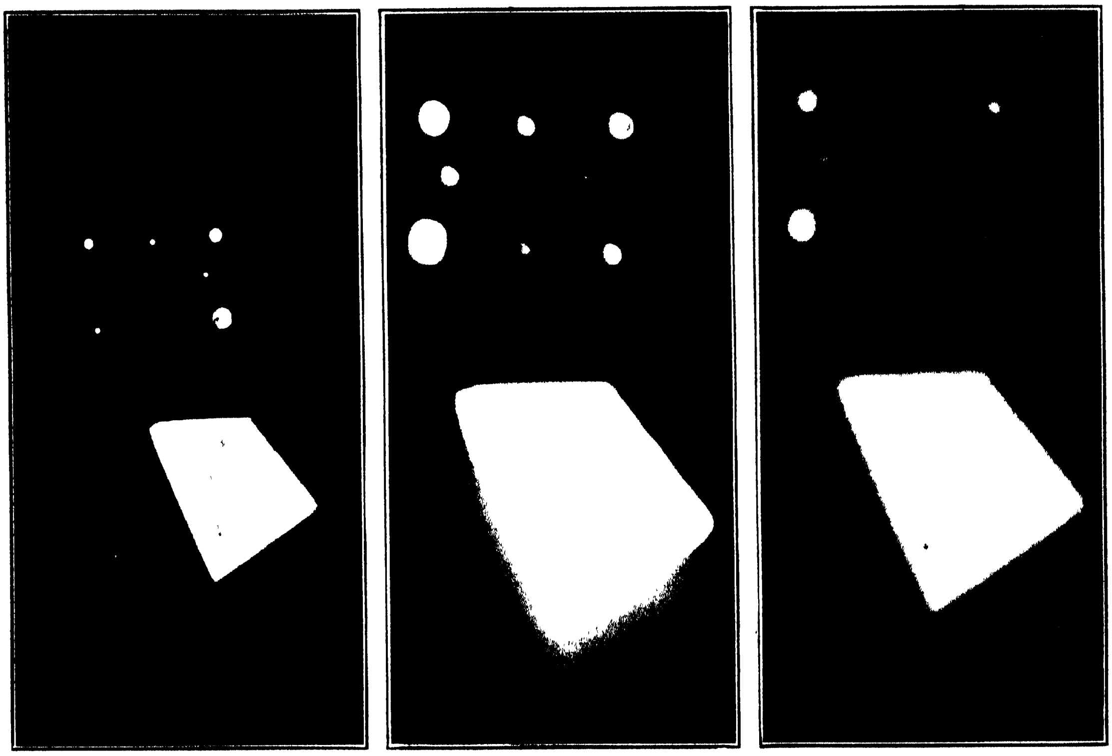
These principles may be illustrated by X-ray exposures of holes in a lead sheet. Fig 7 is the radiograph of a piece of lead sheet in which holes were drilled ranging in diameter from 0.032 up to 0.227 in. There was one large irregular hole made with a file.

[2]"X-Ray Studies," page 95. General Electric Research Laboratory, 1919. Dr. Coolidge has explained this effect as due to wandering electrons that do not hit the focal area but reach other parts of the target.

The smallest hole was carefully cleared. Some of the other small holes contained metal shreds which were purposely left so as to give the effect of irregularly shaped small holes. The film was placed 1 in. below the lead. The images appear sharp, even the metal shreds showing.

Fig. 8 represents a radiograph of the same piece of lead, but here the lead is 11½ in. away from the film. There was no metal interposed except the aluminum top of the cassette holder. In this picture the smaller holes show a distinct image of the focal spot of the target. This effect is the same for the cleared central hole and for the irregularly shaped small holes. The peculiar spiral appearance at the tiny central hole and the one at the left is not accidental—it is a correct image of the focus, and shows details lacking from the round white spot of Fig. 6. Fig. 10 shows a negative print of a film registering a focal-spot image taken through a pinhole 0.017 in. in diameter with the film 18 in. from the lead. The negatives for these show of the whole target that appears as tails below the largest drill holes and the trail of light below the large irregular hole. Fig. 9 represents a radiograph of the same lead sheet, but in this case 0.35 in. of steel was introduced just beneath the lead, and the film was 11½ in. from the lead. An attempt was made in this exposure to bring out the effect of radiation from the bottom of the steel and to illustrate the effect of the interposition of metal on definition.

A comparison of Figs. 8 and 9 shows that the relative *contrast* is less where additional metal is interposed. This is due to the fact that radiation from the bottom of the steel affects parts of the negative which formerly were completely shielded by the lead. The *definition* in Fig. 9 is, however, somewhat better, at least at the corners of the large image. The blurring effect and the "tails" caused by the characteristic radiation from the target support are missing. This radiation being less penetrating than the radiation from the focal spot, it is entirely absorbed by the iron. When Fig. 8 is com-



FIGS. 7, 8 AND 9 RADIOGRAPHS OF A PERFORATED LEAD SHEET
Fig. 7 Film 1 in. below lead. No screen. Fig. 8 Film 11½ in. below lead. No screen. Fig. 9—Film 11½ in. below lead. Screen: 0.35 in. of steel

more than is evident in the print, even though the latter has been slightly retouched. The cathode stream evidently plays on certain favored spots on the target which may be small irregularities in the surface. The stream, however, tends to describe a circle around the outer edge of the focal area and travels from the spots to the outer circle by definite spiral paths. Sometimes as many as seven spots were counted, most of which were near the center of the focal area, and from each of these there was a spiral path leading to the outer circle.

There is also evident in Fig. 8 the effect of X-rays coming from other parts of the target, shown so clearly in Fig. 6. This radiation causes the indefinite image pared with Fig. 7, a remarkable loss of definition is noted at the corners. In Fig. 7 the corners are sharp angles, in Fig. 8 they are arcs of circles; in Fig. 9 they are rounded also, but the radius of curvature is much less, so that the corners are much sharper than in Fig. 8. This rounded corner effect is due to a sharply defined band (much more evident in the negative than in the print here reproduced) located just inside the image. It follows the contour of the image except at the corners where this line makes the rounded corner effect noticed in the reproduction. In fact, this dense line is the edge that shows in Fig. 8. In the negative for Fig. 9 the line is still present but is less pronounced and it makes a much sharper turn at the corners. In

Fig. 11 the line is missing entirely. The latter figure is a negative print of a sheet of lead bent sharply around the end of a screwdriver and squeezed home with pliers. The sharp angle is faithfully reproduced.

The band causing rounded corners is undoubtedly due to X-rays reflected from lead crystals in the vertical surfaces of the holes. It travels toward the interior of the image as the film is moved away. Since the sheet of steel interposed in Fig. 9 filters out much of this scattering radiation, the band formed by the reflection of shorter wave lengths is reduced nearly to a line, and follows the contour more closely. Fig. 11 was taken through 2.35 in. of steel, which entirely absorbed the lead radiation. Therefore the edge of the image is less definitely marked due to the absence of the band, but the corners are faithfully reproduced. Another negative too faint for reproduction was taken of a V-shaped opening in a piece of lead sheet ⅛ in. thick through 3.1 in. of steel. The definition was as sharp as that illustrated in Fig. 11. We concluded that the definition remains sharp as long as the image is detectable, no matter how much metal is being penetrated, except where pinhole effects occur.

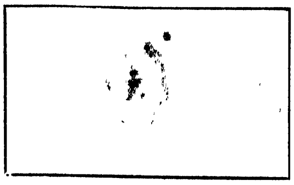


FIG. 10—PINHOLE IMAGE OF FOCAL SPOT (RETOUCHED NEGATIVE PRINT)

The magnitude of the fault in the direction of the X-ray beams—i.e., the thickness of the fault—is usually of greater importance than the sectional area. In fact, an estimate of the sectional area can often be got from the thickness of the fault and a general knowledge of blowholes and pipes, without relying on the geometric relationships sketches in Fig. 5.

However, it is difficult or impossible to arrive at definite conclusions on the thickness of a cavity from an inspection of the negative. In order to determine the thickness of the fault the relative density of the image to the density of the adjacent portion of the film must be considered. If that ratio is great—i.e., there is much contrast—the magnitude of the fault is apt to be considerable, but densitometer measurements would in most cases not give reliable data on which to compute definite measurements. The difficulty comes from the fact that the density in a photographic film is not a linear function of the exposure, as noted in equation 2 of the appendix. X-ray exposures usually fall in what is known as the "underexposed" portion of the curve. The image of a fault may fall near the bend of the curve where the slope changes rapidly, while the density of the adjacent portions of the film may come further down on a nearly straight portion. Therefore the densities of the negative may not give direct information on the size of the blowhole. If the film were exposed so that both portions of the film fell in the correct exposure region, then a linear relationship could be established that would give a definite measure of the thickness of the fault. However, this is not practicable, because it would increase the time of exposure too much.

The problem of getting a relationship between the relative densities of the image and adjacent film and the thickness of the fault is an important one. It is planned to attack the problem in this laboratory. We judge the magnitude of the fault by the density of the image at present, but we realize that our judgment is more or less a guess.

The value of the radiographic method as a detector of flaws can be determined more accurately by relatively simple experiments. Obviously the relative density of the image will depend upon the relative thickness of metal traversed by the radiation in passing through the region in which the fault occurs and the region adjacent to this. If we adjust the exposure so that there is no visible density in the developed negative in the region adjacent to the image and then reduce the magnitude of the experimental flaw until its image is barely perceptible, we then have determined the limit of magnitude of flaw that can be detected. Experiments of this sort showed that with a steel plate ½ in. thick a difference of 0.0005 in. could be readily detected. This amounts to a flaw thickness of one part in one thousand.

However, this experiment is misleading. If instead of having one part of the film clear and apparently unaffected by the rays, both parts are exposed "(underexposed" in the sense of equation 2 in the appendix), then the detection of the faint image is more difficult. In order to test this more general case a steel plate 8 in. long was ground so as to form a wedge 0.5 in. thick at one end and 0.492 in. thick at the other. This wedge was divided into 1-in. sections by lead strips and radiographed so that the negative under the thick end was nearly clear. The rest of the negative showed bands of increasing density. Other negatives were made with the steel built up to various thicknesses by the addition of parallel plates. Thus it was possible to distinguish between bands 2 and 4 with the steel ½ in. thick. With the steel 1 in. thick the difference between bands 2 and 7 could be detected. When the total steel was 1.2 in. thick, no difference could be found between one end of the film and the other.

These negatives show contrasts too faint for reproduction, or even for printing, but with good illumination the differences in density can be detected in the negative. Such experiments indicated that differences in metal thickness of about 5 parts in 1,000 could be detected in this way.

Still the test is hardly fair, because it is easier to detect slight differences in large areas where the total light coming to the eye might be materially different, even though the illumination of the two areas is nearly the same. It is much more difficult to detect small differences when one area is much greater than the other. These circumstances obtain, of course, when radiographing a small defect in a large section. It is possible, however, to use an illuminator and an exploring screen —that is, a screen with a hole in it so as to inclose the image to be detected against a minimum of adjacent

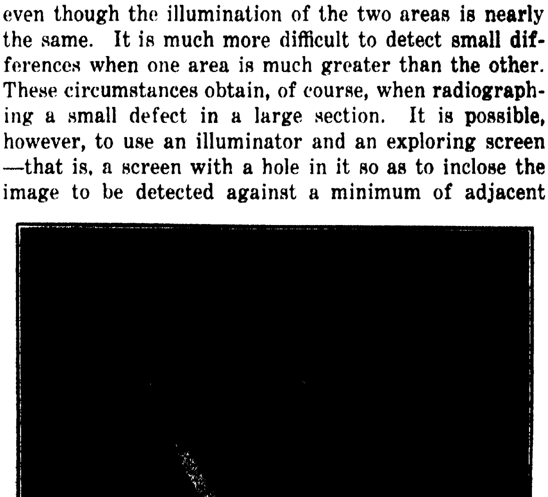


FIG. 11—TWO PIECES OF LEAD EXPOSED THROUGH 2.35 IN. OF STEEL. FILM 4 IN. FROM LEAD

film. If this is done it should be possible to detect flaws of the ordinary magnitude indicated above. In order to hunt small images in a large field, test specimens were prepared by drilling holes of various diameters in a sheet of transformer iron 0.015 in. thick.

Other sheets 0.03 in. thick were similarly prepared. One of these was placed on a stack of steel plates and the whole radiographed. Using the 0.015-in. plate the smallest hole (0.03 in. in diameter) disappeared when shooting rays through 0.9 in.; the largest hole, 0.25 in., was still visible at 1.1 in. Using the 0.3-in. plate the holes disappeared at about 1.8 in., the smallest hole disappearing certainly at 1.6 in.

These experiments would place the limit of detectability for this particular case at somewhere near 15 parts in 1,000. That is, a blowhole 0.04 in. in diameter in a piece of steel 2.5 in. thick should be detectable under ordinary exposures of 10,000 milliampere-seconds. This is the upper limit. It is probably better to regard the limit for practical work at about 2 per cent.

The surface markings on a casting are often of greater magnitude than this. In such cases doubt may arise as to whether a dense spot in a negative is a surface mark or a hidden flaw. Comparison with the original casting may remove the doubt, but in important cases we use a stereoscope. Stereoscopic negatives are taken by making two exposures under as nearly identical conditions as possible, except that the X-ray tube is displaced the distance center to center of the observer's eyes. These two negatives, properly mounted, viewed in a stereoscope enable the operator to distinguish very definitely between the surface markings and the inner flaws, because they then give the illusion of depth—the defect appears in its proper position in space. This method gives the operator definite results with a little practice. In fact, the stereoscope greatly extends the usefulness of the radiographic method, and we regard it essential equipment of the laboratory.

The radiographic process as used in foundry testing is most useful to detect the existence of flaws; it is only in special cases that the exact outline of the flaw must be known. Then the sharpness of definition is of chief importance. The effect of secondary radiation is sometimes spoken of as an effect that tends to destroy definition.

Secondary radiation is in some ways analogous to the effect of light shining in a fog. The water particles reflect and refract the light in all directions so that all objects are seen in uncertain outline. If the photographic films were actually within the body of the metallic substance, the same shadowy outlines would be produced. Since the metal and film are separated, the scattering rays act differently from light in a fog principally because X-rays are much more nearly monochromatic than ordinary sunlight, which, as we all know, is a mixture of the rainbow hues. Scattered X-radiation therefore may be thought of as monochromatic, its wave-length depending upon the characteristic frequencies of the metallic atoms. This radiation is most easily absorbed by the neighboring atoms so that most of the scattered radiation is absorbed by the metal itself. There is a certain amount escaping from a thin layer next to the photographic plate. This is indicated in sketch C of Fig. 5. If, as usually happens, the film is perpendicular to the axis of the X-ray beam, that portion of the scattered radiation that originates within the metal will have its components selectively absorbed so that the emergent components will be greatest in the direction of the radiation that proceeds from the target. This part of the scattered radiation assists in forming the image. The part that originated at or near the surface will proceed in all directions and will tend to fog the film.

That portion of the incident radiation that is transmitted directly through the metal will be highly monochromatic when it emerges (due to the filtering action of the metal) and its wave-length depends on the voltage across the bulb. Furthermore, its wave-length is very different from the wave-length of the scattered radiation and will probably have a different photographic effect. Hence even when photographing through thick metal a sharp image of the flaw should appear upon a background of general fog, except where the pinhole effect comes in. This would destroy the definition even when photographing with ordinary light.

Summary

1. Our experiments in radiographing steel indicate that for material at a fixed distance from the target of the X-ray bulb and with the use of intensifying screens, the relationship between thickness, potential and exposure may be expressed by an equation of the form

$$y = (AV - B)\log x$$

where y is the thickness in inches, V is the potential in kilovolts, x is exposure expressed as the product of the current through the bulb in milliamperes multiplied by the exposure time in seconds. A and B are constants for our particular machine and with steel at a distance of 17 in. from the target. $A = 0.0048$ and $B = 0.26$.

2. The limit of penetrability based on 30 minutes exposure with apparatus commercially available is placed at approximately 3 in. of steel.

3. The magnitude of a fault may be judged from the area and relative density of the image only within rather indefinite limits.

4. For thickness of metal near the limit of penetrability a flaw approximately 2 per cent of the thickness of the metal may be detected.

5. Where the flaw is sufficiently large or sufficiently close to the film so that the pinhole effect is not important, the definition of the image remains sharp as long as the image is visually detectable in the negative.

Appendix

Mathematical Relationships

The law of absorption of X-rays is well known. If monochromatic radiation is incident upon material of given density, each successive increment of thickness absorbs an equal fraction of the radiation incident upon the sheet of material represented by that increment.[1] This gives rise to the equation:

$$\rho = \frac{2.3}{y}(\log I_0 - \log I)$$

where ρ is the linear absorption coefficient, y is the thickness of material, I_0 is the incident radiation and I is the radiation transmitted. It is known that the coefficient ρ is proportional to the wave-length. The wave-length of the radiation is inversely proportional to the potential applied to the tube so that the equation could be written:

$$y = VK(\log I_0 - \log I) \qquad (1)$$

where V represents the potential applied to the bulb and K is a constant depending upon the material, units employed, etc. The absorption law has been verified by ionization methods and also by the direct action of the transmitted radiation on a photographic plate. In practice the photographic film is used with intensifying screens. The fluorescence of the screen varies with the wave length of the exciting radiation. This variation[2] makes it difficult to apply equation (1) where the density of the film is used to judge the exposure.

In equation (1) I and I_0 represent

[1] Kaye, "X-Rays," p. 100 (1914).

[2] Millard B. Hodgson, "The Physical Characteristics of X-Ray Fluorescent Intensifying Screens," *Phys. Rev.*, vol. 12, No. 6, p. 431 (1918).

intensities. The photographic plate responds to intensity times time or total radiation. However, since I_o and I occur as a ratio the equation may just as well be written in terms of the total radiation received by the material and plate respectively during time of exposure. The radiation that affects the plate is IT. The negative density is related to this IT term in accordance with the well-known Hurter and Driffield equation for photographic density,

$$D = A + B \log E \qquad (2)$$

where D is the density of silver deposit, E is exposure and is represented by IT, A and B are constants. If we, by trial, make the negatives all of the same density then IT should be a constant, provided the fluorescence of the screen does not change. Equation (2) may therefore be written

$$y = K'V(\log I_oT - A) = C'' \log x - \frac{A'}{V} = \text{constant} \qquad (3)$$

where x is put for I_oT.

The intensity of the X-ray beam is proportional to the current through the tube. Hence x may be expressed as the product of the tube current multiplied by the time of exposure. For want of a more convenient expression we have conformed to the usual practice and called this quantity the "exposure." It is the exposure to which the material rather than the film is subjected.

Equation (3) was checked by making a series of exposures of a pile of steel strips placed en echelon, as outlined above. "Exposure" for a given density on the film was then plotted against thickness of iron. The experimental values plotted along the 195- and 100-kv. curves (Fig. 4) were obtained in this way. It was found that in each case the values could be represented by an equation of the form of equation (3).

We were not successful in the attempt to fit the experimental data to a *family* of curves of the form $y = KV(\log x - A)$, since K and A both vary with V. For instance, the 195- and the 100-kv. curves are represented by the equations

$$y = 0.00343V(\log x - 0.02) \text{ and}$$
$$y = 0.00195V(\log x - 0.45) \qquad (4)$$

respectively. This fit is not to be expected if the variation of the screen fluorescence with V affects the values of I. It is evident, however, that the experimental values represented by equations (4) may be represented nearly as well by equations of the form:

$$y = C \log x \qquad (5)$$

where C is a parameter depending on V. For instance, equations (4) may be represented within the limits of experimental error by equations

$$y = 0.68 \log x$$
$$y = 0.22 \log x \qquad (6)$$

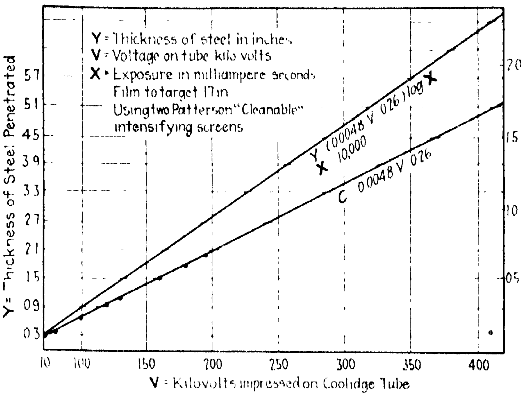


FIG. 12—THICKNESS OF METAL PENETRATED BY EXPOSURES OF 10,000 MILLIAMPERE-SECONDS

Assuming equation (5) to be the type of equation best fitted for the curves, experimental values for C were obtained for a series of values of V and these were plotted against V. The points fell very accurately on a straight line between V equal 80 and V equal 195 kv. This line, shown in Fig. 5, curve A, has for its equation

$$C = 0.0048V - 0.26 \qquad (7)$$

Substituting this value in equation (5) gives the relationship between potential, thickness, and exposure in the following equation:

$$y = (0.0048V - 0.26) \log x \qquad (8)$$

where y is expressed in inches, V in kilovolts and x in milliampere-seconds. Equations 7 and 8 are plotted in Fig. 12.

In obtaining equation (8) the film was kept at a fixed distance of 17 in. from the target. The exposure varies with the distance according to the inverse square law. The interposition of absorbing material in X-ray exposure is analogous to the interposition of an absorbing screen of sectored disk in optical pyrometry: the effect is to change the apparent intensity of the source of illumination. The effective illumination on the film system is inversely proportional to the square of the distance from the target for the transmitted radiation, and it is sufficiently accurate for practical work to apply the same law to the exposure as we have used it in the foregoing discussion.

Equation (8) is empirical and does not hold for small values of V. This may be due to peculiarities of the screens or to the fact that for values of V above 100 kv. the transmitted radiation plays the more important part in the photographic action. This radiation, is, however, not all the radiation that affects the film. The fluorescent radiation from the bottom layer of the steel also reaches the film and probably becomes relatively more important for smaller values of V down to about 10 kv., where the K absorption frequency for iron occurs. We have tested the relation down to 80 kv. with satisfactory results. It is probable that the relation holds for values greater than 200 kv., which is the upper limit of potentials possible with our machine. The curves for 300 kv. and 400 kv. in Fig. 4 are derived from values of C obtained by exterpolating equation (7). If this is permissible, these curves give us a means of estimating the bulb potentials that will be necessary for going through greater thicknesses of material than is now possible with present equipment.

Sponge Iron

Work has been conducted for some time past at the Seattle station of the Bureau of Mines hoping to develop a method by which sponge iron can be made by using low-grade coals and iron ore in a direct-fired, rotary kiln. The sponge iron will be useful in the production of foundry iron, steel, and for the precipitation of copper from solutions resulting from leaching operations.

Tests will now be made in a small furnace that will treat about half a ton of ore per day. Attempts will be made to increase the rate of reduction of the iron oxide by adjusting the operating conditions of the furnace and the conditions of the charge. Concentration studies will be made on a product with a view to obtaining a high-grade sponge iron suitable for melting in an electric furnace, or for use in precipitating copper from solution.

Melting this sponge to foundry iron involves its carburization. Consequently the latter reaction has been studied on a laboratory scale and is to be continued on a commercial scale, using some of the local commercial electric furnaces and foundry cupolas. A study of the mechanism of carburization and of the causes of graphitization will be conducted in the laboratory. After the above studies have been completed, the conditions determined therein will be applied to the melting of sponge iron.

Steel Treaters to Publish Data Sheets

As a service to its members, the American Society for Steel Treating plans to prepare, publish and distribute, in loose-leaf form, data sheets relating to steel treating. These sheets will consist of tables, charts and pertinent information useful to the practicing metallurgist and heat treater.

It is proposed that the A.S.S.T. Handbook will have the same relationship to the steel treating industry as the S.A.E. Handbook to the automotive industry and Kent's Handbook to the engineering industry. D. K. Bullens, author of "Steel and Its Heat-Treatment," will be the editor, and the members of the society have been circularized asking them to send in suggestions concerning useful data to be included.

Legal Notes

BY WELLINGTON GUSTIN
Of the Chicago Bar

Decision Upholding Validity of Tungsten Filament Patents Brings Out Points on Foreign Process Patents

In the infringement suit brought by the General Electric Co. against F. Alexander and another involving the Just and Hanaman patent, No. 1,018,502 and the Langmuir patent, No. 1,180,159, the United States Circuit Court of Appeals has affirmed the decree of the District Court in favor of the plaintiff holding these patents valid.

These patents have been a great deal in the courts and the trial court gave the litigants the widest opportunity to put forward almost any conceivable fact, experiment or theory, with any and all defenses thereto, relating to validity or infringement, in order that litigation as to the validity of these patents should some day come to an end one way or the other.

The court finds that there is not a shred of merit to the attack on the validity of the Langmuir patent. It was contended that the American Sinding-Larsen patent, No. 672,019, invalidates the Langmuir patent. The court found that the Sinding-Larsen lamps have never been used, because the theory was wholly wrong. (277 Fed., 290.)

ARGUMENTS AGAINST VALIDITY OF JUST AND HANAMAN PATENT

The defendants were making and selling tungsten nitrogen lamps substantially identical with those made and sold by plaintiff under the asserted protection of the aforesaid patents and the Coolidge patent. The defenses urged against the validity of the Just and Hanaman patents were:

(1) That the same patentees obtained a German patent, 154,262, valid from April 15,1903, for substantially the same invention as is revealed by their patent in suit applied for July 6, 1905; wherefore the patent at bar is invalid under a federal statute (Rev. Statutes, section 4,887) requiring foreign patents to be registered in this country within 2 years from the time they are obtained in another country.

(2) There is no infringement, because defendant's filaments contain an extremely small quantity of thoria, which prevents said filaments being the "pure, coherent, or homogeneous" tungsten filaments of Just and Hanaman. In point of fact defendant's filaments are admittedly made in the manner of Coolidge, and contain thoria for the reason and purposes set forth in Coolidge's disclosure.

INOPERATIVE FOREIGN PROCESS PATENT CANNOT DEFEAT PRODUCT PATENT

Passing on the first defense set out above, the court says the defense of invalidity under section 4,887 puts a heavy burden on a defendant. The various amendments to that section have not changed the truth of Judge Putnam's statement in a former case, 183 Fed., 828, that the act applies only to cases where the inventions actually claimed in the foreign and domestic patents are identical. It is not sufficient that the foreign patent may disclose the invention of the later United States patent where it is not therein claimed.

Again it points out that the claim of the German patent is for a process which it says is wholly inoperative, in that it cannot produce the product covered by the patent in suit. The essential reason for this conclusion is that doing what the German patent calls upon one to do will never replace carbon or tungsten. The process rests upon the theory of replacement, and that theory has no substratum of fact.

The German patent being for a process and the American patent for a product, the court says it is true that, if the only use of the process is to make the product, such foreign process patents would and should affect an attempt to get American protection for the product. But that is not true in this case, the court finds. The German process patent will not make anybody's incandescent lamp filament, and especially will it not make the product of the patent in suit. Therefore the court holds that in no sense are the two patents for the same invention, whether one regards the proved facts or the language of disclosure and claims.

USE OF THORIA DOES NOT PREVENT INFRINGEMENT

Now the defendants admitted the use of Coolidge's thoria-containing filament; but as they were not being sued on the Coolidge patent they could not infringe here. A former decision in the Laco-Phillips case, 233 Fed., 96, specifically held that a Coolidge drawn filament infringed the Just and Hanaman patent, although it was an improvement of such striking nature that it completely drove all other tungsten filaments from the market.

Now the court points out that while impairment of function is no defense to infringement and improvement of function is oftentimes patentable matter of a very valuable kind, if the functioning of a patent is substantially appropriated by substantially using the patented means, infringement always exists. The object of all makers of light filaments is to get the best light, and what at present makes the tungsten filament the best light-giving means is pure, cohering and homogeneous tungsten. Tungsten of that kind is functioning just the same with or without the mechanical thoria stiffener. This is true, whether the slender thread of incandescence is made by Just and Hanaman, or by Coolidge, or by the defendants.

IMPREGNABLE INVENTION, SAYS COURT

Defendant Alexander and one Fabian were once partners trading as Alpha Electric Laboratories. This concern sold infringing lamps, whereupon this action was brought against the partners trading as aforesaid. Subsequently plaintiff learned that, before the bill was filed, the business was incorporated as Alpha Laboratories, Inc., at which time Alexander bought out Fabian and became the owner of all the shares in the new company. The corporation continued to do the same business, making and selling the infringing lamp. Suit was dismissed as to Fabian, but the decree against both the corporation and against Alexander personally was upheld.

The court says that "notwithstanding the ingenuity and ability with which the Just and Hanaman American patent has been attacked, it remains where it was and where it should be—the embodiment of an impregnable invention of the highest order."

Elastic Column Dynamometer for Hardness Testing

BY HERMAN A. HOLZ

A NUMBER of devices have been developed during recent years to measure the load in small static testing machines used in hardness testing by the ball or cone methods of Brinell or Ludwik.

The original Alpha machine made in Sweden and several American-made Brinell machines make use of a spring manometer gage which is checked either against a piston loaded with weights or against another spring manometer gage. The spring manometer, suffering from changes in the spring and temperature variations, is by no means a satisfactory instrument of precision. Amsler's hardness (Brinell and Ludwik) testing press utilizes the well known pendulum dynamometer for measuring the load on the indenting tool. It utilizes what is undoubtedly the most accurate and constant apparatus known to modern science for measuring the load. However, it is quite expensive, and is difficult to adjust or modify to meet a wide variety of special problems encountered in practice.

Some of the other schemes used for determining the load in hardness-testing apparatus are the deformation of calibrated springs (Guillery), the deformation of the frame of the testing machine itself (Derihon), the balancing of weights by levers (Avery, Herbert, Riehle, etc.). Levers and knife edges subjected to heavy stresses, jerks, sudden releases and other slowly but progressively deteriorating influences are by no means ideal elements in the construction of testing machinery. Even in the large tensile machines, the lever type machines are being rapidly superseded by those machines which do not contain any knife edges.

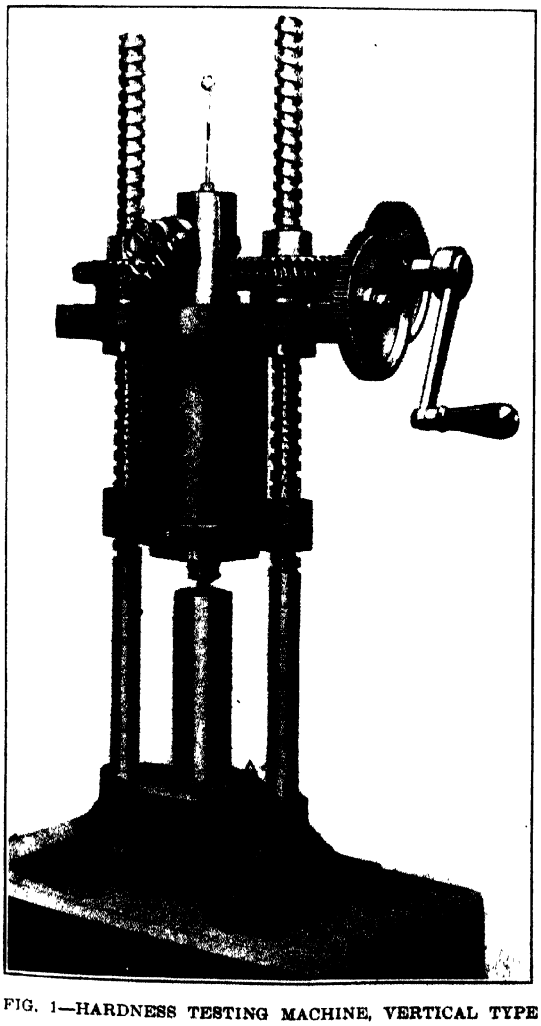


FIG. 1—HARDNESS TESTING MACHINE, VERTICAL TYPE

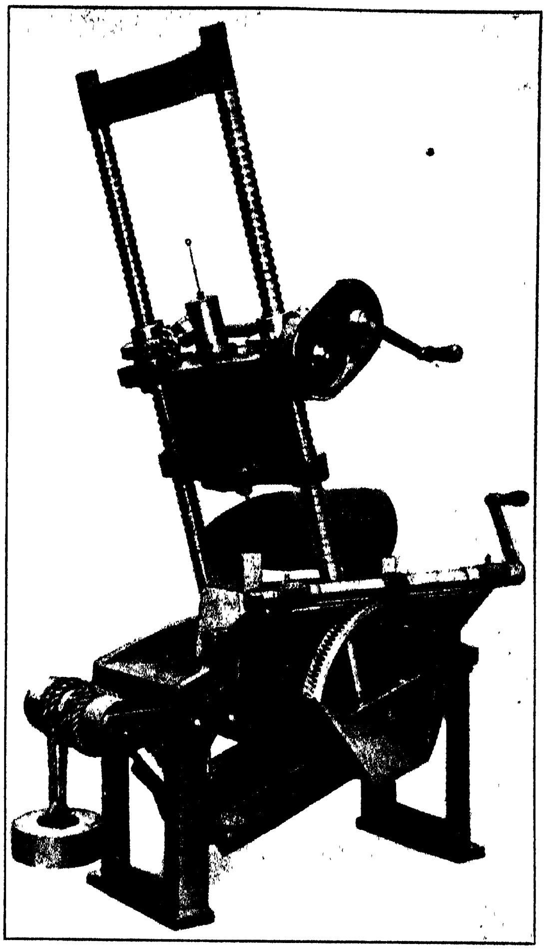


FIG. 2—HARDNESS TESTING MACHINE, SWINGING TYPE

Methods of *applying* the load do not vary so widely. In nearly every design a small hydraulic pump builds up pressure within a cylinder, and this pressure is transmitted to the testing point by means of closely fitting pistons and rods. Small hydraulic machines are not altogether suitable for continuous use in places where dust and soot are apt to get into valves, such as often occurs in heat-treating shops. The elastic column dynamometer described below imposes a load by a train of gears and screws, so that we now have practical, accurate and rugged instruments for measuring the load on hardness testers in which nothing can get out of order and that can be operated satisfactorily and correctly by anybody, in any position and at any range.

The principle used by Dr. Alfred J. Amsler in designing this dynamometer is illustrated in Fig. 3. The apparatus forms the upper part of a press; the material under test is pressed against plate *B* with a load *P*. The reaction is taken up by shoulders *A*, which are

securely connected to the base of the machine. The total load which acts on the test piece is transmitted by means of columns *C* from the compression plate *B* to the shoulders *A*. Under compression these columns shorten a very small amount, their deformation being always proportional to the load which they transmit, since they are loaded far below their elastic limit.

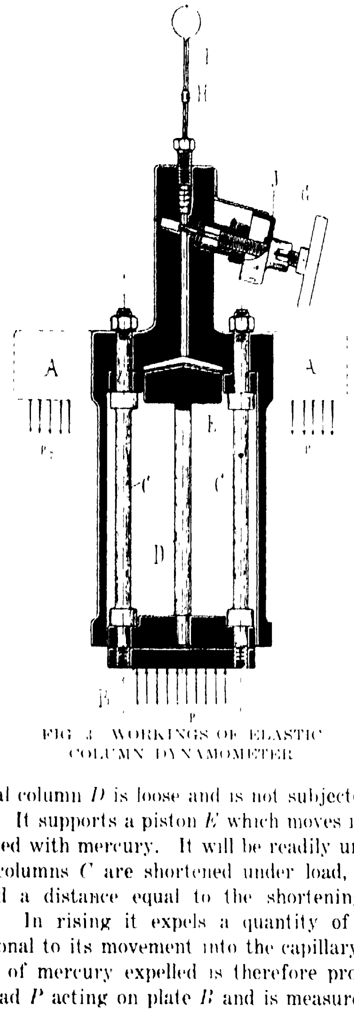


FIG. 3—WORKINGS OF ELASTIC COLUMN DYNAMOMETER

Central column *D* is loose and is not subjected to any stresses. It supports a piston *E* which moves in a small space filled with mercury. It will be readily understood that if columns *C* are shortened under load, piston *E* is raised a distance equal to the shortening of the columns. In rising it expels a quantity of mercury proportional to its movement into the capillary *F*. The quantity of mercury expelled is therefore proportional to the load *P* acting on plate *B* and is measured by the micrometer screw *G*, the end of which is immersed in the mercury.

The level of the mercury in the capillary can be adjusted to any desired height by turning the screw. The most practical manner of reading the load is to bring the meniscus to the fixed mark *H*, where it stood at "no load." The amount by which the screw is turned back is then the measure of the load applied. The dimensions of the apparatus are usually chosen in such manner that one complete revolution corresponds to 1,000 kg. pressure, and one division on the head to 10 kilos. When it is desired to apply a definite load, say 3,000 kilos, the micrometer is turned back three complete revolutions and then the load is gradually increased until the level of the mercury returns to its original height.

Readings are independent of the bore of the capillary *F*, so that an accidental breakage can be immediately replaced by another tube without influencing the accuracy of the apparatus. This dynamometer is very sensitive and at the same time of very rugged construction; it can be overloaded only when the testing machine itself is being wrecked. Each dynamometer is carefully calibrated by dead load up to its full capacity; the calibration can be checked at any time by hanging the entire machine up by the compression plate *B*. The load then shown on the dynamometer should agree with the weight of the machine, and if other comparisons be thought desirable extra weights may be added to the machine base.

The practical application of this dynamometer is shown in Fig. 1, a hardness-testing machine with two speeds; the high speed is applied to bring the ball quickly into its required position, the slow speed is used to apply the load. It is apparent that the main side screws can be made of any desired length and set at any reasonable distance center to center, so that very large pieces—like great gear wheels—can be tested at various points on the rim or teeth.

An especially interesting application is shown in Fig. 2, of a machine developed for the French Government. The entire frame can be rotated about an axis placed below the lower base frame of the machine. A counterpoise balances the weight of the frame and of the moving head, so that any required adjustments require very little power. The ball itself follows the curvature of the pointed part of the shell, so that it is always in the proper position for testing. The radius of arc of the circle described by the ball can be adjusted from 6 in. to 40 in.; it is set at the radius of the part to be tested, and the later held in place by an appropriate fixture or steady rest.

Coke as a Blast-Furnace Fuel

Operators believe that loss by "solution" of coke in the blast-furnace stack gases is detrimental to economical operation. A laboratory test has been devised at the Southern station of the Bureau of Mines by which the relative reactivity of cokes with carbon dioxide may be quantitatively determined. Correlation of test results with those of actual furnace practice will be undertaken on furnaces operating on coke from Alabama, Pennsylvania and Illinois coal.

Combustion of coke in the blast-furnace hearth has also been studied in the Birmingham district. Additional work will be done at furnaces in the Pittsburgh districts and at the furnaces of the St. Louis Coke & Chemical Co. at Granite City, Ill., which are operating on coke from Illinois coal. By means of analyses of gas taken from different parts of the blast-furnace hearth, the rate of combustion of different kinds of coke will be determined under actual operating conditions. Results so obtained will be correlated with the physical and chemical properties of the coke as determined by laboratory tests.

In making calculations of the efficiency of operation of a blast furnace, the amount of carbon available for combustion at the tuyeres is taken as the so-called fixed carbon of the proximate analysis. The official determination of volatile matter is made at a temperature of 950 deg. C. Since coke is subjected to temperatures up to 1,800 deg. C. before being burned at the blast-furnace tuyeres, there is the possibility that less carbon is actually "fixed" in a condition to reach the tuyeres than is indicated by the ordinary proximate analysis. Experiments are now under way at the Birmingham station of the Bureau of Mines in which the volatile matter of several varieties of metallurgical coke will be determined at temperatures up to 1,700 deg. C.

Recent Chemical & Metallurgical Patents

Coal Carbonization—In two patents Charles C. Bussey describes the apparatus and procedure for treating carbonaceous materials and recovery of the volatile hydrocarbon products of destructive distillation. The process is essentially an internally fired vertical retort or combination of producer and vertical retort. The process and apparatus are like those which were tested out several years ago in Brooklyn and later used to a limited extent in or near Louisville, Ky. One of the important features, more or less novel in this apparatus, is the reciprocating grate at the bottom which by alternate forward and backward movement at controllable intervals provides for the ejection of the carbonized residue at the bottom of the retort. (1,432,275-6. Charles C. Bussey, assignor to Samuel E. Darby, trustee. Oct. 17, 1922.)

Evaporating Milk—Various objections to the ordinary vacuum pan method of evaporation of milk are claimed to have been overcome by a process patented by David D. Peebles of Eureka, Calif., and assigned to Bair, Peebles & Tooby of Eureka. Among these objections may be mentioned the high initial expense of installation of a vacuum pan system; the tendency of the liquor foaming and priming, and being carried over with the vapor escaping from the pan; adhesion of the concentrated material to the heated surfaces of the pan, thereby resulting in scorching; the need of special apparatus for homogenizing the milk; the necessity of maintaining a high temperature in the vacuum pan to prevent incubation of the bacteria, thereby breaking down the chemical constituents of the original milk; and finally the necessity of separate sterilizing apparatus at destructively high temperatures. The present invention consists in the continuous and successive circulation of the milk through a heater under pressure and an expansion chamber closed against access of surrounding air, the temperature of the milk being suddenly raised in the heater above the temperature at which the germination of the active organisms takes place and suddenly reduced in the expansion chamber to a temperature below that at which such germination is active, and removing the vapors resulting from the expansion of the water of the milk in a separate expansion chamber. At each successive cycle in the process a percentage of dehydration is effected and the milk is condensed and made more sterile without altering its chemical composition. The milk is heated to approximately 160 deg. F., which is a pasturizing temperature, and then cooled to the temperature of the vacuum under which the concentrator is operating. A tubular heater is employed, the milk being circulated through the tubes. (1,438,502. Dec. 12, 1922.)

American Patents
Issued Jan. 23, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,442,814—Device for Spraying Paint. F. R. Long, assigned to American Car & Foundry Co., New York.

1,442,818—Derivatives of 1 4 Naphthylenediamine. G. T. Morgan; assigned to Imperial Trust for the Encouragement of Scientific and Industrial Research.

1,443,077—Process for Producing Sulphides. A. Helbronner and P. Piperdant, Nantes, France.

1,443,094—Method of Making Phthalic Anhydride. H. Sasa, Tokyo, Japan.

1,443,149—Rubber Composition. P. Schidrowitz, London.

1,443,161—Coke Oven. G. A. Bolz, Rahway, N. J.

1,443,184—Centrifugal Separator. R. E. Lapham, Oakland, Calif.

1,443,189—Plates for Vulcanizing Press. A. C. V. Malm, assigned to E. W. Bliss Co., Brooklyn, N. Y.

1,443,220—Recovery of Nitrogen Oxides. P. A. Guye and A. Schmidt, assigned to "L'Azote Francaise" Co. of Paris.

1,443,221—Insulating Material. J. Hawkridge, D. Robertson, C. J. Nevine, of London.

1,443,231—Non-Freezing Attachment for Water Tank. F. W. McCauley, Goodes, Va.

1,443,328—Explosive. E. Herz, Vienna, Austria.

1,443,330—Determination of Naphthalene in Gas. W. H. Fulweiler, assigned to U. G. I. Co.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Anthraquinone Dyes—Ewald Steinbuch, Franz Ackerman and Max Utzinger, of Basel, Switzerland, assignors to the Society of Chemical Industry in Basel, Switzerland, have patented a process for the manufacture of new condensation products of the anthraquinone series which contain in their molecule 1.3.5-triazine nuclei and constitute colored powders generally difficultly soluble in organic solvents and forming colored solutions with concentrated sulphuric acid. The condensation can be affected in such a manner that the respective anthraquinone and 1.3.5-triazine derivatives are left to react on each other for a sufficient length of time dissolved or suspended in suitable agents such as nitro-benzene, chlorbenzene, naphthalene, toluene, glacial acetic acid, etc., the temperature begin maintained constant as desired. The solvent may also be omitted by simply melting together the respective compounds to which a catalytic agent, such as cuprous chloride, may be added if necessary. (1,437,783. Dec. 5, 1922.)

Chrome Dyes—Fritz Straub, of Basel, Switzerland, has patented a method of making chromium compounds of azo dyes by treating an alkaline solution of the dye with a complex chromium compound formed by the action of alkaline suspension of chromium hydroxide on organic compounds containing more than one hydroxyl group, as polyvalent alcohols and phenols, tannins, saccharides and derivatives of cellulose.

In an example, 46.8 parts of caustic potash are introduced gradually into 100 parts of aqueous paste of hydrate of chromium oide, with stirring, care being taken that the temperature does not rise above 70 deg. C. After all the potassium hydroxide is dissolved, 20.8 parts of glycerine are added with stirring. The mass is heated to boiling and maintained in ebullition until all of the chromium hydrate is dissolved. To this solution is added 71.2 parts of the dye derived from 1-diazo-2-oxy-naphthalene-4-sulphuric acid and alphanaphthol. The dye dissolves quickly and the dark blue coloration of the resulting solution turns rapidly to blue-violet. The mass is boiled for 10 hours in a vessel provided with a reflux condenser, the temperature of the reaction being 100 to 102 deg. C. The mass is then diluted with 600 parts of cold water and the liberated caustic potash is neutralized with mineral acid and the dye salted out, filtered and dried. (1,440,566. Jan. 2, 1923.)

Cellulose-Ether Solvent — A compound solvent for alkyl ethers of cellulose, comprising a mixture of methyl alcohol and toluene, is covered by a patent taken out by Stewart J. Carroll, of Rochester, N. Y., and assigned to the Eastman Kodak Co. The solvent is designed to be used for film dope, where a very viscous solution is desired. The proportions recommended vary between 25 to 50 of methanol and from 50 to 75 parts of toluene. (1,441,143. Jan. 2, 1923.)

High Explosives for Detonators—Fulminate of mercury has long been the chief initiating explosive of commercial importance used in detonators. Its great advantage over other initiating explosives is that by its use detonation is assured, either by the spit of a fuse or other means of ignition or by moderate percussion. On the other hand, it exhibits several undesirable properties

in that it is easily affected by moisture, its detonating value is diminished by compression, it has a relatively low brisance, which renders necessary the use of an inner capsule or reinforced shell when it is desired to use fulminate of mercury as a priming charge in the TNT type of detonator, and finally because it has a corrosive action on a number of metals and alloys, thereby rendering them unsuitable for detonator casings.

The heavy metal azides, which are salts of hydrazoic acid, have been proposed as a substitute for fulminate of mercury, but they also have their drawbacks in that they are not easily ignited. It would seem that the desirable properties of the two types of explosives might be obtained by a proper mixture of the two, but unfortunately the azides corrode some of the metals and alloys which are not affected by fulminate of mercury, so that there is really no metal which could be used for a casing for the combination explosive.

Bennett Grotta, of the Atlas Powder Co. experimental laboratory at Tamaqua, Pa., has been granted a patent covering the use of the mercurous salt of hydrazoic acid in combination with fulminate of mercury for use in detonators. The mercurous salt is not nearly as unstable as the mercuric salt, and seems to be admirably suited for admixture with mercury fulminate because both compounds, being salts of the same metal, may be mixed without danger of chemical action, and in the second place, because there is no appreciable action between such a mixture and shells which would be suitable for fulminate detonators. It is claimed that the mercurous compound, in contradistinction to lead azide, does not form supersensitive copper azide. The inventor attributes this to either of two explanations: First, to the comparative positions of the metals involved in the electromotive series, and second, to the comparative solubilities of mercurous azide and lead azide in water.

Another advantage of the mercurous azide over the better known lead compound is that it is not attacked by the carbon dioxide of the air with consequent liberation of hydrazoic acid which in turn may act upon the copper of the shell with the formation of the super sensitive copper azide.

It is claimed that from the standpoint of detonating efficiency, the admixture of small quantities of mercurous azide with fulminate of mercury produces most gratifying results. It is said that the advantageous effects of such mixtures hold equally true when the mixtures include suitable proportions of potassium chlorate. (1,439,099. Dec. 19, 1922.)

Purification of Naphthalene—In using this invention, crude naphthalene is distilled and the vapor passed through sulphuric acid of about 66 deg. Bé. at a temperature high enough to avoid condensation of the vapor. The temperature is usually 134 to 144 deg. C. at the preferable pressure, but the operation may be at various pressures with corresponding change of temperature. The impurity in the vapor is sulphonated and forms a byproduct in the acid residue which is described as "useful in the arts as ingredients of synthetic tanning liquor, for saponification of oils, or for other well-known uses to which crude sulphonic acids may be put." (1,438,710. S. P. Miller, assignor to The Barrett Co. Dec. 12, 1922.)

French Patents

Separating Constituents of a Gas Mixture—To the gas or gaseous mixture are added particles of a solid substance, held in suspension therein and of such a chemical nature as to combine with the particular constituent to be removed, with formation of a fume or a fog. This fog is then precipitated by a high-tension electrostatic field. (Fr. Pat. 534,879. A. L. Stinville.)

Purification of Liquids Contaminated by Phenol—Liquors contaminated by phenol may be evacuated into rivers following their filtration through a bed containing certain aerobic bacteria which destroy the phenol, presumably by oxidizing it to innocuous substances. A filtering bed of humus (to protect the bacteria) mixed with coke is prepared which allows access of air circulated through it either by suction or pressure. Through this filter-bed activated sludge (drawn from the aeration chambers of sewage treatment plants) is allowed to percolate, after which it is topped with a layer of farm manure. The waste liquor to be treated is then passed through the filter bed. This liquor is generally a residual ammoniacal liquor from a gasworks or a coke-oven plant, which has been diluted by water or, better still, by the effluent itself, until it has no longer a highly toxic effect upon the filter-bed bacteria—viz., until the phenol content has dropped to below 3 parts in 10,000. For instance, in the operation of the filter, 10 to 15 per cent of the effluent is evacuated into the river and 85 to 90 per cent is recirculated through the filter to which is added 10 to 15 per cent of crude residual liquor (sometimes 5 to 30 per cent). One cubic meter of the filter-bed composition is sufficient for treating 60 to 120 liters of residual liquor each 24 hours. Since the filter is operated continuously, the reproduction and the growth of the phenol-destroying microorganisms compensate the losses. If the losses become excessive, the degree of dilution may be increased or the flow reduced. The amount of inflowing liquor may even be stopped altogether, thereby affording time for the replacement of the killed bacteria. The optimum filtration temperature is 20 to 25 deg. C. In the residual ammoniacal liquors the sulphocyanates are likewise oxidized by the bacteria, although subsequently to the phenols. For this type of waste liquor it is advisable to effect, prior to purification by filtration, the removal of the solid and tarry constituents, as well as the sulphides (CaS), by preliminary decantation followed by a filtration through an iron-oxide mass or blast-furnace slag. This may be supplemented by a special treatment for the elimination of the cyanogen compounds. (Fr. Pat. 533,922. The Koppers Co., Pittsburgh, Pa.)

Continuous Distillation of Bituminous Shales—This process consists in admitting air, occasionally even steam, into the lower part of a downwardly moving column of highly heated bituminous shale, whereby the residual carbon (10-12 per cent in the case of Autun shales) is converted into gas, the latent heat of which brings about the distillation of the upper layers of the shale column, and the condensable oils and the ammonia are swept out of the retort. In this manner an extraneous source of heat for carbonization is dispensed with. (Fr. Pat. 534,659. Société d'Etudes et de Recherches Minières du Centre.)

Separating Asphalt and Ozokerite From Hydrocarbons—Crude petroleum oils to be purified are subjected to a chemical treatment prior to distillation. The reagents proposed by the inventor are comparatively dilute sulphuric acid solutions (40 to 60 per cent H_2SO_4), to which small amounts of solutions of metallic salts have been added, particularly halogen derivatives of trivalent iron, the function of which consists in promoting the precipitation of the colloidal compounds present in the crude oils. The oils, after having undergone this treatment and having been subjected to a cooling process, abandon their solid hydrocarbons in the form of ozokerite and ceresin wax, and no longer in the form of a low-melting point paraffine. (Fr. Pat. 536,172. H. Neumann.)

Production of Metallic Powders—This process is applicable for instance to the pulverization of aluminum, magnesium, copper, zinc, etc., which metals are susceptible of undergoing superficial oxidation and also of combining with nitrogen. The metal is heated in the open air or in a closed crucible to a little above its melting point. The molten metal is then drawn off and subjected to the action of a jet of compressed nitrogen at a suitable temperature whereby it is solidified in the form of fine ellipsoidal globules. The nitrogen may be that extracted from the air, for instance in the form of waste combustion gases whose CO_2 has been removed by bubbling them through milk of lime. In the case of aluminum, for instance, the nitrogen forms at the surface of the globules a protecting layer of nitride which prevents access of atmospheric oxygen to the subjacent metallic aluminum. (Fr. Pat. 532,470. J. Sejournet.)

Esters From Aluminum Alcoholate—Aluminum alcoholates may be obtained by the action of alcohols on aluminum amalgam or preferably on a ternary aluminum alloy, the latter being more readily prepared. By causing such an

alcoholate to act on an ester there is displacement of the alcoholic radicle of the ester by that of the alcoholate, provided these have a higher molecular weight. The yield is excellent. The acetic acid esters derived from secondary amyl alcohol, phenylethyl alcohol, and linalool have thus been obtained from ethyl acetate, and the phenyl acetic esters of amyl alcohol and phenyl ethyl alcohol from phenylacetic acid. The process is particularly applicable in the case of the esterification of tertiary alcohols which do not resist well the action of mineral acids, anhydrides or acid chlorides. It is also well adapted in those cases where the preparation of the ethyl esters is less onerous than that of the corresponding anhydrides or acid chlorides. (Fr. Pat. 531,960, Société Laboratoire-Usine.)

Aromatic Nitro-Amino Compounds—The replacement of chlorine atoms of aromatic chloro-nitro compounds by amino-groups does not require that the reaction be carried out under pressure (in an autoclave) proving that ammonium acetate is used in a current of gaseous ammonia. The amino-derivative is separated by washing the reaction product with water. The ammonium acetate is used in a current of this manner have been prepared 2:4-dinitro-aniline, 1:3:4:6-diaminodinitrobenzene, 1:4:3:5-chloraminodinitrobenzene, 1:2:4.3:5-chlorodiaminodinitrobenzene, 1:2:4:5-dichloraminonitrobenzene, 1:2:4-aminochloronitrobenzene, 1:4.2-aminochloronitrobenzene, o-nitroaniline. (Fr. Pat. 432,405. Société Chimique de la Grande Paroisse, Lille, France.)

Improved Hydrogenation of Naphthaline—A nickel catalyst suitable for the hydrogenation of naphthalene and much more active than that obtained by reduction of its oxide is obtained by forming it in a colloidal condition in the hydrocarbon itself. A current of hydrogen is passed into 1,000 parts of naphthalene and 5 parts of nickel carbona. heated to 220 to 250 deg. C. under a suitable pressure. The precipitated nickel carbonate is already in a finely divided condition. The dispersion is pushed even further by the liberation of carbon dioxide and the reduction process. (Fr. Pat. 533,033. Prax Chemische Versuchs und Verwertungs Gesellschaft m.b.H.)

De-inking Paper—The ordinary beater engine is equipped with a screen which holds back the pulp while the washing water is afforded free passage through it and through a circulating mechanism. In this engine a charge is made up composed of 1 ton (metric) of waste paper, 100 kg. of sodium carbonate, 320 hl. of water and 150 kg. of bentonite or analogous product. Bentonite is a clay having an exceedingly fine grain. The material used in this process should be such that at least one-half of its particles have a diameter less than 0.0015 mm. and 70 per cent of which is in a colloidal condition. The ink attaches itself to the colloid and is carried with it through the screen. After this operation an acid or an acid salt is used to neutralize the excess alkali and to brighten up the color of the paper. (Fr. Pat. 535,859. H. R. Eyrich and J. A. Schreiber.)

Production of Alumina and Aluminum Compounds—Bauxite is treated with nitric acid, and the iron is precipitated from the resulting solution. The purified solution gives pure aluminum nitrate, which, when calcined, yields alumina and nitrous vapors which are reconverted into nitric acid. The alumina may be extracted from the solution by any other method—for instance, by precipitation. (Fr. Pat. 529,569. Norsk Hydro-Elektrisk Kvaelestofaktieselskab, Christiania, Norway.)

Production of Aluminum and Potassium Compounds—Potash-bearing aluminous minerals, such as leucite or feldspar, are treated by mineral acids, preferably nitric acid. It is advantageous to carry out the operation in two phases, by first using an amount of acid sufficient to dissolve only the potash in the mineral and treating the residue from this solution with the amount of nitric acid, required for the dissolution of the aluminous compounds. (Fr. Pat. 529,570. Norsk Hydro-Elektrisk Kvaelestofaktieselskab, Christiania, Norway.)

A New Hypochlorite Bleach—A mixture of chlorine and air is passed over a paste consisting of lime and water to which has been added a saturated solution of calcium chloride and calcium hypochlorite. This paste may also contain the products of decomposition of calcium hypochlorite, as well as the soluble salts present in the caustic lime used. The reaction mass is continuously stirred during the chlorination. The resulting paste is filtered and the solid part which is the active product, is dried in a vacuum at a low temperature. The resulting product is characterized by its stability. (Fr. Pat. 530,706. P. Andren.)

Breaking Down Emulsions—A reagent is added to the emulsion which disperses as a colloid in the continuous phase of the emulsion and hence comes automatically into contact with the suspended globules, causing the latter to coalesce. The reagent used is a compound which acts as an emulsifying colloid tending to invert the form of the emulsion, and a second compound capable of dissolving the former and the continuous phase of the emulsion. Good results are obtained, for instance, by means of a reagent composed of about 25 per cent of a soda soap, 10 per cent of water and 65 per cent of oleic acid. This reagent may be prepared so as to render it colloidally soluble in oil. Likewise good results are obtained from a reagent composed of 4 per cent of calcium oleate dissolved in a mixture of 50 per cent alcohol and 50 per cent glycerine to which 1 per cent of gelatine is added as a stabilizer. A reagent answering this description is soluble in water, although it contains hydrophobe colloidal calcium oleate. One practical example of the invention consists in adding 1 per cent by weight of a reagent composed of 40 per cent of water, 35 per cent of free rosin and 25 per cent of soda-rosin soap to a viscous oil-water emulsion, the mixture being stirred to promote the dissolution of the reagent in the emulsion, and centrifuged whereby the water is caused to separate from the oil. (Fr. Pat. 532,148. Sharples Specialty Co., West Chester, Pa.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Antiseptic Soap—An antiseptic and insecticidal compound comprises soap, alkali benzoate and vegetable or mineral tar. In examples, 80 parts of hard or soft soap are mixed with 10 parts of sodium or potassium benzoate and 10 parts of birch tar; or a mixture of 80 parts of fatty acids, 10 parts of benzoic acid and 10 parts of birch tar is saponified in a manner not involving boiling or salting out of the soap. (Br. Pat. 186,078. R. Macpherson, Worthing, Sussex, and W. E. Heys, Bushey, Hertfordshire. Nov. 15, 1922.)

Synthetic Resins—Resinous products are obtained by heating phenols with sulphur in the presence of a base, the amount of base employed being not more than one-fifth equivalent of the phenol; from 2 to 3 atoms of sulphur per molecule of phenol are used and the heating continued until evolution of sulphuretted hydrogen ceases. Catalysts such as halogens or compounds yielding halogens may be added. The products are fusible and soluble in alkalis, alcohol, acetone or benzene, and may be converted into insoluble infusible products by prolonged heat, or heat and pressure, or they may be hardened by treatment with a small amount of formaldehyde or substances yielding it. According to examples, the following parent materials are employed: phenol, sulphur, and potassium hydrosulphide; o-cresol, sulphur and potassium carbonate; phenol, tri-cresol, sulphur, aniline and iodine; resorcin or α- or β-naphthol, sulphur and caustic soda; an example of hardening the resin by means of hexamethylene-tetramine is also given. (Br. Pat. 186,106. T. M. Hickman, Wolverhampton. Nov. 15, 1922.)

Chrome Alum—Chrome alum crystals are prepared by adding to green chrome alum solution small quantities of potassium bichromate, sulphuric acid and sulphurous acid, when the violet chrome alum is immediately produced and is readily crystallized. The quantity of potassium bichromate is not sufficient to oxidize any iron present and the sulphuric acid is equivalent to the potas-

sium of the bichromate. In an example. ferrochromium is dissolved in sulphuric acid, and about half of the ferrous sulphate is removed by crystallization. The ferrous sulphate is separated in a centrifugal machine and the necessary quantity of potassium sulphate is then added. The green solution is then treated as above described to obtain chrome alum crystals.

A second specification covers a modified process involving the intermediate production of chromium hydroxide. Ferrochromium is dissolved in sulphuric or hydrochloric acid, and an alkali hydrate or carbonate or an alkaline earth hydrate is added in quantity sufficient to precipitate the chromium a-hydroxide free from iron. The precipitate is washed and dissolved in sulphuric acid, and potassium sulphate is then added to produce chrome alum. (Br. Pat. 187,231 and 187,232; not yet accepted. Chemische Fabrik in Billwarder vorm. Hell and Sthamer Akt.-Ges. and P. Hasenclever, Hamburg. Dec. 13, 1922.)

Evaporation In evaporating liquids in multiple-effect apparatus particularly of the kind described in specification 180,963 in which the liquid is fed in parallel to the effects the liquid is passed in series through a number of multiple-effect plants, the temperature ranges of which coincide or overlap substantially. In concentrating brine or other liquid the boiling point of which rises on evaporation, the first effects of each plant are preferably supplied with steam from the same source and the last effects are connected to the same condenser, and the number of effects in each succeeding plant is progressively diminished. In evaporating cane or beet sugar solutions, the concentration obtained in the last plant may be such that crystals separate in the effects of this plant, or crystallization may be effected outside the plant in crystallizing vessels which may be supported on wheeled devices or in heated pans in which slow evaporation takes place. When the concentrated liquid is to be cooled to cause crystallization or for other purposes, the vessel containing the liquid is connected to the vapor spaces of effects at progressively lower pressures as to cause the liquid to flash off steam and to lower the temperature in stages. The method of cooling the concentrate and recovering the heat for use in the evaporating process may be used in plant in which the multiple-effect apparatus is replaced by apparatus of the kind described in specification 12462/11, in which the vapors evolved on evaporation are compressed and used as the heating agent. In concentrating impure liquids such as sea water, which at one stage of the concentration will deposit impurities, such as calcium sulphate, etc., on cooling, the cooling may be effected by flashing-off vapors from the solution by connection with effects of lower pressure, during the passage of the solution from one evaporating plant to the next. The solution may be preheated before passage into the next plant by heat-exchange with the solution from the first plant. According to one provisional specification the control device described in specification 180,963 for controlling the passage of vapor from one effect to another may be used also to control the flow of liquid from the source of supply into the effect. (Br. Pat. 187,260. T. Rigby, Westminster. Dec. 13, 1922.)

Fertilizers—Manures containing an ammonium compound or compounds and a secondary fertilizing agent or agents, such as a salt of potassium or a phosphate, are obtained by reaction between gases containing ammonia and the semi-dry product obtained by treating with acid a naturally occurring material that contains the secondary fertilizing agent or agents, but which is free, or almost free, from lime and is not generally regarded as a manure in itself. Thus clay containing a compound of potassium may be treated with sulphuric acid, if desired after drying and pulverizing, in sufficient amount to constitute a semi-dry mass, which is brought into contact with gases containing ammonia.

The product contains the oxides of iron and aluminum, and ammonium sulphate, together with a soluble compound of potassium, the content of which may be increased by direct addition of potassium salts. Other examples of naturally occurring materials suitable for use in the process are alunite and shales containing iron, aluminum, sulphur and potash, with or without phosphorus. Alunite may be calcined and used without any addition of acid. Instead of sulphuric acid there may be used sulphur dioxide or trioxide, hydrochloric or phosphoric acid, spent pickling liquor, or acid salts, or mixtures of any of these. Where phosphoric acid is used, gases containing ammonia may be treated in a heated condition; if, however, the absorption is allowed to proceed for a long time at atmospheric temperature, material containing tri-ammonium phosphate is obtained. The products may be lixiviated to remove the soluble salts, or they may be heated to about 400 deg. C., when about 50 per cent of the ammonia present is evolved, leaving a residue still suitable for use as a fertilizer or for re-use in the process. (Br. Pat. 187,251. E. L. Pease, Hurworth Moor. Dec. 13, 1922.)

Motor Fuel—A fuel for internal-combustion engines comprises a mixture of ether, alcohol and a volatile vegetable oil such as rosin oil or oil of turpentine, with or without a small amount of caustic soda. The preferred proportions are 36.75 parts by volume of alcohol, 62 parts of ether, 1 part of rosin oil and 0.25 part of a saturated solution of caustic soda in alcohol. "Commercial" ether may be used in slightly larger proportion. The fuel is miscible with lubricating oil and thus is suitable for two-stroke engines. (Br. Pat. 187 326. H. R. Giles, London. Dec. 13, 1922.)

Motor Fuel—The method of producing an alcohol fuel described in specification 178,498 and consisting in agitating, under pressure, a mixture of commercial alcohol and acetone with calcium carbide, is applied to monohydric alcohols, other than commercial alcohol, such as amyl, butyl and propyl alcohols. The alcohols preferably contain up to 10 per cent of water, and 5 to 40 per cent or more of acetone is added. The pressure is preferably from 10 to 40 lb. per sq.in., depending on the amount of acetylene to be absorbed. The lime in solution or suspension in fuels of this type is removed by chemical means, such as by treating the fuel with ammonia and passing in carbon dioxide, or by the addition of powdered ammonium carbonate. A suitable lubricant may be added. (Br. Pat. 187,335. S. W. Blake, Oudtshoorn, South Africa. Dec. 13, 1922.)

Coal Carbonization A mixture of powdered caking and non-caking coal is carbonized at a temperature of between 600 and 760 deg. C., whereby expansion and the development of a highly cellular structure is avoided and a bright and hard coke is obtained. Coke breeze may be substituted for a portion of the non-caking coal, or the latter may be replaced by a caking coal the caking properties of which have been destroyed by a preliminary heat treatment of between 100 and 350 deg. C. (Br. Pat. 187,336. J. Roberts, Glamorgan. Dec. 13, 1922.)

Synthetic Resins — Synthetic resins are produced by subjecting an aldehyde or its products of condensation or polymerization to the continued action of a mineral acid or acid salt, in the presence of a solvent if desired and preferably at a raised temperature. The products may then be hardened by prolonged heating at a high temperature, with or without the separation of the excess of acid. Further hardening may be effected by fusion with metal oxide or esterification with an alcohol, such as glycerine, before or after the heat-treatment; subsequent oxidation bleaches the products and makes them soluble in borax. The synthetic resins, when dissolved in the usual resin solvents, can be used as lacquers, polishes and finishes; and, being of low melting point, they can be added to other resins to render them more fusible. According to the examples, (1) acetaldehyde and sulphuric acid are heated together at 40 deg. C. for some hours and then raised to 100 deg. C. until a sample sets on cooling to a tough mass; the product is maintained in the molten condition, about 150 deg. C., for a long time, and sets when cold to a hard resin; (2) crotonic aldehyde is heated with hydrochloric acid, or with sulphuric acid in the presence of acetic acid as a solvent, or acetaldehyde is heated with sodium bisulphate solution, and the products in each case are further treated as in example (1). (Br. Pat. 187 619; not yet accepted. Consortium für Elektrochemische Industrie Ges., Munich. Dec. 13, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Muscle Shoals Disposal Discussed Anew

Hearings on Resolution to Create Revolving Fund for Government Fertilizer Business Renews Storm Over Nitrate Plant Sale

REVIVAL of the controversy over the disposition of the government's hydro-electric development and nitrate plants at Muscle Shoals has come in Congress as the result of hearings by the House Committee on Agriculture on the resolution to create a revolving fund of $10,000,000 for the purchase by the federal government of stocks of nitrate of soda and sale at cost to farmers. This resolution has passed the Senate.

While the resolution has no direct connection with the Muscle Shoals proposition, the latter were brought into the discussion because of the fertilizer portion of the Ford offer.

Advocates of acceptance of the Ford offer for the properties have come into conflict with those who contend that this bid is not acceptable, and with others who are urging a government corporation to operate both the power project and the chemical works.

The sharpest conflict over the Muscle Shoals project was not before the House committee, but was inspired by its hearings. Bernard Baruch, former chairman of the War Industries Board, appeared before the committee among other witnesses, advocating adoption of the resolution by the House. Subsequently Mr. Baruch sent a letter to Gray Silver, representing the American Farm Bureau Federation, in which he recommended acceptance of the Ford offer for Muscle Shoals because of the clause which would specify production of fixed nitrogen. This letter was made public and caused a heated reply from Senator Norris, author of a bill to establish a government corporation, in which he charged that Mr. Silver represented Mr. Ford rather than the farmers of the country. Mr. Silver subsequently called upon the Nebraska Senator for a retraction and asked an investigation by the directors of the Farm Bureau.

Baruch Supports Ford

The conclusions given in Mr. Baruch's letter are based on a survey of Leland L. Summers, an engineer employed by Mr. Baruch.

Mr. Summers considered every possible method of disposing of the plant, weighing the merits of each. Mr. Baruch limited his suggestions to the following three:

1. Government development. Except as a last resort, I am opposed to this on account of its inherent disadvantages.

2. Combination of industry either with government co-operation or independently.

3. The Ford development. This apparently is the only offer that has come forward so far from a private source promising development along commercial lines. If no more advantageous offer should be made, the arguments against awarding the contract to Henry Ford would not be convincing.

Urges Modification

"Without commenting upon the terms of the contract or considering the adequacy of the price, there are certain modifications or clarifications that should be made," says Mr. Baruch. "All doubt in regard to Mr. Ford's personal liability should be removed.

"The most important thing that ought to be clarified is the following: That Mr. Ford undertakes to make 40,000 tons of fixed nitrogen per year, and if he does not make it the property is to revert to the government. After all, it is the fixing of the nitrogen that is the crux of the whole contract. I am quite sure that the contract means to cover this point, but it should be made clear.

"However great the pecuniary rewards might be to Mr. Ford, or to anyone else who will undertake it, there will be added a contribution of almost inestimable value to the future of American agriculture and the safety of America in time of war."

Work on Dam Progresses

The concrete work in the foundation in the cofferdam across the north channel at Muscle Shoals has been finished and the cofferdam is being torn out. Brigadier-General Harry Taylor has returned from a visit to the work and reports that the higher water in the Tennessee River in no way has delayed the work thus far. During December, due largely to the favorable season, 41,491 yd. of concrete was put in, he said. The latest figures available when he left Muscle Shoals were those from Jan. 1 to 20, during which period 24,279 yd. of concrete was put in.

General Taylor states that the work is being carried well within the estimates and that it can go forward at the maximum rate if the Senate approves the appropriations allowed by the House. The House voted $6,998,800 in cash and authorized $10,501,200 for continuing contracts. This amount will complete the dam and the power house and will permit of the installation of eight power units. Practically all of the waterwheel machinery for four of these units now is on the ground and con be installed immediately when they are ready for it.

New Appropriation Proposed

So that the possibilities of Nitrate Plant No. 1, at Muscle Shoals, in the matter of fertilizer production may be known, Senator Norris, chairman of the Committee on Agriculture, has proposed the following legislation:

"For the improvement of Nitrate Plant No. 1, at Muscle Shoals, Ala., by the installation of new machinery therein, in order that said plant may be utilized for experimental purposes in extracting nitrogen from the air with a view of lessening the cost of explosives in time of war and fertilizers in times of peace, $2,000,000."

Nitrate May Be Sold to Farmers at Cost

The resolution authorizing the President to purchase nitrate for sale to farmers at cost and creating a $10,000,000 revolving fund for this purpose has been ordered reported favorably by the House Committee on Agriculture. It has been adopted by the Senate. This is one of the measures advocated by the farm bloc in Congress.

By the terms of the resolution, the President is "authorized and directed to procure, or aid in procuring, such stocks of nitrate of soda as he may determine to be necessary and find available for increasing agricultural production during the calendar year 1923, and to dispose of the same at cost, payable in advance." The President is authorized to make such regulations and to use such means and agencies of the government as he may deem best in carrying out the provisions of the resolution.

Canada May Be Arsenic Source

In the calculation of supplies of arsenic which might be secured from abroad, the possibilities of an expanded production in Canada seem to have been overlooked. Advices reaching Washington are to the effect that Canadian exports can be materially increased. Steps are now being taken by government statisticians to ascertain the approximate possible increase of the Canadian output.

Officials Still Grope for Dye Valuation Basis

Importers and Manufacturers Unable to Agree on Definition of Term "Competitive"—May Use Trade Journal Prices as Authority

Suggestions for regulations regarding the administration of the coal-tar product paragraphs of the 1922 tariff bill have been submitted to the Customs Division of the Treasury Department by the New York appraiser's office, which has been conducting research work on the subject. They have been taken under advisement, with indications that formal regulations will be promulgated before the end of February.

One of the stumbling blocks that has been encountered in framing these regulations is the proper definition of "competitive." The tariff act provides that imported coal-tar intermediate and finished products which are comparable, and thus competitive with domestic products shall be assessed on American valuation, a considerably higher rate than the United States selling price, which is to be the basis of assessment of non-competitive products. The definition has not been decided by the Treasury Department.

When Is Product Competitive"?

It has been determined, broadly, that a coal-tar product of domestic manufacture shall not be considered competitive with a comparable imported product unless "freely offered for sale in the usual course of business." Thus, if a certain color, for instance, is produced in the United States in such limited quantities as to be wholly insufficient to supply the demand, it will not be able to command the protection of the higher customs duty against an imported competitor because not "freely offered for sale." It is considered also that certain price factors will be taken into consideration under this part of the proposed regulations in determining the question of competition.

It has been no secret that the work of determining such valuation has been shunned by the Board of Appraisers and customs officials because of the great difficulties in arriving at an equitable basis for determining the American valuation of these products. The several conferences which have been held failed to clarify the situation to any extent. In fact matters have virtually reached an impasse.

Daily Source of Trouble

Instances of the chaotic situation which has been reached are an almost daily occurrence in the fine chemical trade. An importer desires information on a coming shipment of acetanilide. He calls the proper official and asks the duty on it. He is told 7c. per pound specific and 55 per cent ad valorem on the basis of American valuation. So far, so good. He then asks for purposes of computing the actual duty in dollars and cents what the American valuation is. He can get no answer, for there is none. The effect upon trade is apparent.

May Use Journal Prices

A proposal has recently been made to the effect that for purposes of American valuation of these items the average prices are reported in the three leading chemical and drug trade journals be accepted as the American value of the item in question. The trade has welcomed this suggestion as a way out of a very troublesome and confusing situation. It is proposed that the appraisers accept the average prices of drugs and chemicals, as quoted by the recognized authorities among the trade publications, and assess the duties upon this average. This would simplify and clarify the work of the appraisers as well as the actual business of importing such materials as come under the American valuation plan in the tariff law. Representative interests in the trade who have been interviewed refused to make any comment on the scheme in the absence of any definite information regarding the attitude of officials at Washington.

Daily Customs Reports on Dyes

So that current information may be available as to the volume of dye imports, the Department of Commerce has stationed a man in the New York Custom House to make a special study of these imports and furnish information from day to day as to the character of the receipts of foreign dyes.

Government Will Sell Nitrate in Small Lots for Farmers

Formal reannouncement has been made of the sale of 28,000 short tons of surplus nitrate of soda held by the government at the Old Hickory Ordnance Depot at Jacksonville, Tenn. This material is being offered for sale in lots of 20 short tons or more. Bids will be received at the Army Building 39 Whitehall St., New York, until noon, Feb. 15.

This surplus nitrate previously had been offered for sale in lots of 100 tons or more. The offer was withdrawn, however, after several Senators and Representatives had petitioned the Secretary of War to lower the minimum limit so that farmers could purchase the material for fertilizer purposes.

Leather Chemists to Meet at White Sulphur Springs

The American Leather Chemists Association will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W. Va., on June 7, 8 and 9. Full information concerning details of the meetings, hotel rates and transportation may be obtained by addressing H. C. Reed, secretary, 22 East 16th St., New York City.

Alien Property Bill Revised

Winslow Bill Now Provides Return of Confiscated Alien Property Valued at Less Than $10,000

Revision of the Winslow bill to return certain classes of trusts held by the Alien Property Custodian has been directed by the House Committee on Interstate and Foreign Commerce, this duty being referred to a subcommittee composed of Representatives Graham of Illinois, Newton of Minnesota and Johnson of Mississippi.

Change in sentiment came among members of the committee when the State Department, aroused by reports that the majority of the committee inclined to go further than recommended by Colonel Thomas W. Miller, Alien Property Custodian, who urged return of all trusts valued at $10,000 or less, and $10,000 of the value of larger trusts, and voiced disapproval of lowering the holdings to a point which might not secure payment of American citizens' claims against Germany. Some members of the committee previously had favored return of 50 per cent of the value of all trusts over $10,000.

Will Return Smaller Trusts

By vote of the committee, the subcommittee was instructed to redraft a bill providing for return only of those trusts valued at $10,000 or less which are not involved in litigation. The question of what shall be done about patents was reserved for a later vote. Indications are that patents and trademarks will be excepted from the terms of the bill. If this were done, questions affecting the Chemical Foundation and certain patents used by the War Department and Navy Department would be deferred.

There are 28,144 trusts now held by the Alien Property Custodian valued at $10,000 or less, and to return these would involve $22,122,002, which would leave a balance on 2,224 larger trusts of $296,236,899, according to testimony of Colonel Miller.

Forest Products Chemicals Exhibit to Feature Paper Show

In connection with the Paper Industries Exposition, which is to be held in the Grand Central Palace, New York, during the week of April 9, the management has decided to install a booth devoted to dendrochemistry, wherein will be exhibited all of the forest products chemicals which may be produced in the working of the forest for the paper industry. This exhibit is to be purely educational in character and it is hoped to get representative exhibits which will demonstrate to visitors the possibility of profit from the utilization of the chemical byproducts of the forest.

A general request for material for this exhibit has been broadcast. The display will be purely educational, so that no advertising of individual companies or persons will be permissible, except the acknowledgment card giving the names of those who furnish exhibits.

Gas Explosion Wrecks Springfield Plant

Purification Building of Gas Light Company Explodes, Killing Three and Causing Heavy Property Loss

An explosion of the gas-purifying plant of the Springfield Gas Light Co., Springfield, Mass., resulted in three deaths, scores of injuries and property loss running into several hundred thousands of dollars. For the most part, the brunt of the blow fell on business buildings, but in one section of the river front district, in which the explosion occurred, a residential district of tenements and flats, houses were made uninhabitable. Shattered windows, roofs, and in some cases walls that collapsed with the concussion, caused half a hundred families to vacate their homes.

Cause Unknown

Explanation of the explosion was lacking. Officially, the Gas Light Co. said the cause was undetermined. Arthur S. Hall, works manager and superintendent, said he could account for it only on the theory that a slow leak of gas had caused an accumulation under the roof, and that this gas pocket became ignited in some way. He asserted that the machinery, which constituted most of the plant, was virtually intact, and that the damage practically was limited to roof and walls.

The purifying building is about 120 ft long, half as wide and divided into two sections. That to the east was three ordinary stories high, that to the west about half a story lower. The explosion occurred in the eastern section. The western section suffered little more than did some buildings half a mile away, and to the north the main gas-making plant lost only its windows, which were shaken out by the blast.

The section that was the scene of the explosion was wrecked, but not entirely. The walls went out and the roof went up, but the machinery that they housed can be replaced and repaired.

Gas and Fuel Section of A.C.S. Plans Motor Fuel Symposium

In accordance with a resolution passed at the Pittsburgh meeting of the American Chemical Society the officers of the Gas and Fuel Section are arranging a second sectional meeting for the New Haven meeting. The section program will consist of papers on gas and fuel chemistry and a symposium on motor fuels, held jointly with the Petroleum Division. Under the rules of the society, papers presented at the meeting must be presented by members and must be listed in the final program. In order that they may be so listed the title and an abstract of the paper, preferably about 100 words, must be in the hands of the secretary of the section not later than March 8. The titles and abstracts of articles should be sent to R. S. McBride, 617 Colorado Building, Washington, D. C.

Cresol May Be Placed on Free List

Classification experts of the Treasury Department have prepared a ruling, which probably will be promulgated as a Treasury decision, that cresol shall be admitted without payment of duty under the tariff act. If this ruling is confirmed, other tar distillates with distillation characteristics similar to those of cresol will also be entitled to entry under the free list.

Paragraph 27 provides that all tar distillates yielding 5 per cent or more tar acids below 190 deg. C. or yielding 75 per cent or more tar acids in the portion distilling below 215 deg. C. shall be dutiable. Paragraph 1549 provides for duty-free importation of tar distillates which yield in the portion distilling below 190 deg. C. less than 5 per cent tar acids, but makes no reference to distillation at 215 deg. C. Cresol does not yield 5 per cent tar acids below 190 deg. C. but does give more than 75 per cent below 215 deg. C. It thus falls under both paragraphs but since paragraph 27 permits alternate tests, while paragraph 1549 provides a single requirement which is met by cresol, it has been held that cresol should be entitled to classification under the latter paragraph.

Canadian Paper Mills Plan Expansion

Plans have been perfected or are rapidly maturing for considerable expansion among the paper mills in the vicinity of St. John, N. B., involving a total investment of many millions of dollars.

The construction of a large addition to the plant of the St. George Pulp Co., Ltd., St. George, to provide extensive increase in capacity is planned and will probably cost more than $200,000.

The Nashwaak Pulp & Paper Co., Ltd., will proceed with the construction of an addition to its St. John pulp mill, designed to increase the capacity of sulphate pulp approximately 50 per cent during the present year.

The Bathurst Co., Ltd., has construction under way and will push to completion a new mill at Bathurst, to have a maximum capacity of 20,000 tons of newsprint and 30,000 tons of sulphate pulp per annum.

The International Paper Co., New York, is projecting a large mill in the Grand Falls district, in connection with an important hydro-electric development.

The Snowball Co., Ltd., is arranging to operate its mill at Chatham at full capacity, and a number of improvements and extensions will be made.

The Fraser Companies, Ltd., is planning for the construction of a large new paper mill on the St. John River, vicinity of Grand Falls, to include a complete sulphate pulp mill; the last noted company also has tentative plans under consideration for enlargements in its present paper mill at Edmunston.

Gathmann Solvent Recovery Process Suit Settled

Holder of Patent Rights Loses Suit Against Navy Department

There was no contract between the Navy Department and Louis Gathmann whereby the government was bound to use his process for drying smokeless powder and recovery of the solvent, according to a decision of the United States Supreme Court affirming the action of the Court of Claims in dismissing a claim of $236,750 filed against the government by Olga Gathmann Foley, administratrix.

Furthermore, according to the Supreme Court decision, there was no distinctive feature of the Gathmann process which entitled it to patent.

By letters exchanged between Gathmann and the Ordnance Bureau of the Navy Department, the latter, in 1904, agreed to install apparatus at Indian Head, Md., for experiment with Gathmann's process and to pay a royalty of 1 cent per pound on all powder thus dried if the method proved satisfactory. After several months Gathmann was notified that the experiment had not proved satisfactory. The administratrix of his estate filed a claim, asserting that the process had been used and that the letters established a contract. The Court of Claims and the Supreme Court held that the letters constituted an option, not a contract.

New Cellulose Division of A.C.S Seeks Support

The Cellulose Division of the American Chemical Society has recently been authorized as a permanent division of the society and wishes to enroll as members in the division all those who are interested in cellulose chemistry either from a scientific or practical standpoint. All members of the American Chemical Society wishing to become members of this division are requested to send their names, business connections and one dollar dues to the secretary, L. F. Hawley, Forest Products Laboratory, Madison, Wis.

Eyesight Conservation Council Appoints Directors

Election of Secretary James J. Davis of the U. S. Department of Labor and of Prof. F. C. Caldwell of the department of electrical engineering, Ohio State University, as directors of the Eyesight Conservation Council of America is announced by L. W. Wallace, president of the Council, the annual meeting of which was held in New York City, Feb. 6.

Secretary Davis and Professor Caldwell will act with leading engineers, educators, state and federal officials, economists and civic leaders in carrying on a nationwide plan to conserve vision in industry and education. The movement is being directed from New York by Guy A. Henry, general director of the Council.

December Chemical Exports Decline

Show Improvement Over Same Period Last Year, However

While there was a decrease of nearly half a million dollars in the value of chemicals and allied products exported during December as compared with the value of exports in November, export still ranged well above those of December, 1921. The decline in December of 1922 did not apply to the same extent to chemicals proper. In that case the value of the exports in December was only about $200,000 under those of November.

In December, 1922, there were substantial increases in acid exports, the increase being particularly notable in boric acid, where the amount exported increased from 82,506 lb. in November to 503,263 lb. in December. Exports of copper sulphate more than doubled in December, as compared with November, as did the value of exports of calcium carbide. Exports of formaldehyde fell off, as did those of cyanide of soda and water glass and caustic soda. There were substantial increases in exports of borax and of soda ash.

Exports of pigments, paints and varnishes continued at about the November rate, which is substantially above the rate of export during the corresponding period of 1921. The value of exports of fertilizers dropped about $300,000 as compared with November, but were in excess of the value of exports in December of 1921. Exports of sulphate of ammonia aggregated 10,716 tons, as compared with 9,220 tons in November. Exports of explosives increased decidedly. The figures of those of the Bureau of Foreign and Domestic Commerce.

Comparative figures showing the volume of exports of some of the chemicals of less importance are as follows:

	Dec., 1921 Lb	Dec., 1922 Lb
Carbolic acid	7,511	93,461
Magnesium sulphate		157,167
Chlorate of potash	78,399	48,431
Thorium nitrate		96
Zinc chloride		875
Carbon and lamp black		787,196
Litharge	74,619	193,184

Industrial Situation in the Ruhr Being Studied by Government

A study of the effect on world chemical markets by the occupation of German territory by the French is being made by government specialists. Unofficial reports are to the effect that most of the chemical plants still are in operation, but cable advices to the Department of Commerce on Feb. 1 indicated that the continuance of operations is highly uncertain. The entire industrial situation in the occupied region was described as critical.

A large number of chemical plants in unoccupied Germany are affected by the situation, since they depended on the Ruhr for coal tar and intermediates. While it is believed that foreign orders will be sent forward through France as long as stocks last or output can be maintained, the matter of transportation even by that route is uncertain.

The Commerce Department's cable also contained the information that Germany had discontinued deliveries of reparation dyes to France and to Belgium, but that deliveries to England and to the United States were continuing.

At the State Department no comment was forthcoming on the dye situation, but it is known that an active cable correspondence is being conducted and there is reason to believe that the negotiations in connection with the application of dye deliveries on the account of the United States against Germany for costs of the Rhine army are in a precarious state.

Personal

Prof. VICTOR ANDRES BELAUNDE, of the University of St. Marcos, Lima, Peru, is in New York City, and can be reached through the Peruvian Legation. He is editor of the *Mercurio Peruano*.

Dr. LEONARD H. CRETCHER has been appointed to the research staff of the Mellon Institute, Pittsburgh, Pa., to head an industrial fellowship devoted to the synthesis of chemicotherapeutic products. Dr. Cretcher is a graduate of the University of Michigan, studied one year in Germany and afterward took his Doctor's degree at Yale University. During the war he was commissioned a Captain in the Chemical Warfare Service. Later, at the close of the war, he became connected with the research department of the National Aniline & Chemical Co., subsequently being placed in charge of one of the large dye works of the company in the Buffalo, N. Y., district.

B. H. DELONG, metallurgist of the Carpenter Steel Co., Reading Pa., presented a paper on "The Manufacture of Alloy Steels" before the Washington Chapter of the American Society for Steel Treating at its monthly meeting on Jan. 26.

W. H. HENDRICKS, general sales engineer of the N. J. Zinc Co., New York, was the speaker at a meeting of the N. E. Paint and Varnish Production Club, Jan. 18. He discussed the history of lithopone from the inception of the industry to the present-day production. He also answered a number of questions concerning lithopone and zinc oxide.

THOMAS J. KEENAN, well known to the paper industry through his long years of work with the Technical Association of the Pulp and Paper Industry and as editor of *Paper*, has retired from that editorship. He will devote his time for the present to the coming Paper Industries Exposition which will be held in New York during the week of April 9.

W. F. LANTZ has been appointed chief chemist at the plant of the Bethlehem Steel Co., Bethlehem, Pa., to succeed A. D. SHANKLAND, who has been appointed metallurgical inspector at the No. 1 and No. 2 mills.

GEORGE D. PAINE, formerly of Chicago but more recently with Cook & Swan, N. Y., has been transferred to the latter company's office at 128 N. Wells St., Chicago, as manager.

DONALD K. PATTILLO has severed his connection as chemical engineer with the Hamersley Manufacturing Co., of Garfield, N. J., to accept a position as research chemical engineer with the Western Electric Co., of Chicago, Ill.

O. D. STREET, well known for the last 10 years as general manager of distribution of the Western Electric Co., has been elected a vice-president of the McGraw-Hill Co. He will have executive charge of *Electrical World*, *Electrical Merchandising*, *Journal of Electricity and Western Industry*, *Industrial Engineer*, *Electric Railway Journal* and *Bus Transportation*.

Obituary

GEORGE ELLIOT BROWN, vice-president, Swan & Finch Co., New York, refiners and dealers in oils, died suddenly on Jan. 24 from pneumonia, after a brief illness at his home in Norwalk, Conn. He was 55 years of age.

WILLIAM P. WAUGH, consulting engineer for the H. H. Robertson Co., Pittsburgh, Pa., and well known through his development of skylights and the solution of ventilation problems for many industrial plants and public buildings, died at his home at Sewickley, Pa., on Jan. 15. Mr. Waugh was born in Hedrick, Iowa, and attended Iowa State College, at Ames, Iowa. During Mr. Waugh's association with the H. H. Robertson Co. his skylights were developed to their present state of perfection. Some of his most notable installations are those on the Cadillac, Packard and Dodge Motor company plants in Detroit, the Indianapolis Union Station, and the Centennial Memorial Building at Springfield, Ill. During this period he also developed a double glazed skylight that is widely used on paper mills and in textile plants where drippage must be constantly guarded against.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

Domestic Business Conditions Continue Almost Uniformly Favorable

Seasonal Declines Expected in January Fail to Appear—Outlook Is Particularly Bright—Chemical Prices Are Mounting, Although General Commodity Prices Are Relatively Stable

JANUARY almost always shows some let-up in industrial activity after the first rush of contract making and inventory re-stocking has subsided. This year, however, the month has been characterized by well-sustained business in practically all lines, and in many instances there have been increases over the preceding month. The Department of Commerce reports that figures which became available during the week ended Jan. 22, 1923, have confirmed this industrial improvement. Particularly has the better transportation situation favorably affected the shipment and distribution of many commodities. Retail sales have been of record proportions and current reports indicate that sales have been well maintained during January. General price levels have remained relatively stable, although increases in some groups and decreases in others have tended to bring these groups more in line with other commodities.

Chemical prices have shown a very sharp rise since the first of October and especially during January was the increase most marked. The total gain, as recorded by *Chem. & Met.'s* index of chemical prices, amounted to about 30 points. Almost half of this gain occurred during January, as will be seen from Fig. 1.

The Trend of Production

The index of production in the basic industries compiled by the Federal Reserve Board has also been rising rapidly since last August. A very slight recession was shown in December, although, on the whole, production was maintained at a level near the peak of 1920. The output of pig iron and coal continued to increase, but the production in certain industries, notably textiles, has shown some declines. Consumption of cotton by textile mills in December totaled 527,945 bales, or about 50,000 bales less than the very high record made in November.

Petroleum production in the week ended Jan. 27 has been estimated by the American Petroleum Institute to have amounted to 1,755,300 bbl. This is the highest rate of production ever recorded and is an increase of 18,400 bbl. over the preceding week.

Copper production in December reached 103,845,000 lb., the largest for any month since 1920. This compares with 18,595,000 lb. in December, 1921.

Current production figures in the heavy chemical industry are not avail-

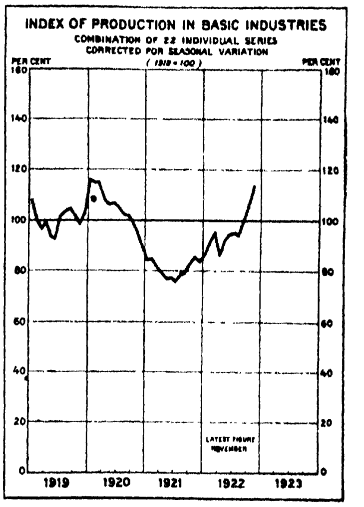


FIG. 2—FEDERAL RESERVE BOARD'S INDEX OF PRODUCTION

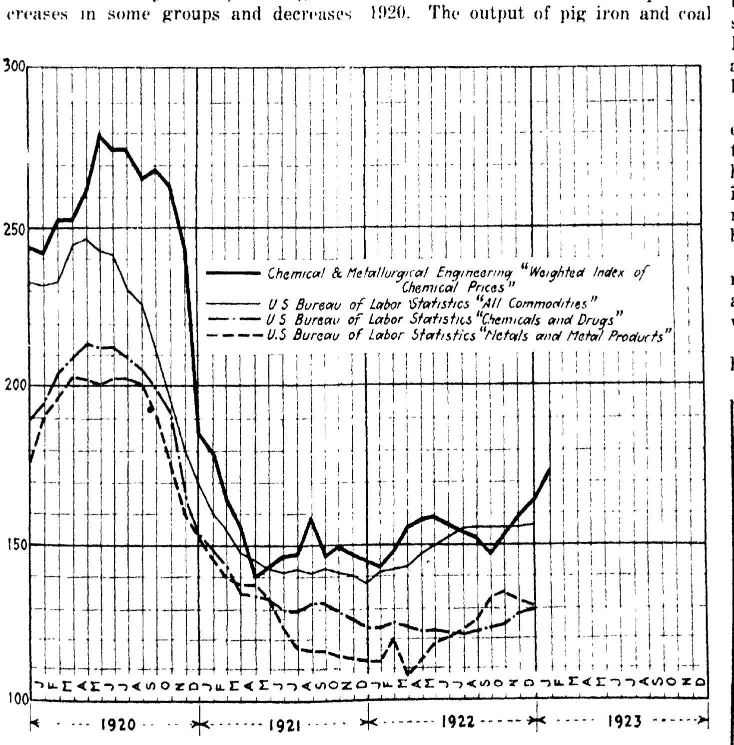


FIG. 1—WHOLESALE PRICES FOR CHEMICAL, METALLURGICAL AND ALLIED PRODUCTS

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

Last week	175.08
February, 1922	148
February, 1921	166
February, 1920	252
April, 1918 (high)	286
April, 1921 (low)	140

Included in this index are acetic, citric, hydrochloric, nitric, and sulphuric acids, ethyl and methyl alcohols, anhydrous ammonia, ammonium sulphate, barium chloride, bleaching powder, borax, caustic potash caustic soda, copper sulphate, formaldehyde, glycerine, potassium carbonate, salt cake, soda ash, sulphur, benzene, aniline, and cottonseed and linseed oils.

able, but the manufacturers of alkali report that their plants are now operating at practically maximum capacity In the dye and fine chemical industries the improvement has been less general, but there is, nevertheless, substantial evidence of better business prospects.

Employment in December

The Bureau of Labor Statistics, in its reports on the volume of employment during December, states that 3,294 representative establishments in 43 manufacturing industries employed 1,587,708 employees, as compared with 1,551,080 in November. There was an increase of 2.4 per cent in the number of employees and of 3 per cent in the total payrolls.

Increases in the number of employees in December, 1922, as compared with the number of employees in identical establishments in November, were shown in 33 of the 43 industries, with decreases in the remaining 10 industries. Pottery, owing to the resumption of work after the settlement of the recent strike, shows the greatest increase, 29.9 per cent. Fertilizer plants, following a seasonal let-up in December, showed decreased employment of 11.4 per cent.

TABLE I—INDEX NUMBERS FOR WHOLESALE PRICES IN NOVEMBER AND DECEMBER, 1922

	1921 December	1922 November	1922 December
Price Index Numbers			
Wholesale prices:			
Department of Labor			
Farm products	120	143	145
Food, etc.	136	143	144
Cloths and clothing	180	192	194
Fuel and lighting	199	218	216
Metals and metal products	113	133	131
Building material	158	185	185
Chemicals and drugs	127	127	130
Housefurnishing goods	178	179	182
Miscellaneous	121	122	122
All commodities	140	156	156
Dun's (first of month)	136	153	153
Retail price, food	150	145	147

In 40 chemical works employing 14,025 workers in November there was an increase of 0.2 per cent in number on payroll and of 3.8 in amount of payroll. Twenty-eight petroleum refineries employed 41,903 employees in November and 42,693 in December, an increase of 1.9 per cent. Wage increases, however, raised the amount of their payrolls by 6.5 per cent.

Wholesale Prices

The Department of Labor wholesale price index showed no change in December, remaining at 156, the same as in November. Slight increases in farm products, foods, cloth and clothing, chemicals and housefurnishing goods were offset by declines in fuels and metals. Dun's index number also showed no change, while Bradstreet's declined 1 point. The retail food index increased again, reaching 147, the highest for any month of 1922. These index numbers are shown in Table I. The chemical, metallurgical and all commodity indexes are shown graphically on the preceding page (Fig. 1).

Disturbing Influences Result in Higher Prices in New York Chemical Market

Transportation and European Difficulties Have a Tendency to Maintain Strength Throughout the List—Manufacturers Reduce Quotations on Citric Acid—Arsenic Continues in Scant Supply

NEW YORK, Feb. 5, 1923.

THE growing shortage of freight cars has caused a pronounced scarcity of caustic soda and soda ash on the spot market and has also strengthened prices along the entire list. It is expected that the European disturbance will continue to affect German chemicals, and dealers in barium chloride, prussiate of soda, barium carbonate and sal ammoniac have not shown any inclination to sell at low prices.

Manufacturers of citric acid reduced prices to the level of imported material. Bleaching powder has been in very scarce supply at the works and second hands have been getting a premium for spot and prompt shipments. Oxalic acid was somewhat lower among producers. Sulphate of ammonia is quite scarce due to the recent heavy shipments to Japan. The demand for arsenic has again strengthened and resale stocks are rapidly diminishing. Prices for spot goods were materially higher. Caustic potash, carbonate of potash, chlorate and permanganate of potash continue along very firm lines.

Principal Price Changes

Alcohol—There were no important changes during the week. The 95 per cent methanol was quoted at \$1.21@\$1.23 per gal. in barrels, with 97 per cent at \$1.23@\$1.25. Denatured 188 proof No. 1 formula held around 38@40c. per gal. in drums.

Arsenic—The lowest price heard for resale stocks ranged around 15¾c. per lb. Recent heavy arrivals have been quickly sold.

Bichromate of Soda—The demand is running along moderately active lines with carload quantities quoted at 7½c. per lb. and lesser lots at 7¾@8c. f.o.b. works.

Bleaching Powder—Producers reported a heavily sold up condition at the works and quote the market at 2c. per lb. for large containers. Second hands have been getting up to 2½c. per lb. for prompt shipment goods in large drums and 2¾c. per lb. for export packages. Demand is exceptionally active.

Caustic Soda—The export inquiry is rather quiet, but prices are quite firm, due to the scarcity of spot goods. Domestic material is in very good demand and sales went through at \$3.75 per 100 lb. ex-store. Contracts continue at 2½c. per lb., basis 60 per cent f.o.b. works, in carload lots.

Citric Acid—Leading producers announced a reduction to a parity with imported goods. Prices range around 49c. for crystals and 50c. per lb. for powered. Demand is quite steady.

Copperas—Several transactions have been reported at \$21.50 per ton in barrels. Bulk material is somewhat lower at \$16.50 per ton f.o.b. works.

Formaldehyde—Producers continue to quote 16c. per lb. for carload lots f.o.b. works. Second hands were anxious to dispose of stocks and quoted down to 15½c. for 25-bbl. lots.

Lactic Acid—Leading producers report a regular demand from consumers for the various grades. The 44 per cent light was sold at 11c. per lb. in barrels, with 22 per cent light at 5c. per lb.

Nitrite of Soda—Several lots of imported material were on the market at 8½@8¾c. per lb. Domestic producers continue to quote 10@10½c. per lb., f.o.b works. The general market is irregular.

Salt Cake—The demand is rather steady, with quotations heard around \$25 per ton f.o.b. works for bulk. Spot material is in scarce supply around \$30 per ton.

Soda Ash—Spot material is quite scarce, due to transportation difficulties. Spot goods in single bags were held around \$1.75 per 100 lb., carload lots. Contracts at the works were quoted at \$1.20 per 100 lb., basis 48 per cent, single bags, carload lots.

Sulphate of Ammonia—The lowest quotation heard for prompt shipment ranged around \$3.85 per 100 lb., double bags, f.a.s. New York.

Coal-Tar Products

Aniline Oil—Several fair-sized sales were noted at 16½@17c. per lb. in drums on spot. Quotations in general held quite firm, with producers quoting 16c. per lb. at the works.

Benzene—Manufacturers report a steady call from consumers and quote the 90 per cent at 27c. per gal. in tanks and 32c. in drums. The pure material is quoted at 30c. in tanks and 35c. per gal. in drums. Deliveries have been materially improved.

Beta Naphthol—Although actual sales were not heavy, prices held quite steady at 24@25c. per lb. for technical goods. Sublimed material was quoted at 55@60c. per lb.

Carbazol—The general tone is somewhat irregular, with producers quoting around 75@80c. per lb.

Cresylic Acid—Spot stocks have been practically exhausted and producers announced a heavily sold up condition at the works. Several small lots of 95 and 97 per cent goods were offered among second hands up to \$1.75@\$1.80 per gal. Actual sales were small, due to the scarcity of supplies.

Phenol—Spot material is quite scarce and dealers are not anxious to dispose of any material under 35c. per lb. Imported good were quoted at 40c. per lb. for shipment.

Better Volume of Business in Chicago District

Revival of Consuming Interest Noted as Imported Chemicals Are Advanced

CHICAGO, Ill., Feb. 1, 1923.

Business in industrial chemicals continued good in this district and all factors reported a satisfactory volume. No great increase was to be noted, but business was steady, with most of it from consumers who were buying for their immediate or near future requirements. Prices held firm with only a few advances noted and these were mainly on imported items. The situation abroad is bad for the importer, as he has no assurance that his present stocks can be replaced.

Principal Price Changes

Caustic soda continued to move well in consuming channels, but the spot movement was not good. Ground 76 per cent soda was quoted on spot in ton lots at \$4.25 per 100 lb. and the solid in similar quantities at \$3.50. *Caustic potash* was very firm following the recent advance, and 8c. per lb. for the 88-92 per cent material was the best offer noted. *Soda ash* moved well and was unchanged at \$2.25 per 100 lb. for material in cooperage.

Potash alum was in good demand and only moderate lots were available for spot delivery. The iron-free lump was quoted at 4½@5c. per lb. and the powder at 5½@6c. Small sales of *ammonium carbonate* were reported with 9c. per lb. the best price named. *Ammonium chloride* was firm with a good demand reported. The white granular material was quoted at 8@8½c. per lb., with slightly better figures named on material for shipment from the East. *Barium compounds* were steady and unchanged in price. *Barium chloride* was offered in small quantities at \$110 per ton and the carbonate at \$90. *White arsenic* showed no signs of breaking and the small lots available on spot were held at 17c. per lb. *Blue vitriol* was firmer due to the strength of the metal, but it was still possible to purchase material at 6c. per lb. in less than carload lots. *Carbon bisulphide* was unchanged in price with small lots offered for spot delivery at 7½c. per lb. *Carbon tetrachloride* was firm and spot material was held at 10½@11c. per lb. *Formaldehyde* was quiet, but the price held firm at 17c. per lb. in single-barrel lots. Consumers apparently took on heavy supplies when the price was low and will not be in the market again for some time. *Furfural* was unchanged at 25c. per lb. in thousand-pound lots. *Glycerine* was quite firm and 18½c. per lb. for c.p. material in drums was the inside.

The price on *phosphoric anhydride* was reduced to 38c. per lb. in case lots of 1-lb. tins. *Potassium bichromate* was firm and was reported as moving well at 12½@13c. per lb. *Sodium bichromate* was also in good demand and was firm at 8½@9c. per lb. *Potassium cyanide* was slow and the price was unchanged at 55c. per lb. in single-case lots. *Yellow prussiate of potash* was offered in small or moderate lots at 40c. per lb. One small lot of the *red prussiate* was offered at 85c., but no quantity was available below 90c.

Linseed Oil and Turpentine

Boiled *linseed oil* was quoted higher at 98c. per gal. in single-drum lots at the close of today's market. The material continued to move very slowly to the consuming trade and only small transactions were reported.

Turpentine was lower today and pure gum spirits were quoted in single-drum lots at \$1.50 per gal. Like boiled oil, turpentine was in very poor demand and only very small quantities were moving.

Steel Mills to Operate at Physical Limits

Recent Buying Has Given Momentum to Carry Industry Along Even in a Quiet Market

PITTSBURGH, Feb. 2, 1923.

While there is still a very fair degree of activity in finished steel products in point of tonnage turnover in the open market, the curious buying movement of the past 2 months may be said to be over. In each of these months the independent steel producers as a whole sold much more steel than they shipped.

Practically all the mills are now well sold for the remainder of the present quarter, and some are oversold, while in no important product has the Steel Corporation much unsold tonnage for the half year. Many independents have a good backlog of business for second quarter. At the beginning of December, on the contrary, some mills did not have enough business to carry them through the month.

The plain outlook now is that the steel mills will operate substantially at the physical limit to about July 1. The physical limit will probably be made by labor supply rather than any other factor. The mills have had an active market for 2 months and have acquired what is sometimes called "momentum" to carry them along for several months during a relatively quiet market. This is not, however, a momentum that gradually yields to a decelerating influence. Rather it indicates a continuance of the pace of production. That is, if a mill is sold up fully for 2 months and enters business during 5 months at three-fifths of its current shipments, it rounds out the 5 months with its order book liquidated.

Price Advances

The old 2c. price on merchant steel bars may now be said to have disappeared entirely. It remains in the reckoning only in that the Steel Corporation does not seem to have made an "official" advance, though it has sold some tonnage at 2.10c. and would not promise an early delivery at 2c. if it sold at that price at all. Shapes and plates had previously advanced from 2c. to 2.10c., as already reported. News has leaked out that about Jan. 19 the American Steel & Wire Co. advanced its price on plain wire from 2.45c. to 2.55c. The company has not advanced nails from its \$2.70 level. Its prices are not readily ascertained, as it is not usually a seller, having a large order book. Early in January independents had advanced plain wire to 2.55c. and nails to \$2.80. They are making sales at the prices without difficulty.

Advances in manufactured steel products continue, reflecting higher costs of hot-rolled material. Chain advanced \$5 a ton early in January. In the past week cold-finished steel bars and ground shafting have advanced \$3 a ton, to 2.65c. and 3.05c. respectively, while spikes are up \$3 a ton on standard size, to 2.90c., and small spikes and boat and barge spikes are up \$5 a ton, to 3.50c. Rivets, instead of advancing, are still reported a trifle weak on the old price of 3c.

The predicted advance in sheets by independents has not occurred, but the market is lined up for an advance, with several mills out of the market, being fully sold for the quarter. Blue annealed is going more frequently at an advance. The market is 2.50@2.60c. on blue annealed, 3.35c. on black, 4.35c. on galvanized and 4.70@5c. on automobile sheets.

Coke and Pig Iron

The recent settlement of coal wage matters for another year may have been an influence in the decrease in tonnage turnover in steel products. It has not yet had much discernible influence in the matter of coal and coke prices, probably because transportation has been poorer in some districts, notably the Pittsburgh district, than in December. Steam coal is off a trifle in both Pittsburgh and Connellsville markets, but is well above the low points seen about the beginning of December. Connellsville furnace coke has not declined at all, being \$8@\$8.25 for spot or prompt. In other words, the liquidation in coke prices is still to come, but this may be deferred 2 or 3 weeks, on account of the continuance of good demand for coke for heating purposes. Buyers of pig iron evidently expect much lower coke prices and count on the decline having some influence on pig iron prices, for there is no forward buying to speak of, and the markets in practically all districts are dull.

Sales of 20,000 to 25,000 tons of Nova Scotia basic pig iron, high in phosphorus and low in manganese, have been made to Eastern steel works at several dollars a ton below the market for local iron and this will probably have an influence on the Eastern pig iron market. The Pittsburgh valley market has continued quiet, with prices not quotably changed, at \$27.50 for bessemer, \$25@\$26 for basic and \$27@\$28 for foundry f.o.b. valley furnaces, freight to Pittsburgh being \$1.77.

Current Prices in the New York Market

FOR CHEMICALS, OILS AND ALLIED PRODUCTS

Although these prices are for the spot market in New York City, a special effort has been made to report the American manufacturer's quotations whenever available. In many instances these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported and resale stocks are reported when of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb	$0 39 -	$0 41
Acetone, drums	lb	21 -	21½
Acid, acetic, 28%, bbl.	100 lb	3 25 -	3 50
Acetic, 56%, bbl	100 lb	6 50	6 75
Glacial, 99½%, carboys	100 lb	12 00	12 50
Boric, crystals, bbl.	lb.	11½-	11¾
Boric, powder, bbl.	lb.	11 -	.11½
Citric, kegs	lb.	49 -	50
Formic, 85%	lb.	18 -	19
Gallic, tech.	lb	45 -	50
Hydrochloric, 18° tanks	100 lb	.80 -	1 00
Hydrofluoric, 52%, carboys	lb	.12	12½
Lactic, 44%, tech, light, bbl	lb	11 -	11½
22% tech, light, bbl	lb	05 -	05½
Muriatic, 20°, tanks	100 lb	1 00 -	1 10
Nitric, 36°, carboys	lb	04½	05
Nitric, 42°, carboys	lb	06 -	06½
Oleum, 20%, tanks	ton	17 00	18 00
Oxalic, crystals, bbl.	lb	12	13
Phosphoric, 50% carboys	lb	08 -	09
Pyrogallic, resublimed	lb	1 50	1 60
Sulphuric, 60°, tanks	ton	9 00	10 00
Sulphuric, 60°, drums	ton	12 00	14 00
Sulphuric, 66°, tanks	ton	14 50	15 00
Sulphuric, 66° drums	ton	19 00	20 00
Tannic, U S P, bbl	lb	65 -	.70
Tannic, tech, bbl	lb	40 -	.45
Tartaric, imp crys, bbl	lb	30½	31
Tartaric, imp, powd, bbl	lb	31	32
Tartaric, domestic, bbl	lb		32
Tungstic, per lb of WO	lb	1 00 -	1 20
Alcohol, butyl, drums	gal	18	23
Alcohol ethyl (Cologne spirit), bbl	gal	4 75	4 95
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 188 proof No. 1	gal	38 -	40
Alum, ammonia, lump, bbl	lb.	03½-	03¾
Potash, lump, bbl	lb.	03½-	03¾
Chrome, lump, potash, bbl	lb.	05 -	.05½
Aluminum sulphate, com., bags	100 lb	1 50 -	1.65
Iron free bags	lb	02½-	.02¾
Aqua ammonia, 26°, drums	lb.	06½-	07½
Ammonia, anhydrous, cyl	lb.	30 -	30
Ammonium carbonate, powd casks, imported	lb.	09 -	09½
Ammonium carbonate, powd domestic, bbl	lb	.13 -	.14
Ammonium nitrate, tech, casks	lb	10 -	11
Amyl acetate tech, drums	gal	2 80	3 05
Arsenic, white, powd, bbl	lb	15¾	16
Arsenic, red, powd, kegs	lb	13 -	13½
Barium carbonate, bbl	ton	75 00 -	77 00
Barium chloride, bbl	ton	90 00	100 00
Barium dioxide, drums	lb.	18	.18½
Barium nitrate, casks		08½ -	.08¾
Barium sulphate, bbl.	lb	04 -	04½
Blanc fixe, dry, bbl	lb	04	.04½
Blanc fixe, pulp, bbl.	ton	45 00	55.00
Bleaching powder, f.o.b wks, drums	100 lb	2 00 -	2 50
Resale drums	100 lb	2 50 -	2.75
Borax, bbl.	lb.	05½-	05¾
Bromine, cases	lb.	25 -	27
Calcium acetate, bags	100 lb	3 50 -	3 60
Calcium carbide, drums	lb	04½	04¾
Calcium chloride, fused, drums	ton	22 00 -	23 00
Gran. drums	lb	01½ -	01¾
Calcium phosphate, mono, bbl	lb	06½-	07
Camphor, cases	lb	86 -	88
Carbon bisulphide, drums	lb	07 -	07½
Carbon tetrachloride, drums	lb	09½	10
Chalk, precip—domestic, light, bbl	lb	04¼ -	04½
Domestic, heavy, bbl	lb	03½-	03¾
Imported, light, bbl	lb	04½ -	05
Chlorine, liquid, cylinders	lb.	06	06½
Chloroform, tech, drums	lb	35 -	38
Cobalt oxide, bbl	lb.	2 10 -	2 25
Copperas, bulk, f o b wks	ton	16 50 -	20 00
Copper carbonate, bbl	lb	20	20½
Copper cyanide, drums	lb	50	55
Copper sulphate, crys, bbl	100 lb	6 00 -	6 25
Cream of tartar, bbl	lb	25 -	26
Dextrine, corn, bags	100 lb	3 25	3 50
Epsom salt, dom, tech, bbl.	100 lb	2 10 -	2 25
Epsom salt, imp, tech, bags.	100 lb	1 10 -	1 25
Epsom salt, U S P., dom, bbl.	100 lb	2 50	2 75
Ether, U.S.P., drums	lb	13 -	15
Ethyl acetate, com., 85%, drums	gal	80	85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal	.95 -	1 00
Formaldehyde, 40%, bbl	lb	$0 15½-	$0 16½
Fullers earth, f o b mines	net ton	16 00 -	17 00
Fullers earth—imp, powd	net ton	30 00 -	32 00
Fusel oil, ref, drums	gal	3 55 -	4 05
Fusel oil, crude, drums	gal.	2 30 -	2 40
Glaubers salt, wks, bags	100 lb.	1 20 -	1 40
Glaubers salt, imp, bags	100 lb.	1 00 -	1 25
Glycerine, c p, drums extra	lb	18½ -	19
Glycerine, dynamite, drums	lb	17 -	17½
Iodine, resublimed	lb	4 50	4 60
Iron oxide, red, casks	lb	12 -	18
Lead			
White, basic cabonate, dry, casks	lb	09¼	10
White, in oil, kegs	lb	12	13½
Red, dry, casks	lb	11½-	11¾
Red, in oil, kegs	lb	13 -	14½
Lead acetate, white crys, bbl	lb	13	13½
Lead arsenate, powd, bbl	lb	21 -	22
Lime-Hydrated, bbl	per ton	16 80	17 00
Lime, Lump, bbl	280 lb	3 63	3 65
Litharge, comm, casks	lb	09½ -	10
Lithophone, bbl	lb	06½	07
Magnesium carb, tech, bags	lb	07	07½
Methanol, 95%, bbl	gal	1 23 -	1 25
Methanol, 97%, bbl	gal	1 25	1 27
Nickel salt, double, bbl.	lb	10 -	10½
Nickel salts, single, bbl	lb	11 -	11½
Phosgene		60	75
Phosphorus, red, cases	lb	35	40
Phosphorus, yellow, cases	lb	30 -	35
Potassium bichromate, casks	lb	09¾-	10
Potassium bromide, gran, bbl	lb	17 -	23
Potassium carbonate, 80-85%, calcined, casks	lb	06 -	06¼
Potassium chlorate, powd.	lb	07½ -	08
Potassium cyanide, drums.	lb	.47 -	80
Potassium hydroxide (caustic potash) drums	100 lb	7 25 -	7 50
Potassium iodide, cases	lb	3 60 -	3.70
Potassium nitrate, bbl	lb	06½ -	07
Potassium permanganate, drums	lb	17½	18
Potassium prussiate, red, casks	lb	85	90
Potassium prussiate, yellow, casks	lb	38	39
Salammoniac, white, gran, casks, imported	lb	06½	06¾
Salammoniac, white, gran, bbl., domestic	lb	08	08½
Gray, gran, casks	lb	08½	08¾
Salsoda, bbl	100 lb	1 20	1 40
Salt cake (bulk)	ton	25 00	27 00
Soda ash, light, 58% flat, bags, contract	100 lb	1 60	1 67
Soda ash, light, basis, 48%, bags, contract, f o b wks	100 lb	1 20	1 30
Soda ash, light, 58%, flat, bags, resale	100 lb	1 75 -	1 80
Soda ash, dense, bags, contract, basis 48%	100 lb	1 17½	1 20
Soda ash, dense, in bags, resale	100 lb	1 85 -	1 90
Soda, caustic, 76%, solid, drums, f a s	100 lb	3 45 -	3 70
Soda, caustic, 76%, solid, drums, contract	100 lb	3 35	3 40
Soda, caustic, basis 60%, wks, contract	100 lb	2 50	2 60
Soda, caustic, ground and flake, contracts	100 lb	3 80 -	3 90
Soda, caustic, ground and flake, resale	100 lb	4 00 -	4 15
Sodium acetate, works, bags	lb	06¾-	07½
Sodium bicarbonate, bbl	100 lb	1 75 -	1 85
Sodium bichromate, casks	lb	07½-	08
Sodium bisulphate (niter cake)	ton	6 00 -	7.00
Sodium bisulphite, powd, U S P, bbl	lb	.04½-	.04¾
Sodium chlorate, kegs	lb	.06½-	.07
Sodium chloride	long ton	12 00 -	13.00
Sodium cyanide, cases	lb.	19 -	.23
Sodium fluoride, bbl	lb	09 -	.10
Sodium hyposulphite, bbl	lb	03 -	.03½
Sodium nitrite, casks	lb.	08½-	.09
Sodium peroxide, powd, cases	lb	28 -	.30
Sodium phosphate, dibasic, bbl	lb	03½-	04
Sodium prussiate, yel. drums	lb	19 -	19½
Sodium silicate (40°, drums)	100 lb	80 -	1 15
Sodium silicate (60°, drums)	100 lb.	2 00 -	2 25
Sodium sulphide, fused, 60-62% drums	lb.	04½-	.04¾
Sodium sulphite, crys., bbl.	lb.	03½-	.03¾
Strontium nitrate, powd, bbl.	lb.	09½-	.10½
Sulphur chloride, yel drums	lb.	04½-	.05
Sulphur, crude	ton	18 00 -	20 00½
Sulphur dioxide, liquid, cyl.	lb.	.08 -	.08
Sulphur, flour, bbl.	100 lb.	2.50 -	3.15
Sulphur, roll, bbl	100 lb.	$2 15 -	$2 20
Talc—imported, bags	ton	30 00 -	40 00
Talc—domestic powd, bags	ton	18 00 -	25 00
Tin bichloride, bbl	lb	.11 -	11½
Tin oxide, bbl.	lb.	.45 -	.47
Zinc carbonate, bags	lb.	.14 -	.14½
Zinc chloride, gran, bbl	lb	07 -	07½
Zinc cyanide, drums	lb	42 -	44
Zinc oxide, XX, bbl	lb	07½-	08
Zinc sulphate, bbl	100 lb.	2 75 -	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl	lb	$0 85 -	$0 95
Alpha-naphthol, ref., bbl.	lb	1 05 -	1 10
Alpha-naphthylamine, bbl.	lb	28 -	30
Aniline oil, drums	lb	.16½-	17
Aniline salts, bbl	lb	.24 -	25
Anthracene, 80%, drums	lb.	75 -	1 00
Anthracene, 80%, imp, drums, duty paid	lb.	.65 -	70
Anthraquinone, 25%, paste, drums	lb	70 -	75
Benzaldehyde U.S P, carboys	lb.	1 35 -	1.40
Benzene, pure, water-white, tanks and drums	gal.	30 -	35
Benzene, 90%, tanks & drums	gal.	26 -	32
Benzene, 90%, drums, resale	gal.	32 -	.34
Benzidine base, bbl	lb.	85 -	.90
Benzidine sulphate, bbl	lb	.75 -	.80
Benzoic acid, U S P, kegs	lb	72 -	.75
Benzoate of soda, U S P, bbl	lb.	57 -	.65
Benzyl chloride, 95-97%, ref., drums	lb.	25 -	.27
Benzyl chloride, tech, drums	lb.	20 -	.23
Beta-naphthol, subl, bbl	lb.	55 -	60
Beta-naphthol, tech, bbl	lb.	25 -	26
Beta-naphthylamine, tech	lb.	1 00 -	1 25
Carbazol, bbl	lb	75 -	.90
Cresol, U S P, drums	lb	.26 -	.28
Ortho-cresol, drums	lb	.24 -	.26
Cresylic acid, 97%, resale, drums	gal	1.75 -	1 85
95-97%, drums, resale	gal	1 75 -	1 85
Dichlorbenzene, drums	lb	07 -	.09
Diethylaniline, drums	lb	50 -	.60
Dimethylaniline, drums	lb	40 -	.41
Dinitrobenzene, bbl	lb	20 -	.22
Dinitroclorbenzene, bbl	lb	22 -	.23
Dinitronaphthalene, bbl	lb	30 -	.32
Dinitrophenol, bbl	lb	35 -	.40
Dinitrotoluene, bbl	lb	22	.24
Dip oil, 25%, drums	gal.	25 -	.30
Diphenylamine, bbl	lb	54 -	.56
H-acid, bbl	lb	.75 -	80
Meta-phenylenediamine, bbl.	lb	95 -	1.00
Michlers ketone, bbl	lb	3 25 -	3 75
Monochlorbenzene, drums	lb.	08 -	10
Monoethylaniline, drums	lb.	95 -	1 10
Naphthalene, crushed, bbl	lb.	05½-	06
Naphthalene, flake, bbl	lb.	.06 -	.06½
Naphthalene, balls, bbl	lb	07 -	.07½
Naphthionate of soda, bbl	lb	.58 -	65
Naphthionic acid, crude, bbl.	lb	.60 -	.65
Nitrobenzene, drums	lb	.10 -	.12
Nitro-naphthalene, bbl	lb.	.30 -	.35
Nitro-toluene, drums	lb.	.15 -	.17
N-W acid, bbl	lb.	1.15 -	1.20
Ortho-amidophenol, kegs	lb	2.30 -	2.35
Ortho-dichlorbenzene, drums	lb	17 -	.20
Ortho-nitrophenol, bbl	lb.	.90 -	.92
Ortho-nitrotoluene, drums	lb.	.12½-	.14
Ortho-toluidine, bbl	lb	14 -	.16
Para-amidophenol, base, kegs	lb	1.25 -	1.30
Para-amidophenol, HCl, kegs	lb.	1.30 -	1.35
Para-dichlorbenzene, bbl	lb.	.17	.20
Paranitraniline, bbl	lb.	.73 -	.75
Para-nitrotoluene, bbl	lb.	.55 -	.65
Para-phenylenediamine, bbl	lb.	1 50 -	1.55
Para-toluidine, bbl	lb	.85 -	.90
Phthalic anhydride, bbl	lb	35 -	.38
Phenol, U S P, drums	lb	35 -	.37
Picric acid, bbl	lb	.20 -	.22
Pyridine, dom, drums	gal.	nominal	
Pyridine, imp., drums	gal.	3 00 -	3.10
Resorcinol, tech., kegs	lb	1 50 -	1.55
Resorcinol, pure, kegs	lb	2 00 -	2.10
R-salt, bbl.	lb	55 -	.60
Salicylic acid, tech, bbl	lb	40 -	.42
Salicylic acid, U S P, bbl	lb	45 -	.47
Solvent naphtha, water-white, drums	gal.	.37 -	.40
Crude, drums	gal.	22 -	.24
Sulphanilic acid, crude, bbl.	lb.	20 -	.22
Thiocarbanilide, kegs	lb.	35 -	.38
Toluidine, kegs	lb.	1 20 -	1.30
Toluidine, mixed, kegs	lb	.30 -	.35
Toluene, tank cars	gal.	.35 -	.37
Toluene, drums	gal.	.40 -	.43
Xylidines drums	lb.	.40 -	.45
Xylene, pure, drums	gal.	.45 -	.50
Xylene, com., drums	gal.	.40 -	.42
Xylene, com., tanks	gal.	.30 -	......

Naval Stores

Rosin B-D, bbl.	280 lb	$5 75 –	
Rosin E-I, bbl.	280 lb.	5 90 –	
Rosin K-N, bbl.	280 lb.	6 10 –	$6 35
Rosin W.G.-W.W., bbl.	280 lb	7 75 –	8 25
Wood rosin, bbl.	280 lb	6 25 –	
Turpentine, spirits of, bbl.	gal.	1.43 –	1 45
Wood, steam dist., bbl.	gal	1.35 –	
Wood, dest dist., bbl	gal.	1.25 –	
Pine tar pitch, bbl	200 lb	.... –	6 00
Tar, kiln burned, bbl.	500 lb.	. –	12 00
Retort tar, bbl.	500 lb	. –	11 00
Rosin oil, first run, bbl.	gal	43 –	
Rosin oil, second run, bbl.	gal	47 –	
Rosin oil, third run, bbl	gal	.53 –	
Pine oil, steam dist	gal.	... –	90
Pine oil, pure, dest dist.	gal	.. –	85
Pine tar oil, ref	gal.	... –	46
Pine tar oil, crude, tanks f.o.b Jacksonville, Fla	gal	.. –	35
Pine tar oil, double ref., bbl.	gal.	–	75
Pine tar, ref, thin, bbl.	gal	–	25
Pinewood creosote, ref, bbl	gal	–	52

Vegetable Oils

Castor oil, No. 3, bbl	lb	$ 12¼ –	$ 12½
Castor oil, AA, bbl.	lb.	.12¾ –	13
Chinawood oil, bbl	lb.	.17 –	17½
Coconut oil, Ceylon, bbl.	lb.	.09¼ –	9½
Coconut oil, Cochin, bbl	lb	.09¾ –	10
Corn oil, crude, bbl	lb	11¼ –	11½
Cottonseed oil, crude (f o.b mill), tanks	lb	09¾ –	10
Summer yellow, bbl.	lb.	12½	12¾
Winter yellow, bbl	lb	.13 –	13¼
Linseed oil, raw, car lots, bbl.	gal	92	93
Raw, tank cars (dom).	gal.	87 –	88
Boiled, 5-bbl lots (dom)	gal	96 –	97
Olive oil, denatured, bbl.	gal.	1 10 –	1 15
Palm, Lagos, casks.	lb	08 –	08¼
Palm kernel, bbl.	lb.	08¼ –	09
Peanut oil, crude, tanks (mill)	lb.	13½ –	13¾
Peanut oil, refined, bbl	lb.	16 –	16¼
Rapeseed oil, refined, bbl.	gal.	85 –	86
Rapeseed oil, blown, bbl.	gal.	90 –	91
Soya bean (Manchurian), bbl	lb.	11½	
Tank, f.o.b. Pacific coast	lb	.10 –.	

Fish Oils

Menhaden, light pressed, bbl	gal.	$0.60 –	
White bleached, bbl	gal.	.64 –	65
Blown, bbl	gal.	.68 –	69
Whale No. 1 crude, tanks, coast	lb	.06 –	06½

Dye & Tanning Materials

Divi-divi, bags.	ton	$38 00 –	$39 00
Fustic, sticks	ton	30 00 –	35 00
Fustic, chips, bags.	lb	04 –	05
Logwood, sticks	ton	28 00 –	30 00
Logwood, chips, bags.	lb	02½ –	03½
Sumac, leaves, Sicily, bags.	ton	65 00 –	
Sumac, ground, bags	ton	55 00 –	60 00
Sumac, domestic, bags.	ton	35 00 –	
Tapioca flour, bags.	lb	03½	05

EXTRACTS

Archil, conc, bbl.	lb	$0 17	$0 18
Chestnut, 25% tannin, tanks	lb	02 –	03
Divi-divi, 25% tannin, bbl	lb	04 –	05
Fustic, crystals, bbl	lb	20 –	22
Fustic, liquid, 42°, bbl	lb	08 –	09
Gambier, liq, 25% tannin, bbl.	lb.	08 –	09
Hematine crys., bbl.	lb.	.14 –	18
Hemlock, 25% tannin, bbl	lb	.04 –	05
Hypernic, solid, drums	lb	24 –	26
Hypernic, liquid, 51°, bbl.	lb.	14 –	17
Logwood, crys., bbl.	lb	19 –	20
Logwood, liq., 51°, bbl.	lb	09 –	10
Quebracho, solid, 65% tannin, bbl	lb.	.04½ –	05
Sumac, dom., 51°, bbl.	lb.	.06¼ –	07

Waxes

Bayberry, bbl.	lb	$0 28 –	$0 30
Beeswax, refined, dark, bags	lb.	30 –	32
Beeswax, refined, light, bags	lb	.34 –	35
Beeswax, pure white, cases.	lb	.40 –	41
Candelilla, bags.	lb.	.34 –	.35
Carnauba, No. 1, bags.	lb.	.38 –	.40
No. 2, North Country, bags	lb.	.23½ –	.24
No. 3, North Country, bags	lb.	.17½ –	.18
Japan, cases	lb.	.15 –	15½
Montan, crude, bags.	lb.	.03¾ –	04
Paraffine, crude, match, 105-110 m.p.	lb.	.04 –	04½
Crude, scale 124-126 m.p., bags	lb.	.02½ –	02¾
Ref., 118-120 m p., bags.	lb.	.03¼ –	.03½
Ref., 125 m.p., bags	lb.	.03½ –	.03¾
Ref. 128-130 m.p, bags.	lb.	.04 –	.04¼
Ref., 133-135 m p, bags.	lb.	.04½ –	.04¾
Ref., 135-137 m p., bags.	lb.	.05 –	.05¼
Stearic acid, sgle pressed, bags	lb.	.10 –	.10½
Double pressed, bags.	lb.	.10½ –	.10¾
Triple pressed, bags	lb.	.11 –	.11½

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb.	$3.20 –	$3 25
F.a.s. double bags	100 lb	3.85 –	3.95
Blood, dried, bulk	unit	4 60 –	.....
Bone, raw, 3 and 50, ground	ton	30.00 –	35.00
Fish scrap, dom., dried, wks.	unit	5.00 –	5.10
Nitrate of soda, bags	100 lb.	2.60 –	2.65
Tankage, high grade, f.o.b. Chicago	unit	4.70 –	4.80

Phosphate rock, f.o b. mines, Florida pebble, 68-72%	ton	$3 50 –	$4 00
Tennessee, 78-80%	ton	7 00 –	8 00
Potassium muriate, 80%, bags	ton	35 55 –	38 25
Potassium sulphate, bags	unit	1 00 –	

Crude Rubber

Para—Upriver fine	lb	$0 34½	$0 35
Upriver coarse	lb	28½ –	28
Upriver caucho ball	lb	29¾	30
Plantation—First latex crepe	lb	35¼	35½
Ribbed smoked sheets	lb	35¼ –	35½
Brown crepe, thin, clean	lb	31 –	32
Amber crepe No. 1	lb	31 –	32

Miscellaneous Materials

Asbestos, crude No. 1, f.o b., Quebec.	sh. ton	$450 00 –	$550 00
Asbestos, shingle, f o.b., Quebec	sh. ton	60 00 –	80 00
Asbestos, cement, f.o.b., Quebec	sh ton	15 00 –	17 00
Barytes, grd, white, f.o.b. mills, bbl.	net ton	16 00 –	20 00
Barytes, grd., off-color, f o b. mills bulk.	net ton	13 00 –	21 00
Barytes, floated, f o b St Louis, bbl.	net ton	24 00 –	28 00
Barytes, crude f o b mines, bulk	net ton	8 50 –	9 00
Casein, bbl, tech.	lb	11 –	12
China clay (kaolin) crude, f.o b. Ga.	net ton	7 00 –	9 00
Washed, f o.b. Ga.	net ton	8 00 –	9 00
Powd, f.o b Ga.	net ton	13 00 –	20 00
Crude f.o b Va	net ton	8 00 –	12 00
Ground, f o b. Va.	net ton	13 00 –	20 00
Imp., lump, bulk.	net ton	15 00 –	20 00
Imp., powd	net ton	45 00 –	50 00
Feldspar, No. 1 pottery	long ton	6 00 –	7 00
No 2 pottery	long ton	5 00 –	5 50
No 1 soap	long ton	7 00 –	7 50
No. 1 Canadian, f.o b mill	long ton	25 00 –	27 00
Graphite, Ceylon, lump, first quality, bbl	lb	06 –	.06½
Ceylon, chip, bbl.	lb.	05 –	05½
High grade amorphous crude	ton	35 00 –	50 00
Gum arabic, amber, sorts, bags	lb	15 –	16
Gum tragacanth, sorts, bags	lb	50 –	60
No 1, bags	lb	1 75 –	1 80
Kieselguhr, f o.b. Cal.	ton	40 00	42 00
F o b N Y.	ton	50 00 –	55 00
Magnesite, crude, f o b Cal	ton	14 00 –	15 00
Pumice stone, imp, casks	lb	03 –	05½
Dom, lump, bbl	lb	05	05½
Dom, ground, bbl	lb	06 –	07
Shellac, orange fine, bags	lb	84 –	85
Orange superfine, bags	lb	86 –	87
A C garnet, bags.	lb.	81 –	82
T N, bags	lb	82 –	83
Silica, glass sand, f o b. Ind	ton	2 00 –	2 50
Silica, sand blast, f o b Ind	ton	2 50	5 00
Silica, amorphous, 250-mesh, f.o b Ill	ton	17 00 –	17 50
Silica, bldg. sand, f o b Pa	ton	2 00 –	2 75
Soapstone, coarse, f.o.b. Vt, bags	ton	7 00	8 00
Talc, 200 mesh, f o.b., Vt, bags	ton	6 50 –	9 00
Talc, 200 mesh, f.o.b Ga, bags	ton	7 00 –	9 00
Talc, 200 mesh, f o.b. Los Angeles, bags.	ton	16 00 –	20 00

Refractories

Bauxite brick, 56% Al_2O_3, f o b Pittsburgh	ton	$45-50
Chrome brick, f o b Eastern shipping points	ton	50–52
Chrome cement, 40-50% Cr_2O_3	ton	23–27
40-45% Cr_2O_3, sacks, f.o.b Eastern shipping points	ton	23.00
Fireclay brick, 1st. quality, 9-in. shapes, f o.b Ky wks.	1,000	40–46
2nd quality, 9-in. shapes, f o b wks.	1,000	36–41
Magnesite brick, 9-in straight (f o b. wks)	ton	65 68
9-in arches, wedges and keys.	ton	80 85
Scraps and splits	ton	85
Silica brick, 9-in sizes, f o b Chicago district	1,000	48–50
Silica brick, 9-in. sizes, f o b. Birmingham district	1,000	48 50
F o.b. Mt. Union, Pa	1,000	42 44
Silicon carbide refract brick, 9-in	1,000	1,100 00

Ferro-Alloys

Ferrotitanium, 15-18% f o b. Niagara Falls, N Y	ton	$200 00 –	$225 00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	11½	11¾
4-6% C	lb.	.12 –	13
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	105.00 –	107 50
Spiegeleisen, 19-21% Mn.	gr ton	35 00 –	37 00
Ferromolybdenum, 50-60% Mo, per lb. Mo.	lb.	1.90 –	2.15
Ferrosilicon, 10-15%	gr ton	38.00 –	40 00
50%	gr. ton	80.00 –	85.00
75%	gr. ton	150.00 –	160.00
Ferrotungsten, 70-80%, per lb. of W	lb.	$0.90 –	$0.95
Ferro-uranium, 35-50% of U per lb of U	lb.	6.00 –	....
Ferrovanadium, 30-40%, per lb. of V	lb	3 50 –	4.00

Ores and Semi-finished Products

Bauxite, dom crushed, dried, f o b. shipping points	ton	$6 50 –	$8 75
Chrome ore, Calf concentrates, 50% min Cr_2O_3	ton	22 00 –	23 00
C i f. Atlantic seaboard	ton	18 50 –	19 00
Coke, fdry, f o b ovens	ton	9 25 –	9 50
Coke, furnace, f o b ovens	ton	8 00 –	8 50
Fluorspar, gravel, f o b. mines, New Mexico	ton	17 50 –	
Fluorspar, No 2 Lump—Ky & Ill mines	ton	25 00	
Ilmenite, 52% TiO_2	lb	01½ –	01½
Manganese ore, 50% Mn, c i f Atlantic seaport	unit	30 –	
Manganese ore, chemical (MnO_2)	ton	75 00 –	80 00
Molybdenite, 85% MoS_2, per lb MoS_2, N. Y.	lb	70	75
Monazite, per unit of ThO_2, c i f, Atl seaport	lb	06 –	.08
Pyrites, Span, fines, c.i f Atl seaport	unit	11½ –	12
Pyrites, Span, furnace size, c i f. Atl seaport	unit	.11½ –	12
Pyrites, dom. fines, f o.b. mines, Ga	unit	12	
Rutile, 95% TiO_2	lb.	.12 –	....
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8 00 –	8.50
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	7 50 –	8 00
Uranium ore (carnotite) per lb of U_3O_8	lb	3 50 –	3 75
Uranium oxide, 96%, per lb U_3O_8	lb	2 25 –	2 50
Vanadium pentoxide, 99%	lb	12 00 –	14 00
Vanadium ore, per lb. V_2O_5	lb	1 00 –	
Zircon, washed, iron free, f.o.b. Pablo, Fla	lb	04½ –	13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	15 00
Aluminum, 98 to 99%	22 00-23.00
Antimony, wholesale, Chinese and Japanese	7 15-7.50
Nickel, virgin metal	25 00-27.00
Nickel, ingot and shot	29 00
Monel metal, shot and blocks	32.00
Monel metal, ingots	38 00
Monel metal, sheet bars	45 00
Tin, 5-ton lots, Straits	39 875
Lead, New York, spot	8 00
Lead, E St Louis, spot	7 90-8 00
Zinc, spot, New York	7 25-7.30
Zinc, spot, E St Louis	6 90-7.05

OTHER METALS

Silver (commercial)	oz	$0.64⅝
Cadmium	lb	1 15
Bismuth (500 lb. lots)	lb	2 50
Cobalt	lb	3 00@3.25
Magnesium, ingots, 99%	lb	1 00@1 05
Platinum	oz	110 00
Iridium	oz	250 00@275 00
Palladium	oz.	65 00@70.00
Mercury	75 lb	72 50

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20 75
Copper bottoms	30 75
Copper rods	20.50
High brass wire	19.50
High brass rods	17 00
Low brass wire	21.10
Low brass rods	22.00
Brazed brass tubing	24.25
Brazed bronze tubing	29 00
Seamless copper tubing	25 25
Seamless high brass tubing	23.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.30@11.50
Copper, heavy and wire	11 25@11.50
Copper, light and bottoms	9 25@ 9 50
Lead, heavy	5.75@ 6.00
Lead, tea	3 50@ 3.75
Brass, heavy	6 25@ 6 40
Brass, light	5 35@ 5 75
No. 1 yellow brass turnings	6 30@ 6.50
Zinc	3.50@ 4.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.29	$3.14
Soft steel bars	3.19	3.04
Soft steel bar shapes	3.19	3.04
Soft steel bands	3.29	3.19
Plates, ¼ to 1 in. thick	3.29	3.14

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Arkansas

RITCHIE—The Arkansas Pipe Line & Navigation Co., Smackover, organized with a capital of $5,000,000, is planning for the construction of a new oil storage and distributing plant in the vicinity of Ritchie. The initial tankage installation will consist of nine 20,000-bbl. and four 55,000 bbl steel tanks. A similar plant is also contemplated at New Orleans, La. Grant Stebbins is president.

PINE BLUFF—The Pine Bluff Refining Co is planning for the immediate installation of additional equipment at its local refining, including pressure stills and other apparatus, estimated to cost close to $100,000.

SMACKOVER—F. M. Lege, Jr., and associates, Dallas, Tex., have organized a company to construct and operate a new oil storage and distributing plant at Lege in the Smackover district, consisting of an initial capacity of 5,500,000 bbl., estimated to cost in excess of $1,500,000, including operating equipment. A total of sixteen steel tanks will be installed.

California

SOUTH SAN FRANCISCO—The Metal & Thermit Corp., 120 Broadway, New York, manufacturer of Thermit welding apparatus, chemical and metal products has plans in progress for the erection of a new local plant on Swift St., where a site of 11 acres is available. The works will consist of a number of buildings, with main rolling mill, estimated to cost in excess of $1,000,000, with machinery. The Engineering Department, New York office is in charge. E. W. Kardos is district manager, with office on Swift St., South San Francisco.

COALINGA—The Continental Petroleum & Refining Co is arranging for the immediate construction of ten gasoline refining plants in different points of the San Joaquin Valley, estimated to cost close to $1,000,000.

FRESNO—The Tyre Brothers Glass Co., 162 J St., is planning for the erection of a new building at its works to cost about $27,000. Trewhitt & Shields, Rowell Bldg., are architects.

YUBA CITY—The King's Food Products Co., Salem, Ore., is negotiating with the local Chamber of Commerce for a site for the erection of a new hydrating plant, with initial unit estimated to cost approximately $100,000, with machinery. A number of sites are said to be under consideration. R. G. Grant is representative for the company.

NAPA—The Mercury Oil Co. will commence the immediate erection of a new oil storage and distributing plant at East Napa, estimated to cost approximately $35,000.

ANTIOCH—The Paraffine Companies, Inc., 34 1st St., San Francisco, will call for bids early in February for the erection of a new plant building at Antioch, estimated to cost close to $40,000. Leland Rosener, Insurance Bldg., San Francisco, is architect.

Florida

SOUTH JACKSONVILLE—C. S. Burgess, 423 Cornelia St., is considering the establishment of a local plant for the production of oils and extracts from citrus fruits. Inquiries are being made for suitable machinery.

Idaho

PAYETTE—Danney & Co. have tentative plans under consideration for the rebuilding of their fruit evaporator plant, recently destroyed by fire with loss approximating $35,000.

Illinois

CHICAGO—L. Mitchell & Co., 1311 East 61st St., manufacturers of washing compounds, chemical products, etc., have purchased property, 225x300 ft. at Ellis Ave. and 83rd St., as a site for a new plant. No date for erection has as yet been set, and tentative plans only will be developed for the present. Frederick G. Mitchell is head.

CICERO—The American 3-Way Prism Co., 1305 South 55th Ct., manufacturer of glass products, has tentative plans under consideration for the erection of a new 1-story plant at Roosevelt Ave. and 65th Ct., 215x300 ft. An architect to prepare detailed drawings will be selected in the near future. C. H. Paschall is president.

Indiana

SEYMOUR—The Blish Milling Co. has plans in preparation for the erection of a new plant for the manufacture of oils from soy beans. A complete extraction works will be installed. The plant is estimated to cost close to $35,000, including machinery. John A. Shields is secretary.

Iowa

BURLINGTON—The Burlington Glass Co., 315 Tama Bldg., is considering plans for the erection of a new plant on North Main St., to be 1- and 2-story, 150x150 ft., estimated to cost approximately $250,000, including machinery. W. A. Rayburn is president.

Louisiana

LAFAYETTE—The Star Salt Co. has commenced the construction of a new plant at its works, to be equipped primarily for the evaporation of salt from the brine as pumped from the wells. It will have an initial capacity of about 200 tons per week, and is estimated to cost in excess of $55,000. John J. Kean is general manager.

Maryland

PINESBURG—The Keystone Limestone Co. has acquired the local limestone properties of the Potomac Valley Stone & Lime Co., Pinesburg, near Hagerstown, comprising about 165 acres of land, for a consideration of $65,000, and plans for the installation of plant and extensive operations.

HAGERSTOWN—The Hagerstown Lime & Chemical Co. is perfecting plans for the construction of its proposed local plant for the manufacture of agricultural lime and kindred products, and will call for construction bids in about 30 days. The plant will include a complete grinding and pulverizing works, with daily capacity of about 100 tons. J. S. Myers is president.

Michigan

LUDINGTON—The Morton Salt Co., 80 East Jackson Blvd., Chicago, Ill., has acquired the local plant and property of the Stearns Salt & Lumber Co., with capacity of 500,000 bbl. per annum. The purchasing company also operates a plant at Ludington, as well as at Port Huron, and plans to construct a large addition to the Ludington works, discontinuing operations at the Stearns plant. The plant of the Morton company has a present rated capacity of 1,000,000 bbl per year.

RIVER ROUGE—The Ford Motor Co., Highland Park, is taking bids for the construction of a new 1-story foundry at River Rouge, to be used for automotive casting production. Albert Kahn, 1000 Marquette Bldg., Detroit, is architect.

MANISTEE—The Filer Fibre Co., Filer City (recently incorrectly noted under Manistee, Mass.) has construction under way on a new local plant and will commence the machinery installation at an early date. The mill will be equipped to give employment to about 100 operatives. M. Oberdorfer is vice-president.

Mississippi

GULFPORT—The Gulf Coast Refining Co. has tentative plans under consideration for the construction of an addition to its local plant for considerable increase in production.

Missouri

FLAT RIVER—The Federal Lead Co. is reported to be planning for the construction of a new mill in the Dobson section, vicinity of Hockerville, Okla., where property has recently been acquired. The company also has plans under consideration for taking over the Bunker Hill properties in this same district.

KANSAS CITY—The Phillips-Morgan Estates, 607 Ridge Bldg., has plans in progress for the construction of a new paper mill, to consist of two main buildings, each 50x220 ft., estimated to cost close to $70,000. The general contract will be handled by the D. H. Greene Construction Co., same address. L. L. Morgan is president.

New Jersey

BAYONNE—The Ingram-Richardson Mfg. Co., Beaver Falls, Pa., manufacturer of enameled iron signs, will soon commence the erection of a new plant at Bayonne, comprising a main 1-story building, 181x325 ft., estimated to cost more than $60,000, with equipment. The A. M. Allen Co., 7016 Euclid Ave., Cleveland, O., is architect. Ernest Richardson is vice-president and treasurer.

NEWARK—The Martin Metals Corp. has leased a portion of the 4-story building at 115-17 Monroe St., owned by the Foster Engineering Co., for the establishment of a new foundry for the manufacture of aluminum and other metal castings.

NEWARK—The Nickelsburg Brothers Co., Meadow Ave., near the Lincoln Highway, has tentative plans under consideration for the enlargement of its leather tanning and manufacturing plant for considerable increase in capacity. The company has recently been disposing of a preferred stock issue of $1,000,000, a portion of the proceeds to be used for the proposed expansion.

TRENTON—The Reading Rubber Co., recently organized under state laws with a capital of $250,000, with initial paid-in capital of $51,000, has preliminary plans under way for the erection of a new plant on local site, replacing its present works at Kutztown, Pa. Negotiations are said to be in progress for the purchase of the land. The company is headed by Frank C. Myers, Trenton, Samuel H. Bell, Reading, Pa., and Jesse P. Stiles, Allentown, Pa. It is represented by Maxwell A. Kraemer, American Mechanic Bldg., Trenton.

BAYONNE—The National Sulphur Co., 80 Maiden Lane, New York, announces that the addition to its plant at North Akron, O., which was reported in these columns last week, is for the purpose of increased operations in that city and it is not the company's intention to vacate or lessen in any way its activities at the present works in Bayonne.

TRENTON—Officials of the Traveler Rubber Co., Bethlehem, Pa., headed by Guy de la Rigaudiere, president, have acquired a substantial interest in the United & Globe Rubber Co., Prospect and Frazier Sts., Trenton, and have organized a new company under the same name, with larger capitalization, to take over and operate the present business, devoted to the manufacture of mechanical rubber goods, automobile tires, etc. Extensions and improvements in the works are under consideration. John S. Broughton, president of the former organization, has been elected chairman of the board; Mr. de la Rigaudiere, president; and Victor Durand, Jr., 1st vice-president.

New York

LONG ISLAND CITY—The A. C. Horn Co., Bodine St., manufacturer of waterproofing products, technical coatings, etc., has purchased property on Hancock St., near 14th St., approximating 30,000 sq.ft., for proposed extensions.

HUDSON—The Knickerbocker Portland Cement Co. has awarded a contract to the Turner Construction Co., 242 Madison Ave., New York, for foundations and other work in connection with an addition to its local cement mill.

BUFFALO—The Williams Gold Refining Co., 2978 Main St., has work under way on extensions and improvements in its plant, estimated to cost about $15,000.

WATERFORD—The Goodyear Tire & Rubber Co., Akron, O., has acquired local property, heretofore occupied by the Beaver Mills Co., with option to purchase, for the establishment of a new branch plant for the manufacture of tires and other rubber products.

NEW YORK—The International Paper Co., 30 Broad St., has tentative plans under consideration for the construction of a large paper mill and hydro-electric power plant for operating service, at Grand Falls, N. B., estimated to cost in excess of $5,000,000.

Ohio

CLEVELAND—The Forest City Foundry & Mfg. Co., 1220 Main Ave., N. W., special-

izing in the production of small gray-iron castings, has tentative plans under consideration for the erection of a new 1-story foundry at Maywood Ave. and West 90th St., estimated to cost close to $400,000, with equipment. Albert Gerdum is president.

Oklahoma

TONKAWA—The Champlin Oil & Refining Co., Enid, Okla., has acquired a tract of local property, comprising about 45 acres of land, as a site for the construction of a new oil refining plant. Plans will be prepared at early date.

ARDMORE—The Hewitt Refining Co., recently organized with headquarters at Ardmore, is perfecting plans for the immediate erection of a new oil-refining plant on site secured at Wilson, near Ardmore, with initial capacity of about 1,500 bbl. per day. It is estimated to cost in excess of $200,000, with machinery. C. E. Sykes is president, and Ross W. Coe, secretary and treasurer.

TONKAWA—The Golden Rule Refining Co., Wichita, Kan., is planning for the construction of a new local oil refinery, estimated to cost approximately $100,000. A tract of property has been purchased.

TONKAWA—The Constantin Refining Co., Tulsa, has plans in progress for the construction of a new refining plant on 50-acre tract of land here, lately acquired. The refinery will be used for the production of refined petroleum, lubricating oils, etc.

Pennsylvania

PHILADELPHIA—The Philadelphia Paper Mfg. Co., River Rd., has awarded a general contract to the J. S. Rogers Co., Drexel Bldg., for the construction of a new 5-story building at Randolph and Willow Sts., estimated to cost approximately $225,000.

YORK HAVEN—The Conewago Felt & Paper Co., recently organized with a capital of $300,000, is perfecting plans for the erection of the initial unit of its proposed new local plant, to be 1-story, 35x170 ft. A site has been selected. Hamme & Witman, City Bank Bldg., York, Pa., are architects. E. E. Brunner, president of the York Haven State Bank, is head of the new company.

OIL CITY—The Penn-American Refining Co. has work under way on extensions at its local gasoline refinery, for considerable increased output. A 3-unit cracking plant will be installed.

South Carolina

COLUMBIA—The Southern Silica Mining & Mfg. Co., 1643 Main St., is planning for the installation of additional mechanical sand drying equipment at its plant with capacity of about 150 tons per day. Inquiries are out for the apparatus.

Tennessee

RICHARD CITY—The Dixie Portland Cement Co., Chattanooga, has tentative plans under consideration for extensions and improvements in its local cement manufacturing plant, estimated to cost about $175,000, including machinery.

Texas

BLOSSOM—The Blossom Oil & Cotton Co. is reported to be planning for the rebuilding of the portion of its local cotton oil mill, destroyed by fire, Jan. 18, with loss approximating $60,000. The reconstruction is estimated to cost a like amount. Additional equipment will be installed.

HOUSTON—The Magnolia Paper Co. has plans in progress for the erection of an addition to its local paper mill, estimated to cost approximately $75,000.

ROTAN—J. W. Patton, operating a local lime plant, has disposed of a portion of his property to the Universal Gypsum Co., which plans for the early erection of a new plant for the manufacture of cement, wallboard and other gypsum products. It is estimated to cost close to $75,000, with machinery, and will give employment to about 125 men at the start. C. E. Williams is an official of the purchasing company.

Virginia

ROANOKE—The Cement Products Mfg. Corp., recently organized with a capital of $30,000, has plans in progress for the erection of a new plant on local site for the manufacture of cement products, including tile, shingles, blocks, etc. Ground will be broken at an early date. E. A. Buchanan, P. O. Box 1172, is secretary and general manager.

WINCHESTER—The National Fruit Product Co., manufacturer of vinegar and other apple byproducts, is planning for extensions in its plant to double the present output. A new tank department will be installed with total capacity of 2,500,000 gal. C. E. Koontz is manager.

PETERSBURG—The Dodge Leather Co. has tentative plans under consideration for the erection of an addition to its plant for considerable increase in capacity. L. F. Dodge is president.

SOMERSET—The Rapidan Soapstone Corp., Orange, Va., recently organized with a capital of $200,000, has plans under consideration for the erection of a new plant on property acquired in the vicinity of Somerset. Kesee Brooking is president, and D. N. Davidson secretary and treasurer.

PETERSBURG—The Capitol Oil Co., Union Trust Bldg., recently organized, will soon commence the erection of a new oil storage and distributing plant, estimated to cost about $40,000.

West Virginia

SOUTH CHARLESTON—The Westvaco Chemical Co., Charleston, is planning for the construction of an addition to its South Charleston works, to consist of a complete operating unit, estimated to cost close to $50,000. The structure will be used for the conversion of brine products into chemicals. F. J. Kaufman is general manager.

CHARLESTON—Foundations are under way for the erection of the proposed 1 story addition to the local plant of the Owens Bottle Co., to be 120x200 ft., estimated to cost approximately $150,000. Other additions will be made at a later date. Headquarters of the company are in the Nicholas Bldg., Toledo, O.; the Devore Co., same address, is engineer.

Wyoming

CLAYTON—The Sinclair Crude Oil Producing Co., affiliated with the Sinclair Consolidated Oil Corp., 45 Nassau St., New York, will commence the erection of a new local storage and distributing plant comprising thirty 80,000-bbl. capacity steel tanks and auxiliary equipment.

Industrial Developments

LEATHER—Dungan Hood & Co., Philadelphia, Pa., are running their tanneries at close to 75 per cent of normal.

The Premier Leather Co., Boston, Mass., has resumed the production of black and colored glazed kid at its Philadelphia, Pa., plant, and expects to gradually advance manufacture in this line.

Robert H. Foerderer, Inc., Philadelphia, Pa., specializing in the production of glazed kid, is operating at its Frankford tannery at about 75 per cent of capacity.

CERAMIC—The Western Brick Co., Danville, Ill., is maintaining capacity production at its plant giving employment to about 400 operatives. The wage scale has recently been advanced.

The Champion Spark Plug Co., Toledo, O., is now operating on a production basis of 120,000 spark plugs per working day, or on a schedule of 271 a minute. A full working force is being employed. The plant is said to be the largest in the world devoted to this line of manufacture.

The Mapelton Clay Products Co., Mapleton, O., specializing in the manufacture of face brick, is developing capacity operations and expects to be running on a basis of 45,000 bricks daily at an early date. This schedule will be maintained for an indefinite period.

The Birmingham Clay Products Co., Birmingham, Ala., manufacturer of brick, is running on a full-time schedule at its local plant, giving employment to the regular working force. The company has work under way for a new kiln room for general increase in capacity, and is also considering the erection of other plant additions.

The Southern Brick & Tile Co., Louisville Ky., is arranging for the early resumption of operations at its plant, recently closed down for necessary repairs. A close to normal working force will be employed.

The I. L. Stiles & Son Brick Co., North Haven, Conn., is operating on a basis of about 60,000 bricks per day at its local plant, and is installing additional mechanical drying equipment to provide for further output.

Terra cotta plants in the Chicago, Ill., district are operating at maximum capacity with full working forces. A number of the plants are booked with orders insuring the continuance of this schedule well into spring.

The Louisville Fire Brick Works, Louisville, Ky., is operating its local plant at approximately 65 per cent of normal capacity. The branch plant at Grahn, Ky., is maintaining approximately this same schedule.

The Alton Brick Co., Alton, Ill., is planning for the early resumption of operations at the plant of the Banner Clay Works, Edwardsville, Ill., recently acquired. A portion of the plant is being remodeled and improved, and additional equipment will be installed.

GLASS—The National Glass Co., Shreveport, La., manufacturer of window glass, has perfected plans for the immediate reopening of its plant, giving employment to about 250 operatives. The works have been closed for some time past.

The Owens Bottle Co., Toledo, O., is running on a capacity basis at all of its plants, and expects to continue on this basis for some time to come. Full working forces are being employed.

RUBBER—The Woonsocket Rubber Co., Woonsocket, R. I., a division of the United States Rubber Co., has announced a full-time working schedule, effective Feb. 1 until further notice; it is expected that this basis will be continued throughout the year. At the same time the company has advanced wages at the plant, as well as at the branch factory at Millville, Mass., affecting about 1,900 operatives.

The B. F. Goodrich Co., Akron, O., has acquired the plant of the Ames-Holden Tire Co., Kitchener, Ont., for increased production for Canadian trade. The plant has a rated capacity of 1,000 tires a day and will immediately be placed on this full-production basis for a full line of Goodrich tires. The company is maintaining full operations at its main works at Akron, O.

The Boston Rubber Shoe Co., Malden, Mass., a branch of the United States Rubber Co., has advanced the wages of employees at the local mill. Employment is now being given to close to 2,000 persons.

CEMENT—The Atlas Portland Cement Co. New York, is arranging for an early increase in production at its mills in different parts of the country, placing all plants on a full-capacity basis for the first time since 1914. The No. 3 plant at Northampton, Pa., has already adopted a maximum output schedule, with capacity of 10,000 bbl. per day. Other plants of the company are located at Hudson, N. Y., Hannibal, Mo.; Leeds, Ala.; and Coplay, Pa.

The majority of the cement mills in the Lehigh Valley district of Pennsylvania are running on a full turn, giving employment to regular working forces. This schedule will be maintained for an indefinite period.

Riggers at the plant of the Alpha Portland Cement Co., Martin's Creek, Pa., declared a strike, Jan. 22, when a demand for an advance in wages from 44 to 65 cents an hour was refused by the company. The men are still out.

IRON AND STEEL—The Algoma Steel Corp., Sault Ste. Marie, Ont., is arranging to resume operations at its local mills before the close of February. The plant has been closed down for some weeks past.

The Wickwire-Spencer Steel Corp., Buffalo, N. Y., is operating at capacity at all plants, with a day and night working schedule. The Worcester, Mass., mills are giving employment to 3,500 men and are declining immediate orders as the maximum production is not equal to the demand.

The Alan Wood Iron & Steel Co., Conshohocken, Pa., has advanced the working time at its Ivy Rock blooming mill from 5 to 6 days a week, with day and night operating forces.

The Temple blast furnace, Temple, Pa., now under new management, has repairs and improvements under way at the stack, and expects to blow in during March. The furnace has been idle for about 24 months past.

The American Sheet & Tin Plate Co., Pittsburgh, Pa., has advanced production at its Wheeling, W. Va., works, bringing the average production of the different plants to 90 per cent of capacity. It is said that labor shortage will not permit an increase over this schedule at the present time. All plants of the company are on the active list.

Steel mills in the Chicago, Ill., district continue to advance production and the leading plants are now running on a basis of 80 to 85 per cent of capacity, as compared with 75 to 80 per cent a month ago.

In accordance with its proposed schedule the Thomas Iron Co. has blown in its new blast furnace at Hokendaqua, Pa., with

rated capacity of 400 tons of pig iron daily The organization recently came under the control of the Reading Iron Co., of which L. E. Thomas is president.

MISCELLANEOUS—The American Cellulose & Chemical Mfg. Co., Ltd., Amcelle, Md, is perfecting arrangements for the early resumption of operations at its local plant, which has been closed for some time past

The Standard Oil Co of New Jersey has refused the demand of employees at its three refineries at Constable Hook, Bayonne Bayway and Eagle Works, Jersey City N J, for a wage increase. It is pointed out that the increase in average hourly earnings at the plants from 1914 to the present time has been approximately 190 per cent

Capital Increases, etc.

THE WHITEHEAD BROTHERS RUBBER CO Whitehead Rd, Trenton, N. J, manufacturer of mechanical rubber products, has filed notice of increase in capital from $60,000 to $180,000

THE PAN-AMERICAN PETROLEUM & TRANSPORT CO, 120 Broadway, New York operating oil refineries in Mexico, California and other locations, has arranged for an increase in capital from $150,000,000 to $230,000,000 for general expansion

THE MICHIGAN GREY IRON CASTINGS CO Harbough St, Detroit, Mich, has filed notice of increase in capital from $10,000 to $250,000 for proposed expansion

THE BROWN CO, Berlin, N. H, manufacturer of paper and sulphite products, is disposing of a bond issue of $2,500,000, a portion of the proceeds to be used for general operations, additions to working capital, etc

THE LAKE VIEW BRICK CO, 2758 Irving Park, Chicago, Ill, has arranged for an increase in capital from $50,000 to $200,000, a portion of the proceeds to be used for expansion and additions to working capital

GEORGE D WETHERILL & CO, INC, 113 Arch St, Philadelphia Pa, manufacturers of paints, white lead, etc., are arranging for an increase in capital from $500 000 to $3,000,000 for general expansion

THE DETROIT RUBBER PRODUCTS CO, INC, 565 East Jefferson St, Detroit, has filed notice of increase in capital from $50,000 to $125,000

THE BLOOMSBURY GRAPHITE CO, Bloomsbury N J, has arranged for an increase in capital from $50,000 to $100,000

THE KALAMAZOO SANITARY MFG CO Kalamazoo, Mich, manufacturer of sanitary earthenware products, has filed notice of increase in capital from $350 000 to $700 000

New Companies

THE BEETLE-BAKER CO, Lynn, Mass, has been incorporated with a capital of $10 000, to manufacture liquid rubber cement waxes, etc Lorenz F Muther is president and William L Newton, 362 Massachusetts Ave Boston, treasurer

THE HOOSIER RENDERING CO Kentland Ind, has been incorporated with a capital of $25,000, to manufacture fertilizer products The incorporators are Egbert S Hess, Rufus Robinson and Samuel L Barnhard, all of Kentland

THE NITRO CHEMICAL PRODUCTS CORP, New York, N. Y, care of J M Kram, 51 Chambers St, New York, representative, has been incorporated with a capital of $50,000, to manufacture chemicals and chemical byproducts The incorporators are C. Leventhal, N Gray and B Sustrain

THE GENERAL SMELTING & REFINING CO, Detroit, Mich has been incorporated with a capital of $10,000, to operate a metal smelting and refining plant The incorporators are Daniel Temchin and Samuel Cooper, 678 Leland Ave, Detroit

THE HUDSON FIREPROOF BLOCK CO, North Bergen, N J, has been incorporated with a capital of $300,000, to manufacture burned clay building blocks and kindred ceramic products The incorporators are John E Toolam, David T Wilentz and Leon E McElroy, Garden St., North Bergen

THE GENERAL PETROLEUM CO, 208 South La Salle St., Chicago, Ill, has been incorporated with a capital of $100,000, to manufacture petroleum products. The incorporators are Frank Tillotson, I N Walker and O. E. Edfast

THE PEACE CHEMICAL CO., Phillipi, W Va., has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are H. B. Grant, Sherman Lindsey and B. E. Snyder, all of Phillipi

THE UNITED PROTECTIVE COATINGS CORP., New York, N. Y, care of J. J Finn, attorney, Yonkers, N. Y, representative, has been incorporated with a capital of $50,000, to manufacture paints and special coatings The incorporators are C R Douglas and M F Cole

THE BENTON HARBOR CHEMICAL CO, Benton Harbor Mich, has been incorporated with a capital of $10 000, to manufacture chemicals and special chemical preparations The incorporators are Walter S. Burgess, H J Dunleavy and A L Hogue, all of Benton Harbor

THE ENTERPRISE LIME & BALLAST CO, 11 Green St, Cumberland, Md, has been incorporated with a capital of $100,000, to manufacture lime and affiliated products The incorporators are Charles E Schadt, William M Somerville and Harry R Donnelly

THE BERGER LEVY CO, New York, N Y, care of Bloomberg & Bloomberg, 1482 Broadway, New York, representatives, has been incorporated with a capital of $100,000, to manufacture glassware specialties The incorporators are H A and E N Bloomberg and W Kaufman

THE APEX SMELTING CO 180 North Market St, Chicago, Ill, has been incorporated with a capital of $60,000 to operate a metal smelting plant The incorporators are William Helfand, Samuel Berenbaum and Sidney E Levy

THE SHELBY IRON & CHEMICAL CO, Memphis, Tenn, care of the Delaware Registration Trust Co, 900 Market St, Wilmington Del, representative, has been incorporated under Delaware laws with capital of $1,000,000 to operate iron properties, byproduct chemical works, etc The incorporators are M N Harris H W Dow and C D Shelow, Memphis

THE FRENCH MICA CO, 208 Broad St, Elizabeth, N J, has been incorporated with a capital of $10 000, to manufacture mica products The incorporators are Russell W Leary, Malcolm W Clephane and Donald McL Somers

THE SERVICE GLASS CO, Detroit, Mich, has been incorporated with a capital of $10,000, to manufacture glass products The incorporators are E F Kellum, Roland H Newton and George W Clay, 2019 Poplar St

THE VITROLITE PRODUCTS CO, Buffalo, N Y care of Kent, Cummings & Means Dun Bldg, Buffalo, representative, has been incorporated with a capital of $55 000, to manufacture composition materials for table tops, etc The incorporators are F E Beluche, C DeF Cummings and G A Brenner

THE HOFFMAN BROTHERS TANNING CO, 1701 Grand Ave, Chicago, Ill, has been incorporated with a capital of $250,000, to operate a leather tanning plant The incorporators are Olaf C and Anton R Hoffman and Carl Peterson

THE PITTSBURGH LEATHER & GLUE CO. Pittsburgh, Pa., care of W F Stadtlander, 115 Frick Bldg, Pittsburgh, representative, is being organized under state laws to manufacture glue and adhesives, leather products, etc

THE PACIFIC BRICK & TILE CO., 5233 Alhambra Ave Los Angeles, Cal, has filed notice of organization to manufacture brick, tile and affiliated burned clay products The company is headed by Carl B Gallasch and Claude S Kerrick

THE DIXIE DISINFECTING CO, Dallas, Tex, has been incorporated with a capital of $10 000, to manufacture chemical disinfectants etc. The incorporators are E J and O S Boyd and S P. Solomonson, all of Dallas

THE CHEROKEE BRICK CO, Knoxville, Tenn, care of the Delaware Corporation Co Ford Bldg, Wilmington, Del, representative, has been incorporated under Delaware laws with capital of $250,000, to manufacture burned clay products, including brick, tile, etc The incorporators are R G and J C. Wright, and C. E. Campbell, Jr, all of Knoxville

THE HANNIGAN WATERPROOFING & MFG. CO, New York, N. Y, has been incorporated with a capital of $50,000, to manufacture waterpoofing compounds, paints, etc The incorporators are C R Buell, E Kazemier and T. P Hannigan, 51 Chambers St, New York. The last noted represents the company.

THE REGISTER OIL CORP care of the Delaware Registration Trust Co., 900 Market St, Wilmington, Del., representative, has been incorporated under Delaware laws with a capital of $100,000, to manufacture petroleum products

THE ADENZIT CO., Long Island City, N. Y., care of J. K. Gillette, 424 Steinway Ave., Long Island City, representative, has been incorporated with a capital of $15,000, to manufacture chemicals and chemical compounds The incorporators are T Moore, W. C. and I W Kober

THE R A MOORE LEATHER CO., Greenville, Tex, has been incorporated under state laws to manufacture leather products The incorporators are R A Moore, J. M. Massey and W N Miller, all of Greenville

THE ALUMINUM FOUNDRY CO, Boston Mass, has been incorporated with a capital of $10,000, to manufacture aluminum, bronze and other metal castings Harry D Finberg is president and Abraham Sherman, 138 Gaston St, Roxbury, Mass, treasurer

THE PETERS PETROLEUM CORP, care of the Corporation Service Co, Equitable Bldg, Wilmington, Del, representative, has been incorporated under Delaware laws with capital of $1 000,000, to manufacture petroleum products

THE LAKESIDE OIL REFINING CO, care of the Corporation Trust Co of America, du Pont Bldg, Wilmington, Del, representative, has been incorporated under Delaware laws with a capital of $5,517,500 to manufacture refined petroleum products

THE SOBRITE CHEMICAL CO, 236 7th St, Jersey City, N J, has filed notice of organization to manufacture polishes, etc G L Shoemaker heads the company

Coming Meetings and Events

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual convention in Norfolk, Va May 7 to 9

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa, Feb. 12 to 17, 1923

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5 1923, at the Commodore Hotel, New York.

AMERICAN FOUNDRYMEN'S ASSOCIATION will hold a meeting in Cleveland, O, April 28 to May 1

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its annual meeting in New York City during the week of Feb 19, 1923

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W Va, June 7, 8 and 9

AMERICAN SOCIETY FOR STEEL TREATING will hold its winter sectional meeting in the City Club, Chicago, Feb 8 and 9, 1923

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL FOREIGN TRADE COUNCIL has postponed its annual conference from April 25, 26 and 27, to May 2, 3 and 4 It will be held in New Orleans, La

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St, Newark, N. J, the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923 The major subject will be "Management Problems of the Smaller Plants."

A PAPER INDUSTRIES EXPOSITION will be held in Grand Central Palace New York City, during the week of April 9, 1923, by the International Exposition Co.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting May 4—American Chemical Society, regular meeting May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

CHEMICAL
& METALLURGICAL
ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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The Real Need for Aggressive Leadership

RECENTLY we have had some clear thinking and straight talking about international relations and this country's responsibility in the present European situation. It is especially significant that it is the voice of American business that is most insistent in its demand that our government should no longer seek to avoid its moral obligations to the rest of the world.

One of the most recent names to be added to the growing list of American business men who have protested our ineffective foreign policy is that of A. C. BEDFORD, chairman of the board of the Standard Oil Co. of New Jersey. Not long ago in the course of an address before the Merchants' Association in New York he laid the blame for our vacillating course squarely at the door of the "partisan political controversies which have driven us as a people into a position with reference to the rest of the world that is contrary to the sentiments and traditions of our country."

The real need of the moment is for aggressive leadership, and there are few that will disagree with Mr. BEDFORD that this must come from Washington.

> We are entitled to look to our government for leadership and guidance in this great crisis. We feel that it is of utmost importance that matters of such supreme and transcendent consequence should be considered by the American people and the American Government from the American standpoint and without regard to partisan political considerations.
>
> We business men appreciate fully all the difficulties which confront the administration, but we feel that we can unhesitatingly assure our government at Washington that the most aggressive leadership will be welcomed by the whole American people and supported by the irresistible forces of intelligent public opinion.

If such leaders cannot come from among those in our government who have guided our foreign policies in the past, it is not unreasonable to believe that organized American business will unofficially, but none the less effectively, assert itself in the interest of peace and order in Europe. In fact had not the last Paris Conference of Allied Premiers already been called for Jan. 2, it is not at all unlikely that American business through the agency of the Chamber of Commerce of the United States might have taken a hand in an effort to straighten out the reparations tangle. On Dec. 25, 1922, the German Industrie- und Handelstag, the leading commercial body of Germany, invited the Chamber of Commerce of the United States to appoint a commission to investigate and express American opinion on the subject of German reparations. This evidence of confidence on the part of the leading commercial body of Germany in a similar organization in this country was sympathetically received, and the invitation probably would have been accepted but for the fact that it was considered proper to suspend decision pending a possible settlement at the Paris conference. Events following the failure of the diplomats to reach an agreement moved with such swiftness and in such unexpected directions that hope of further action by the Chamber of Commerce of the United States is now rather remote. The incident is noteworthy, however, as indicating sentiment on both sides of the ocean that the time is not far distant when the business man will be asked to take a more active part in solving the political as well as the purely business problems of international relations.

Education Of the Intuitions

IN THE current issue of *Engineering Education*, the president of Antioch College, ARTHUR E. MORGAN, declares that the chief defect in technical education today is the failure to educate the intuitions. By intuitions he means the ideas that seem to spring into being spontaneously and do not come as the result of conscious reasoning. Mr. MORGAN begins by acknowledging the debt that education and our modern engineering world owe to conscious reasoning and scientific analysis—a debt that is monumental and undisputed. But he points out that these rationalistic activities, which have built up the astonishing materialistic civilization that we now enjoy, are but tools by which intuitive purposes are accomplished.

All of us, he asserts, including engineers, live in the main by intuition. When we choose a wife, select a home, make friends or vote as a citizen, our intuitions generally control us. Yet the technical schools give students the impression that professional life is largely a succession of analytical processes. "As a matter of fact, in the professional work of most engineers who have gone beyond the stage of routine computers, decisions which must be arrived at by intuition both outnumber and outweigh those which can be reached by a purely technical approach."

President MORGAN continues: "Intuitions are not vagrants, arriving from nowhere and without cause or parentage. Rather they are normal and natural offspring, to some extent of heredity, but in very great measure of education and environment. . . . To the extent that the student's attention at college is confined to a consideration of technical principles and processes, his intuitions, outside of these phases which technical training specifically develops, will remain narrow, instinctive, primitive and crude, and made up of comparatively few factors."

Intuition is an important source of knowledge, a source too often overlooked. It is true, as President MORGAN declares, that most of us make important decisions by use of intuition. We decide by its aid whether

or not to accept offers and opportunities, whether a new acquaintance is worth trusting or not, and what personal policy to pursue. EMERSON pointed out that most of our mistakes come from not following our intuitions, and that life's most difficult problem is in deciding in what proportions to mix intuition and rationalism. He personally advocated more intuition and less rationalism. The distinguished French philosopher BERGSON has taught similar principles.

Without doubt the ancient and medieval wise men trusted intuition too much and rationalism too little. But perhaps in our reaction away from mysticism and *a priori* judgments we have emphasized rationalism at the expense of intuition. We are even apt to belittle or forget the fact that many great contributions to science probably came from *a priori* ideas. Such a hard-headed and mathematical-minded scientist as JOHN DALTON is said to have got his great idea on the atomic theory more by intuition than rationalism. That is, he got the idea before he made the experiments; as a laboratorian he was what we should call a "sloppy chemist." How many of the great discoveries and inventions in science have probably come by flashes of insight (intuition) rather than by cold reasoning! Yet to hear many college lecturers expound their scientific methodologies, a student would be led to think that there is no such thing as intuition, and that professional life is entirely applied rationalism.

Should we not then admit the importance of intuition, and see that teachers of engineering are broad minded and philosophical enough to develop its use? President MORGAN suggests that this should be done by mixing cultural and technical teaching, not by keeping them in watertight compartments. The great need is for professors of engineering who are at the same time cultured and philosophical men of the world.

An Immigration Policy In the Making

NOT long ago the National Association of Manufacturers decided it was time to answer the question: What shall we do about immigration? The opinions of representative industrial leaders, farmers, bankers and economists were sought and their replies furnished the basis of an interesting discussion in the current number of the association's magazine, *American Industries*. As might have been expected, there was a unanimity of opinion that the present quota law is wholly unsatisfactory. But the symposium also brought out sufficient constructive criticism to form the basis for a sound and permanent immigration policy.

All of the replies to the association's inquiry have been summarized in a number of recommendations which will be found on page 327 of this issue. Among these are the proposals that the quotas should refer to the net immigration from any particular country and that in case of labor shortages in this country the Secretary of Labor should be authorized to bring about the admission of desirable immigrants. It is further recommended that registration, distribution and education of the incomers should be handled by a centralized bureau or commission with the idea that these processes could thus be carried out more expeditiously and at the same time in a more humane way. It was almost unanimously agreed that the literacy test should be abandoned and that in its place we should have a scientific selection of our prospective citizens made by American officials on the other side of the ocean.

It is gratifying to learn that the effect of these recommendations has already been felt and that some of them probably will be incorporated in a measure soon to come up for Congressional consideration. Members of the House Immigration Committee have agreed among themselves on several basic principles that will underlie any revision of the present immigration law. Although these plans would call for a 2 per cent quota based on the number of foreign nationals residing in this country in 1890 (instead of 3 per cent in 1910 as at present), it is claimed that such a law would be so liberalized as to make it possible to bring in 200,000 more aliens than are now admitted. This would be accomplished by broadening the executive powers of the Secretary of Labor and increasing the number of exemptions to the present quota classifications.

It is apparent that the change from the 1910 to the 1890 basis would have the effect of sharply reducing the quotas allotted to Italy, Greece and southeastern Europe, without materially affecting those of the northern European countries that in the past have furnished us with a more desirable type of immigrant. Certain features of the proposed bill, however, will require further classification and perhaps will have to be modified considerably. For example, the flexible provision authorizing the Secretary of Labor to extend quotas when necessary is now so worded as to apply only to skilled labor and accordingly would not be effective in relieving shortages of common labor such as are currently reported in the steel industry.

This much, however, can be said in favor of both the association's proposals and the committee's tentative bill: They mark the first step toward establishing a definite immigration policy for the United States. If this policy is to be a lasting one, it must be designed to serve the economic and social interests of the country as a whole—without giving favor to either manufacturing or laboring classes.

Twelve Months' Armistice In the Coal Industry

THE coal stock report just issued by the Department of Commerce and U. S. Geological Survey shows an encouraging increase in the supplies of bituminous coal on hand the first of January, as compared with the stocks 2 months before. Despite large winter demands and active business conditions, the supply has evidently slightly exceeded the consumption so that 36,000,000 tons is now on hand in the commercial stocks of the country. This is a sufficient excess above the minimum safe stock, approximately 20,000,000 tons, so that there need be no fear of serious coal shortage this winter.

It has recently been announced also that wage agreements between mine operators and bituminous coal miners will be perfected for the coal year beginning April 1. Thus the industry declares another 12-month armistice in the wage wars which have threatened to wreck not only that industry but all of the rest of American business. In the meantime, the coal "fact-finding" commission will have completed its studies and reported to Congress on the remedies for the persistent and recurring troubles incident to coal shortages.

It has been many months since industry has been able to look forward as comfortably to as regular fuel supply as is now assured for the next year. Within that year it is certainly to be hoped that a permanent solution will be found of the problems of this basic industry.

What Makes a Good Journal Bearing?

IT MIGHT be assumed that the problems connected with bearings and bearing metals have been solved. On the one hand, mechanical engineers have constructed roller and ball bearings, assembled with a watchmaker's precision, or installed very effective systems of forced lubrication for the older types of journal bearings. Metallurgical problems might also be thought to have vanished, since specifications and foundry practice on babbitt, railroad "brasses" and bearing bronzes have been little changed for years. However, new metallurgical problems are continually cropping up and are being given careful consideration. To cite only three: How far can hardness in a bearing race be sacrificed to machinability? What is the best bearing metal for alloy-steel shafts in high-speed automobile or airplane engines? What kind of metal should aluminum castings or forgings rub against?

Theoretically, the load on a journal should be borne by an oil-film. Practice sometimes falls far short of this ideal, but all the progress that has been made in the mechanical and metallurgical construction of bearings has been effected by providing this minutely thin film more perfectly and more continuously. In view of its tremendous importance, we might pause to ask, Who is pressing a systematic, scientific research on the physical and chemical properties of lubricants? But that inquiry would lead us far afield, so for the present let us consider the effect of those undoubted metallurgical factors which come into play when the oil film is temporarily broken—chiefly when the shaft is starting or stopping its motion.

Experience had developed several highly successful bearing alloys long before modern metallography showed us that each was comprised of an aggregate of dissimilar crystals having a marked difference in hardness, plasticity and resistance to wear. The hard ones support the journal when metallic contact exists, and at such times they must be hard enough to support the load and yet not hard enough to score the shaft. The softer constituents wear away slightly faster and leave pocks for the lubricant. They always contain a minute amount of oil, but a quantity so necessary to prevent seizing during those critical periods when the journal is just starting or when enduring a momentary overload. It has also been found that successful bearings of long life almost invariably polish the journal during "running-in," and in turn the journal polishes the bearing. Now, bearing in mind that diamond dust will polish diamond, but no matter how worn it is, it will not polish emerald, it is apparent that the hardest constituent of the bearing must be of the same order of hardness as the journal which runs in it. Of course if a journal were glass hard and were mechanically and geometrically perfect it would run in any true bearing, but imperfections in alignment and finish are always greater than the thickness of the oil films; consequently in practice incipient wiping and polishing of one on the other always results. Sometimes the harder crystals in a bearing actually fuse on their surface to an observable extent during the preliminary "running-in."

For several years past a research committee of the American Society of Mechanical Engineers has been considering problems allied to the main question, "What makes an excellent bearing?" Early in their investigations they concluded that the literature was so contradictory it could not possibly be harmonized. Furthermore, they were of the opinion that experience furnished the only criterion of a successful bearing. If a number of satisfactory combinations of bearing and journal (and some unsuccessful ones as well) could be collected, the next step would be to study the hardness, orientation, melting point and relative amount of the various microconstituents of both pieces. In other words, the utmost resources of modern metallography must be brought to bear on the problem in order to duplicate the successful combinations unerringly, and as certainly avoid the failures.

The first steps have been brilliantly successful. They have devised a beautiful instrument of precision (called by the ugly word "micro-character"), whereby a jewel point, 1,000 times sharper than the finest cambric needle, is drawn across a polished surface, ploughing a tiny groove in the crystals of the alloy of a width depending upon the hardness of each constituent. Its use has already cleared up several puzzling anomalies. Tin oxide crystals more than twice as hard as martensite have been found in poorly cast, oxidized bronzes—evidently such a bearing would score any journal. One babbitt analysis (Sn 90, Cu 10 per cent) contains crystals of $SnCu_4$ harder than cold-drawn shafting of low-carbon steel, and contrary to the theory of babbitting and the general impression among engineers harder than anything yet found in bronze. Nevertheless, that is the reason this particular babbitt is most unsatisfactory with soft steel journals.

However, the problem has outgrown the resources of the committee. It will be necessary, therefore, if the work is to continue, to put a competent investigator at work in some institution like the Bureau of Standards studying the intimate metallurgical details of many tried and true bearings now existing. In view of the importance of accurate knowledge about bearings to railroads, machine tool builders, engine and pump manufacturers, the automotive trade and the makers of bearing metals, the necessary funds will doubtless be forthcoming without extensive solicitation. Enlightened selfishness demands that the metallurgists in these industries get behind the most excellent program proposed by the Mechanical Engineers' committee—the results of the study will return their cost over and over again, like perpetual compound interest. Many a "hot box" has cost more than the expense of the research for a month.

A Protest From Germany

THERE has come to our desk a 28-page pamphlet containing a reprint of articles recently appearing in the *Chemiker-Zeitung*, by Dr. W. A. DYES of Berlin, relative to Mr. NEGRU'S articles on conditions in Europe. It is a protest against almost everything that Mr. NEGRU has said about Germany. The author marshals no fewer than ninety-seven references to other authors or publications whose expressions regarding Germany evidently please him better than did those appearing in this magazine. It is another example of the unwillingness or inability of the German mind to admit that Germany did anything during the years 1914-1918 to lose the confidence and respect of the other civilized nations of the world, or that in her evasion of the terms of the treaty of Versailles and the general conduct of her economic affairs in the past 4 or 5 years she has immeasurably delayed a return to world-wide peace and prosperity. The editor of *Chemical Age*, London, has appraised the value of Dr. DYES' pamphlet so fairly that we publish his comment elsewhere in this issue.

Readers' Views and Comments

Costs of Producing Natural-Gas Gasoline

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have carefully looked over the costs of producing natural-gas gasoline as given in the manuscript you kindly sent for my inspection[1] and I believe that the figures are approximately correct. However, I should change the cost of construction of a high-pressure absorption plant with a capacity of 10,000 gal. per day from the figure Mr. Sievers uses—namely, $450,000 or $500,000—to $200,000 to $300,000. Also I should change the cost of a charcoal plant of 4,000 gal. a day capacity from $90,000 to $125,000. I happen to be building one of about this size at the present moment, and I think this latter figure is more nearly correct.

The reason I am suggesting that the 10,000 gal. per day absorption plant be reduced is that I am familiar with some very recent developments whereby it is claimed a 6,000-gal. oil-absorption plant can be built for only $100,000. This plant embraces some new improvements, and while I am a little skeptical about the figure, yet it is probably not far from the actual cost.

It might be pointed out that while the cost of operation of the compression plant showed 11c. per gallon, this includes a very large sales cost, whereas apparently the absorption plant cost of 6½c. per gallon, which Mr. Sievers mentions, does not include sales. At the present moment the production at the compression plant he cites is about 5,200 gal. a day, and the costs have been reduced through various economies and larger gallonage to about 8½c. a gallon.

Pittsburgh, Pa GEORGE A. BURRELL, Petroleum Engineer

What Is Steel?

To the Editor of Chemical & Metallurgical Engineering

SIR:—In my opinion this question—What is steel?—has been treated in a most masterly way by the late Dr. H. M. Howe in the chapter on Classification and Nomenclature of his book, "The Metallography of Steel and Cast Iron," in which he shows that historically and logically we seem to be forced to use a classification based on origin; and, according to the practice generally used in all but the Teutonic countries, the present industrial classification is satisfactory and sufficient except for blister steel and ingot iron. In accord with this system is Dr. Matthews' definition of steel: "Steel of commerce is that form of iron which has been produced by melting to yield a finished product which is malleable."

Dr. Howe considered a structural classification not practical; nevertheless, if it be considered desirable to distinguish between low-carbon steel and ingot iron, which difference Dr. Matthews' definition ignores, this may be done metallographically, since it so happens that cementite appears to be soluble in ferrite over the carbon range embraced by ingot iron. Thus, up to a content of 0.03 per cent carbon, according to H. Scott (*Chem. & Met.*, Dec. 13, 1922), its existence is not detected by thermal or microscopic means, or A_1 is absent in ingot iron and of course also in electrolytic iron and in much wrought iron. The other elements, manganese, sulphur, silicon, etc., which may also be present, need not be considered in the definition, since they may be classed as constituents of, or impurities in, either iron or steel.

On the high-carbon side, there does not appear to be as sharp a demarcation between steel and cast iron, for example, as appears to exist between ingot iron and steel.

Your proposed definition, "Steel is a malleable alloy of iron and iron carbide," may be ambiguous with respect to wrought iron.

Recognizing the disappearing product known as blister steel as an anomaly, Dr. Matthews' definition may be modified to eliminate ingot iron: "Steel of commerce is that form of iron which has been produced by melting to yield a malleable, finished product in which iron carbide can be detected." GEORGE K. BURGESS,

Bureau of Standards, Washington, D. C. Chief, Division of Metallurgy.

Problems in the Production of Sodium Sulphide

To the Editor of Chemical & Metallurgical Engineering

SIR:—Referring to the editorial on "Sodium Sulphide" in your issue of Jan. 10, this company has produced sodium sulphide both by the direct method and as a byproduct from the barium industry. While we believe the barium industry is permanent in this country, still you are correct in saying the sodium sulphide derived therefrom cannot be regarded as a basic source, because at the very best it is variable. Regarding the direct method, what you say is very true indeed. It is our belief that any great improvement in the direct process must of necessity get away altogether from either reverberatory or rotary furnaces. However, experiments along this line we think should be confined solely to the amount anyone can afford to lose on a venture. JAMES B. PIERCE, JR.

Rollin Chemical Corporation, South Charleston, W. Va

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have noted with interest your editorial in the Jan. 10 issue regarding the manufacture of sodium sulphide. This problem is indeed an intricate one and one to which manufacturers have given serious thought. A process with a low per cent yield of the soda input is one which offers a big chance of improvement and, at the same time, the rough semi-skilled labor necessary, which continually grows harder to obtain, also makes improvement necessary.

Seemingly all attempts at improvement have met with only meager success, both in this country and abroad. Careful temperature control would aid greatly, but to simplify this for operation by the class of labor necessary presents a difficult problem in that no suitable recording instrument has yet been found which stands up under the furnace conditions. Again, impurities entering the crude product from the furnace walls, etc.,

[1]This article by E. G. Sievers appears on pp. 297-8 of this issue of Chem. & Met.

tend to make filtration of the solution of dissolved sulphide melt impossible, and here again a difficult problem is met.

The production of a fluid melt which could be run directly from the furnace into water, forming an immediate solution, would cut down subsequent crushing and handling costs, but to obtain proper fluidity, the amount of the reducing medium, such as coal screenings, has to be lessened to such an extent that proper reduction does not take place and again one is baffled. Finally, a large stack loss is also entailed in the present process which presents a problem where a saving could be made.

It is believed, however, that in time these problems will be solved as this one of the crudest processes in the inorganic chemical industry must of necessity be eventually improved.

Further comments on your editorial will be interesting.

ARTHUR L. GARDNER.

Merrimac Chemical Co.,
Everett, Mass.

Long-Term Credits and The Fertilizer Industry

To the Editor of Chemical & Metallurgical Engineering

SIR:—Referring to your editorial in the Jan. 10 issue, entitled "Long-Term Credits and the Fertilizer Industry," the facts as you state them are essentially correct, but the conclusion at which you arrive is not a practical possibility, if for no other reason than that it undoubtedly would be held to be an agreement in restraint of trade.

CHARLES H. MACDOWELL,
President, Armour Fertilizer Co.

Chicago, Ill.

To the Editor of Chemical & Metallurgical Engineering

SIR:—I read your recent editorial entitled "Long-Term Credits and the Fertilizer Industry" with a good deal of interest. You are quite right in saying that long-term credits is one of the very serious problems of the industry, and you could safely have added that it is also one of the most pernicious practices. However, I hardly think this practice was started with a view of increasing the tonnage already established, but on the other hand I think it was more to induce the use of fertilizer where it had not been used before. Now that its use has passed the experimental stage, it seems to me high time for the industry to change its selling policy.

Years ago the average farmer looked on a sack of fertilizer as being nothing more than a bag of sand through which a polecat had been drawn, but since that time our agricultural colleges have established without question the value of fertilizer and have convinced the intelligent farmer it is as necessary for him to feed his plants as it is for him to feed his stock if he hopes to get best results.

You are right in saying that competition is one of the causes of long credits. Some fertilizer concerns, in their anxiety for tonnage, seem to have little if any regard for the credit risk involved, and apparently are willing to give almost any credit terms, merely to effect a sale, with the result that the fertilizer industry has really been playing the part of banker to the farmer. However, the industry is endeavoring to get away from this practice, with the hope of putting the business on a cash basis, as it should be.

Cottonseed meal is rarely, if ever, sold on other than cash against documents terms, even though it is used by the farmer as a fertilizer, and yet that same farmer, who would willingly pay cash for his meal, nitrate of soda and other fertilizer materials, balks when it comes to paying cash for his manufactured fertilizer.

Another bad feature about long-term credits is that a great many merchants were really averse to handling fertilizer, but did so in order to get the other business of the planter. However, to get this business they used the fertilizer as a leader and sold it at practically cost to them, thereby losing the interest on the money they advanced to pay the freight (where freight was not prepaid) and also receiving nothing for their trouble and expense in handling the goods. The result was, when their notes for this fertilizer became due, they figured that the fertilizer end of the business was the last thing to be paid, for the reason that they themselves made no profit out of it, which, of course, was a poor excuse.

Again, country merchants, who could not borrow money from a bank without putting up ample security, bought fertilizer on credit and sold it out at its exact cost for cash, which money they used in their business without interest from date of shipment until May 1 (the usual settling date). Then when they settled on May 1, they would give their notes due in the fall, said notes including interest from May 1 to maturity, without any security whatever. When these notes matured, the merchants seemed to feel that they were the last things to be paid, and in many instances it was with great difficulty that collection of them was effected.

In the southeast Atlantic states the custom has been to prepay freights on shipments of fertilizer. This means that the fertilizer manufacturers have not only extended credit on their goods, but they have loaned the country merchant the money (without interest) with which to pay the freight. The reason this pernicious practice was started was competition. However, it did not reach what is known as the Southwestern territory —that is, the Southern section west of the Mississippi River—until the last few years, when it was introduced by the packers at the time they entered this field.

The industry has made greater strides in the last 2 or 3 years toward putting the business on a cash basis than ever before, and banks throughout this territory are beginning to recognize the fact that they must assist in carrying the credit risk, and therefore a number of them are now beginning to make loans to farmers to enable them to buy fertilizer, and the fertilizer industry is helping this along by offering very attractive discounts this year.

E. K. HUEY.

American Cotton Oil Co.,
New Orleans, La.

To the Editor of Chemical & Metallurgical Engineering

SIR:—Referring to your recent editorial, the manufacture of sodium sulphide still remains, so far as I am aware, just about where it was in Weldon's time. During the 25 years that I have been interested in it, the slight attempts that have been made toward improvement have left the process just about where it was. Mr. Gardner's letter to you enumerates some of the difficulties that have been met. The men who did much of the work many years ago are no longer with us. The results were negative and the details of the work done are lost. I am quite convinced that any real improvement in manufacture must be along lines radically different from any that have as yet come to my attention.

F. G. STANTIAL.

Merrimac Chemical Co.,
Woburn, Mass.

British Chemical Industries

FROM OUR LONDON CORRESPONDENT

LONDON, Jan. 18, 1923.

ALTHOUGH the political situation in Europe gives rise to anxiety, the general improvement that has taken place in the chemical trade during the last few months is still maintained and prices as well as business both for home and export account are increasing slowly but surely. It is perhaps premature to form any opinion as to the effect of the occupation of the Ruhr upon specific industries, but it is fairly clear that the coal and the iron and steel trades will improve, at any rate temporarily. The textile trades continue very firm and have helped to maintain stability in chemical markets. The prices of German fine chemicals will presumably advance in the near future, and it almost seems as if the British fine chemical industry, which, as previously noted in these columns, has been more or less moribund for a long time past, will experience something of a revival. There is also a distinct improvement in the sales of dyestuffs.

GOOD COAL AND OIL PROSPECTS

Cheap coal has always been a prime necessity for this country, but although the output is almost at its maximum, having regard to the 7-hour day, and pithead prices are only about 60 per cent above pre-war, freight and other expenses are up about 90 per cent. Pressure has been brought to bear upon the railways to reduce freights, but so far without success. Nevertheless, a reduction is confidently expected in the late spring and if it should also be possible to induce the miners to revert to the 8-hour day, that would make all the difference in enabling the heavy influx of orders to be filled and in giving the necessary impetus to the chemical and allied industries.

Fuel oil continues to gain favor and low-temperature carbonization of certain cannels and other low-grade coals is showing a progressive increase, probably because such installations do not depend upon the sale of smokeless solid fuel. Very substantial progress has been made in low-temperature retorting, and active developments are reported in the distillation of shales, torbanites, lignites and the like.

INDUSTRIAL AND TECHNICAL DEVELOPMENTS

The past year has not been very prolific as regards the introduction of new processes, and that may have to some extent been due to the natural reluctance of manufacturers in hard times to encourage expenditure on hypothetical schemes. The outlook and position is now changing and quite a number of promising developments are under way. Mention might be made of the tendency to import liquid rubber latex instead of crêpe and of two processes using latex, the one giving cold vulcanized products practically without odor and without brittleness in the cold, and the other enabling practically the whole of the constituents of the latex to be imported in solid or pasty instead of liquid form, thus saving freight yet enabling the essential parts of the latex to be reconstituted for manufacturing processes after arrival. As mentioned in last month's notes, the process for coagulation of blood and tankage by means of suitable reagents is now being tried out and phonograph records, cotton spinners' bobbins, waterproof paper, electrical goods and buttons may be instanced as probable applications. English patent 165,832 indicates that the blood is heated for about 24 hours at about 50 deg. C., preferably in a closed vessel, and the aëration is carried to such a point that coagulation to a stiff jelly can be effected in about 2 hours by adding 2 to 4 per cent of 40 per cent formaldehyde or ½ per cent of caustic soda. Alternatively the blood may be injected in a thin stream into hot water containing coagulating reagents, and it is stated that the cost of manufacturing material that would be suitable for molding purposes is about 3c. per pound. In referring to development and new inventions your correspondent has often been struck by the fact that business trips to Europe would be more profitable in every way if made in the spring instead of being combined with a vacation during the "rush" period. In the summer business topics are at a discount in spite of numerous "prospects" from America, and firms would do well to consider carefully planned winter or spring trips instead, preparing the ground beforehand by correspondence and representatives' reports.

GENERAL NEWS AND NOTES

The Society of Chemical Industry's new weekly journal *Chemistry and Industry* has, on the whole, been favorably and tolerantly received and is already showing signs of improvement. A not unexpected feature is the indirect advertising that the society has received by providing a general topic of conversation. The *Chemical Age* has now incorporated the monthly *China Clay Trade Review* and in view of the revival in this industry and its close connection with many chemical works, the moment seems opportune.

The public is taking considerable interest in the official inquiry as to charging for gas by its thermal value and a few recent accidents have produced much unjustifiable criticism of carbon monoxide content and its dangers. The tendency is still for a reduction in gas prices and for an increase in the declared calorific value.

E. V. Evans has resigned his appointment as a member of the Dyestuffs Advisory and Development Committees and his place has been taken by Mr. Dawson, manager of the British Alizarine Co., and Mr. Blundell, of the North British Chemical Co., Ltd., respectively. Dr. Carpenter has resigned from the Council of the A.B.C.M. (Association of British Chemical Manufacturers) and Dr. Clayton, M.P., succeeds him.

The death of Prof. George Lunge at Zurich is a reminder of the great debt which the chemical industries of all countries owe to this literary pioneer and inventor. It may be of interest to know that one of his sons is head of the development department of Courtaulds, Ltd.

The Institution of Chemical Engineers is now definitely in being and the first batch of members has already been elected by the Council. Reciprocal arrangements have been made with the American Institute of Chemical Engineers for attendance at meetings and in regard to proceedings; applications for membership already exceed two hundred.

Your correspondent regrets an unfortunate error in quoting prices for pitch in last month's notes. The price a few months ago should read $12.50 and the level in December was $28. As anticipated, prices have slightly increased since to $30.

Although the Wooden Barrel Was Invented Far Back Before the First Dawn of Written History, Little Is Known by the Average User as to the Proper Care to Give Them When Handling and Storing — Some Startling Figures Are Presented Showing the Money Involved

The Dollars and Cents Of Careful Barrel Handling

BY MATTHEW WILLIAM POTTS
Consulting Engineer, New York City

THERE is no doubt that the chemical and allied industries of this country are the greatest users of wooden barrels, and this includes what is known as tight and slack cooperage. I have been in plants where the plant managers and purchasing agents are not familiar with the meaning of the terms tight and slack cooperage, and yet they are using hundreds of barrels per day. This lack of knowledge goes right down through the organizations and is the cause of much abuse to the barrels, loss of materials through leakage, contamination of contents, etc., which amounts to thousands of dollars per year.

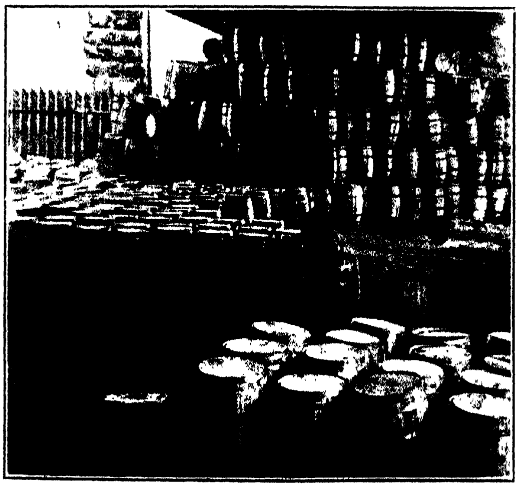

FIG. 1—EXAMPLE OF POOR EMPTY BARREL STORAGE

Recently a large chemical company contemplated the use of bilged steel barrels as shipping containers for its products. These barrels were to be billed to the customer with a refund, providing they were returned to the company.* This system is now in use by a number of large chemical industries, but it has nearly as many disadvantages as the old wooden barrels.

Upon investigation, the chemical company of which I speak found that most of its trouble was due to its own carelessness in the handling and storage of the wooden barrels, both before and after filling. After correcting a few of the most flagrant cases of barrel abuse it was found unnecessary to provide a returnable container system and in this way an investment of money amounting to over a hundred thousand dollars was saved.

In another plant it was found that by properly storing the wooden barrels, both before and after filling, a cheaper grade of barrel could be used. This change in grade made a saving of 45 cents per barrel. The company was using approximately 200 barrels per day, 300 days per year, so this small saving per barrel amounted to $27,000 per year in barrel costs alone. There were additional savings in labor costs for repairing and coopering, claims on carriers and delays to customers.

"BARRELS ARE NOT WELL MADE ANY MORE"

The common complaints against the wooden barrels of today are: the wood dries out, hoops fall off, heads break in, liquid contents leak out between the staves, at the bung and around the croze of the barrel. These complaints are summed up by plant managers and purchasing agents in the statement, "The barrels of today are not properly made."

Replacing heads, putting on new hoops, coopering and recoopering are expensive. Leakage of contents amounts to a loss of thousands of dollars every year to manufacturer and consumer alike, but why place all the blame against the barrel manufacturer? Experience proves that leaks are caused more frequently from abuse (many times unintentional) than from improper manufacture. Barrels are most frequently ruined at the users' plant while empty. Fig. 1 illustrates a very frequent example of barrel abuse.

In the first place the storage location is improper. It is under a viaduct where rain and snow can beat in from either side, and there is a continual circulation of air. Drip and drainage from the viaduct falls down on the heads of the barrels, causing them to swell. When the photograph was taken the sun was beating down on the barrels as shown to the left. They are

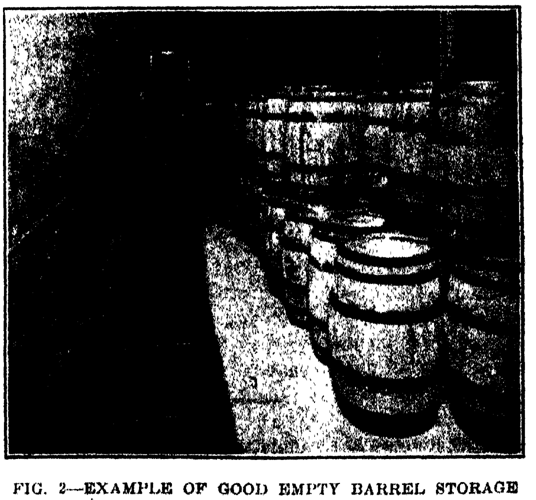

FIG. 2—EXAMPLE OF GOOD EMPTY BARREL STORAGE
Also shows barrels being handled by means of slat conveyors and gravity conveyors. (Courtesy Matthews Gravity Conveyor Co.)

FIG. 3—STEAMING THE BARRELS SO AS TO FORM THE BILGE
(Courtesy Cleveland Cooperage Co.)

practically unprotected and the alternating wetting and drying out of the wood has a disastrous effect. By looking closely, a number may be seen where the hoops have fallen off, one has only the two head hoops remaining. Considering that these barrels had been in storage only a week when the photograph was taken, they are in poor condition.

The Barrel Manufacturer Is Careful of Stock

To appreciate why a barrel should be protected it is helpful to give a little detail as to the method of manufacture. From the very start, great care is taken to remove just the right amount of moisture from the lumber. The rough staves are usually stored in the open for a year to season. Before they are ready to assemble into a barrel they are put into a hot room or dry kiln to evaporate the remaining moisture. To make the bilge, steaming is necessary, but this slight addition of moisture is later removed by firing. (See Figs. 3 and 4.)

This dryness of the barrel makes the staves and heads equivalent to blotting paper, with an affinity for moisture. This is the reason why the inside of the barrel is sized (or lined) if it is to be used as a container for liquids or pastes. If the absorption of moisture from the outside is not excessive, is constant and of an even temperature, the barrel will not be damaged. However, when moisture has been absorbed and subsequently evaporated, leaks will develop, because the swelling of the barrel has expanded the hoops and they do not return to their original diameter to hold the joints tight.

This is the reason it is necessary to store barrels in a proper location, under cover and in an even temperature. Extreme variations in temperature will open the joints. This trouble is experienced in March and April, when we have warm days and cold nights. This causes the staves and heads to expand during the high temperature in the day and there is no corresponding shrinkage of the hoops at night.

Fig. 2 illustrates a good empty storage and a good method of handling barrels. The features to note are the clean, dry, well-ventilated room where the barrels are kept, the even piles, the spacing so that the top ones are not resting on the heads of those beneath, but are resting on the chimbs with four points of contact and support. Also all hoops are tight and in proper place.

The handling of barrels is often considered of no importance because they are provided with a bilge which makes them easy to roll. This general practice or method is not recommended except where a track or runway is provided so that it is possible to get two points of contact near the quarter hoops. Fig. 2 shows an ideal way of handling barrels by means of an apron conveyor, or elevator, and gravity conveyors. Another means is by electric storage battery lift truck that transports the barrels from place to place and also elevates them for piling. The careless dropping of a barrel, if even for only 6 inches, is likely to break a stave, and to roll them on the bilge, allowing them to bump one another with force, has a tendency to spring the staves and produce leakers, especially if the barrels are packed with liquids or pastes.

Taking a little more care in barrel handling will be found a profitable investment. When unloading from trucks or automobiles the barrels should be lowered by means of skids. When being tiered they should be raised and lowered by means of portable elevators. When the barrels are to be transported for a long distance the track runway will be found very advantageous. This track or runway is simple in construction and consists of two strips of wood or small iron rails spaced approximately 18 in. apart. The writer has seen barrels filled with liquids rolled for a distance of a quarter of a mile and then turned at right angles to the first run

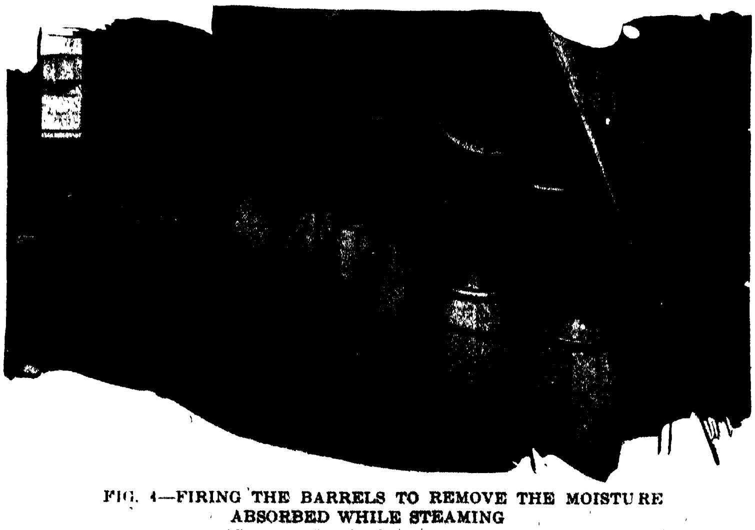

FIG. 4—FIRING THE BARRELS TO REMOVE THE MOISTURE ABSORBED WHILE STEAMING
(Courtesy Cleveland Cooperage Co.)

and rolled for an additional distance of over a thousand feet. In the entire length of this runway only two men were required to handle the barrels. One man was stationed at the right-angle turn and the other man patrolled the entire runway, so that when a congestion at any point made it necessary to stop the barrels he stopped them gently and did not permit them to bump together. In this way it was possible to load cars quickly and economically, as many as eight cars being loaded at a time.

The High Art of Coopering

Barrels are often ruined when they are being filled. They are almost always improperly coopered. These two points can be given very careful consideration. When barrels are to be filled with liquids, more care is required than if they are to be filled with a powdered or lump material. First the hoops should be driven tight. It is best to do this coopering by machinery as shown in Fig. 5, as barrel coopering is an art that few men understand and the machine coopering has been perfected to eliminate the human element. If, however, the number of barrels is small, hand coopering can be used and at all times the employing of an experienced cooper will be found economical, although it will be necessary to pay him more wages than an ordinary laborer.

For hand coopering and other purposes every barrel user should supply the cooper with the proper tools, which include a cooper's hammer, chimb maul and bung reamer. In addition, the cooper should have on hand at all times a supply of bungs, flag, pegs, extra heads and extra hoops. The hoops on a barrel should be tightened by light taps around the barrel and not by a hard blow at any one point. If the barrels are slippery, lump chalk should be used for better friction until hoops are in final position and fastened.

No matter what the product is, a barrel should never be completely filled. Ample room must be allowed for expansion. Some barrel users leave out a gallon in a 50-gal. barrel and smaller sizes proportionately. Others stop filling when the liquid is within 2 or 3 in. of the bung hole. Of course some liquids have a greater tendency to expand than others, which prevents giving a universal rule to follow, but care should be taken in this respect and the filler should adopt a safe, conservative policy covering this important point. Where barrels are filled by removing one head, as in the case of dry products, heavy pastes, etc., care must be exercised in replacing the head so that it fits square in the croze or groove. A leak in the croze (where head and staves come together) usually indicates a poor fit and can generally be stopped by hammering the outside of the barrel at that point until the head falls into place.

The final job of bunging up the barrel is often badly done. Putting in the bung is very simple, but it must be done right. First soak the bung in hot water so that it will expand quickly after it is driven in. Then insert it part way to make sure that it exactly fits the hole. If it is too tight, ream out the hole just a trifle with the proper tool. If it is too loose, wrap it with a piece of cloth, or preferably use a large bung. The final driving should not be done until the grain of the bung runs parallel with the grain of the stave (to avoid breakage), then hammer it "home" and turn the barrel to test for leakage. If it holds tight, seal the bung with a bung seal, or strap, and the job is properly done.

A number of chemicals are packed in the form of fine powder and it has been found that in order to save the leakage of content, no matter how well the barrel is made, it is necessary to remove one of the heads before filling and to insert a paraffine paper bag liner. The contents are then packed into this paper bag within the barrel, the top of the bag is drawn together and tied, the head replaced and the barrel is ready for painting and shipping. At this point there is overlooked an important help to the customer—namely, the marking of the head that has been removed so it will be possible for him to open the proper end of the barrel, so that when he has removed only a portion of its contents he can again tie the bag. This marking can easily be taken care of by having the cooper when he removes the head (before filling) nail a small embossed disk on the upper side. This disk can be about an inch in diameter and carry the words, "Open this end." Then when the head is replaced after the barrel has been filled there is no guessing as to which end to open.

After Filling and Before Shipping

Every barrel upon being filled, whether filled with liquids, lumps or powder, should have the hoops driven tight and nailed down with fasteners, or cleats, or dented into the wood with a sharp tool. This holds the hoops firmly in place against jolts and rough handling. Each hoop should have at least two nails or dents, one on each side of the barrel, and these should be placed only after the final driving of the hoops.

Painting of barrels is done for two reasons. First, to provide a protective coat for the wooden heads and staves, and second, to give a neat appearance to the package and to serve as an advertisement for the company whose products it contains. The painting and marking of barrels is according to the taste of each individual user. Some like blue barrels with white

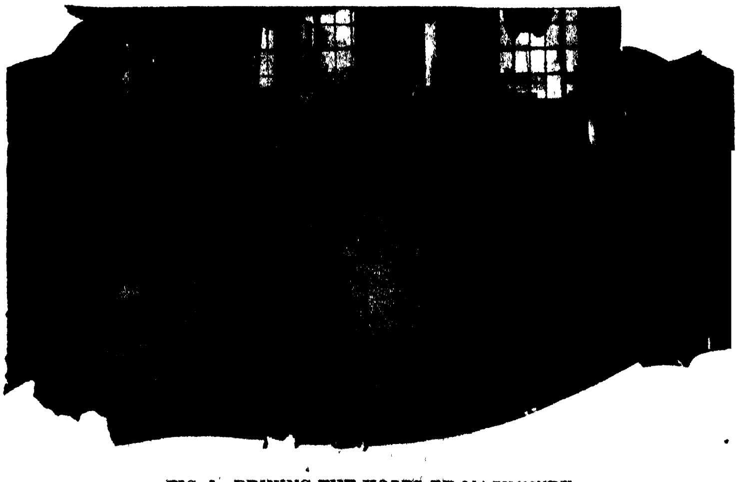

FIG. 5—DRIVING THE HOOPS BY MACHINERY
Note the number of grips on the hoops. This drives the hoops even and with just the right pressure.

heads, carrying a stenciled trade mark and the necessary shipping marks such as "Net, Tare and Gross" weights. Others like a red barrel with a white band around the center or bilge. The decorative effect is not so important as the proper time and method of painting. In a number of cases the barrels are painted before filling, but I believe the time to paint a barrel is just prior to shipment. The paint then acts as a protective coat, as it is fresh, and the slight addition of moisture swells the staves just enough to keep the hoops tight while in transit.

Machine Painting Often Economical

The method of painting depends upon the number being shipped per day. If this exceeds fifty, the use of machine equipment will be found economical. When the barrels are painted before filling, a revolving machine is the most advantageous, but when the barrels are filled and then painted, an air brush equipment with a revolving, lift turntable, will be found most satisfactory.

An investigation made by the writer gives the following comparison between the hand and machine methods of painting barrels as follows:

Data	Hand	Air Brush
Number of men on painting operation	2 or 3	1
Number of hours worked	9 to 12	9
Average man-hours per day	18	9
Wages per man hour	$0 45	$0 55
Average labor cost per day	$8 10	$4 95
Average number barrels possible to paint per day	175	175 plus
Cost for paint per month	$211	$110
Cost for brushes per month	18	0
Maintenance and operation per month	0	15
Depreciation per month using 15 per cent	0	$13 64
Total cost for 25 working days	$431 50	$262 39

Net savings due to air-brush methods $169 11 per month

Over and above the direct money savings is the speeding up of the work, a neater and cleaner painting space and general better working conditions.

The grade of paint to be used is also a matter of personal choice, but it must be remembered that your barrels in transit are a good source of advertisement and it is well to give them a good coat of paint and to use care in selecting distinctive colors. For ordinary commercial purposes, I would suggest either a paste, barrel paint, thinned with rosin oil or gloss oil, or a cheap dry earth paint mixed with rosin oil. The rosin oil can be purchased or can be made by pulverizing 3½ lb. "F" grade rosin and adding 1 gal. of naphtha. Apply heat, stirring until dissolved. This mixture should be kept in a covered receptable, as it evaporates quickly.

The common blue and white combination on staves and heads requires a paint mixture of 5 lb. dry paint with 1 gal. of rosin oil. If red or yellow is preferred, 3 lb. paint with 1 gal. of rosin oil. Raw naphtha should not be used for thinning, as it will make the surface dull or flat. When using the air-brush method of painting, the above specifications should be submitted to the manufacturer of the air-gun and should be approved by him before being used in the equipment.

The marking or tagging of barrels for identification is a problem on which many users have spent considerable time and money without obtaining satisfactory results. A covered envelope made of paper and tacked to the head or side of the barrel is generally used. These tear off in storage and in transit. If wetted, the writing blurs and the identification of the barrel is lost. The most satisfactory method of marking is to use an embossed metal tag. The barrel will then practically have to be destroyed before it will lose its marking.

Effect of Manganese on Steel

A method of preparing very pure iron has been developed at the Bureau of Standards and with this iron as a base various steels and other iron alloys have been made for the purpose of testing them without the complicating effect of impurities which are usually present in commercial iron and steel.

The use of manganese in steel as a strengthening agent in addition to the carbon is the chief subject of the investigation described in Scientific Paper 464 from the bureau, entitled "The Effect of Manganese on the Structure of Alloys in the Iron-Carbon System."

The use of higher percentages of manganese for producing high tensile properties in low- and medium-carbon steels has been recommended at times by various metallurgists, and to some extent such recommendations have been carried out in commercial practice. The results obtained in this investigation of the structural effects of manganese in steel strongly confirm such recommendations concerning this use of the element.

The general effect of manganese may be concisely described as a "restraining influence" so that the pearlite, even after annealing, exists in very fine-grained condition if considerable manganese is present. In this respect the steel resembles in structure and mechanical properties the condition which usually obtains in similar steels of low manganese content after rather rapid cooling—for example, air-cooling.

Manganese also appears to have a very noticeable effect upon the rate at which high-carbon steels, such as carbon tool steels and file steels, assume the granular or "spheroidized" state—a condition which for many purposes is very desirable. Manganese exerts its characteristic retarding influence upon this change.

Quarry Operators Should Apply Engineering Principles

"During recent years I have visited about 600 stone quarries," states Oliver Bowles, mineral technologist of the Bureau of Mines. "Many of these quarries are highly efficient operations, but on the other hand I find some processes in use that are as crude as those employed in Egypt when the pyramids were built. The employment of inefficient methods is due partly to lack of capital, partly to tradition or to the influence of methods used in surrounding operations, and partly to unusual quarry conditions, but one great outstanding lack is the failure to apply the principles of engineering to the problems encountered. Some problems may require the experience and knowledge of a trained engineer, and he should be called in consultation. In many instances, however, the operator is quite capable of solving his own problems by applying to them two important engineering principles. The first principle is the ability to see both sides of a question, to weigh the evidence impartially, and to dismiss from consideration any preconceived opinion as to the most desirable solution of the problem. The second important principle is the establisment of conclusions on a sound basis of fact. Thus the preparation of positive data is a necessary function of any investigator, and this can be done only by keeping exact records of tonnage and costs. Few economic problems can be solved without using figures, and no quarryman can hope to solve his problems without the aid of systematic records. Many processes now in use would be abandoned tomorrow if the operator had before him figures indicating their excessive cost."

Cost of Producing Natural-Gas Gasoline

The Scope of the Industry Is Briefly Outlined and Recovery Costs for Various Types of Plants Are Carefully Analyzed

BY E. G. SIEVERS
Washington, D. C.

FROM experimental production on a small and crude scale in 1900 to an output of 450,000,000 gal. in 1921 is the story, in brief, of the growth of the natural-gas gasoline industry in the United States. The first plant was constructed in Pennsylvania in 1904, but not until 1910 did the industry assume commercial importance. The production of natural-gas gasoline has made marked progress since 1915, due to the development at that time of the absorption process, which made it possible to remove the gasoline from dry gas and also to treat a much larger quantity of gas.

In 1911 the total output in the United States was 7,425,000 gal., but the annual production since then has increased rapidly. The output in 1921 was 596 per cent greater than that of 1911. Table I shows the production from 1916 to 1921 inclusive, and Table II shows the output in 1921 by states.

Gasoline is recovered from natural gas by two chief methods—namely, by compression and absorption. The compression method is applied to wet gas or that having a high gasoline content, whereas the absorption process is used for dry gas yielding less than 1 gal. of gasoline per thousand cubic feet of gas. Absorption plants are now largely replacing compression plants because the absorption product is more stable and demands a higher price. Present-day practice, however, has shown that the combination of compression and absorption plants is very successful, consequently many of the operators are combining these processes. About 75 per cent of the total annual output is produced at the compression plants.

One of the vital problems in the production of natural-gas gasoline is that of plant efficiency. Many plants are today operating under conditions not in conformity with good conservation practice. The producers, however, are mindful of this fact and are constantly working toward greater improvements. According to data compiled by the United States Geological Survey the yield of gasoline per thousand cubic feet of gas in 1921 was nearly 0.2 gal. greater than in 1920. In Table I it will be noted that there has been an annual increase in yield since 1916.

The economic importance of natural-gas gasoline is better appreciated when it is realized that it constitutes nearly one-tenth of all the gasoline produced annually in the United States. Natural-gas gasoline is highly volatile and therefore is blended with naphthas or refinery gasolines in preparation for the market. This is an economic factor in that the blending makes it possible to utilize large quantities of naphthas at the refineries otherwise having little commercial use. In view of the constantly increasing demand for motor fuels, the production of natural-gas gasoline must of necessity continue to be one of our essential industries.

Because of the rapid growth of the industry, due perhaps to the increasing demand for gasoline, not enough attention has been paid to the costs of construction and operation of plants. The greatest expansion of the industry came during the war when manufacturers were able to market their product at almost any price. Consequently there was little necessity for careful analyses of costs. The manufacturers were making good profits and, furthermore, were too busy solving mechanical problems to give more than cursory consideration to the matter of costs. The depression following the war demoralized prices, and made it difficult for the natural-gas gasoline manufacturer to locate a market. As a result there was greater scrutiny in business methods and costs, and at the present time every effort is being made to put the industry on a firm basis.

One of the first steps necessary was to combine

TABLE I NATURAL-GAS GASOLINE PRODUCED IN THE UNITED STATES, 1916-1921
(Data Compiled by the United States Geological Survey)

			Gasoline Produced			Gas Treated (Estimated)		
				Value				
Year	No. of Operators	No. of Plants	Gal	Total	Average (Cents)	M. Cu ft	Value*	Average Yield of Gasoline per M. Cu.ft. (Gal.)
1916	460	596	103,492,689	$14,331,148	13 8	208,705,023	$14,609,300	0.50
1917	750	886	217,884,104	40,188,956	18 4	429,287,797	34,343,000	0 51
1918	503	1,004	282,535,550	50,363,535	17 8	449,108,661	40,419,700	0 63
1919	611	1,191	351,535,026	64,196,763	18 3	480,403,963	41,314,700	0.73
1920	576	1,154	384,743,922	71,788,122	18 7	496,430,952	41,700,000	0 78
1921	458	1,056	449,934,402	61,815,258	13 7	479,618,194	41,500,000	0 94

* The value of the gas is based on sales to gasoline producers, not on sales for domestic and industrial purposes

TABLE II UNBLENDED NATURAL-GAS GASOLINE PRODUCED IN THE UNITED STATES IN 1920 AND 1921
(Data Compiled by the United States Geological Survey)

			Gasoline Produced			Gas Treated		Percentage of Total Production				
				Value				State		United States		
State 1921	No of Operators	No of Plants	Gal	Total	Average (Cents)	M. Cu.Ft.	Average Yield per M. (Gal)	Compression	Absorption	Compression	Absorption	Total
Oklahoma	123	280	185,340,742	$22,066,014	11.9	88,380,173	2.10	89	11	49.9	16.7	41.2
Texas	24	65	77,141,201	9,118,420	11.8	26,460,805	2.92	89	11	20.6	7.3	17.2
California	29	73	58,220,498	9,874,594	17.0	69,356,048	0.84	63	37	11.1	18 1	12.9
West Virginia	66	179	54,646,053	9,889,861	18.1	135,483,171	0.40	31	69	5.0	32.2	12.2
Pennsylvania	170	264	19,856,373	3,354,233	16 9	46,336,174	0.43	58	42	3.5	7.1	4.4
Louisiana	13	26	15,340,374	1,812,268	11.8	45,543,846	0.34	46	54	2.1	7.0	3.4
Wyoming	6	7	14,557,684	1,599,591	11 0	4,559,639	3.19	99	1	4.4	0.1	3.2
Ohio	27	48	9,099,897	1,546,551	17 0	35,888,504	0.25	18	82	0.5	6.3	2 0
Illinois	34	90	7,536,073	1,101,227	14 6	3,102,246	2.43	100	.	2.3	. . .	1.7
Kentucky	8	9	4,241,938	834,983	19.7	16,520,224	0.26	5	95	0.1	3.4	0.9
Kansas	9	11	3,587,329	565,408	15 8	7,784,339	0.46	42	58	0 4	1.8	0.8
New York	4	4	366,240	52,108	14.2	203,025	1 80	100	. . .	0 1	. . .	0.1
Total, 1921	458	1,056	449,934,402	61,815,258	13.7	479,618,194	0 94	73.9	26.1	100.0	100.0	100.0
Total, 1920	576	1,154	384,743,922	71,788,122	18.7	496,430,952	0.78	73.1	26 9	100.0	100.0	100.0

small unprofitable plants into fewer large plants. It is recognized that profits on plants producing less than 1,000 gal. of gasoline per day are very uncertain. The overhead expenses, the difficulties of marketing a comparatively small quantity of gasoline, and the fact that these small plants require as much attention as large plants have proved that even under favorable conditions they are not particularly profitable. This is especially true with plants which have been installed to handle a much larger volume of gas than is now available. There are today many plants heavily overequipped with machinery, making the maintenance and depreciation charges on such properties greatly out of proportion to the gasoline produced and the revenue derived.

This condition was largely brought about by overbuilding prior to and during the war. During this time a large number of plants with the intrinsic weakness of insufficient permanent supplies of gas were installed in various parts of the country. The gathering lines of these plants in many instances overlapped the lines of other gasoline plants, so that at present the plant capacity far exceeds the gas now available.

TABLE III COST OF CONSTRUCTING A COMPRESSION PLANT IN 1919-20

Compressors and engines	$33,000	Gathering lines	$50,000
Freight, hauling and setting compressors	10,000	Electrical equipment	1,000
Buildings	5,000	Switch and loading rack (and tankage at loading rack)	15,000
Condensors	5,000	12 mile pipe line to loading rack	40,000
Accumulator tanks	1,000	Water supply	5,000
Auxiliary engine, pumps, etc	3,000		
Storage tanks	25,000		
			$193,000

TABLE IV COST OF CONSTRUCTING AN ABSORPTION PLANT

Absorbers and accessories	$12,000	Railroad switch	$2,000
Pumps	2,000	Buildings	5,000
Compressor (direct connection)	4,000	Boilers	10,000
Still	1,400	Labor	20,000
Oil separator (on gas line)	500	Tools	3,000
Condensor boxes and coils	1,000	Electrical equipment	1,500
Storage tanks	10,000	Grading, draining, ditching	1,000
Loading rack	500	Main lines around plant	5,000
Oil coolers	3,500	Meters, thermostats, and laboratory equipment	500
Heat exchangers	4,500	Building materials	10,000
Site	500	Contingent	10,000
Water supply	3,000		
			$110,900

In the older fields where the gas supply has declined greatly, manufacturers have found that to dismantle many of these plants or to convert them into vacuum or booster stations does not involve a large expenditure. Natural-gas gasoline manufacturers interested in the consolidation of plants and the change of processes have carefully calculated the cost of diverting gas from small to large plants, and of changing the process from compression to absorption, and have found that in most cases it is more profitable to consolidate the plants and change to the absorption process.

The cost of constructing gasoline plants naturally fluctuates according to the cost of material, labor, transportation, etc. The location of the plant, the quality of the gas to be treated, and the capacity of the plant, are factors in determining the cost of installing the plant. If the location of the plant is a considerable distance from a railroad the cost will be appreciably higher. Table III shows the cost of constructing a compression plant in the Appalachian field in 1919 and 1920. This plant could be built at a very much lower cost today. Furthermore, it was built during a period of bad weather, when bad roads were a serious handicap. The plant treats 1,100,000 cu.ft. of natural gas a day and yields as much as 4,500 gal. of gasoline a day.

The cost of labor is included. The cost of operation, including overhead expense, sales, depreciation, interest, depletion and freight is in the neighborhood of 11 cents a gallon.

Production of a plant has little relation to the cost of construction. The cost of installing a plant producing 1 gal. of gasoline to 1,000 cu.ft. of gas would be very little less than for one having a higher production.

An absorption plant having a daily capacity of 20,000,000 cu.ft. of gas and producing about 4,000 gal. of gasoline at high pressure will cost approximately $110,900. This cost is analyzed in detail in Table IV.

It will be noted that this amounts to $27.50 per gal. capacity per day. An absorption plant with a capacity of 1,000 gal. per day would cost about $40,000, and one with a capacity of 10,000 gal. per day would cost from $450,000 to $500,000.

Pressure is an important item in connection with cost. An absorption plant producing 4,000 gal. of natural-gas gasoline per day at 10 lb. pressure would cost from $175,000 to $200,000.

An absorption plant using the charcoal method can be operated successfully regardless of pressure. Such a plant producing 4,000 gal. of gasoline a day would cost approximately $90,000.

The cost of operating an absorption plant having a capacity of 4,000 gal., and costing $110,000 to construct, is as follows:

Interest, 6 per cent	$6,600	Sales expense	5,000
Depreciation, 10 per cent	11,000	Insurance and taxes	3,000
Labor	13,000	Fuel, natural gas at 50 cents per M cu ft	20,000
Repairs and supplies	10,000		
Tank-car rental	7,000		
Administrative expenses	14,000		
			$89,600

This is equal to about 6¼ cents a gallon and may be considered a minimum for operating absorption plants in the Eastern fields.

Welding Pressure Vessels

One of the many difficult problems concerning the boiler code committee of the American Society of Mechanical Engineers in its effort to draw up satisfactory codes governing the construction of unfired pressure vessels was that of welding. Rules applicable to riveted constructions do not always apply to fabrication by welding.

The problem is seriously complicated because of the meagerness of scientific data upon which to base proper requirements for safety without placing unjust restrictions on the use of welding. Wide differences of opinion prevailed not only among the members of the committee, the insurance companies and inspectors, but also in the industry itself.

A hydrostatic and hammer test was finally proposed for determining whether a vessel was safe for the purpose designed. Eight manufacturers placed at the disposal of the committee about forty tanks and enough funds. These tanks have been tested to destruction by the U. S. Bureau of Standards. The shells of most of the tanks were 6 ft. long and 2 ft. in diameter, and made of ⅜-in. mild steel plate. Both electric and oxy-acetylene welding were used. The hydrostatic and hammer test developed that the welded pressure vessel, according to the regular formula for working pressure, has a factor of safety of about 6.

Our Broadening Knowledge of Lubrication

The Recent Chemical and Physical Researches That Have Given Us a Better Insight Into the Composition and Properties of Mineral Lubrication Oils Are Reviewed and the Main Paths for Future Study Are Indicated*

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DURING the last few years rapidly increasing attention has been directed by chemists and physicists to the study of lubricating oils. The former have attempted to obtain some knowledge of the various types of hydrocarbons in the oil and their physical and chemical characteristics; the latter have endeavored to elucidate the why and wherefore of lubrication and the most recent researches have tended to develop along the line of contact of the two sections of the investigation.

CHEMICAL COMPOSITION

The chief points so far elucidated regarding the chemistry of mineral lubricating oils are[1]:

(1) It appears beyond doubt that the high-boiling fractions of petroleum, irrespective of their place of origin, are complex mixtures containing but a small percentage of paraffine hydrocarbons of the formula C_nH_{2n+2}, and consisting chiefly of compounds whose formulas range from C_nH_{2n} to C_nH_{2n-8}. A few of these compounds have been isolated by Mabery, by repeated fractional distillation of crude American oils, even from a crude so pronouncedly paraffinoid in nature as Pennsylvania oil.

(2) In no case has the chemical constitution of a component of a lubricating oil been established, but the chemical behavior of these oils indicates that among the components are unsaturated hydrocarbons (possibly open-chain but more probably naphthenic and polynuclear, or perhaps of both types), saturated hydrocarbons (naphthenic and probably to some extent polynuclear, but not to any appreciable extent paraffinoid), and aromatic hydrocarbons (to an unknown and probably a limited extent), together with small amounts of sulphur- and oxygen-containing compounds, the latter of which can be isolated and are probably the principal cause of gumming.

(3) "Unsaturated" compounds constitute between 20 per cent and 40 per cent of most lubricating oils, and are in part removed from the oil by agitation with concentrated sulphuric acid.

CHARACTER OF "UNSATURATED" COMPOUNDS

Brooks and Humphrey have shown that the higher simple olefines are polymerized by concentrated sulphuric acid yielding a colorless condensation product which is insoluble in the acid but soluble in hydrocarbons. Small amounts of carbinols, and acid and neutral sulphates are also produced. It follows, therefore, that the olefine contents of a hydrocarbon mixture cannot be determined volumetrically by extraction with sulphuric acid.

When lubricating oils are shaken with concentrated sulphuric acid, a heavy tarry mass separates which soon becomes solid. It seems doubtful, therefore, if lubricating oils contain more than a small percentage of true olefine hydrocarbons. This conclusion is strengthened by the fact that, so far as our experience goes, attempts to hydrogenate such oils by the Sabatier method have uniformly failed. It would therefore appear that the nature of the unsaturated bodies in lubricating oil is at present an unsolved problem.

A partial separation of these unsaturated hydrocarbons from the saturated ones which does not involve their destruction can be achieved by employing their superior solubility in liquid sulphur dioxide. Thus a lubricating oil with an iodine value of 46 on extraction with liquid sulphur dioxide gave a residue with iodine value 33 and an extract with iodine value 73.

A similar effect can be achieved by filtration through fullers earth, a material which adsorbs unsaturated compounds to a greater degree than saturated compounds. Neither method is sufficiently discriminating to be of use in effecting even an approximate separation of the two types.

The curious iodine value results given by lubricating oils seem to indicate that the unsaturated compounds attacked by sulphuric acid and by formaldehyde do not react readily or normally with iodine.

The reaction of mineral oils toward iodine differs profoundly from that of fatty oils. Experience in the determination of iodine values by means of Wijs' reagent has indicated that by varying the time and proportion of iodine chloride a given mineral lubricating oil may yield widely varying values. For example, a California mineral oil gave a value of 20 in 2 hours, 40 in 4 hours, 60 in 64 hours and 80 in 266 hours, whereas rape oil reached a steady value in 3 minutes. Again, the iodine value of rape oil was found to be practically independent of the amount of Wijs' solution used (provided a fair excess was employed), but with the mineral lubricating oil an increase in the proportion of reagent to oil invariably augments the iodine value.

The interpretation of these results is difficult when coupled with the reluctance exhibited to hydrogenation; unsaturated glycerides of comparable molecular weight behaved quite normally in both respects.

The facts again seem to lead one to the conclusion that the "unsaturated" hydrocarbons in mineral oil consist to a small degree only of true olefines. The sluggish reactivity of the greater part may be due to the somewhat slow and difficult rupture of closed ring systems, which can be brought about by the drastic action of sulphuric acid and Wijs' reagent respectively, whereas the milder action of hydrogen and nickel fails to operate.

NAPHTHENIC, AROMATIC AND RESINOUS COMPOUNDS

(4) Analysis indicates that the residual saturated compounds after treatment with concentrated sulphuric acid are principally naphthenic, and most probably polynuclear in structure, since they contain less hydro-

*A paper presented before the Petroleum Division of the American Chemical Society at Pittsburgh, Sept. 7, 1922.

[1]The present authors have on various occasions (*J. Inst. Pet. Tech.*, 1918, vol. 4, p. 191; British Association, Cardiff, 1920; *J. Inst. Pet. Tech.*, 1921, vol. 7, p. 417; British Association Colloid Committee, Third Annual Report, 1921) discussed the chemical composition of mineral lubricants.

gen than is demanded by the simple naphthenic formula, C_nH_{2n}.

(5) The presence of aromatic hydrocarbons is possible, but has not been definitely proved. By nitration, nitro-derivatives are obtainable; the reduction products from these will, however, not yield azo-dyes, so the nitro-compounds may not be aromatic in type.

(6) Resinous components have been shown by Holde to be present to the extent of a few tenths of a per cent, and to be capable of separation from the hydrocarbons by treatment with alcohol and ether. They are solid, oxygen-containing, lac-like bodies, and are probably an important cause of "gumming," since they would tend to accumulate as the hydrocarbons in the oil evaporated. Moreover, the hydrocarbons thus purified showed no tendency to gum on prolonged exposure to heat and air. Holde's statement would appear to go too far. The removal of these bodies reduced the gumming tendency. Removal of unsaturated hydrocarbons still further reduces it, but even the saturated hydrocarbons oxidize appreciably on exposure to air and heat.

Viscosity and Chemical Character

The actual influence on the viscosity of the oil of the differences in chemical nature of the different components has been stated by several workers, the statements being in some cases contradictory. Mabery and Mathews have published figures which indicate conclusively that an increase in viscosity occurs concurrently with a decrease in the hydrogen content, paraffines being comparatively very mobile and inefficient in lubricating powers, while hydrocarbons of the formula C_nH_{2n-4} are said to be as viscous and as efficient as sperm oil.

It is a well known fact that paraffines are comparatively poor lubricants, while oils such as medicinal paraffine and vaseline, which have been submitted to vigorous refining by acid or filtration generally with the object of decolorizing, are inferior in viscosity and in lubricating efficiency to those which still contain a certain proportion of unsaturated hydrocarbons. The oil refiner should therefore carefully regulate the treatment given so as to remove as far as possible the oxygenated compounds and the more highly reactive of the unsaturated hydrocarbons, which are chiefly responsible for gumming and carbonization, while destroying only a minimum of those more stable unsaturated hydrocarbons the presence of which in the oil is an asset.

Krämer and Spilker have synthesized condensation products from methylated benzenes and alkyl alcohol, which possess extremely high viscosity, and are in fact synthetic lubricating oils. For example, with mesitylene as a starting-out material, they have made:

$$(CH_3)_3C_6H_2-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\underset{|}{\overset{|}{C}}}}-C_6H_2(CH_3)_3 \text{ or } C_{21}H_{28}\text{; i.e., } C_nH_{2n-14}$$

This compound has a specific viscosity of over 700. They consider that such bodies are the true "viscosity carriers" in lubricating oil and that the high viscosity is due to the accumulation of methyl groups.

R. H. Brownlee has recently shown that a hydrocarbon oil of high flash point and viscosity and very low cold test, suitable for lubrication, is obtained by the polymerization of light unsaturated hydrocarbons by agitating them with a catalyst preferably at 200 to 400 deg. F. As catalysts anhydrous aluminum chloride, or a halide or reagents which produce a halide in the nascent state, are used. The oil, after treatment, is washed and distilled with steam. The distillates include products having the flash points of naphtha and kerosene, and a variety of lubricating oil fractions.

(8) The influence of physical conditions on the viscosity of lubricating oils, especially as regards preliminary heat-treatment, was pointed out long ago by Bender, while the recognition of colloidal components in machine oil by Schneider and Just brought lubricating oils into line with other colloids as regards the well-known manifestation of temperature-viscosity hysteresis. Heavy mineral oils must undoubtedly be iso-colloids—i.e., polyphase systems in which the dispersed component is of the same chemical nature as the dispersion medium. Just as water must be regarded as a system in which molecules such as $(H_2O)_n$ coexist with simple H_2O molecules, so in a lubricating oil the disperse phase is a molecular aggregate suspended in a dispersion medium of simpler and similar structure.

The Property of "Oiliness"

(9) The vital importance of maintaining the film of lubricant between shaft and bearing necessitates that mysterious property known as "body." Perhaps no property has been discussed so assiduously among lubrication experts as this. Archbutt and Deeley refer to this as "oiliness" and indorse the opinion of Wilson that, in reality, oiliness or body is a function both of viscosity and of capillarity. Unfortunately there is little experimental record on the surface tension of mineral oils, but there is a very close relationship between the two properties to which reference has been made. Both are conditioned by the play of intermolecular forces, and both are intimately affected by association and unsaturation.

It is not improbable that some connection exists between body and molecular weight. When it is realized that the triglycerylester of ricinoleic acid, which is present in castor oil, has a molecular weight of 932, whereas that of Russian engine oil is 426, it is reasonable to expect a much higher value for the molecular volume in the fatty oil. This enhanced value shows itself not only in high viscosity but also in "oiliness."

Granted that lubricating oils are iso-colloids, it is possible that this mysterious oiliness or body may be dependent on the degree of dispersion exhibited by the particular oil.

In recent years the property of "oiliness" has become associated with the presence of unsaturated compounds which constitute 20 to 40 per cent of most lubricating oils.

W. B. Hardy concludes that lubrication depends wholly on the chemical constitution of a fluid; the fact that the true lubricant is able to render slipping easy when a film of only about one molecule deep is present on the solid faces suggests that the true lubricant is always a fluid which is adsorbed on the solid face, such adsorption being dependent on the attractive forces associated with unsaturated compounds. It follows that lubrication is merely a special problem of colloid physics. A surface saturated with a film of condensed matter (ordinary glass, for example, possesses a film of grease on the surface with a depth of $1\mu\mu$) differs from one with a cleaned or raw surface. The surface of water after scraping has a higher surface tension and is highly adsorptive. Vigorous rubbing of a glass surface under water with the finger tips until a clinging feel is produced yields a fresh surface which possesses peculiar

properties such as "seizing" when in contact with a similar fresh surface.

Deeley has measured static co-efficients of various oils between metals. When no lubricant is used the static co-efficient increases as the surfaces continue to rub against each other. Such clean surfaces are very sensitive to contamination influences—e.g., moisture. It is interesting to note that the oils which have the smallest coefficient of friction are those which have proved the best lubricants in practice. It would appear that the unsaturated molecules of the lubricant enter into a firm physicochemical union with the metallic surfaces, forming a friction surface which is a compound of oil and metal. This surface would also appear to be of more than molecular thickness. Thin films of this kind cannot be removed by merely wiping, but must be ground off under water, or a thin layer of metal must be cut off.

Fatty Acid Blending

H. M. Wells and J. E. Southcombe consider that the superiority of a blended or compounded oil is due to the presence of a small amount of free fatty acid, either pre-existing in the added saponifiable oil or formed therefrom by hydrolysis. They therefore propose to prepare lubricating oils by adding to mineral oils such a quantity as 1 to 2 per cent of free fatty acid. Acids of low molecular weight such as butyric and cinnamic acids results in the formation of a non-emulsifiable oil, while the acids of high molecular weight like those obtained from whale oil, wool grease, etc., form emulsifiable oils suitable for marine lubrication.

During the past year these workers have continued the development of their views on the influence of small amounts of fatty acids when dissolved in mineral oils. They emphasize the distinction between the lubrication of fast running shafts with a large excess of oil, where the frictional values are a function primarily of the oil viscosity, and that of slow speed machinery with high bearing pressure, where viscosity measurements no longer assist in the choice of the lubricant. They have found that the interfacial tension against water of vegetable and animal oils was very much lower than that of a mineral oil, and this lowering was due to the slight content of free fatty acid in the fatty oils; by removing the free fatty acids from the saponifiable oils the tension rises, and by adding free fatty acids to the mineral oil the tension can be lowered. It follows that if a substance be added to an oil which brings about a lowering of interfacial tension, such addition will act favorably as far as lubrication is concerned by preventing a rupture of the liquid film and consequent direct contact between the metals.

In point of fact, Archbutt concludes from experiments which he has recently communicated to the Physical Society that the addition of 1 per cent of free fatty acids to a mineral oil lowers the frictional coefficient to the same extent as does 60 per cent of pure rape oil, and thus lends support to the contention that it is not the glyceride, but the free fatty acid in a compounded oil which improves its lubricating value. The theory that the action of the fatty acid is due to the fact that the interfacial tension between oil and water and between oil and mercury is greatly lowered by the addition of fatty acid to a mineral oil has met with criticism, and it has been pointed out that, although neutral rape oil added to mineral oil greatly reduced the friction coefficient, the interfacial tension between neutral rape oil and water was nearly as high as that between mineral oil and water. In the lubrication of a shaft or journal running at a fairly high speed and under moderate pressure, the bearing is separated from the journal by a film of oil, and the friction is solely due to the viscosity of the lubricant. That property of a lubricant which is not viscosity and is termed "oiliness" becomes important only when the conditions are such that solid or "contact" friction occurs, and all recent work points to the fact that it is the chemically reactive unsaturated constituents of lubricants which promote "oiliness" and that they do so by entering into physicochemical union with the solid faces lubricated, forming new composite surfaces with lower surface energy and opposing less resistance to shear than the unlubricated surfaces. The greater activity of free fatty acids is quite in accordance with this theory.

Our Knowledge of Vegetable and Animal Oils

(10) It will be manifest from the foregoing brief summary of our present knowledge on this subject that a very wide and extremely important and absorbing field of research is open not only with reference to mineral oils but including also the vegetable and animal lubricating oils and perhaps synthetic compounds of know composition and ascertainable lubricating efficiency.

The number of lubricating oils derived from vegetable and animal sources is limited, and the chemical constitution of these oils, with some exceptions, is fairly well known. They are composed of the esters of trivalent and monovalent alcohol radicles, containing saturated and unsaturated fatty acids. The particular esters contained in the different oils and fats have to a large extent been identified, and their quantitative proportions can in some cases be stated approximately. Further research is most needed in the case of the sperm oils, the particular alcohols and acids of which are still quite unknown. Castor oil also needs further investigation. The number of different esters in each vegetable and animal oil is comparatively small. The oil or fat yielded by each kind of seed or animal tissue is sufficiently uniform in composition for its lubricating value to be known from past experience. The knowledge that we lack in the case of these oils is the relative lubricating values of the individual esters composing them, and as all the natural oils are mixtures, it is desirable that the pure esters should be prepared and their lubricating properties determined.

With mineral lubricating oils the circumstances are entirely different. The number of these oils is very large, and our knowledge of their composition very incomplete. We know that they consist in the main of hydrocarbons of different series, some saturated and others unsaturated. We know broadly, but very incompletely, the principal series of hydrocarbons existing in the lubricating oils that are manufactured from the crude petroleum obtained from the different oil fields, but we have no knowledge of the quantitative composition of these oils nor of the chemical constitution of any of the particular hydrocarbons composing any particular oil. We are also possessed of very little information as to the relative lubricating values of the different series of hydrocarbons. If the number of mineral lubricating oils were as limited as that of the vegetable and animal oils, if they were definite products like the oils naturally occurring in vegetable and animal tissues, it would not be a difficult matter to learn by experience the lubricating values of the different oils, and a knowledge of their

constitution would then be of secondary importance to the user of lubricants. But the variety of mineral lubricating oils is so great and their composition so variable and so dependent upon the process of manufacture that it is a matter of the utmost importance for us to be able to analyze these oils. For this purpose it is desirable to determine the nature and relative proportions of their constituents, and also to separate the main constituents from each other and determine their relative values as lubricants.

A Suggested Research Program

The main lines on which research is needed may be summarized as follows:

(1) To isolate and determine the nature of the hydrocarbons in mineral lubricating oils which especially promote the properties of viscosity and "oiliness."

(2) To determine the classes of hydrocarbons desirable in lubricants required to work under high pressures and high temperatures, particularly as regards their relative stability under the conditions obtaining in internal combustion engines, steam engines and air compressors.

(3) To study the causes and means of preventing the formation of carbonaceous deposits from lubricating oils under the conditions named in (2), with special reference to the nature of the hydrocarbon and non-hydrocarbon constituents of such oils.

(4) To study the causes of emulsification in circulating oiling and in splash systems, with special reference to (a) the influence of the oxy- and thio-compounds in mineral oils, and (b) the characteristics of oils with non-emulsifying properties.

(5) To study the causes and conditions of oxidation of hydrocarbons at elevated temperatures.

(6) To determine the direction in which the processes of manufacture can be modified so as to lead to the production of lubricating oils of improved types.

(7) To discover new methods of analysis that will enable the chemist when examining a lubricating oil in the laboratory, besides determining its viscosity, specific gravity, flashpoint, etc., to determine the constituents of the oil and with the help of the knowledge gained under (1) to (5) to measure its ability to reduce friction and to meet the conditions of speed, load, temperature and atmosphere in which it is required to work. Much of this information can be ascertained today only by the costly method of trial.

(8) To elaborate further methods of producing lubricants synthetically in order to meet special requirements. Dicresyl-carbonate, for example, has been used as a lubricant. Reduced naphthenes, glycerides of naphthenic acids and cinnamenes have been prepared and shown to have lubricating value. It might be found possible to produce lubricants whose rate of change of viscosity is less and whose freezing point is lower than is the case with existing lubricants.

(9) To prepare in a pure state the esters met with in animal and vegetable lubricating oils and determine their relative lubricating values.

(10) To investigate the claim that the free fatty acids present in commercial fixed oils are the active constituents which enable these oils to improve the lubricating value of mineral oils, and to investigate further whether the addition of such acids to mineral oils may have any deleterious effect.

(11) To investigate the colloidal nature of lubricating oils and its bearing upon lubricating problems.

(12) To study the effect of ultra-violet light, sunlight and ozone upon lubricating oils.

(13) To investigate the phenomena of dissimilar surfaces (oil and metal) in contact, especially in relation to the property of "oiliness."

Testing Oiliness by Friction-Testing Machines

By Winslow H. Herschel
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Viscosity is the only property of a lubricant which lends itself readily to mathematical treatment and which is usually taken into consideration in investigations of the laws of fluid friction. Oiliness is a more elusive property, which has been defined as the property which causes a difference in friction when two lubricating oils of the same viscosity at the temperature of the oil film are used under identical conditions.[1]

Oiliness has little or no effect under conditions of complete film lubrication, but a change of bearing metal will produce a marked change in friction and of carrying power under conditions of speed and pressure when a change from one lubricant to another of the same viscosity will produce no effect. High pressures, wide clearance, low speeds or low viscosity have a tendency to produce a condition of incomplete film lubrication in which differences in the lubricant in regard to oiliness may be detected. It is generally recognized that fatty oils are superior to mineral oils in regard to oiliness, and hence fatty or compounded oils are in general use on gearing and for cutting oils.

There is coming to be a fair agreement that oiliness is due to some form of interaction between the lubricant and the bearing metal, although different investigators may speak of it as adhesion, adsorption or interfacial tension. There is therefore nothing illogical in the view of Von Dallwitz-Wegner[2] that oiliness is a joint property of liquid and metal, although varying only with the one if the other remains constant. In this paper it will be considered that the bearing metals are constant and that oiliness is a property of the lubricant.

Methods of Measuring Oiliness

Considerable work has been done in England in measuring oiliness by the use of special apparatus such as the Lanchester oil gear-testing machine[3], the Deeley oil friction-testing machine[4], and the interfacial tension apparatus of Donnan[5]. This last-named apparatus is open to the objection of making it necessary to assume that the relative interfacial tension between the lubricants and some liquid is the same as the relative tension between the lubricants and the bearing metal.

Bingham[6] suggests eleven different methods of measuring oiliness, the two most immediately available being the use of a lubricant as a cutting oil and the determination of the coefficient of friction of rest by the inclined plane. Wilson and Barnard[7] had the greatest success with the inclined plane and the Deeley friction machine, and also developed two new lines of investigation.

It was found that the flow through metal capillaries, under a constant head, decreased with time, this de-

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[1]Winslow H. Herschel, J. Soc. Automotive Eng., vol. 10, pp. 31, 369 (1922).

[2]R. v. Dallwitz-Wegner, Zeit. für techn. Physik, vol. 2, p. 160 (1921) and vol. 3, p. 21 (1922).

[3]Report of Lubricants and Lubrication Inquiry Committee, pp 50-79, 110-112; London, 1920.

[4]R. M. Deeley, Proc., Physical Soc. London, vol. 32, part 2, p. 1S (1920); Report of Lubricants and Lubrication Inquiry Com., p. 101.

[5]F. G. Donnan, J. Soc. Chem. Ind., vol. 39, p. 51T (1920).

[6]E. C. Bingham, Bu. Standards Technologic Paper 204, pp. 39, 49 (1922), and Fluidity and Plasticity, p. 271 (1922).

[7]R. E. Wilson and D. P. Barnard, 4th, J. Ind. Eng. Chem., vol. 14, p. 683 (1922).

crease being the more rapid for oils of good oiliness. Similar observations were made by Fulweiler and Jordon[8] with glass capillaries, in investigating sources of error in viscosimetry, but they found that with some oils the flow increased with time. If it should be confirmed that the rapidity of clogging of metal capillaries is a measure of oiliness, this method is very promising as a routine test, because it could be readily standardized and does not necessitate laborious polishing and repolishing of metallic surfaces.

Wilson and Barnard give as a tentative conclusion that in tests with friction-testing machines the location of the point of minimum friction, or critical point, is "lowered by the oiliness of the lubricant." Any conclusion must necessarily be based upon the very meager data available. The literature is full of reports of inconclusive tests on friction machines, where unsuspected variations of roughness and of clearance between rubbing surfaces, as well as uncertainty in regard to the viscosity of the oil film, cause discordant results. It is believed that the following method of reporting tests is of general application and will make results of tests much more intelligible. The method has been used at the Bureau of Standards in an investigation of the possibility of measuring oiliness with an oil friction-testing machine, and it is hoped to report the results of this work in a subsequent paper.

Method of Reporting Results

It is now generally recognized that a journal is eccentric in its bearings, the eccentricity diminishing as the speed is increased. It is also known that the friction varies with the clearance and with the eccentricity, and according to Sommerfeld[9] eccentricity is a function of $\frac{\mu n d^2}{p \Delta^2}$, that is a function of viscosity, speed and ratio of diameter to clearance, divided by the pressure. Hersey[10], who considered all possible factors which might influence the friction, comes to a similar conclusion provided the supply of lubricant is adequate so that friction is independent of the rate of feed and the bearing is free from cavitation or end effects. Replacing Δ, the film thickness of a concentric journal, by 2Δ, the difference in diameter of bearing and journal, the term $\frac{\mu n}{p}\left(\frac{d}{2\Delta}\right)^2$ may be called Sommerfeld's criterion and will be represented by S.

Considering the factors of Sommerfeld's criterion separately, μ is the viscosity, preferably taken in poises, the c.g.s. unit of viscosity, since data on viscosity are usually given in this unit or in times of flow from which values in poises may be determined by suitable equations or diagrams.[11]

Wilson and Barnard[11] plot the coefficient of friction against zN/p, where "z is in centipoises relative to water at 68 deg. F., where it has a viscosity of 1 centipoise = 0.01 poise." As I have taken μ in poises, $z = 100\ \mu$. The viscosity of lubricating oils is high enough so that the poise is at least as convenient as the centipoise, and there is some objection to introducing the idea of relative viscosity since this is so often confused with relative times of flow.

With μ in poises, S will be dimensionless if the pressure, p, is expressed in dynes per square centimeter (1 lb. per sq.in. = 69,000 dynes per sq.cm.), the speed, n, is expressed in revolutions per second, and d and Δ are taken in any convenient unit.

For a given bearing of constant smoothness, the friction is a function of the viscosity if the pressure, speed and clearance are constant. If the viscosity and speed are both variable, the friction will be a function of $\mu\, n$ as plotted by Biel.[12] If μ, n and p are all variables (and they are seldom absolutely constant in actual tests) and the clearance is constant, friction will be a function of $\frac{\mu n}{p}$ as shown by Hersey.[13] It seem preferable, however, to introduce the term $\left(\frac{d}{2\Delta}\right)^2$ and plot the coefficient of friction against S in order to emphasize the effect of the clearance upon the friction, and to prevent a heedless and unwarranted assumption that the clearance was constant when it was not.

According to Sommerfeld the lowest coefficient of friction, or value of f at the transition point, will be

$$f = \frac{2}{3}\sqrt{2}\left(\frac{2\Delta}{d}\right) \tag{1}$$

This will occur when Sommerfeld's criterion has a constant value of

$$S = \frac{\mu n}{p}\left(\frac{d}{2\Delta}\right)^2 = \frac{5}{24\pi^2} = 0.0211 \tag{2}$$

Hersey gives friction curves for ideal bearings, obtained by a graphical method, taking $\frac{2\Delta}{d}$ as 0.001, 0.002, 0.004 and 0.010, for which the values of f at the transition point are 0.00094, 0.00188, 0.00377 and 0.00943 respectively, and agree with equation (1). His values of $\frac{\mu n}{p}$ vary as to the square of the clearance, according to equation (2).

Wilson and Barnard concluded that the value of $\frac{\mu n}{p}$ at the point of minimum friction varied with the oiliness. If this can be confirmed, or preferably if it can be shown that the value of S at the point of minimum friction varies with the oiliness, journal friction machines might be used under certain conditions to measure oiliness.

In the great majority of recorded tests the clearance is unknown. Even in the few cases where the clearance was measured when the bearing was new, it is possible that the clearance changed by wear before the tests were completed. It is none the less desirable, on this account, to introduce the term $\left(\frac{d}{2\Delta}\right)^2$ as a reminder that any interpretation of the results of tests rests upon an assumption in regard to the clearance. When the clearance is unknown, it is convenient to assume that $\frac{2\Delta}{d}$ has the not unusual value of 0.001. Of course the true value should be used whenever known.

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[8] W. H. Fulweiler and C. W. Jordan, *J. Ind. Eng. Chem.*, vol. 14, p. 728 (1922).

[9] A. Sommerfeld, *Zeit. für Math. und Physik*, vol. 50, p. 97, equation 46 (1904).

[10] M. D. Hersey, *Trans.* A.S.M.E., vol. 37, p. 182, equation 24 (1915).

[11] H. G. Nevitt, *Chem. & Met.*, vol. 22, p. 1171 (1920); N. MacCoull, "Lubrication," p. 5 (May, 1921); Winslow H. Herschel, *J. Soc. Automotive Eng.*, vol. 10, p. 87 (1922); R. E. Wilson and D. P. Barnard, 4th, *J. Soc. Automotive Eng.*, vol. 11, p. 49 (1922).

[12] C. Biel, *Zeit. d. v. d. Ingr.*, vol. 64, p. 449 (1920).

[13] *Loc. cit.*, Fig. 8.

A Study of Bearing Metals*

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It is well established that bearing metals must be composed of an intimate mixture of soft and hard crystals, using the term hard to express the capacity for resisting cutting or abrasion. It is now being appreciated more and more that, for the most satisfactory bearing service, the physical properties of the journal bear some relation to the bearing metal, as for best service requirements the bearing and journal must polish each other. Therefore the hardest crystal in the bearing metal must bear some relation to the hardest crystal in the journal. The relative hardness of these individual crystals has not been studied heretofore, and it is with this object in view that the development of the herein described instrument was carried out and study begun.

THE first significant fact observed in the study of bearing metals is that not a single pure homogeneous metal has given satisfactory service; all bearing metals are alloys made up of two or more phases—that is, they consist of hard and relatively soft microscopic particles intimately mixed. The function of the hard particles, or *bearing crystals*, is to support the load and resist the wear when actual metallic contact exists between the bearing surfaces. The functions of the softer particles are to allow the harder particles to adjust themselves to the surface requirements of the journal and to wear down slightly below the surface of the harder, forming slight depressions on the apparently smooth wearing surface of the bearing, in which some of the lubricant is held when the bearing surfaces are brought into contact with each other. It is this characteristic of certain alloys to form these slight depressions, and thus provide the means for retaining a lubricant, that characterizes them as true bearing metals; in fact, a bearing metal has been defined as "an alloy that is capable of retaining a lubricant upon a bearing surface."[1] The extent to which the lubricant can be so held determines the most valuable characteristic of an alloy as a bearing metal.

An alloy that, perhaps, most characteristically represents a bearing metal is the composition of copper and tin that contains sufficient tin to produce the tin-copper eutectoid, or delta crystal. The depressions worn upon the surfaces of the softer crystals of the teeth of a motor-truck worm wheel, made of an 11 per cent tin bronze, in many cases were from 5 to 6 microns in depth; all other conditions remaining constant, this depth of wear increases with an increase of working pressure. This copper-tin bronze contains intercrystalline shrinkage cavities, which also tend to retain the lubricant, and the relatively low fusing temperature of the delta crystal permits the same, under severe treatment, to fuse upon the bearing surface, while it is being "run in." It is the dissimilarity of the component crystals, both in physical properties and in chemical composition, that makes bronze a bearing metal, and it is the similarity in physical properties and chemical composition of the component crystal that makes brass unsuited for this purpose.

Metals, as cast in the foundry for bearing purposes, are not in a state of equilibrium; they, therefore, must be studied in the condition in which they exist under service conditions. In fact, the value of controlling the chill effect on alloys, thereby rendering them especially serviceable for bearing purposes, is being appreciated more and more. In the copper-tin bronzes, where the delta crystal is desired, the chilling must be done with care; excessive chilling reduces the amount of this eutectoid formed, while cooling too slowly produces an undesirable coarse structure. Some other alloys cannot be chilled too suddenly, especially those in which it is important to reduce the grain size to a minimum. A bearing surface of bronze cast on a carbon chill, having grains of microscopic size, showed that, because the grains presented different angles of orientation, they wore at different rates, producing slight unevenness on the bearing surfaces, for which reason the grains, in a limited manner, caused a functioning of this bronze as a bearing metal.

So far all efforts to make accelerated wearing tests on bearing metals have failed because these tests are not made under service conditions, while tests made under service conditions are so prolonged that they lose their value. In almost all laboratory tests the softer, or more readily conforming, alloys are favored, as they are "run in" in a shorter time. The test of a readily conforming bearing metal upon the hardened-steel arbor of a testing machine is meaningless, when considering practical requirements; a bearing alloy should be tested against the same metal with which it is to be used in service.

The only physical tests on a bearing alloy, in the aggregate state, that can have any possible practical value are those for determining its physical properties and its safety factor for withstanding the treatment to which it is to be subjected under service conditions and temperature; all other conditions relating to bearing metals are of a microscopic nature and depend on the physical properties of the individual crystals constituting this metal.

If a journal could be fitted so as to be absolutely smooth, true and cylindrical, and additional polishing in service would be neither possible nor necessary, the journal could be made of a material having infinite hardness; but a journal of infinite hardness, not having a theoretically accurate surface, could not possibly give satisfactory wear with any bearing metal. In service, the bearing surfaces must polish each other; therefore, the hardest particles in one member must bear a definite relation to the particles in the other; to insure best results, they must be of the same order of hardness. For a long bearing life, there should be a polishing effect between the two metals rather than an abrading tendency.

When studying the abrasion or polishing effected in

*A paper to be read before the February, 1923, meeting of the Institute of Metals Division.

[1]Report of sub-committee on bearing metals, A.S.M.E. (1919).

a new bearing, we find that the worn-off particles of metal, carried away by the oil, gradually decrease in size. In a new bearing, made of proper material and correct design, though poorly fitted up, the first particles worn off may be large enough to be seen with the naked eye; but as the operation continues the particles become microscopic and then ultra-microscopic in size. The largest abraded particles resemble ordinary filings, but as they decrease in size they become spherical in form. This statement is made with due consideration of the fact that for a proportionate decrease in size of particles, the resolving power of the microscope also decreases. In the coarser abrasions, we may find entire crystals, which may be considered as only incidental in reducing the bearing to proper working conditions. In the operation of a long-life bearing, giving satisfactory service, the wearing is of a microscopic or ultra-microscopic order and represents the abrasion of correspondingly small particles of one member upon those of the other.

From the foregoing, it seems obvious that a study of bearings, without taking into consideration both members, could not be conducive of practical results. It is also obvious that a knowledge of the physical properties, especially of the abrasion hardness of the different microscopic constituent elements of a bearing alloy, as well as those of the journal, is imperative.

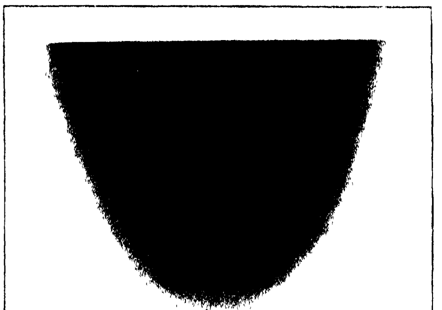


FIG. 1 SHADOWGRAPH SHOWING POINT OF FINEST CAMBRIC NEEDLE, SHARP'S NO. 12. × 2,000

A natural suggestion for testing on so small a scale was to reduce present methods to a corresponding degree of refinement; this at the outset proved impractical. In fact, all methods for testing any one crystal at a time failed, if for no other reason than its difficulty of application. A fact sometimes observed upon a metallographic specimen, polished on soft broadcloth, is that a continuous sharp cut, crossing several crystals, is wider on some than on others; this fact suggested the development of the instrument herein described.

The following fundamental requirements were established, after somewhat prolonged experimentation: (1) The cutting point must be ground with an extreme precision and to definite specifications; its shape must be such that the vertical pressure exerted upon the surface tested will be greater at all times than the horizontal pull applied to the point. (2) The cutting point must be so mounted that it can respond to required successive elevations with the least amount of inertia to overcome, and it must exert a constant pressure while passing over the test surface. (3) The cutting point must be moved over the test surface at a uniform rate, slowly enough so that no additional indentation may occur by stopping on the softest crystal.

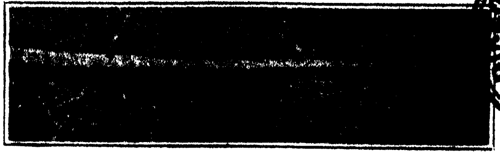


FIG. 2—PHOTOMICROGRAPH OF SOFT-STEEL SURFACE SHOWING END OF MICROCUT. × 2,000

Various materials were experimented with when seeking a suitable cutting point: one that would be hard enough for all ordinary metals and their alloys, if possible including hardened tool steel; one having the necessary hardness and the microscopic homogeneity to permit it to be ground to an extremely accurate point. On account of its hardness, the diamond was the first material suggested, but its grinding has proved unsuccessful. Various other jewels have been tried, the sapphire, tourmaline, ruby, garnet, also various grades of special steels and tungsten. The artificial leuco sapphire (fused Al_2O_3) has proved extremely satisfactory, in that it has the necessary homogeneity, and is much harder than the crystals in the ordinary metals, including martensite in hardened steel and tin oxide (fused SnO_2). The latter is the hardest crystal so far encountered in any of the alloys or their impurities; its hardness is more than twice that of martensite.

The importance of a knowledge of the hardness of the individual crystals of the alloys was appreciated by the early investigators, when applying the microscope to the study of metals. Their investigations, however, were crude, in that they applied the points of steel needles in their work. The crudeness of any work done with a needle is evident from the shadowgraph, of 2,000 magnifications, of the point of the finest cambric needle, Sharp's No. 12, given in Fig. 1; in Fig. 2 is shown the end of a microcut made upon soft steel with a sapphire point ground to definite specifications. The point itself appears sharp under 2,000 magnifications.

After the selection of a suitable jewel, considerable difficulty was experienced in grinding a point that would be sharp and accurate to the extreme limits of the microscope. The grinding of a conical point was early abandoned as being impossible; the point that was finally ground successfully was the corner of a cube or a solid right angle. Fig. 3 gives the details of this point, (1) showing an end view and (2) a side view. The jewel was cylindrical in form 0.022 in. in diameter and 0.08 in. in length. It was cemented securely into a close-fitting hole in the end of the grinding stylus that made an angle of 54.73 deg. with the grinding disk. Three successive facets were ground upon the end of the jewel after successively rotating it through 120 deg., thus making the point the corner of a cube. The jewel point is mounted so that the diagonal of the cube shall be normal to the surface to be tested and with one edge advancing directly in line of motion. After grinding, the jewel was placed in a jig and, after all adjustments for accuracy had been made, cemented into the end of a flexible spring, while both

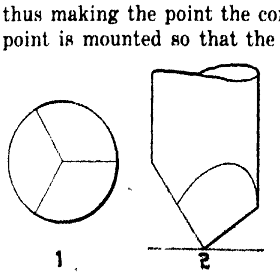


FIG. 3—DETAILS OF JEWEL POINT

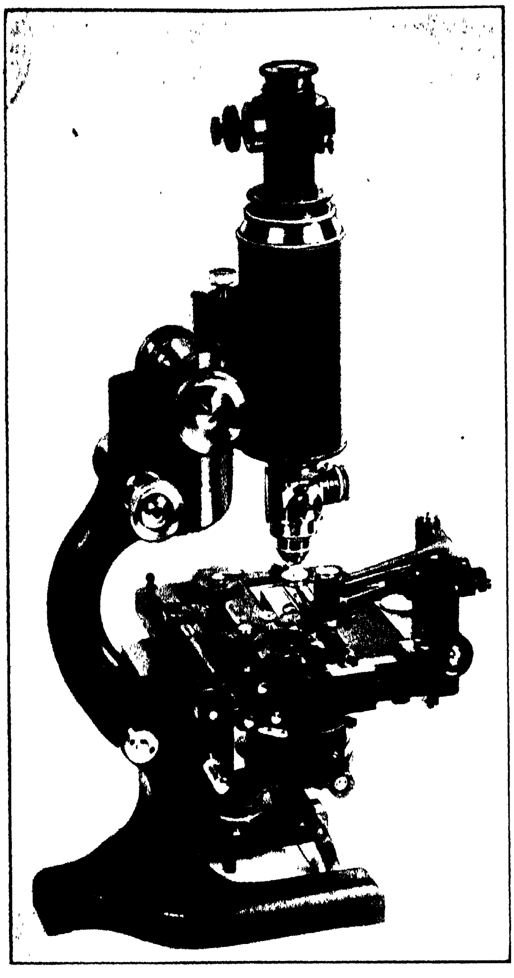


FIG. 4—MICROSCOPE COMPLETELY EQUIPPED WITH MICROCHARACTER AND MICROMETER EYEPIECE

the jewel and spring were held in the jig in the field of the microscope; the cement was a heavy solution of specially refined shellac. After the cement was thoroughly hardened, the excessive length of the jewel was ground off to reduce it to a minimum weight.

Fig. 4 shows a microscope complete and ready for work, equipped with the instrument developed for research on bearing metals; the name chosen for the instrument is Microcharacter. The instrument may be described as a mechanical stage with two additions, the jewel bracket at the right and the micrometer feed at the left. The jewel bracket, as shown in Fig. 5, is provided with a vertical rack for raising and lowering the bracket that carries the jewel suspension. This jewel suspension consists of a balanced arm, pivoted on sapphire bearings, one end of which is provided with a spirit level and the other with a weight, which constitutes the load for the jewel point. The jewel is mounted in the small end of a tapered steel spring, the other end of which is fastened to the lower side of the suspension arm. The suspension bracket is also provided with two adjusting devices, by which the microcut can be located so as to appear in the field of vision. These devices are not absolutely necessary, but are desirable, in that they make possible the testing of a crystal that may be selected in the field of the microscope. A worm and wormwheel attached to the longitudinal movement of the mechanical stage constitutes the micrometer feed.

The specimen to be studied should not be more than ¼ in. thick, and from 1 to 2 sq.in. in area; it should be placed upon an ordinary microscopic slide, leveled, and held in plasticine. After the specimen is in place, the jewel point is brought down upon it and the jewel suspension, by aid of the spirit level, is brought into a level position; this insures that the full load of the weight is being exerted upon the jewel point. The specimen is then moved along under the jewel point by

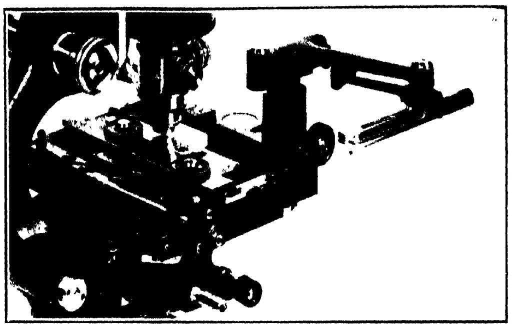
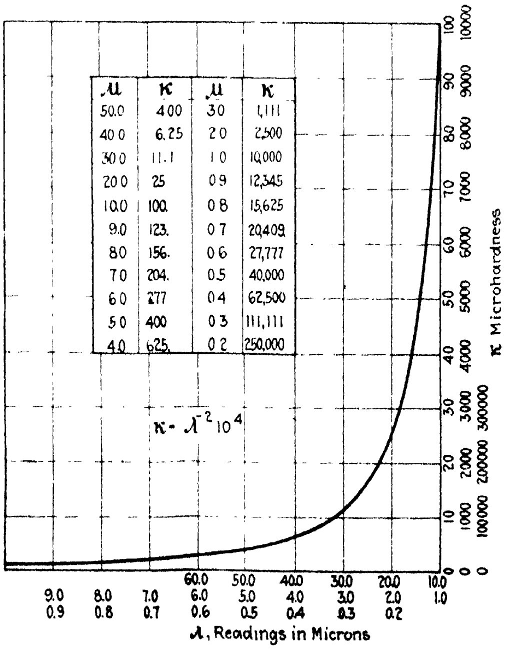


FIG. 5—MICROCHARACTER WITH JEWEL SUSPENSION BRACKET SWUNG OUT

the micrometer worm and wheel actuated by turning the small handle. A drop of oil should be placed upon the test surface and in contact with the jewel before starting, for a somewhat smoother microcut is then made. After the microcut has been made, the jewel bracket is elevated, by turning the knurled head, and swung out of position, as shown in Fig 5. The objective is brought into focus upon the microcut and, after it has been studied through a plain ocular, the micrometer eyepiece is substituted and the widths of the microcut are measured.



λ	κ	λ	κ
50.0	4.00	3.0	1,111
40.0	6.25	2.0	2,500
30.0	11.1	1.0	10,000
20.0	25	0.9	12,345
10.0	100.	0.8	15,625
9.0	123.	0.7	20,409
8.0	156.	0.6	27,777
7.0	204.	0.5	40,000
6.0	277	0.4	62,500
5.0	400	0.3	111,111
4.0	625.	0.2	250,000

$$\kappa = \lambda^{-2}\,10^4$$

FIG. 6—FORMULA, TABLE AND DIAGRAM OF SCALE OF MICROHARDNESS

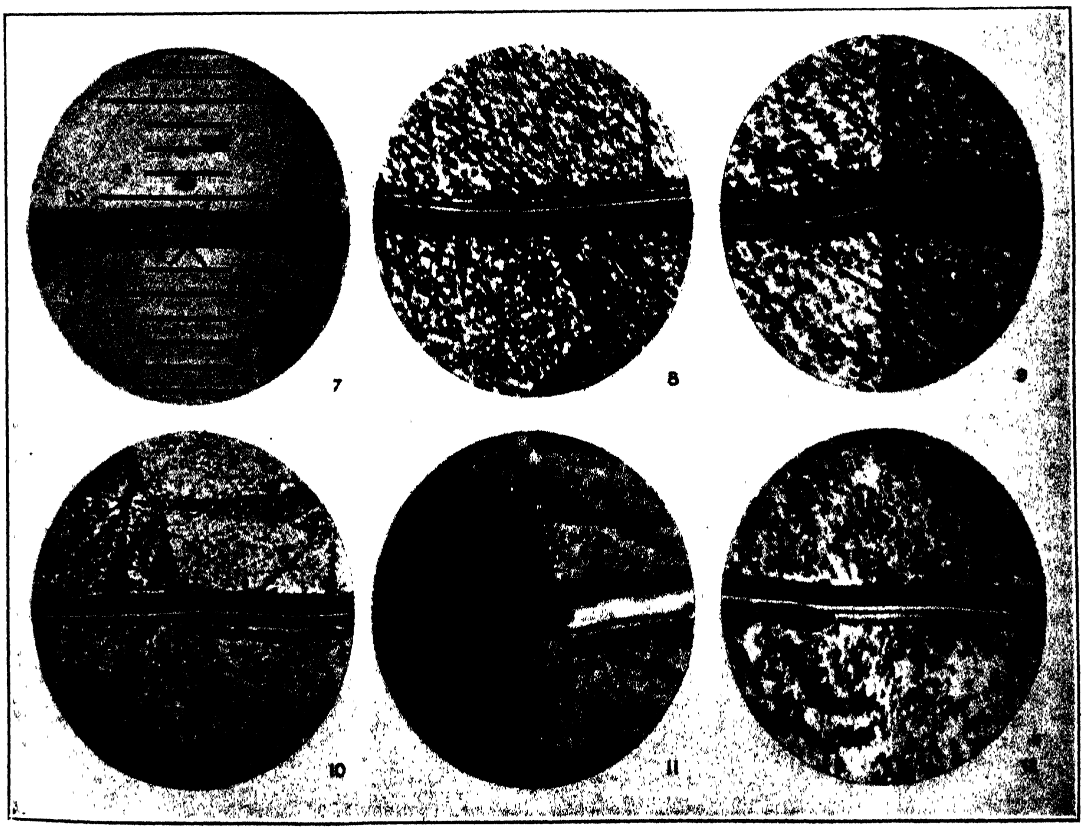
Fig. 7 shows a view of a microcut through the micrometer eyepiece; the focusing, of course, should always be done upon the original surface of the specimen. The X of the scale is moved to one edge, in which position a reading of the vernier is taken; after moving the X of the scale to the other edge the second reading is taken; both edges should be approached in the same direction. The difference between the vernier readings gives the fractional parts, whereas the full units can be read directly. It is necessary to calibrate the scale of the micrometer eyepiece by comparing it with the scale of a stage micrometer, for which the working set-up of the microscope should be used. The micrometer eyepiece scale is then calculated, in terms of microns, and the reading of the width of the microcut multiplied by this factor reduces the reading to terms of microns. A 2-mm. apochromatic objective with 160-mm. tube length and a 20× micrometer eyepiece with a ½-mm. scale gives substantially 2.5 microns per unit of scale division. A convenient weight upon the jewel point seems to be 3 grams, as with this load readings can be made upon the softest lead as well as upon the hardest steel without any change in the microscope set-up.

The micron, 0.001 mm., seems to be a convenient unit for our purpose. As the various cross-sections of microcuts in the different metals and alloys are symmetrical and their areas are proportional to the squares of their respective widths, these squares should be used for comparison. The same should appear as a factor in the mathematical expression for the value which may be designated as microhardness. For the reason that the greater widths represent the softer material the reciprocal of these squares should be used. Let κ represent the microhardness and λ the width of microcuts, then after multiplying by a convenient constant, to avoid unwieldy numbers, $\kappa = \lambda^{-2}10^4$. In Fig. 6 this formula has been plotted to two rectangular co-ordinates covering an ample range of microhardness.

The microhardness of grains in most metals varies in different directions; that is, if a grain on a polished metallographic specimen is cut in different directions the results vary within certain limits, and these limits vary for different metals. This property is illustrated by Figs. 8, 9 and 10. Fig. 8 shows a uniform width of microcut upon a surface of chemically pure copper. The two grains, of necessity, have a different angle of crystalline orientation but they presented approximately the same angle to the surface and the direction of the microcut, so the two crystals present an equal degree of microhardness. Fig. 9 shows the same two grains as in Fig. 8, but the direction of microcut is different, with the result that maximum and minimum microhardnesses are shown.

Fig. 10 shows the greatest difference of microhardness, so far encountered, for chemically pure metal; it shows a microcut of maximum and minimum widths for electrolytic zinc.

Fig. 11 shows a crystal of fused tin oxide imbedded in



FIGS. 7 TO 12

Fig. 7—Microcut through micrometer eyepiece.

Fig. 10—Microcut showing greatest range of microhardness of chemically pure zinc. × 875.

Fig. 8—Microcut in two adjacent grains on pure copper having same apparent hardness. × 875.

Fig. 11—Microcut upon fused tin oxide and bronze. × 875.

Fig. 9—Microcut on same crystals as in Fig. 8 showing maximum and minimum microhardnesses of chemically pure copper. × 875.

Fig. 12—Microcut upon slightly etched hardened tool steel. × 1,250.

bronze. The narrow width of microcut indicates the extreme hardness of the crystal which is found only in bronze that has been heated above the fusing temperature of tin oxide. It has long been known that "burned" bronze was destructive to bearings. The actual hardness of the crystal, however, does not seem to have been determined before this as being more than twice that of hardened tool steel; it is by far the hardest crystal found in any of the common alloys or their impurities.

Fig. 12 shows a microcut in hardened tool steel; the martensite formation is distinctly seen.

Heat tinting or very light etching may be used for the identification of crystals; the etching, however, should always be very light in order not to affect the results. This method of testing offers strictly comparable results, for a single microcut upon a substance of, say, unit microhardness would disturb as large a volume of material as 100 microcuts on a substance having a microhardness of 100. Should conditions require the hardness of the diamond, there is no doubt that it can be ground to this same degree of refinement and results obtained uniform with the present. While it is desirable that the instrument fit the microscope stage it is not absolutely necessary that it should; a plain stand may be improvised, and after the microcut is made the specimen can be transferred to the microscope, where all measurements can be made in the usual way.

By the use of this instrument, it has been clearly shown that the addition of zinc in excess of 2 per cent to a copper-tin bearing bronze increases the hardness of those crystals which, without the zinc, would have been the softest. This addition of zinc, therefore, tends to reduce the range of hardness between the hardest and softest crystals and theoretically reduces the bearing value of such an alloy. This offers a most striking corroboration between theory and practice, for it has long been known that the hardening of bearing bronzes by the addition of zinc increases the rate at which they wear off in service, and that this destructive wearing effect increases with an increase of zinc content.

Name of Substance	Width of Microcut, Average	Microhardness, Average
Lead, c p., Picher	37.7	7.03
Tin, c p., electrolytic	29.3	11.7
Copper, c p., Raritan	11.8	78.4
Antimony, commercial	9.1	121.0
SnSb crystal as found in babbitt	6.9	208.0
Nickel, c p., International Nickel Co	6.4	244.0
PCu_3 crystal as found in phosphor bronze	6.1	267.0
Iron, Swedish, softest crystal	4.8	420.0
Cobalt, c p., International Nickel Co	4.0	625.0
$SnCu_3$, or delta crystal in copper-tin bronze	3.6	750.0
$SnCu_4$, hardest crystal in high-Cu hardened babbitt	3.2	1006.0
Hardened steel - Johansson test block	2.2	2229.0
SnO_2 (fused) as found in burned bronze	1.4	5390.0

An equally interesting fact was brought out in the study of the distinctive effect that a certain high percentage copper babbitt had on a low-carbon journal; the results showed that the $SnCu_4$ crystal was much harder than any crystal in the steel, which was unexpected and accounted for the result. While this instrument was developed for one patricular purpose, it should prove of greater interest, as it offers means for investigation and research that have not been available heretofore.

Dynamite Blasting Tests

A comparison of the breaking qualities of gelatine and ammonia dynamites under actual working conditions is to be made by the U. S. Bureau of Mines. During these tests a study of the fumes from blasting will also be made. An effort will be made to determine the amount of powder required with a standard round to break a foot of drift in different rocks.

A New Method for Case Hardening

BY FRANK HODSON
President Electric Furnace Construction Co.

A PROCESS which seems to have great possibilities for case hardening was recently shown to the writer by the well-known Swedish scientist, Dr. Assar Gronwall, who will be remembered as the inventor of the "Elektrometall" type of electric shaft ore-smelting furnace and various other electrical processes. Dr. Gronwall also showed a number of examples of this new case-hardening method, and I also had the privilege of examining records of tests made by Prof. Armd Johansson of the Tekniska Hogskolan, Stockholm.

Dr. Gronwall's process is based upon the fact that carbonizing is due to carbon monoxide, which in presence with iron at suitable temperature breaks up into carbonic acid and carbon, which latter, together with the iron, forms carbide of iron. In order to facilitate the process it is usual to mix with the carbonaceous packing a so-called carbonizing powder, such as carbonate of barium, metallic oxides, leather, bone, and even quartz and brick dust, which are supposed to facilitate the formation of CO within the furnace.

It is well known, however, that even using the best cementing mediums, the process is unnecessarily slow and that deep carbonization is very difficult. Dr. Gronwall's experiments proved that the gases inclosed in the case-hardening pots reached the equilibrium between CO, CO_2 and the carbonized steel at the outer surface and therefore the process gradually stops. The new method consists of converting much of the carbonic acid as formed to carbon monoxide. This is done by putting catalyzers of a special metal in the form of thin sheets, ribbons or wires into the box with the carbonaceous matter surrounding material to be case hardened. The catalyzer then acts in such a way that the carbonic acid, when coming in contact with it, changes into carbon monoxide. In other words, the catalyzer displaces the equilibrium in such a manner that the amount of CO in the gas is materially increased.

An iron object may be case hardened deeper on a certain spot by placing catalyzer there; gear wheels were carbonized only on the outer parts of the teeth.

The catalyzer is said not to be consumed during the operation and therefore the cost of the new method consists only of expense of original catalyzers and the license to operate.

With the new method less carbonizing material is needed, the temperature can be kept lower than usual, and time occupied is just about half. The tests at the Technical Academy, Stockholm, consisted in treating pieces of steel from the same bar in an electrically heated furnace, first in the usual case-hardening method and second with the addition of the catalyzer. The amount of case was considerably deeper in the second samples, although time occupied, temperature and other conditions were exactly the same.

Paper Waste Costs $50,000,000 Annually

Efforts to save the nation's forests by the reworking of waste paper was a feature of the past year's work of the American Paper and Pulp Association, which found that 300,000 acres of forest land could be saved by the collection of paper now being burned, which would be worth $50,000,000 a year to the paper mills.

A German Apologia

THE following appeared as an editorial in the *Chemical Age,* London, for Jan. 20, 1923, relative to German comment on a series of articles published by Mr. Negru on "European Conditions as I Saw Them":

"A few days ago an interesting package reached us from Berlin—so insufficiently stamped, it is our painful duty to add, that inspection of its contents could only be obtained by the payment of 8d. excess. On being opened, it was found to contain a pamphlet by Dr. W. A. Dyes, of Berlin, constituting 'an appeal to commonsense,' and a reply to a series of articles which Mr. J. S. Negru, a member of the editorial staff of *Chemical & Metallurgical Engineering,* recently contributed to that journal on German conditions as he saw them during a 6 months' tour of Europe.

"We happened to meet Mr. Negru in New York shortly after his return from Europe. He went there as the representative of one of the most reputable journals and one of the best publishing houses in the United States. His object was to see things as they are, and to tell the American public what he saw. He recounted to us some of the difficulties put in his way. In spite of them he collected a considerable body of facts and published them. It was not to his interest or to that of his journal to write mischievous fiction; the purpose of his visit was to obtain first-hand information, and if as a Belgian he wrote occasionally with some feeling it is only what might have been expected.

"But Dr. Dyes resents his description of German conditions, and seeks to discredit it. One might imagine, if we did not recall such judicial reports as those of Lord Bryce's commission, that Germany had hitherto enjoyed a spotless record, and was entitled to have its word accepted against all other witnesses. If Mr. Negru discovered another side, he is by no means alone, and we know no reason for supposing that he visited Germany for any other purpose than to discover and make known the truth.

SAMPLE OF THE STRANGE PSYCHOLOGY OF THE TEUTONIC MIND

With the immense detail of this 27-page pamphlet we have not space to deal. It is mainly interesting as another sample of the strange psychology of the Teutonic mind. During the war we were privileged to see some confidential German documents containing instructions to their information agents in this and other countries. They were a revelation of German mental ingenuity. And we have something of the same quality here. Out of his well-stocked pigeon-holes Dr. Dyes seems able to produce every favorable reference to Germany uttered since the Flood, and with pathetic belief in their efficacy he employs them to display his country arrayed in white robes. It is the attitude of a highly sensitive man, wounded in his conscience by being thought ill of, and indignant at the slightest aspersion on his honor. To Dr. Dyes it really seems impossible to understand any feelings save those of respect and confidence toward his country.

"As representing those who have no desire to see Germany 'go under,' may we offer him a few words of friendly advice? Throughout the war every device which Germany adopted, whether to inspire terror or to elicit sympathy, almost invariably produced the opposite effect. And Dr. Dyes exhibits just the same lack of imagination now—an immense and most ingenious capacity for seeing things in detail and total blindness to broad moral values and effects.

HOW GERMANY CAN RE-ESTABLISH HERSELF

"If Germany wishes to re-establish herself among the nations, it will not be by meticulous reasoning of this sort. It will be by frankly disowning her recent past, admitting the injustice inflicted on others, and making good the damage. France won the respect of the world by the splendid spirit in which she discharged the crushing penalties Germany imposed on her. The profound respect which Great Britain commands in the United States today is due to the quiet and dignified way which we, the most heavily taxed nation of all, face our obligations. If Germany desires to regain the world's respect, it can be done in the same way, but not by weaving ingenious webs of excuses or reciting long rolls of synthetic virtues or affecting the unsuitable rôle of the innocent and injured party. A little sackcloth and ashes would be far more becoming as well as more convincing."

Some Problems Which Brazilian Manufacturers Must Solve

Lack of Fuel and Inadequate Transportation Facilities Are the Chief Handicaps, but Labor Is Plentiful and Efficient

BY WARREN E. EMLEY

FROM August to December, 1922, I was favored with the opportunity of visiting many industrial plants in Brazil and of making a survey of conditions. Many of the ways of doing things are so radically different from the methods in vogue in this country that a description of them would be at least interesting to North American manufacturers. Before going into detail about any particular industry, it might be well to cite a few facts which have a general bearing on every industry.

Probably the most prominent factor, which has modified all manufacturing processes, is the lack of fuel. There is some coal mined in the most southerly state, Rio Grande do Sul, but this is far away from the industrial center of the country, and besides it is of very poor quality, being extremely high in both sulphur and ash. Serious attempts have been made to use this coal, powdered, in locomotives, but it is not satisfactory unless mixed with a better grade of imported coal. English coal costs 140 milreis (about $17) a ton, delivered at a factory in São Paulo. Oil shale and oil made therefrom are to be found in every museum, but the most careful inquiries failed to bring to light any commercial source of this material. Wood has been, and still is, the main reliance for fuel, but is now getting scarce within economical hauling distance of the factories and railroads. An effort is being made toward reforestation. Groves of eucalyptus extending for miles along the railroads are not an uncommon sight.

The fuel situation is saved by the unlimited supply of hydro-electric power. This has been developed to the point that cheap electricity is available throughout the industrial districts of the country. This dependence upon electric power has brought about a condition which seems peculiar, but is quite logical: a single company

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frequently makes a number of products which bear no relation to one another. Having purchased and developed a waterpower site to supply the primary business of the company and having expanded that business to its present economical limit, there is still some power left over, so that an entirely different industry is started to use this excess power or to use some natural resource which was accidentally acquired with the site. Thus one company makes clay tile, lime and paper; another makes enameled iron utensils, locks and keys and nickel-plated ware. Obviously the name of such a company can give no indication of its activities, a fact which is apt to be confusing to a North American.

The development of water power usually involves the holding of large tracts of land. This is facilitated by the fact that there is no tax on unimproved real estate. However, other taxes are sufficiently plentiful to make up for this lack. There is an annual tax to do business —a sort of license. Each state levies an import or export tax, or both, on all materials crossing its borders. Everything is subject to a retail sales tax. Some of these taxes are levied in gold milreis. There is no such thing as a gold milreis, so the taxes must be paid in paper. Once a week the Bank of Brazil publishes a statement showing how many paper milreis make one of gold, which is, in effect, a weekly change in the tax-rate.

TRANSPORTATION, LABOR AND MACHINERY IN BRAZIL

Transportation is difficult. For local hauling, the two-wheeled cart drawn by oxen or mules is very much in evidence. The system of hard-surfaced highways is growing, but outside of the cities the automobile truck is unknown. Some of the railroads are owned by the federal government, others by private individuals, and apparently the gage is fixed by the whim of the owners. This necessitates transshipment of freight into different cars at nearly every junction point. Distances between cities are great, and small towns are very few in number. In vast areas of the country there are no railroads, transportation being effected only by mules. Even the capital, Rio de Janeiro, must rely almost wholly upon ocean steamers to communicate with such large northern cities as Bahia, Pernambuco and Manaos.

Labor is plentiful, low priced and of excellent quality. It is mostly south European stock mixed with Indian and negro. Their necessities of life are few and easily supplied, so that they can live well on a low wage. Artisans have the pride of workmanship so characteristic of Italians and Spaniards, so that they will not do a poor job, no matter what the boss may tell them.

Machinery is practically all imported, and is very expensive. It is not the first cost of a machine which matters so much. In a land of plentiful labor and power, the efficiency of a machine is hardly worth considering. It is the repair cost that counts. If the smallest part of the machine breaks, it may shut down the entire factory for months until a new part can be imported. This is the important factor deterring manufacturers from a more extended installation of machinery. Many machinery manufacturers maintain agencies and carry a stock of spare parts in Brazil. This is frequently the determining factor in the selection of a particular kind of machine.

Although I visited many different kinds of factories, my interest was centered chiefly on building materials, their manufacture aud use. I hope in succeeding articles to show some of the points of difference between Brazilian and North American methods.

Canadian Experiments With Nitrite Fertilizer

Some interesting experiments were made in Canada during the past year with soda nitrogen. This byproduct of the American Nitrogen Products Co. was first brought to the attention of the Canadian Government Division of Chemistry in February, 1921, when it was being offered on the Pacific coast markets as a nitrogenous fertilizer. The examination of a sample received from the manufacturers revealed the fact that of the total nitrogen present, approximately two-thirds existed in the form of sodium nitrite and one-third in the form of sodium nitrate.

The practical experience with soda nitrogen so far has been limited to the knowledge gained from the results of investigations carried on with oats in the greenhouse at the Central Experimental Farm at Ottawa, with oats and potatoes at the Experimental Farm at Agassiz, B. C., and with potatoes, corn, beans and peas at the Experimental Station at Sidney, B. C.

In the experiment with oats in the greenhouse, soda nitrogen and nitrate of soda, in quantities of each representing applications of 150 and 300 lb. per acre, were compared. In some series of plots the smaller and in another series the larger application was made at seeding time. In two further series the applications were made after the plants had attained 1-in. growth.

Of course, under greenhouse conditions the activities of the nitrifying bacteria would be favored, so that the conversion of the nitrite to nitrate would have taken place almost immediately. Be this as it may, observations made at the beginning and during the progress of the experiment failed to detect evidence of injury either to the germinating seedling or to the maturer plant at any stage.

The heavier applications, whether of soda nitrogen or of nitrate of soda, gave results superior to those from the lighter applications, while the untreated checks were decidedly inferior. The experience at Ottawa was repeated in a field test with oats at Agassiz, B. C.

The results of the experiment with potatoes at Agassiz favor nitrate of soda throughout. Besides the nitrogenous material, each fertilized plot received superphosphate and muriate of potash at the rate of 300 lb. and 150 lb. per acre respectively.

The experiments at Sidney, B. C., were carried out on a small scale with potatoes, corn, beans and peas. Of the corn, beans and peas on the plots receiving soda nitrogen, 90 per cent failed to germinate, whereas germination on the nitrate of soda plants was normal. On potatoes there was much less evidence of injury.

Engineering Tables for Low Pressure Air and Gas

Calculations involving the flow of air at low pressure are simplified through the use of data and charts contained in Bulletin 118, Engineering Tables, published by the P. H. & F. M. Roots Co., Connersville, Ind. The bulletin is designed to give as completely as possible the information which is required in making installations of blowers, pumps and exhausters for various services, such as agitation of liquids, pneumatic conveyors, foundry cupolas, combustion of fuel oil, water-gas sets, etc. General tables complete a booklet which chemical engineers will find very useful.

Fundamentals of Rectification

Effect on Rectification of Liquid Feed at an Intermediate Level

Also Conditions for Minimum Reflux and an Example of the Use of the Derived Formula Taken From Liquid Air Fractionation*

BY C. C. VAN NUYS
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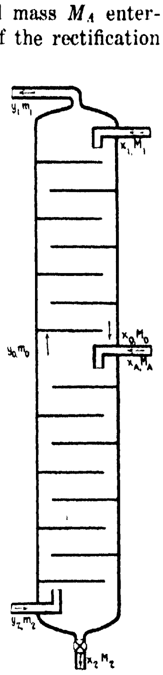
NOW let us consider the case where we have a liquid of composition x_A and mass M_A entering at an intermediate point of the rectification column.



In what follows, we shall assume that the composition of all fluids entering and leaving the column are given or stipulated. That is to say, x_A, x_1, y_1, x_2 and y_2 are to be considered as constants. Since the equations we shall write take no account of phase relations, we may, if we choose, suppose that x_1 and y_1, and also x_2 and y_2, are compositions of liquid and vapor in phase equilibrium. The only supposition we shall make at present regarding x_A is that its value lies between x_1 and x_2.

We then have six equations containing four M's and three m's, and by means of these equations we may determine the ratio between any two of the seven (M, m)'s.

These six equations are as follows in which m_0 is the mass of ascending vapor passing per unit time the level of admission of the liquid x_A and M_0 is the mass of liquid descending from above at this level.

$$M_1 + m_0 = M_0 + m_1$$
$$I_1M_1 + y_0m_0 = x_0M_0 + y_1m_1$$
$$I_1M_1 + J_0m_0 = I_0M_0 + J_1m_1$$
$$M_A + M_0 + m_2 = M_2 + m_0$$
$$x_AM_A + x_0M_0 + y_2m_2 = x_2M_2 + y_0m_0$$
$$I_AM_A + I_0M_0 + J_2m_2 = I_2M_2 + J_0m_0$$

Let us assume that M_A is fixed arbitrarily, then the values of M_1, M_2, M_0, m_1, m_2 and m_0 may be determined in terms of M_A and of the various x's, y's, I's and J's. This system of equations may be readily solved by properly changing subscripts in the results obtained from the system of three equations solved above. We thus obtain

$$M_0 = \frac{(J_1-I_1)(y_0-y_1)+(J_0-J_1)(x_1-y_1)}{(J_0-I_0)(y_0-y_1)+(J_0-J_1)(x_0-y_0)}M_1$$

$$m_0 = \frac{(J_1-I_1)(x_0-x\ )+(I_0-I_1)(x_1-y_1)}{(J_0-I_0)(y_0-y_1)+(J_0-J_1)(x_0-y_0)}M_1$$

$$m_0 = \frac{[(J_2-I_2)\ (x_2-x_A)+(I_2-I_A)\ (x_2-y_2)]M_A}{(J_2-I_2)\ (y_2-y_0)+(J_2-J_0)\ (x_2-y_2)} + \frac{(J_2-I_2)\ (x_2-x_0)+(I_2-I_0)+(I_2-I_0)\ (x_2-y_2)M_0}{(J_2-I_2)\ (y_2-y_0)+(J_2-J_0)\ (x_2-y_2)}$$

whence

$$[(J_2-I_2)(x_2-x_A)-(I_2-I_A)(x_2-y_2)]\ [(J_0-I_0)(y_0-y_1)-(J_0-J_1)(x_0-y_0)]\,M_A =$$
$$\{[(J_2-I_2)(y_2-y_0)+(J_2-J_0)(x_2-y_2)]\ [(J_1-I_1)(x_0-x_1)+(I_0-I_1)(x_1-y_1)]$$
$$-[(J_2-I_2)(x_2-x_0)+(I_2-I_0)(x_2-y_2)]\ [(J_1-I_1)(y_0-y_1)+(J_0-J_1)(x_1-y_1)]\}\,M_1$$

This value of M_A vanishes if

$$\frac{(J_1-I_1)(x_0-x_1)+(I_0-I_1)(x_1-y_1)}{(J_1-I_1)(y_0-y_1)+(J_0-J_1)(x_1-y_1)} = \frac{(J_2-I_2)(x_2-x_0)+(I_2-I_0)(x_2-y_2)}{(J_2-I_2)(y_2-y_0)+(J_2-J_0)(x_2-y_2)}$$

which is the same equation as that obtained above as the necessary relation between x and y in order for perfect rectification to be possible—that is to say, the amount of liquid of composition x_A that it is possible to add at the intermediate point is zero if the composition y_0 of the vapor having phase equilibrium with a liquid of composition x_0 bears the relation to x_0 as determined by the last equation written.

Now assume that we are dealing with a binary system which has the property described above—viz., the total heat J of the mixture at the dew point and also the total heat I at the boiling point follow the proportionality relation indicated by the equations

$$J = J_Bx + J_A(1-x)$$
$$I = I_Bx + I_A(1-x)$$

so that the latent heat L at constant pressure of any mixture of composition x is given by

$$L = L_Bx + L_A(1-x)$$

For such a mixture the above relation between M_A and M_1 may be easily shown to take the form:

$$\frac{L_Bx_0+L_A(L-x_0)}{L_Bx_1+L_A(1-x_1)}\ \frac{M_A}{M_1} = \frac{(x_0-x_1)(y_2-y_0)}{(x_2-x_A)(y_0-y_1)}$$
$$\frac{L_By_1+L_A(1-y_1)}{L_By_2+L_A(1-y_2)}\ \frac{L_Bx_2+L_A(1-x_2)}{L_Bx_1+L_1(1-x_1)} - \frac{x_2-x_0}{x_2-x_A}$$

Let us denote by l_1 the function $L_By_1 + L_A(1-y_1)$ and by L_1 the same function of x_1 with a corresponding notation for y_0, y_2 and x_0, x_2. Then the last equation may be written:

$$\frac{L_0M_A}{L_1M_1} = \frac{M_A}{M_0} = \frac{l_1L_2}{l_2L_1}\ \frac{(x_0-x_1)(y_2-y_0)}{(x_2-x_A)(y_0-y_1)} - \frac{x_2-x_0}{x_2-x_A}$$

In what follows we shall employ the term "equivalent mass," in speaking of the products L_1M_1, l_1m_1, etc. For example, the equation $L_1M_1 = L_2M_2$ obtained above for a simple column may be regarded as a statement that the equivalent masses of the liquid at the top and at the bottom of a simple adiabatic column are equal.

CONDITIONS FOR MINIMUM "REFLUX"

From the above equation for the mass ratio, $Z = \frac{M_A}{M_0}$, it follows that for fixed values of x_A, x_1, x_2, y_1, y_2 the maximum value of the ratio is obtained when y_0

*The first two articles in this series were published in the issues of Jan. 31 and Feb. 7, 1923.

is the least possible. If now, x_1 is less than x_0, it is clear that the minimum possible value for y_0 is the composition of a vapor having phase equilibrium with the liquid of composition x_0, since this liquid has previously been in contact with a vapor whose composition is less than y_0. If, on the other hand, x_1 is greater than x_0, then the minimum possible value of y_0 is that of a vapor having phase equilibrium with the liquids M_1 and M_0 combined. That is to say, if x_c is the composition of those liquids combined, the minimum possible value of y_0 is that of a vapor in phase equilibrium with a liquid of composition x_c.

We shall now ascertain the conditions existing in an adiabatic rectification column when, for a given mass, M_0 of "reflux" liquid entering the top, the maximum possible mass M_1 of a given composition x_1 is entering an intermediate point of that column, the end compositions x_1, y_1, x_2, y_2 being specified. Let us first suppose that the mass M_1 is added at a point in the column and in amount such that after it has been flowing steadily the composition x_0 at this level of the liquid descending from above is the same as the composition x_1 of that liquid i.e., $x_1 = x_0$. Under these conditions, let us determine for what composition $x_1 = x_0$ the ratio $Z = \frac{M_1}{M_0}$ is a maximum if such a maximum exists. If we place $x_1 = x_0$, our original expression for that ratio becomes:

$$Z = \frac{M_A}{M_0} = \frac{l_1L_2\,(x_0-x_1)\,(y_2-y_0)}{l_2L_1\,(x_2-x_0)\,(y_0-y_1)} - 1$$

That x_0 which makes the ratio Z a maximum must satisfy the equation $\frac{dZ}{dx_0} = 0$. From the equation for Z we obtain by differentiation:

$$\frac{dZ}{dx_0} = \frac{l_1L_2}{l_2L_1}\cdot\frac{(y_2-y_0)\,(y_0-y_1)\,(x_2-x_1) - (x_2-x_0)\,(x_0-x_1)\,(y_2-y_1)\dfrac{dy_0}{dx_0}}{(x_2-x_0)\,(x_0-x_1)\,(y_0-y_1)}$$

If, however, the ratio Z is a constant whatever be the value of x_0, then $\frac{dZ}{dx_0}$ must be identically 0. That is to say, the equation

$$\frac{dy_0}{dx_0} = \frac{(y_2-y_0)\,(y_0-y_1)\,(x_2-x_1)}{(y_2-y_1)\,(x_0-x_1)\,(x_2-x_0)}$$

with given end compositions x_2, y_2, x_1, y_1, must be an identity—i.e., it must be satisfied for all possible pairs of values of x_0 and y_0 connected by the relation $y = F(x)$ where F denotes the functional relation between x and y for phase equilibrium.

If we assume that x_2 and y_2 and also x_1 and y_1 are any two given pairs of compositions of liquid and vapor in phase equilibrium, the most general form of the functional relation between x and y in order for the last equation to hold for all possible pairs of values of x and y may be derived as follows: The equation for $\frac{dy_0}{dx_0}$ may in that case be regarded as a differential equation in which the variables are x_0 and y_0. It may be written in the form:

$$\frac{dy_0}{y_2-y_0} + \frac{dy_0}{y_0-y_1} = \frac{dy_0}{x_2-x_0} + \frac{dy_0}{x_0-x_1}$$

Integrating this, we obtain:

$$\log_e(y_0-y_1) - \log_e(y_2-y_0) = \log_e(x_0-x_1)$$
$$= \log_e(x_2-x) + \log_e$$

or

$$\frac{y_0-y_1}{y_2-y_1} = K\,\frac{x_0-x_1}{x_2-x_0}$$

where K is a constant for any (x_0, y_0) with given values of (x_1, y_1) and (x_2, y_2).

Since K in the last equation is a constant for any (x_0, y_0), it must be the same when $x_0 = y_0 = 0$ as when $x_0 = y_0 = 1$. In the first case, we have:

$$\frac{y_1}{x_1} = K\,\frac{y_2}{x_2}$$

and in the second case, we have

$$\frac{1-y_1}{1-x_1} = K\,\frac{y_2-1}{x_2-1}$$

or, by division:

$$\frac{\dfrac{y_1}{1-y_1}}{\dfrac{x_1}{1-x_1}} = \frac{\dfrac{y_2}{1-y_2}}{\dfrac{x_2}{1-x_2}}$$

Since, however, (x_1, y_1) and (x_2, y_2) are any pair of values satisfying the functional relation desired, we must have

$$\frac{\dfrac{y_0}{1-y_0}}{\dfrac{x_0}{1-x_0}} = a$$

where a is a constant for any (x_0, y_0) whatever—i.e.,

$$\frac{y_0}{1-y_0} = a\,\frac{x_0}{1-x_0}$$

is the most general form of the functional relation which makes the above equation for $\frac{dy_0}{dx_0}$ an identity.

This equation between co-existing liquid-vapor phase compositions is characteristic of those mixtures which in the liquid state have the properties of dilute solutions for which the heat of mixture is zero. (See Kuenen, "Theorie Der Verdampfung und Verflussigung von Gemischen," pages 127, 144-145.) This relation is satisfied approximately by a considerable number of two-phase binary liquid mixtures of the type having no maximum or minimum vapor pressure composition. In particular, it is satisfied approximately by liquid mixtures of oxygen and nitrogen, as we shall see later.

The above result shows that for a mixture satisfying this relation, the quantity of "reflux liquid," M_0 of a given composition necessary for a constant equivalent amount of the liquid M_A is constant—i.e., does not depend on the composition x_A of that liquid. We assumed in the above discussion that the composition x_A was identical with the composition x_0 of the liquid descending in the column at the point where the liquid M_A was added.

That, for given compositions x_1, y_1, x_2, y_2 of end products and for a given amount of "reflux" M_1, the amount, M_A, of liquid of a given composition x_A that it is possible to add at an intermediate level in the column is a maximum for this type of mixture when the condition $x_A = x_0$ is satisfied, may be shown as follows:

First assume that conditions are such that $x_0 > x_A$. Then the value of the ratio

$$\frac{M_A}{M} = \frac{l_1L_2}{l_1L_2}\,\frac{(x_0-x_1)\,(y_2-y_0)}{(x_2-x_A)\,(y_0-y_1)} - \frac{x_2-x_A}{x_2-x_0}$$

for given values of x_A and x_0 is the greatest possible

when the relation between x_0 and y_0 is that for phase equilibrium. With this value of y_0 the above expression for the ratio $\frac{M_A}{M_0}$ is a maximum when x_A is as large as possible. That is, x_0 and y_0 being fixed, that ratio is greater when $x_A = x_0$ than when $x_A < x_0$. But since when $x_1 = x_0$ the value of that ratio is independent of x_0, it follows that, x_1 being fixed, the ratio is greater when $x_0 = x_A$ than when $x_0 > x_1$.

Next assume that $x_0 < x_A$. Then the least possible value of y_0 is that for phase equilibrium with the combined liquids M_0 and M_A. If x_3 is the composition of this combined liquid, we have

$$x_3(M_0 + M_A) = x_0M_0 + x_AM_A$$

from which

$$x_A = (x_3 - x_0)\frac{M_0}{M_A} + x_3$$

Substituting this value of x_A in the equation

$$\frac{M_A}{M_0} = \frac{l_1L_2(x_0 - x_1)(y_2 - y_0)}{l_2L_1(x_2 - x_A)(y_0 - y_1)} - \frac{x_2 - x_0}{x_2 - x_A}$$

we obtain

$$\frac{M_1}{M} = \frac{l_1L_2(x_0 - x_1)(y_2 - y_0)}{l_2L_1(x_2 - x_3)(y_0 - y_1)} - 1$$

Now suppose that x_3 remains constant—i.e., x_A decreases and x_A increases in such a way as to maintain x_3 constant; then y_0 remains constant. But as x_0 increases, the ratio $\frac{M_A}{M_0}$ increases—i.e., the ratio when $x_3 = x_A = x_0$ is greater than when $x_0 < x_3 < x_A$. Since, however, when $x_3 = x_A = x_0$, the ratio is constant whatever be the value of x_0, it follows that for a constant x_A a maximum value of the ratio $\frac{M_A}{M_0}$ is obtained when $x_0 = x_A$.

In other words, for minimum reflux the liquid feed entering an intermediate level should be admitted in amount and at a level such that the composition of the liquid descending in the column has the same composition at that level as the entering liquid.

Example of Use of Preceding Formulas

As an example, let us consider the case where we are rectifying a liquid whose molecular composition is 40 per cent oxygen. Then $x_0 = 0.40$. The molecular composition of the vapor having phase equilibrium with the liquid is, according to Baly, 15.5 per cent; i.e.:

$$y_0 = 0.155$$

Let us assume that we obtain pure liquid oxygen at the bottom and pure nitrogen vapor at the top of the column. On this assumption, we have:

$$x_2 = y_2 = 1 \quad x_1 = y_1 = 0$$

For oxygen, $L_B = 51.15$ cal. per gram, or 0.0731 cal. per c.c., and for nitrogen, $L_1 = 47.85$ cal. per gram, or 0.0598 cal. per cc.

Substituting these values in the above equation between M_1 and M_0, we obtain:

$$M_A = 2.42M_1$$

or

$$M_1 = 0.413M_A$$

as the minimum relative amount of "reflux" liquid necessary. If the 40 per cent liquid is obtained by selective liquefaction of a gaseous mixture of nitrogen and oxygen, the percentages of which have the same ratio as those of ordinary air, the increase of the oxygen percentage of the liquid being obtained by withdrawing a residual gas composed of pure nitrogen during the process of liquefaction, then the amount of this pure nitrogen vapor available after liquefaction for use as "reflux" liquid may be calculated as follows:

Dry air contains, by volume, 21 per cent oxygen and 78 per cent nitrogen approximately, the remainder being mostly argon, carbon dioxide and hydrogen—i.e., the relative molecular percentages of oxygen and nitrogen in air are, say, 21 per cent oxygen and 79 per cent nitrogen.

Since the oxygen contained in the 40 per cent liquid is 21 per cent of the original gaseous mixture, all of this liquid is 21 ÷ 40 = 52½ per cent of the whole. Hence the pure nitrogen withdrawn during the formation of the liquid enriched in oxygen is 100 — 51½ = 47½ per cent of the whole.

The minimum amount of nitrogen necessary as reflux liquid, being 0.413 times as much as the liquid enriched in oxygen, will be 0.413 × 0.52½ = 0.217 of the whole. Hence there will be as surplus a maximum of 0.475 — 0.217 = 25.8 per cent of the whole as pure nitrogen not necessary for perfect rectification.

Continuation of this series of articles will be published in a subsequent issue.

Surface Oxidation During Hardening

One of the problems now being studied by the gage steel committee of the Bureau of Standards is the dimensional changes on hardening. To determine this, an accurate 4-in. cylinder 1 in. in diameter is measured and weighed both before and after hardening.

Surface oxidation may easily cause a scale to form thicker than the changes expected. If the scale is removed, some metal is lost and the change recorded is less than that due to hardening alone. The dimensional changes on hardening may be completely masked by the scaling effect. Coatings such as enamels, sodium silicate and electrodeposited silver have been tried in an effort to prevent oxidation in the air atmosphere of an electric furnace, but none was satisfactory under these conditions. However, by allowing illuminating gas to flow into the furnace at a rate just sufficient to burn the air leaking in, oxidation was apparently inhibited without disagreeable fumes from the furnace. Scale is then formed only during transfer to the quenching bath and is removed by cleaning with gasoline and pickling for a short time in cold 10 per cent H_2SO_4.

It was recently noticed that the 4-in. gage specimens, weighing about 400 grams, were losing from 0.5 to 1.0 gram in weight on hardening in this manner. To determine at what stage the loss occurred, a specimen was heated to 800 deg. C. as above, and after holding in the air for 5 seconds, was quenched in a small can of water so that the scale could be recovered. The weight of scale collected was 0.81 gram and the loss of weight of the specimen was 0.56 gram. On pickling 10 minutes the specimen lost 0.19 gram more, and on repeating the pickling only 0.01 gram, showing that the acid removes residual scale not flaked off during the quenching, but does not attack the metal seriously. This specimen increased in length by 0.0144 in. and in diameter by 0.000 in. on hardening, but before pickling. On pickling it lost 0.0004 in. in both length and diameter, which is evidently the thickness of the remaining oxide.

The total loss of 0.76 gram is equivalent to a layer of metal about 0.0004 in. thick over the whole surface or a loss of double that amount in length and diameter

Legal Notes

By Wellington Gustin
Of the Chicago Bar

Officers as Dual Agents

Presumption Against Validity of Transactions by Men Acting for Both Corporations

In a suit brought by the Mathieson Alkali Works against Arnold Hoffman & Co., Inc., the U. S. District Court in its opinion (280 Federal, 133) says that there is a strong presumption against the validity of transactions between corporations where conducted entirely through the agency of officers acting at the same time for both corporations, and the burden is on those who would maintain the transactions to show their entire fairness.

And a settlement or acceptance of accounts rendered requires independent representation to the party to whom they are rendered, and there can be no account rendered as between corporations where the transactions are conducted entirely through the agency of officers acting at the same time for both.

Again the court says that in a controversy between two corporations, when plaintiff corporation sought an accounting from defendant corporation, which was both a buyer and an agent for sale, with a limited agency, as in this case, the plaintiff is presumed to know what disposition was made of its own product and what it received for it from defendant, both as buyer and as sales agent. It is the duty of plaintiff, its officers and directors, to conduct its business with ordinary care, and the burden of explanation rests on it which cannot be sustained by a mere general claim that it confided implicitly in the defendant, so as to require the defendant to assume the burden.

Further, it says that when a business transaction is closed by an agent and his report is made thereon, the principal is charged with knowledge of what is reported, and cannot excuse himself from responsibility for action or inaction by continued reliance on one who is no longer a fiduciary as to completed transactions.

Langmuir Patent Again Upheld

Preliminary Injunction Granted Against Company Copying Tungsten-Nitrogen Lamps

Application of the General Electric Co. for a preliminary injunction against the Incandescent Products, Inc., was recently granted on the basis of the Irving Langmuir patent No. 1,180,159, owned by the former. This patent has been upheld in many cases and in various jurisdictions, and the court says ordinarily a patentee presenting such facts is entitled to a preliminary injunction on a showing of infringement. (280 Federal Rep. 856.)

The courts have written the history of the incandescent electric light lamps prior to the Langmuir invention. The Edison elements were three—a carbon filament, in a vacuum, inclosed in a glass chamber. These elements remained the same, with refinements, until Langmuir introduced into the art a co-ordination between a coiled tungsten filament in nitrogen, argon or mercury vapor gas, inclosed in a glass chamber under pressure.

The court says defendant's lamps are designed for use in the ordinary circuits. Those manufactured directly are rated at 150, 100 and 75 watts. The imported Austrian lamps sold by it are rated at 40 and 25 watts. There is in each a glass container with a coiled tungsten filament, filled with nitrogen gas under pressure. In the Austrian lamp the gas is a mixture of argon and nitrogen.

Defendant's Action Willful Disregard of Established Rights

There is nothing to distinguish defendant's lamps from the plaintiff's, as the entrance of the defendant into such business, after the establishment of the validity of the plaintiff's patent in another jurisdiction, indicates not only a slavish imitation but a willful disregard of established rights, says the court.

Defendant contended that the Langmuir patent is limited by the measure of the effectiveness and life of the lamps, as contrasted with those in which a vacuum was used. But the court points out that the patent was granted on a structure definitely described and clearly portrayed, the privilege being for the structure and not the result. It says it was a device, and not a result, which was patented, and the defendant can avail itself of nothing because in its manufacture the parts used by the Langmuir are so inartistically correlated as to produce a less efficient result.

Again, defendant called attention to the prior French patent La Tang No. 384,915 as an anticipation, and also to the Edison patent. But the court says the Langmuir patent having a tungsten filament in nitrogen gas was not infringed by prior patents for a vacuum tungsten lamp, or for a lamp having a carbon filament in nitrogen gas.

Sale of Element of Patented Combination Does Not Give Implicit License to Use Combination

More litigation involving the infringement of the Langmuir patent No. 1,180,159 is found in two separate suits in equity brought by the General Electric Co., against the Continental Lamp Works, Inc., and against the United Lamp Manufacturers' Corporation. (280 Federal 846.) Defendants admitted the validity of the patents, but denied infringement, claiming an implied license.

It appears that the General Electric Co., plaintiff, sold and continued to sell lamp bases for the lamp of the Langmuir patent to defendants after it knew or had reason to believe that the latter were using these bases in the manufacture of lamps infringing the Langmuir patent. Plaintiff contended that in making such sales it was not granting a license under the lamp patents, the contract of sale providing in red letters:

"The sale of bases by us confers on the purchaser no license under any patents of the General Electric Co. covering or relating to the structure of incandescent lamps, or the materials, machines or processes used in their manufacture."

Trial Court Held Plaintiff's Knowledge Implied License

Regardless of this, the defense contended that by reason of the purchase of the bases there was an implied license to use the lamps constructed under the Langmuir patent. The trial court upheld this contention and gave

judgment for the defendants, upon the theory that the bases which the plaintiff sold to them were sold with the knowledge that these manufacturers were making the lamps under an implied license from the plaintiff, General Electric Co., and that because the bases which were sold could be used only in constructing a patented article (Langmuir construction), it is presumed in law to be intended, by both the buyer and seller, to be used for that specific purpose, and when the plaintiff made a sale it carried with it to the defendants an implied license.

This decision was reversed by the United States Circuit Court of Appeals. It said the burden was upon the defendants to establish that the parties agreed, by a meeting of the minds, that the license contended for should be granted, or that when the bases were purchased the parties understood, and the defendants had adequate reason to assume, that they had received an implied license under the circumstances, which stopped the owners of the patent from denying that such was the intention of the parties at the time of the sales. And the court found the facts to be that there was nothing written or spoken from which a license was granted or might be implied.

Inventor Controls Terms for Use of Invention

Use of an invention can be obtained only on the inventor's terms. Without paying or doing whatever he exacts, no one can be exempt from his right to be excluded and, whatever the terms, the courts will enforce them, provided, of course, the licensee is not thereby required to violate some law outside of the patent law. On this point, in the case of United Nickel Co. vs. California Works, 25 Federal 475, the court said:

"The selling of the solution does not authorize, inferentially or otherwise, the use of it for the purpose of nickel-plating, whatever else it may be used for, without also procuring a license to nickel-plate under the first and fourth claims, which are separate inventions."

So where the owner of a patent sells a patented article subject to a restriction, the purchasers, with notice of this limitation, could acquire no better rights than strangers to infringe upon that part or claim of the monopoly still secured to the patentee. And the sale of an element of a patented combination does not necessarily imply license to use the whole combination. But there is always a question of what is a fair inference from the transaction.

In Edison Electric Co. vs. Peninsular Light Co., 43 C. C. A. 479, Judge Lurton pointed out that there may be circumstances under which the sale of a patented article by the patentee will carry with it the right to use another in co-operation with the first, although the thing be covered by a second patent, such as where an article of a peculiar construction is sold which has no practical use unless it be used in combination with some subordinate part covered by the patent of the vendor and the right to use the latter in co-operation with the former might be implied under the circumstances.

Rule of Law Covering Such Cases

The law was stated by Judge Lurton in these words: "The limitation upon this is that the things which pass by implication only must be incidental to the grant, and directly necessary to the enjoyment of the thing granted; the foundation of the maxim lies in the presumption that the grantor intended to make his grant enjoyable. . . . It is evident that the extent of an implied license must depend upon the peculiar facts of each case. The question in each case is whether or not the circumstances are such as to estop the vendor from asserting infringement."

In the case at bar this rule was applied. The court said that the mere sale imparts no license, except where the circumstances plainly indicate that it did, or except where good faith required, or where it cannot be doubted that the vendees understood that they were getting a license. In view of the red-lettered provision in the terms of sale, there was no justification for the vendees' assumption that they received a license under the patent. Neither conduct or language of the parties would justify the buyers of the bases in their use of the patented lamp in connection with same. The bases were capable of non-infringing uses, and the notice on its face was intended to warn against the use by infringement of the patent in suit. Therefore the lower court's judgment was reversed.

Breach of Implied Warranty

Federal Court of Appeals Holds Payment of Price Does Not Bar Action for the Breach

A question in sales law was presented in an action brought by the Lackawanna Steel Co. against the Herbrand Co. in the federal District Court, whose judgment was partly affirmed by the U. S. Circuit Court of Appeals. (280 Federal Rep., 12.)

Suit was brought for the price of a large quantity of steel bars sold to defendant, which counterclaimed for damages alleged for an asserted breach of implied warranty of fitness of a large amount of steel bars purchased in the previous year. The damages claimed consisted of the difference between the invoice value of the defective steel and its scrap value ($4,605.15), together with expenses incurred by plaintiff ($16,927.50) in manufacturing the defective forgings.

Plaintiff denied the claims of defendant. First, because defendant paid in full for the steel after it knew or should have known of the alleged defects therein. Second, because there was a general custom existing in the steel trade at the time whereby the manufacturer was not liable for the cost of labor or other expense incurred by the buyer in working defective steel, but that the latter's remedy with respect to reimbursement was limited to the replacement of the steel.

A verdict was directed upon the sole ground that defendant's right to complain of the defective steel was barred by its voluntary payment of the purchase price in full, with knowledge of the defects. It is a general rule of law that money voluntarily paid with full knowledge of the facts cannot be recovered.

Question of Waiver of Warranty Is a Question of Fact

But the Court of Appeals points out that an action for breach of warranty is not barred as a matter of law by payment of price. A retention of goods purchased and the payment of the price, or suffering the seller to recover a judgment therefore without defense and with knowledge of breach of warranty, does not as matter of law bar an action for the breach. The question of waiver of the warranty is at the most one of fact. Nor does retention of goods and payment bar an action for breach of warranty under the uniform sales act

as in force in Ohio. And while the extension of time granted for payment would furnish a good consideration for the waiver of action for breach of warranty, an extension does not as matter of law show such a waiver under the uniform sales act.

Now whether the defendant waived its right to damages under the circumstances of having paid without protest, etc., was a question of fact that should be left to a jury to decide.

Custom Limiting Liability Held Not Unreasonable

The custom in the steel trade as alluded to was established by witnesses, and this custom, under which the buyer's only remedy for defective steel was replacement or credit for its value, at the buyer's option, the seller not being liable for cost of labor or other consequential damage, the court held was not an unreasonable custom.

But the court said this custom did not forbid a recovery for failure to replace defective and unused steel, whose purchase price was greatly in excess of its scrap value; the seller being asked to replace such defective steel and having failed to make such replacement.

For error of the District Court in directing verdict for plaintiff in full of its claim the judgment was ordered reversed unless the plaintiff should remit from the judgment the sum of $4,605 15, covering the defective steel.

New Quenching Tank

Fig. 1 shows a quenching device recently designed by the W. S. Rockwell Co. The rectangular tank is filled to any desired depth with circulating oil or water. Heated metal parts of such size and shape as will permit

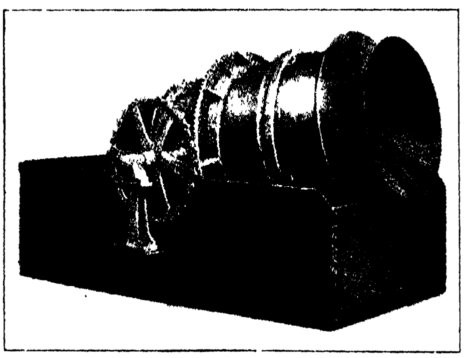


FIG. 1—ROCKWELL ROTARY QUENCHING TANK

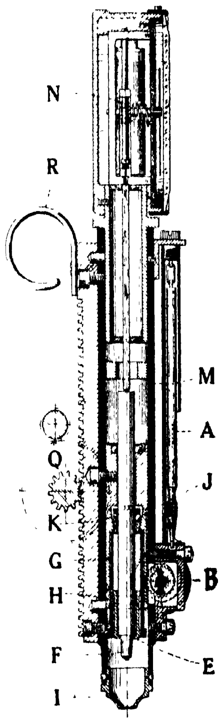
tumbling about are then dropped into the submerged end of the rotating drum. It is then automatically picked up in small batches by the internal thread of the rotating tank and conveyed through the quenching fluid as it is raised to the cone-shaped discharge spout. Naturally the device works best with a continuous flow of heated metal.

New Model Scleroscope

The problem of recording indications of the well-known Shore Rebound Reading Scleroscope Model C was solved by the use of a comparatively long hammer F, which, being much heavier, develops the same striking force by dropping only a short distance ($\frac{3}{4}$ in.). This principle is embodied in the "Model D Recorder." Although too complex to describe here at length, the hammer rebound is locked and recorded by means of a ball and hollow cone clutch. This clutch is made passive and active by raising balls in their retainer cage out of jamming contact with the hammer body, or putting them back to jam on downward pressure—no movement in this direction is then possible.

First Cycle (Second Period)

Thus when the hammer is ready to drop, its shoulder rests on the inner flange of the pilot sleeve E (see illustration), the upper end of which has just raised the ball cage G-J out of clutching contact. This bushing is held up by a hook.



MODEL D RECORDER

Upon releasing the hook, the hammer and its pilot sleeve E drop down together. The clutch having been left open, as it were, the ball cage remains up by friction of a band spring H.

The hammer strikes first, a moment later, the lower end the pilot sleeve E, which falls a little further, strikes the downward extending inner shoulder of the ball retainer sleeve G, instantly dropping them in jamming contact with the hammer. The movement of the ball cage sleeve is very short; the last part of its critical period, or just when the balls begin to touch the hammer body, is done at the moment the hammer is brought to momentary rest preparatory to rebounding.

The balls now in position do not retard the rebound but absolutely prevent a reverse motion, hence the slightest rebound is fixed positively and faithfully recorded.

Second Cycle

The hammer F, now locked firmly in the hardened cone sleeve K, the ball retainer G and pilot sleeve E are all raised up together by a rack and pinion by knob B to an upper stop Q. Here the pilot sleeve catches on its hook D and the hammer is brought in contact with the dial hand rack bar M, moving it to the extent of the recorded rebound. The spiral spring inside of the knob B then holds the clutch hammer and dial hand fixed until the next test is made.

First Cycle (First Period)

The turn of knob forward against its spring causes movements inside which constitute the first cycle. In the first period of this cycle the clutch sleeve, with its hammer still locked in it, is caused to descend. Soon the hammer contacts with the previously hooked up pilot sleeve E, where it remains on it as a standard height rest. As the clutch sleeve descends more, the ball cage contacts with the pilot sleeve, de-clutches the hammer and releases the hook so that they drop again for the second test (see first cycle, second period).

Synopsis of Recent Chemical & Metallurgical Literature

Manufacture of Blue Gas

James Hall, of Glasgow, Scotland, presented at a recent gas association meeting operating results from work at the gas plant of that city where thorough test of the efficiency of water-gas operation was made recently. This test was a 24-hour run with two Humphreys and Glasgow carburetted water-gas sets operated as blue-gas generators, using coke as fuel. The operating cycle was 1½ minutes blow, 1 minute up-run, 2 minutes down-run, and ½ minute up-steam run. Clinkering five times per set per day occupied from 15 to 50 minutes for a total of 6.16 hours out of the 24 operated. Some of the most interesting results are as follows:

Dry ash-free coke used per 1,000 cu ft of blue gas made . . . . . . 33.85 lb

Heating value of gas (gross). . . . . .296 B.t.u per cu ft

Composition of gas	
H	16.8
CH_4	1.1
CO	11.1
O	0.1
CO and H_2S	3.1
N	7.2
Composition of blue gas	
CO	9.0
O	Nil
CO	16.6
N_2	71.1

Further details can be found in *Gas Journal* (London), page 209, issue of Jan. 24.

Automatic Control of Water-Gas Sets

In the current (February) number of *American Gas Association Monthly*, C. H. Stevick presents a history of the development of automatic control of water-gas sets. The article also includes full description of the U.G.I thermal automatic control equipment, the Gas Machinery Co. type of equipment, and the Kennedy automatic control apparatus as made by the Bartlett-Hayward Co. The mechanism thus described is planned exclusively for water-gas apparatus operation, but the methods and apparatus would be adaptable to other types of automatic process control where periodic opening and closing of valves, lids, etc., is necessary. Chemical engineers having problems of this sort will find this review of the subject particularly pertinent.

Electroplating With Cobalt

A few years ago some Canadian research workers in the Canadian Department for Mines created considerable interest by putting forward a proposal to use cobalt as a metal for electroplating in the place of nickel. The results of these researches showed that cobalt could be deposited on brass, iron, steel, copper, tin, german silver, lead and britannia metal, and that the deposits were firm, adherent, hard and uniform, and could be readily polished to a satisfactory finished surface. The cobalt deposited was harder than the nickel and the speed of deposition considerably greater. It was also claimed that its resistance to corrosion was definitely superior to that of nickel, and that the deposits stood satisfactorily all the usual bending, hammering and burnishing tests. The actual weight of cobalt required for a good coating was stated to be about a quarter that of nickel. These claims have not, apparently, been entirely substantiated in British workshop practice, according to *The Engineer* (Jan. 12, 1923), but it is possible to electroplate with cobalt quite satisfactorily and very rapidly. It is considered by that publication unlikely that cobalt will ever attain the industrial importance of its sister element nickel, but it has a peculiar interest of its own, and exercises considerable fascination upon those who work with it.

Recent Chemical & Metallurgical Patents

American Patents Issued Jan. 30, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.*'s staff and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,443,359—Fuel and Manufacturing Process. Christian I Gillstrap, Iowa.

1,443,367—Apparatus for Dehydrating Fruit, Vegetables and Other Materials. Joseph E. Kennedy, New York.

1,443,381—Accelerating the Vulcanization of Rubber and Method of Producing the Same. Stanley John Peachey, Davenport, Stockport, England.

1,443,439—Process and Apparatus for Introducing Electric Energy Into a Space of Action. George T Southgate, Washington, D. C.

1,443,454—Process of Manufacturing Paper or Pulp. Lewis Miller Booth, Plainfield, N. J.

1,443,492—Apparatus for Determining the Relative Density of Two Gases. Ross F. MacMichael, Chicago, Ill.

1,443,538—Foam for Preventing Evaporation of Stored Liquids. Frank A. Howard, George H. L. Kent, James M. Jennings, Elizabeth, N. J.

1,443,547—Apparatus for Recovering Solvent. Arthur Samuel O'Neil, Springfield, Ill.

1,443,552—Esters of Trihalogentertiary Butyl Alcohol and Process of Forming Same. Thomas B. Aldrich, Detroit, Mich.

1,443,602—Preservative Composition. Max G. Weber, Newark, N. J.

1,443,616—Process for Separating Solids by Crystallization from Solvents. Henry Vincent Aird Briscoe, London, England.

1,443,618—Process of Making Coke. William Everard Davies, London, England.

1,443,674—Method for the Treatment of Silicates With Acid in Order to Obtain Saline Solutions Free From Silica. Gian Alberto Blanc, Rome, Italy.

1,443,697—Manufacture and Production of Tanning Agents. Robin Bruce Croad, Liverpool, England.

1,443,707—Roasting of Zinc Sulphide Ores, Preparatory to Leaching. Herbert W. Gepp, Melbourne, Victoria, Australia.

1,443,708—Roasting of Zinc Sulphide Ores, Preparatory to Leaching. Herbert William Gepp, Melbourne, Victoria, Australia.

1,443,714—Concentrating Process. Oliver Edward Merrell, Syracuse, N. Y.

1,443,735—Mixing Machine. Robert Edmondson, Rochester, N. Y.

1,443,742—Method of and Apparatus for Effecting Continuous Distillation. Francis M. Hess, Chicago, Ill.

1,443,743—Vapor Box or Still for Distillation Systems. Francis M. Hess, Whiting, Ind.

1,443,813—Enamel and Method of Making the Same. Alexander L. Duval D'Adrian, Washington, Pa.

1,443,816—Electric Furnaces. Francis A. J. FitzGerald, Niagara Falls, N. Y.

1,443,881—Fermentation of Cellulose. Herbert Langwell, Stockton-on-Tees, England.

1,443,935—Resinous Product. Louis Weisberg, Grantwood, N. J.

1,443,936—Process of Making a Molding Composition. Louis Weisberg, Grantwood, N. J.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Artificial Silk.—W. O. Mitscherling, of the Atlas Powder Co., Wilmington, Del., has been granted a patent covering a process for the preparation of viscose solutions of cellulose for the production of films or threads whereby the keeping qualities of the solution are improved, and at the same time the product is improved in quality. The ordinary carbon bisulphide viscose solution is quite unstable and gradually decomposes so that the mass sets to a solid jelly in about a week. This of course necessitates spinning before the setting takes place.

The process described in this patent is briefly as follows: The soda-cellulose is treated with carbon bisulphide to form the cellulose xanthate without aging the soda-cellulose and by using a weight of carbon bisulphide, which instead of being from 40 to 60 per cent of the weight of cellulose is only 30 to 32 per cent of that weight. The temperature does not have to be carried so low, the patentee recommending a temperature of approximately 20 deg. C. The cellulose xanthate formed is dissolved without aging in an alkaline solvent containing an amount of caustic soda so that the total amount of caustic soda is not less than the weight of the cellulose and not more by 2 per cent.

In connection with this patent, it will

be interesting to refer to British patent 183,882, which was granted to H. Dreyfus of London on Sept. 27, 1922, and which was abstracted in *Chem. & Met.* on p. 1138 of the issue for Dec. 6, 1922. (1,435,650. Nov. 14, 1922.)

Oil Treatment—An improvement in petroleum refinery methods, particularly as they relate to the washing of mineral oil, paraffine wax and other petroleum products, is described in a patent by Charles F. Kennedy, which has been assigned to the Atlantic Refining Co. of Philadelphia. The purpose of the washing, of course, is to improve the odor or color of the product or to render it non-emulsifying. Recourse is made to a suitably diluted solution of soap such as can be made by the combination of an alkali metal or ammonium salt with those organic or sulphonic acids found in ordinary acid sludge, such as results from the treatment of petroleum or petroleum distillates with strong or fuming sulphuric acid. Another and perhaps better source of these acids is the acid coke or tar which separates from the sludge.

Washing wax-bearing mineral oil or distillates prior to chilling and pressing is said to result in an improved crystalline structure of the wax formed upon chilling the oil, with resultant improved pressing qualities of the oil itself, better and more complete separation of the wax from the filter medium, an improved slack wax and a resultant improvement in the filtered oil.

Thus, in fractionating crude petroleum, as is indicated in Fig. 1, there is a residuum in the still which is heavy wax bearing oil, from which heavy or so-called cylinder lubricating oil may be produced. This residue may be washed with the soap solution previously referred to, and upon reducing its viscosity by the addition of naphtha or other low viscosity oil, it is chilled and the contained solids of the nature of petrolatum separate out more readily. In Fig. 2 is indicated one of the various forms of cracking distillation of crude petroleum, resulting in various cuts or products, any of which may be washed by the solution of sludge acid soap described in this patent. (1,439,171. Dec. 18, 1922.)

Dyes—A new yellow dye which is insoluble in water and in most organic solvents and for which is claimed superior fastness to washing, acids, chlorine and to light, is covered by a patent taken out by Georg Kalischer, Jens Muller and Detlev Nissen, all of Frankfort-on-the-Main, Germany, and assigned to Leopold Cassella & Co., Gaselschaft mit Beschrankter Haftung. This vat dye is prepared by heating methylanthraquinone with sulphur and aromatic compounds which contain the paradiamine-nucleus in their molecule. The paradiamines themselves such as benzidine, p-phenylenediamine and its substitution products are particularly well suited for the reaction. The quantities of the paradiamines of the compounds containing the paradiamine-nucleus may be varied considerably, but the proportion of 2 molecules 2-methylanthraquinone to 1 molecule paradiamine has proved particularly advantageous. The dyes yield olive to brown colored vats with hydro sulphites from which vegetable fibers are dyed greenish to reddish-yellow shades. The new dyestuffs are distinguished from those obtained by heating 2-methylanthraquinone with sulphur alone by their different chemical behavior and also by their superior tinctorial properties. (1,440,833. Jan. 2, 1923.)

Dehydration of Petroleum Emulsions—It is proposed to apply the principles of osmosis to effect a separation of water from emulsions of various petroleum products. In brief, the process consists of separating a body of the emulsion from a body of water by means of a porous diaphragm, and causing a direct current of electricity to flow between these two bodies. The water particles of the emulsion are caused to pass through the diaphragm by osmosis, thus dehydrating the emulsion. (1,440,835. Wynn Meredith, assignor to Petroleum Rectifying Co., of San Francisco. Jan. 2, 1923.)

Recovery of Phenol Vapor—Walter Runge and H. A. Curtis, of the International Coal Products Co., describe in two patents methods for recovery of phenol vapors evolved from solvent recovery processes or from other gaseous mixtures. The first of these patents proposes the use of phenolates, the second the use of suitable tar-oils, such as the material commonly known as "dead oil."

"When the sodium phenolate solution is made by neutralizing a sodium hydroxide solution of greater than 1.07 specific gravity the resulting sodium phenolate solution is miscible with tar acids in all proportions. It is feasible to employ this absorbing function of the sodium phenolate solution to ad-

FIG. 1.

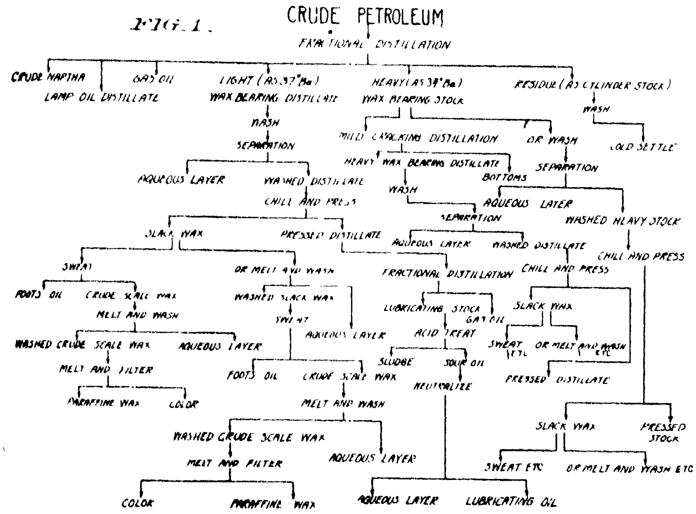


FIG. 1—A TYPICAL SCHEME FOR THE FRACTIONAL DISTILLATION OF CRUDE PETROLEUM

FIG. 2

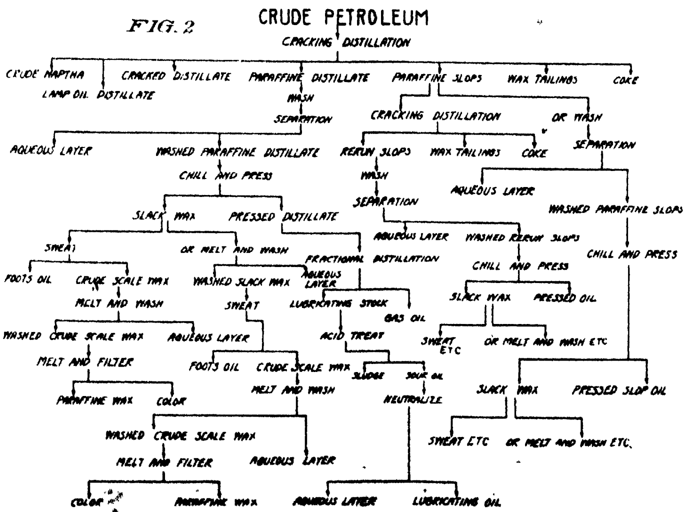


FIG. 2—DIAGRAMMATIC REPRESENTATION OF A TYPICAL CRACKING DISTILLATION OF CRUDE PETROLEUM

vantage in the recovering of the phenol-cresol-vapors from the gaseous mixture, and the present process employs the sodium phenolate solution of sodium cresylate solution—of the character specified—as the absorbing agent for the phenol or cresol vapors. The sodium phenolate solution picks up much less carbon dioxide from the air than would be the case with sodium hydroxide or caustic soda. The process may be employed as a continuous process or as an intermittent one."

The second patent, relating to the use of tar-oils, employs oils distilled from tar between 170 and 230 deg. C., preferably oils freed from tar acid.

Both patents are assigned to the Bregeat Corporation of America; and reference to this company's process is made in describing the invention. (1,439,128, 1,440,108, granted Dec. 19, 1922, and Dec. 26, 1922, respectively.)

Purification of Liquors Containing Phenol—Two recent patents, both assigned to the Koppers Co., Pittsburgh, relate to somewhat similar procedures for purification of waste liquor from ammonia stills of coke or gas plants and other waste liquor containing phenol which cannot be discharged to waste because of the damage done in streams, lakes or other water courses. The first of these patents, issued to Ralph L. Brown, relates to the use of certain phenol-destroying micro-organisms which are apparently of the bacterial type for the elimination of phenol apparently by oxidation to other unobjectionable compounds. The operation is conducted by passing the liquor through a filter of humus material properly activated by the presence of the suitable micro-organism. The other invention relates to the use of humus material for filtration with intermittent operation during which the humus material is used and then subsequently revived for re-use. (1,437,394 and 1,437,401, granted Dec. 5, 1922, respectively to Ralph L. Brown and to H. S. Davis and Saul D. Semenow.)

Anesthetic Compound—Roger Adams and Ernest H. Volwiler have patented a process of manufacture of the normal butyl ester of para-amino benzoic acid, an anesthetic compound which may be used locally, internally, for dusting on wounds and for anesthetic purposes in general. The compound is made by the reduction of the normal butyl ester of para-nitro benzoic acid. The latter is prepared by refluxing a mixture of para-nitro benzoic acid and butyl alcohol with a small amount of concentrated sulphuric acid for 8 hours. The reaction mixture is then distilled in a vacuum to remove the excess alcohol, the residue treated with dilute sodium carbonate solution, then extracted with ether, dried and distilled. After the ether has been removed, the residue is warmed up to vacuum for some time to remove the remainder of the normal butyl alcohol. The residue consists of fairly pure normal butyl ester of para-nitrobenzoic acid, which may be crystallized from petroleum ether. This nitro ester is mixed with powdered iron and 20 per cent of hydrochloric acid added gradually, the mixture being kept at about 50 deg. C. during the reduction. The reaction mixture is filtered, made alkaline with sodium hydroxide and extracted with ether. The compound may be crystallized from water or petroleum ether and has a melting point when pure of 57 to 58.5 deg. C. (1,440,652. Jan. 2, 1923.)

Commercial Fertilizer—E. A. Morgan, of Dorchester, Mass., has patented a commercial fertilizer which he claims is exceedingly beneficial. Primarily, it consists in the use of an appreciable percentage of finely ground sulphur in a dry mixed fertilizer. For example, 600 lb. of Canadian hard-wood ashes, 200 lb. of commercial crude potassium carbonate, 400 lb. of powdered sulphur, 400 lb. of sodium nitrate, 300 lb. of ground bone and 300 lb. of acid phosphate make up what might be called a typical formula. Sometimes when a less concentrated fertilizer is desired, a proportion of 5 parts of sifted soil or loam, ground wood, sawdust, etc., to 1 part of the formula is used. (1,440,836. Jan. 2, 1923.)

Method of Controlling Foaming of Boiling Liquids—C. E. Dolbear has assigned to the Industrial Research Corporation of San Francisco the following patent on preventing foaming in boiling liquids. Both petroleum and chlorine individually have some effect on the diminution of foaming, but the author has found that if the lighter boiling petroleum oils (the lighter oils prevent foaming which would be present in the heavier boiling fractions), the so-called "slop distillate" or "tops," are used in conjunction with chlorine (as the element or as chlorite or hypochlorite or other chlorine compound), the foaming is cut down by a very much greater amount. The author has used it particularly on potassium bearing brine. (1,440,973. Jan. 2, 1923.)

Vulcanizable Composition — W. E. Gardner, of Pittsburgh, has patented the following compositions which can be vulcanized to any degree of hardness or softness, depending on the time of heating. Twenty-five per cent of commercial rubber is broken down on the rolls to a consistency of thick molasses, and the following ingredients are incorporated with the rubber by sifting on to the roll: Sixty parts of fine Tripoli or its chemical or geological equivalent, 5 parts of sized mica, 2 parts of hydrated lime and 8 parts of sulphur. The compounding is then finished as usual on the roll and the sheets thus obtained can be treated in any way desired. (1,440,455. Jan. 2, 1923.)

Process and Apparatus for Treating Rubber—G. B. Britton assigned to the Firestone Tire & Rubber Co. a patent on a machine for drying rubber sheets. The washed sheet, thoroughly cleansed, is run through a pair of squeeze rollers and then into a small chamber, where it is treated with a blast of hot air from both sides. From this chamber it passes over a number of heated rolls, finally being wound up in convenient rolled form. It should be noted that the last roller is water-cooled, in order to prevent any bad effect from the rolling of the heated rubber. (1,440,371. Jan. 2, 1923.)

British Patents

For complete specifications of any British patent apply to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Artificial Silk—In the manufacture of artificial threads from an unripened viscose employing an acid coagulating bath, the carbon bisulphide contained in the freshly precipitated acid threads is removed by treating the threads, without previous washing, with an alkaline bath. The threads may be in the form of hanks or layers of yarn, the bath may be maintained at 60 deg. C., and to it may be added a small quantity of sodium sulphide so as simultaneously to remove the sulphur; in that case, only a single washing is necessary. (Br. Pat. 187,942; not yet accepted. Glanzfäden Akt.-Ges., Petersdorf. Dec. 20, 1922.)

Chromium Compounds—Chromite is decomposed by treatment with sulphuric acid and an oxidizing agent, such as chromic acid, at a temperature above 150 deg. C., the oxidizing agent, whether added directly to the reaction mixture or generated *in situ* by electrolysis, being present in amount insufficient to oxidize the iron completely. The chromite may first be treated with carbonaceous matter or a gaseous reducing agent at a red heat and part of the iron then extracted with dilute acid. Under the conditions set forth above, the chromium and part of the iron are converted into insoluble sulphates, from which the chromium is separated by adding a reducing agent to the diluted reaction mixture when the ferric sulphate is reduced, leaving a residue of insoluble chromium sulphate. This compound may be decomposed by boiling in aqueous suspension with caustic alkalis or alkaline earths, alkali sulphides or carbonates, alkaline earth carbonates or ammonia to yield chromium hydroxide or basic carbonate; it may be heated with caustic soda or potash in presence of air and with the optional addition of other oxidizing agents to yield sodium or potassium chromate; or it may be boiled with strong barium chloride or acetate solution to yield the corresponding chromium salt and barium sulphate. Alternatively it may be dissolved in dilute sulphuric acid in presence of ferric oxide and a small amount of oxidizing agent and the solution, after reduction of any ferric salt formed, treated with potassium sulphate for the production of chrome alum.

Instead of first separating the insoluble chromium sulphate, the mixture of

insoluble chromium and iron sulphates obtained in the initial decomposition may be treated directly for the production of chromium oxide.

In one process the mixed sulphates are washed and heated with excess of coal in a reducing atmosphere, a mixture of iron sulphide and chromium oxide being obtained.

In another process, the mixed sulphates are boiled with a slight excess of alkali-sulphide solution and the black precipitate obtained ignited in a reducing atmosphere at red heat.

In a third process the mixed sulphates are calcined and the resulting oxides mixed with coal and heated in a reducing atmosphere.

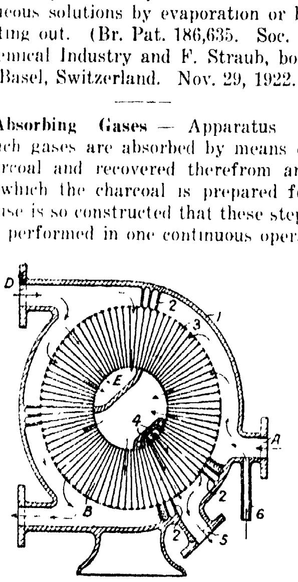
In each case the product is treated with acids to dissolve the iron, and the residual chromium oxide may be dissolved in sulphuric acid in presence of a small amount of oxidizing agent and used for the preparation of other chromium compounds. (Br. Pat. 187,636. C. K. Potter, St. Annes-on-Sea, and F Robinson, Bolton. Dec. 20, 1922.)

Dehairing Hides—Skins, especially those of rabbits, hares, kangaroos and opossums, are treated for the removal and recovery of the fur and hair without impairing the usefulness of the skins for the production of leather, by immersing them in a solution of sulphite of soda, then in a solution of ammonia, and finally subjecting them to a sweating process. The solution of sulphite of soda is of about 3 per cent strength, and the skins are soaked therein for about 12 hours to remove blood and fatty matter. The solution of ammonia contains about 4 pints of 880 ammonia in 4 gal. of water, and the treatment therewith is carried out in a closed vessel at a temperature of 80 to 120 deg. F. for about 12 hours. The skins are left in the sweating vat for 12 to 24 hours, the time varying according to the strength of the ammonia solution used and the temperature at which the sweating is carried out. The hair is then removed by scraping or brushing, which operation should be carried out as soon as possible after the removal of the skins from the sweating vat. (Br. Pat. 186,608; not yet accepted. G. Duckworth, Victoria, Australia. Nov. 22, 1922.)

Azo Dyes and Chromium Compounds—The chromium compounds of chromable azo dyes described in the parent specification are prepared by treating the dyestuffs in question in alkaline solution with the complex chromium compounds made by action of alkaline suspensions of chromium hydroxide on organic compounds containing more than one hydroxyl group. The process permits the use of iron vessels. According to examples: (1) the dyestuff from diazotized 1-amino-2-oxynaphthalene-4-sulphonic acid and α-naphthol, or that from diazotized 1-oxy-2-amino-4-methylbenzene-6-sulphonic acid and β-naphthol is refluxed with the product made by heating glycerine with caustic potash and chromium hydroxide paste; after diluting with water and neutralizing free alkali, the dyestuff is salted out; (2) the dyestuff from diazotized 1-oxybenzene-2-amino-4-chloro-6-sulphonic acid and 1-phenyl-3-methyl-5-pyrazolone is boiled with the chromium compound from gallic acid or glucose, the free alkali neutralized and the chromium compound salted out. The products dye wool blue, violet or red shades fast to light.

Complex chromium compounds of organic compounds containing more than one hydroxyl group are obtained by heating with alkaline suspensions of chromium hydroxide the parent compounds—for instance, polyhydric alcohols and phenols, tanning agents, sugars, degradation products of cellulose and waste products from sulphite cellulose manufacture; glycerol, glycol, glucose, tannin, gallic acid and phloroglucinol are mentioned. The compounds may in part be separated from their aqueous solutions by evaporation or by salting out. (Br. Pat. 186,635. Soc. of Chemical Industry and F. Straub, both of Basel, Switzerland. Nov. 29, 1922.)

Absorbing Gases — Apparatus in which gases are absorbed by means of charcoal and recovered therefrom and in which the charcoal is prepared for re-use is so constructed that these steps are performed in one continuous opera-



tion. The annular sieve drum 3 is subdivided by radial imperforate partitions into a series of narrow sectors containing charcoal, and the annular space between the drum 3 and the closed cylindrical casing 1 is divided by partitions 2. Gas entering at A passes radially through the charcoal, from which the absorbed constituents are recovered by rotating the drum so that sectors containing absorbed gas are subjected to the action of steam introduced from inlets 4. The mixture of steam and liberated gas leaves the apparatus at 5 for condensation and recovery, any residual gas being returned by the inlet 6. The gas originally introduced at A passes again through the charcoal at B, thereby cooling and drying the charcoal, and the gas having been cooled, it is passed again through the charcoal by means of the inlet D to complete the cooling process, and is finally withdrawn at E. The gas streams and the steam current may be applied axially instead of radially, and it is also stated that the system of supply pipes may be rotated. The apparatus is described with reference to the removal of benzene from illuminating gas. (Br. Pat. 187,223. Farbwerke vorm. Meister Lucius and Bruning, Hoechst-on-Main. Dec. 6, 1922.)

Desulphurizing Oils—Petroleum and similar oils are desulphurized by vaporizing the oil to convert the sulphur into sulphuretted hydrogen, and then treating the vapors with water or steam and a gaseous dissociating agent such as chlorine or sulphur dioxide, preferably under the action of a magnetic field. The vaporized oil, steam and dissociating agent are led into a chamber, packed with firebrick, pumice, etc., and surrounded by an electrical coil. The chamber is heated to 300 to 400 deg. C. In an example, the oil is vaporized, and the contained volume of sulphuretted hydrogen is determined. An equal volume of chlorine or sulphur dioxide and five volumes of steam at 240 deg. F. are then admitted. (Br. Pat. 186,738. W. R. Walkey, Westminster, and A. F. Bargate, London. Nov. 29, 1922.)

Food Products From Colloid Mill—Fruit, vegetables, etc., are made into colloidal dispersions in water or other liquid by a mechanical process such as that described in specification 155,836; undesired constituents may be precipitated and the solution concentrated or dried. When grapes are treated, the cellulose may be coagulated by boiling or by alcohol, which may be added or produced by fermentation. Apples may be treated and the juice freed from cellulose by boiling, mixed with sugar and evaporated to form a conserve. In treating beet, impurities may be coagulated by boiling and sugar separated in the ordinary way. Cacao beans may be treated and the solution heated to 60 to 80 deg. C. to coagulate cellulose, lignin, etc. The solution is concentrated by drying with or without sugar and a protective colloid such as gelatine or Iceland moss, and the dry product pulverized. (Br. Pat. 186,756. Plauson's, Ltd, London. Nov. 29, 1922.)

Hydrogen Peroxide—Hydrogen peroxide is distilled from solutions containing or yielding it by bringing the solutions into contact with the highly heated surface of a liquid or a fused salt, the evolved vapors being rapidly condensed. The liquid or fused salt employed is such that it can be heated, without boiling, to a temperature higher than the boiling point of the solution to be distilled, and this having been done, the solution is directed on to the heated surface either as a thin sheet or, preferably, as a spray; a stream of air may be sucked through the liquid to prevent sudden frothing. The preferred material for the heated surface is sulphuric acid or a fused bisulphate, and as examples of solutions which may be treated by the process, the following are mentioned: crude solutions of hydrogen peroxide, sodium, potassium, or ammonium persulphate, persulphuric acid and inorganic peroxides. (Br. Pat. 186,840. Woodlands, Ltd., Dover. Nov. 29, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Bureau of Mines Plans Ceramic Studies

Georgia Clays and Bauxites to Be Investigated in Co-operation With Manufacturers

In the course of the investigation of the kaolins, bauxites and feldspars along the right of way of the Central of Georgia R.R., being conducted by the United States Bureau of Mines at its ceramic experiment station, Columbus, Ohio, under a co-operative agreement with the Central of Georgia R.R., which was recently renewed for another year, the work is being grouped under three heads — whiteware clays, refractory clays and bauxites, and vitrified face brick.

In order to attempt the separation from the whiteware clays of certain deleterious materials, a semi-commercial centrifugal elutriation outfit has been devised by R. T. Stull, supervising ceramist of the Bureau of Mines, and set up at the Columbus station. With this outfit, about 1,000 lb. of clay is washed at one time. Seven clays have been so washed and seven more are still to be washed and tests made on the several separations. The clay washer has proved very satisfactory. The most highly purified material from the several clays burns to a white body free from specks.

Manufacturers to Co-operate

Five hundred pounds of the most promising of these clays will be sent to the Homer Laughlin China Co., at Newell, W. Va., where about eight hundred pieces of china are to be made in accordance with pottery practice. The behavior of these clays, as to working properties, color, percentage loss, etc., will be tabulated.

Some clays which are unsatisfactory for casting and jiggering can be used successfully in dry-press processes; so 500 lb. of one of the washed clays is to be made into tiles at the American Encaustic Tiling Co., Zanesville, Ohio, where this process is used.

Electrical porcelain is to be made from another of the clays at the plant of R. Thomas & Sons Co., East Liverpool, Ohio. The body which is best suited for this purpose is to be worked out and prepared at the station.

Proper dewatering methods will be studied in an endeavor to make both a saving in the time necessary to refine the clay and to improve its slaking properties. In this connection arrangements have been made to have some of the slips washed by the Bureau of Mines put through a Dorr thickener and continuous filter process. The Dorr Co. and the United Filters Corporation are co-operating in the work.

Preheating in order to improve the casting properties of these clays will be tried out, as a preliminary investigation has indicated that this property can be improved by such treatment.

Tests of Impure Bauxites

Great quantities of impure bauxites and bauxitic clays, which have been little utilized up to the present time, are being tested for their utility as material for refractories.

Bricks made from these clays and bauxites have been proved to have a higher fusion temperature than the best grade of firebrick, exceptional hot crushing strength and low spalling tendency. These properties, together with the large range of basicity obtainable in such refractories made from it, should insure a large application.

Tests are under way to prove whether it is not possible to use the same material for the bond as is used in the grog, since this would greatly cheapen manufacturing costs.

The bauxite grog is to be electrically sintered at the Seattle station of the Bureau of Mines. This grog is to be used in the electric furnace refractories.

Refractory Tests

The refractories are to be tested out in electric furnace practice, and bungs for malleable iron furnaces. The refractories are to be made at one of the plants of the Harbison-Walker Co., Pittsburgh, Pa. Mechanical strength, low spalling tendency and resistance to cinder abrasion are prime requisites for this type of refractory.

The electric furnace refractories are to be tested at the plant of the Bonney Floyd Co., Columbus, Ohio, in a Heroult furnace melting alloy steel. The requisites for such refractories are high fusion point and low slag penetration.

The bung brick, which have to withstand considerable heat together with sudden temperature changes, are to be tested at the plant of the Ohio Malleable Iron Co., Columbus, Ohio.

Large deposits of feldspar not sufficiently pure for pottery purposes exist along the right of way of the Central of Georgia R.R. These deposits can probably be utilized, together with some of the white clays, for making a semi-vitreous face brick. It is the purpose of the Bureau of Mines to run an investigation pursuant to the utilization of this material.

Chemical Products From Ruhr Cut Off by Occupation

Latest advices reaching Washington from the Ruhr indicate that practically all hope of any early shipments of chemical products from occupied Germany has been abandoned. Because of the exchange situation, however, it is believed that any stocks of chemicals in unoccupied Germany will be shipped to the United States in preference to other countries.

Manning Will Lead A.C.S. Motor Fuel Symposium

Motor fuels and substitutes will be the subject of discussion at a joint meeting of the gas and fuel chemists and petroleum chemists at the New Haven meeting of the American Chemical Society. Dr. Van H. Manning has consented to preside at this meeting and several well-known speakers will contribute important papers to the discussion. In addition to a résumé of present chemical knowledge in this field, some important new research results on several phases of the motor fuel problem will be included.

British Report on Transmission of Heat

A recent report of the Food Investigation Board of the British Government gives particulars of experiments carried out at the instance of the engineering committee of the board. The primary purpose was to obtain data which would be of assistance in investigations on problems of insulation connected with cold storage construction, but as the work progressed it became somewhat more general in character and a large number of the experiments were carried out as pure problems of engineering.

The process of the transfer of heat by convection of air has been exhaustively investigated, and it is said that the experiments throw new light on the mechanism of convection, especially in connection with the loss of heat from parallel vertical walls with an air space between. It is believed that these results will be of service not only in cold storage work but in various other departments of engineering.

House Approves Federal Sale of Nitrate

Recommends Adoption of Resolution to Authorize Government Sales of Fertilizer and Insecticide

With an amendment extending the period through the calendar year 1924 as well as throughout 1923, the House Committee on Agriculture has reported, with a recommendation for adoption, the Senate joint resolution authorizing and directing the President to procure stocks of nitrate of soda and calcium arsenate and to dispose of them at cost. The resolution also creates a $10,000,000 revolving fund for this purpose.

During and immediately after the war, nitrate of soda was purchased by the government and sold at cost to farmers under authority of the food control act. Charles J. Brand, who was chief of the Bureau of Markets of the Department of Agriculture at that time, testified before the House committee that during 1917 and 1918 120,000 tons of nitrate was purchased in Chile. Only 75,000 tons was received in time to be distributed during the season of 1918. Forty thousand tons of the 1918 purchases remained on hand and was sold in 1919, together with 113,000 tons declared surplus by the War Department and distributed by the Department of Agriculture, the total for the 2 years under this form of distribution being 228,000 tons. The testimony showed that the 1918 and 1919 nitrate deals of the Department of Agriculture involved about $20,000,000 and that the operations were conducted without loss and with a small fraction of 1 per cent gain.

Competition Among Nitrate Importers

B. M. Baruch, former chairman of the War Industries Board, and L. L. Summers, formerly a member of the Munitions Board of the Council of National Defense, told the House committee that competition among importers of Chilean nitrate has been keen and that there have been no evidences of combinations or price-fixing agreements.

The committee amended the Senate resolution to apply to 1924, because the reason when farmers purchase both nitrate and calcium arsenate is well advanced for this calendar year.

The report shows that government distribution of nitrate in 1919 represented sales in 38 states from 21 storage points. The normal quantity of nitrate of soda used for agricultural purposes in the United States annually is between 250,000 and 300,000 tons.

The report points out that white arsenic, which is chiefly a product of the copper smelters of the United States, is available only in limited quantities under existing circumstances.

The Department of Agriculture recommends the use of calcium arsenate as an insecticide for the control of the boll weevil. Its use for this purpose began only in 1919 and has increased so rapidly that the supply has not kept pace with the demand.

White arsenic is oxidized to arsenic acid under very carefully controlled conditions. The arsenic acid is then combined with hydrate of lime, both processes under very strictly controlled operation, and by the use of elaborate factory equipment, to produce calcium or lime arsenate. This careful preparation is of the utmost importance, as an improperly prepared product might readily kill a large number of plants.

In 1922 about 8,000 tons of calcium arsenate was sold and did not satisfy the demand. In the manufacture of this tonnage 3,600 tons of white arsenic was required. The probable minimum demand for the present and future seasons is about 12,000 tons of 2,000 lb.

Klein Explains Hoover Stand on Foreign Trade Zones

Criticism of Secretary Hoover's attitude on foreign trade zones and on the exemption from federal taxation of the income of American citizens engaged abroad has led Julius Klein, the director of the Bureau of Foreign and Domestic Commerce, to make the following explanation:

"The kind of products which are most likely to be imported into foreign trade zones for re-exportation are raw materials and certain types of bulk foodstuffs for which, under favorable conditions, we might become distributors. Such products are very largely of a non-competitive nature, many of them being on the free list of our tariff. Furthermore, they are produced, to a large extent, by tropical countries not possessing any considerable merchant marines. It is evident, therefore, that the creation of foreign trade zones could not possibly injure American industry, while, on the other hand, they are likely to benefit our shipping by enabling it to obtain return cargoes. Then, too, the benefit to be derived from free trade zones is not confined entirely to exemption from customs formalities, but is also due to the simplification of shipping regulations which make for a more economical utilization of merchant vessels.

Would Relieve Income Tax Burden

"With reference to the question of tax exemption, Mr. Hoover's proposal contemplates only the provision of relief for those incomes actually earned abroad in professional or trade activities by Americans resident overseas. At present they are compelled to pay in most instances a double income tax, to the United States and to the country in which they earn their income. In the World War states, this double taxation amounts to practical confiscation, and is rapidly driving American citizens out of representation of our commerce abroad. We are, therefore, confronted with the unpleasant prospect of entrusting our commercial interests abroad to the hands of foreigners, which is, of course, undesirable under all circumstances and decidedly dangerous. It is manifestly unjust, as it puts our citizens on a clearly unfavorable footing as against their rivals."

Representative Favors Ford Shoals Offer

Madden, of Illinois, Desires Matter Closed in Businesslike Manner —Has Confidence in Ford

Unqualified acceptance of Henry Ford's Muscle Shoals offer was proposed on Feb. 3 in the House, by Chairman Madden of the Appropriations Committee.

Representative Madden declared he viewed the matter purely from a business standpoint and that his desire was to put the great Alabama project in the hands of a man of demonstrated capacity, irrespective of his politics.

"I know of no person who has demonstrated a larger capacity to handle an undertaking of this magnitude than Henry Ford," declared the Illinois member.

Mr. Madden received an ovation as he concluded, many Democratic members from the Southern states being among those who rose to applaud him.

History of the Project

The appropriations chairman reviewed the whole history of the Muscle Shoals project and declared the issue had narrowed itself down to whether the government would spend another $100,000,000 in completing the dams and plants and putting them in operation or would turn the whole project over to Mr. Ford and receive a "substantial return" annually with a repayment at the end of 100 years of practically what it had spent under the Ford offer.

"We can't stop now," he said. "I feel we owe it to the taxpayers, the farmers and the nation to finish the operation. My own judgment is we should accept the Ford offer and get out of the business so as better to provide for the common defense in time of war and the welfare of the nation."

Pointing out that the government already had spent $107,000,000 on the project, Mr. Madden said estimates were that it would have to expend an additional $84,000,000 to complete it and get it into operation under government control. Under the Ford offer, he added, the government would have to put up another $50,000,000 to complete the dams and other work and then the demand on the Federal Treasury would end.

8 Per Cent Profit on Nitrate

For his part, Mr. Ford, he went on, would agree to operate nitrate plant No. 2 to its present capacity of 40,000 tons of nitrate annually, and in addition would keep the other plant fully equipped and ready for operation in the event of war. Profits on the sale of nitrate to the farmers would be limited to 8 per cent.

"Mr. Ford agrees to pay the government $5,000,000 for the project," he continued. "In addition he would have to put up $59,000,000 to get the whole works into operation, so he would not get such a wonderful bargain."

In concluding Mr. Madden said he had tried not to take sides in the matter but

to state "the plain, unvarnished facts," so that the House might draw its conclusions.

While Representative Madden's announcement that he regards it desirable for Congress to accept Henry Ford's Muscle Shoals proposition did much to stimulate the flagging hope of the advocates of that proposal, it apparently has brought the realization of those hopes no nearer.

It is admitted that this statement from such a prominent member of the House of Representatives is a great asset to the proponents of the Ford offer, but it is an asset which will be of more service in the next Congress than in this, since it is conceded that no vote can be had in the Senate at this session.

Coke Plants Plan to Install New Ovens

It is announced by the Columbia Steel Co. that a byproduct coke-oven plant of 33 new-type Koppers ovens will be constructed near Salt Lake City, Utah, for carbonization of Utah coal. This installation will have a carbonizing capacity of approximately 1,000 tons of coal per day. It will be the first plant installed to carbonize Utah coal in a coke oven.

An extension of the Republic Iron & Steel Co.'s Youngstown plant is planned to include a battery of 61 of the same type combination oven. This battery will be of the standard 12½-ton, 13¾-in. average width oven, designed to carbonize approximately 30 tons of coal per oven per day.

The small gas oven developed some time ago by the Koppers Co. is to be given practical plant trial through the installation of eleven 6¾-ton ovens for the Battle Creek Gas Co., Battle Creek, Mich. These ovens will be 13½ in. wide, designed for an average coking time approximately 12 hours, giving the plant a capacity of about 1½ million cubic feet of gas per day when fired with producer gas. The producer will utilize breeze and small coke and will operate in connection with a waste-heat boiler. Normally the plant will use producer gas for heating the ovens, but any individual oven or the entire battery may be changed over to burn coke-oven gas for oven firing if desired. The new oven corresponds in general type with that which has been tested out during the past year or more at the Chicago By-Product Coke Co. plant, with only such modifications as change in size make necessary.

Reviews Work of A.P.P.A.

Hugh P. Baker, executive secretary of the American Paper and Pulp Association, has opened a tour of the papermaking districts of the South and West, his first address having been delivered before the Virginia manufacturers at the Jefferson Hotel, on Feb. 6. He devoted his talk to a review of the work of the American Paper and Pulp Association, and made public a notable list of accomplishments of the association during the year just closed.

French Purchase of Haber Rights Approved by Deputies

The plan of the French Government to operate a fifty million franc nitrogen and synthetic ammonia plant and its agreement to purchase the rights of the Haber patent from the German Badische Anilin Co. today safely ran the gantlet of the anti-German criticism of members of the Chamber of Deputies, says an Associated Press dispatch dated Feb. 6. Government leaders were confident that Parliament would approve the proposed use of the enormous Toulouse gunpowder plant for the manufacture of fertilizers and gunpowder materials.

Louis Loucheur, former Minister of Reconstruction, was complimented for his success in negotiating for the Haber rights in 1919, for the option on which France paid 2,500,000 francs. The balance is to be paid when the factory is functioning normally. A French engineer has been for 9 months in the Badische Anilin plant watching the process of manufacture. Under the agreement France will be entitled to all developments in the process for 15 years. Under the plan the French Government will rent the Toulouse plant to a private corporation, but will subscribe for one-half of the stock.

Revised Winslow Bill Excludes Chemical Patents

Chemical Foundation Trusts Not Included in Those to Be Returned to Owners

A new bill which represents majority sentiment among the members of the House Interstate Commerce Committee has been introduced by Representative Winslow, to provide for the return by the Alien Property Custodian of certain trusts held by him under the trading with the enemy act. This measure will displace the one on the same subject which has been considered by the committee several months.

The revised bill, broadly speaking, provides for the return of trusts valued at less than $10,000, but no more than that maximum amount shall be returned to any one person regardless of the number of trusts in which he may possess an interest. A new provision is written in this bill stipulating that after its enactment dividends and interest on trusts still held shall be paid to the one for whom the trust is retained.

Excludes Foundation Patents

Exceptions to the bill are patents, trademarks and copyrights which have been "sold, licensed or otherwise disposed of" or which are involved in litigation "in which the United States, or any agency thereof, is a party." This exception excludes from the provisions of the bill all the patents given into custody of the Chemical Foundation, Inc., and all licenses under these patents and the patents previously issued by the War Trade Board, and also excludes various patents held by the War Department and the Navy Department.

The funds still to be held by the Custodian under the terms of the Knox-Porter peace resolution, together with several hundred million dollars worth of former enemy ships, will, in the opinion of administration officials, be a sufficient guarantee of American claims against Germany when adjudicated, although this administration has made it plain that it does not approve of confiscating the remainder of this property to pay these debts. This bill if enacted into law will provide:

1. For the return to their former owners of all trusts of the value of $10,000 and under, and a like sum to be returned to the owners of all trusts whose value exceeds $10,000.

There are approximately 28,000 trusts held by the Alien Property Custodian valued at less than $10,000 and approximately 2,200 trusts of the value of over $10,000; the total amount to be returned under this item alone will approximate $45,000,000.

2. On and after the passage of the act, all income accruing to the various trusts will be remitted by the Custodian to the former owners or their beneficiaries.
3. All patents that are not the subject of litigation, such as in the suit of the United States Government vs. the Chemical Foundation, Inc., or those that have been sold or assigned to the War and Navy Departments, will be returned by the Custodian.

This includes patents that are held by the Custodian and have not been sold, assigned or licensed by the previous administration to any government department or the Chemical Foundation.

4. Fugitives from justice are prevented from receiving any return of their property.
5. Another provision permits a corporation, partnership, or association to recover their property if their principal place of business is outside of Germany, Austria or Hungary and the majority of their stock is not owned by individuals of German, Austrian or Hungarian nationality.

This includes certain banks, corporations, etc., in those nations which formerly were a part of the Austro-Hungarian Empire, and those portions of Germany which are Polish or Danish territory, or Alsace or Lorraine, now French territory.

6. Extends power of the Custodian in deciding expatriation claims.

This relates to Americans or naturalized Americans who were caught in Germany or Austria at the outset of the war and whose property was seized and who have not satisfactorily explained or satisfied the State Department that they did not expatriate themselves.

No estimate has yet been prepared of the full effect of this bill as revised, Testimony before the committee by Alien Property Custodian Miller showed that there are 28,144 trusts held by that official valued at $10,000 or less each, the return of which would involve $22,122,002, leaving still in custody 2,224 trusts valued at $296,235,899.

Expect New Dye Customs Rules This Month

Special Deputy Appraiser of the Port of New York John Donnelly stated last week that tentative rules and regulations governing the customs appraisal of imported dyes may be issued by the Division of Customs, Treasury Department, prior to Feb. 15. The rules that will be issued will be of a temporary nature only and subject to change where such change may improve the method of ascertaining the tariff values of incoming dyes.

"We want importers and manufacturers to 'shoot' at these rules when they are issued," Mr. Donnelly declared. "This," he continued, "will enable us to perfect them from time to time in accordance with suggestions from interested parties."

The draft of the new rules, as prepared by the appraising officers at New York, were to have been submitted to the Treasury Department last week. It is believed that several days will be consumed by the Treasury in studying the draft as submitted and making any necessary changes. This means, it was explained, that the tentative or test rules will be in operation possibly on or about Feb. 15.

Canadian Experimental Farms Reports Busy Year

In the latest report of the work performed by the Division of Chemistry of the Dominion Experimental Farms in Canada during the past year, details and the results are given of the examination of 4,122 samples sent in for analysis from different parts of the country and including every province. Of these samples, 626 were of soils, 146 of manure and fertilizers, 597 of forage plants, fodders and feeding stuffs, 300 of waters, 2,190 samples of food products from the Meat and Canned Foods Division, and 263 under the head of miscellaneous, including dairy products, insecticides and fungicides.

The investigational work on soils for the Reclamation Service of the Department of the Interior, which was begun 2 years ago for the purpose of assisting in classification of the irrigable lands of southern Alberta and southwestern Saskatchewan, has been continued. The chief object of this work is the determination of alkali, enabling a report to be made upon the lands examined, as to their suitability or otherwise for cultivation under irrigation.

As required and in as far as circumstances permitted, analytical work and research was undertaken during the year for the several branches of the Department of Agriculture, the Post Office Department, the Department of the Interior, Department of Customs and Excise, Department of Marine and Fisheries, Department of Naval Service, and the several commissions and boards in connection with soldiers' civil re-establishment and settlement, so that the division acts as a bureau of chemistry for the entire government service.

New Laboratory Planned for Johns Hopkins

Plans for a new chemical laboratory for the Johns Hopkins University, to be erected at Homewood at a cost of about $600,000, have been completed. The details of the building have not been made public, but it is known that the type of architecture will conform to the Colonial style of the buildings in that group.

New Anode Alloy Cuts Copper Cost

Copper-Silicon Alloy Developed by C. G. Fink Reduces Anaconda Co.'s Costs to 6.4c. Per Pound

From the standpoint of technology, the most interesting and important portion of the annual report of the Anaconda-Copper Minning Co. is the following statement referring to electrometallurgical practice at Chuquicamata: "The solution is electrolyzed with a special copper-silicon anode which has greatly reduced the cost."

At this plant the solution for electrolysis is formed by leaching oxide ores containing about 1.8 per cent Cu with dilute sulphuric acid. In the electrodeposition of copper from such copper sulphate electrolytes ferrosilicon anodes (about 87 per cent Fe and 13 per cent Si) have been largely employed in commercial practice. Lead has also been used. The copper-silicon anodes referred to contain 15 to 25 per cent Si, 2 to 15 per cent Mn, 0.5 to 10 per cent Pb, 0.01 to 10 per cent Ba or Ca, with the remainder Cu.[1]

These have the advantage over ferrosilicon anodes that a normally lower voltage can be used and substantially no iron is introduced into the electrolyte by corrosion of the anode, whereas with ferrosilicon anodes a very considerable contamination of the electrolyte by introduction of iron takes place, and this contamination increases progressively with recirculation of the electrolyte.[1]

Long Life of Anodes

By avoiding such introduction of iron the copper-silicon anode materially decreases the cost of maintaining a low iron content in the electrolyte, since the electrolyte can be used for longer periods of time without requiring purification, thus reducing the acid lost with the impure electrolyte and reducing the amount of impure copper formed. As compared with the use of a lead anode, the copper-silicon anode presents the advantage of increased efficiency, particularly in electrolytes containing iron, inasmuch as lead anodes give extremely low current efficiency with such electrolytes unless special precautions are taken to keep the iron in the ferrous condition. The anode loss is materially less than with either ferrosilicon or lead anodes, with certain electrolytes, particularly copper sulphate electrolytes containing chlorides and nitrate. Owing to the relatively low cost of the anodes themselves in the first instance, and their resistance to breakage during handling and ordinary use, as well as their resistance to anodic disintegration, the process can be carried out for long periods of time, with resulting low cost of operation for the anodes, as well as with economy of operation in low voltage and power consumption and high current efficiency.

Reduction of Costs

Referring again to the annual report of the Chile Copper Co., the cost per pound of copper exclusive of interest, depreciation and depletion dropped from 10.8c. in 1921 to an average of 6.4c. in 1922. In 1915 the figure was 16.34c. Percentage recovery of copper has improved from 66.87 per cent in 1915 to 91.07 per cent in 1921. Present production rate is about 200,000,000 lb. per year, but further extension in the use of the new anodes will probably raise this to 225,000,000 lb. per year by May, 1923.

[1]See U. S. Patents 1,441,567 and 1,441,568, issued Jan. 9, 1923, to Colin G. Fink, assignor to Chile Exploration Co.

Paint Concern Restrained on Misbranding Charge

Misrepresentation in the advertisement and sale of paint was found by the Federal Trade Commission in the case of L. C. Orrell & Co., of Chicago, Ill. It developed in the commission's investigation that the company sold and offered for sale, through catalogs and other literature, ready mixed paints under the principal brand of "Painters' Pure Paint." This brand, the commission found, was represented as "100 per cent pure" and as composed of pure ingredients, whereas the fact was that substitutes comprised the principal component parts of such paints.

By specific terms of the commission's order, L. C. Orrell and Fredericka B. Orrell, co-partners in the Orrell company, are prohibited from using representations of "Painters' Pure Paint" brand or any other paint so offered and sold by respondents.

Chemical Tariff Rate Protests Will Be Heard First

Complaints against the chemical schedule of the new tariff act will be among the first to be investigated by the Tariff Commission, says a dispatch to the New York *Journal of Commerce*.

The commission expects to take up early next week the report of its advisory board with particular reference to the chemical schedule and investigations into costs of production as preliminary to public hearings which are to start shortly thereafter.

Lack of a quorum has delayed the commission in its plans to begin the preparation of recommendations to President Harding under the elastic provisions of the new law. Commissioner Edward P. Costigan is in the West and Commissioner William Burgess is ill, but is thought both will be ready to take up their duties next week.

Explosion Damages Helium Purification Plant

It was not an "explosion of helium" which damaged the purification plant at Langley Field, Va. In an official statement, R. B. Moore, chief chemist of the Bureau of Mines, declared that "there was no helium in the plant at the time of the accident and helium had absolutely nothing to do with the explosion." The accident took place when one of the liquefaction machines was being tested under air pressure.

The plant at Langley Field is intended to purify helium after it has been used in airships. There is some infiltration of air through the gas bag which must be removed periodically to maintain the lifting power of helium. It is for that purpose that the plant is being provided at Langley Field. It has no connection whatever with the production plant at Fort Worth and this accident has no bearing whatsoever on the general helium program.

Engineering Colleges Neglect Social Sciences

Federated American Engineering Societies' Committee Urges Broader Scope for Education

The colleges of the country are urged to "point engineers toward leadership in public affairs" in a report submitted to the Federated American Engineering Societies by its committee on industrial ideals, of which Prof. Joseph W. Roe, head of the department of industrial engineering at New York University, is chairman.

The report stresses the need of the engineer in public life, asserting that he must aid in removing the difficulties of the material world which he has created. Carrying out the idea expressed by Edwin Ludlow, past president of the American Institute of Mining and Metallurgical Engineers, that "this is an engineer's country but a lawyer's government," the report continues:

"For a century, engineers have directed their energy toward the utilization of the physical forces and the materials of nature. The developments which they have brought about have created an epoch in human history.

"While these developments have been of inestimable benefit and modern society could not exist without them, they have introduced many public problems and social readjustments so closely related to the engineer's activities that it is increasingly evident he must assume an active part in their solution.

Need for Public Service

"Recognizing this growing need, the engineers of the country formed the Federated American Engineering societies, primarily to place their knowledge and training at the public service on all public matters affecting engineering, or affected by it.

"Engineering education, reflecting closely the attitude of engineers heretofore, has confined its work almost exclusively to scientific and technical training, giving little if any attention to the social and human aspects of engineering enterprises.

"The Federated American Engineering Societies, therefore, speaking for the engineering profession, urges upon engineering colleges an increased attention to the social aspects of engineering activities and a broadening of their technical training in every way possible, to develop in engineering students the spirit of, and a capacity for, active leadership, not only in industry but in public affairs."

The other members of the committee, whose report has been adopted by the governing body of the Federation, are: Mortimer E. Cooley, dean of the engineering schools of the University of Michigan, Prof. C. F. Scott of Yale University and J. C. Ralston of Spokane, Wash.

Herty Optimistic on the Outlook for Industry

Tells Boston Meeting Ruhr Occupation Will Cut Off German Dyes, U. S. Will Not Notice It

An optimistic view of the present status of the American synthetic organic chemical industry was presented by Charles H. Herty, president of the Synthetic Organic Chemical Manufacturers' Association, in a speech before the Northeastern Section of the American Chemical Society in Boston, Feb. 10.

"The economic struggle now in progress between France and Germany will, in all probability, result in the cessation of exports of German dyes and other synthetic organic chemicals, just as the blockade of German ports during the great war cut off all German chemical exports in 1916," said Dr. Herty. "It is very plain that with the Ruhr Basin isolated, thereby shutting off the coal needed for power and the essential raw materials, with transportation demoralized throughout the Rhine territory, which is the center of the dye and chemical industry in Germany, and, finally, with upset labor conditions as the result of French occupation, the crippling of the German chemical industry must necessarily follow, unless reparations questions are quickly settled by France and Germany."

Pre-War Conditions Changed

The blockade of 1916 found the American textile industry in a very embarrassing position, for there was then in this country barely a few months' supply of necessary colors, and no factories, or even a nucleus of an industry prepared to make dyes and chemicals. These facts are too well known to need repetition here. The American chemical manufacturer can justifiably point with pride to the condition which exists today, with an American synthetic organic chemical industry ready to supply practically the entire needs of the country. As a matter of fact, the American consumer would scarcely feel the result of the complete stoppage of German colors, so well has the American industry progressed during the 6 years of its existence.

Corn Products Acquires "Sealite" Rights

Newly Developed Substance for Preventing Oil and Gasoline Evaporation Was Perfected by Standard Oil Co.

Formal announcement has just been made that the Corn Products Refining Co. has acquired from the Standard Development Co., a Standard Oil subsidiary, control of all the rights of "Sealite," the newly developed preparation used to prevent evaporation of oil in storage and to minimize the danger from lightning. Negotiations have been under way for some time for the control of the product. The amount involved in the transfer was not made known.

Development of "Sealite"

The product "Sealite" represents the result of several years' research and development work by the technical staff of the Standard Oil Co. of New Jersey. The patents have been owned by the Standard Development Co. The product went into general use in the refineries of the Standard Oil Co. of New Jersey and its subsidiaries last year.

The principal constituents of "Sealite" — glucose, corn starch, glycerine, calcium chloride and glue—are produced by the Corn Products Co. at its various plants in the United States, and arrangements have been concluded to produce the "Sealite" itself at these plants so that it may be delivered to the petroleum refining and producing industry at a minimum cost.

Properties of Compound

It is explained that "Sealite" is a highly viscous fluid weighing approximately 4.75 lb. per gallon and having the appearance of a thick white paint. Although its viscosity increases at low temperatures, it flows freely down to 25 deg. F. It can be pumped, but only with great difficulty due to its high viscosity. Some of its constituents are of a drying character and some of a hygroscopic character, the proportions being so balanced that the material neither loses nor gains water upon exposure to the air. Tests and experience justify the conclusion that it is unaffected by atmospheric conditions.

It is chemically neutral, faintly sweet in odor and taste, non-poisonous, non-corrosive, and would be rated as non-combustible, although it decomposes under extreme temperatures, as do all organic materials. It is soluble in water in all proportions and insoluble in any petroleum oil in any proportion. It does not impart any color or odor to either crude or refined petroleum products. It is not subject to fermentation or decay.

New Society Formed to Champion Chemist

American Institute of Chemistry Will Devote Efforts to Promotion of Economic Status of Profession

The American Institute of Chemistry, an organization with the announced objects of aiding in the establishment of the professional status of chemists and promoting their economic interests, was formally organized on Feb. 5 in New York City. Constitution and bylaws were adopted and temporary officers elected.

The general purposes of the organization, as stated in the constitution, also include the compilation of a code of ethics and the promotion of popular appreciation of chemical research and control in the industrial field. The efforts of the Institute are to be devoted primarily to the interests of chemists rather than to the interests of the science. In a general way the functions of the new society will follow the model of the British and Canadian Institutes of Chemistry.

No Conflict With Present Societies

"It is not the intention of the Institute to encroach upon the fields of usefulness of the American Chemical Society, the American Electrochemical Society or the American Institute of Chemical Engineers," says a statement of the president, Horace G. Byers. "On the contrary, it earnestly seeks the co-operation of these agencies in their fields of usefulness with the efforts which the Institute will make in its own

"The Institute does not propose to enter the field of publication in any connection either directly or indirectly," continues the statement, "and it hopes to be mutually helpful to all the agencies of publication of chemical information which are now serving the public. The scientific papers presented at its meetings will seek publication in the present journals and every effort will be made by the Institute to co-operate with existing agencies for the benefit of the profession."

Its objects appeal naturally more strongly to the younger men, and development will doubtless be guided largely by their influence.

Temporary Officers

Temporary officers were elected as follows: President, Horace G. Byers; vice-president, Lloyd Van Doren; treasurer, Clarence K. Simon; secretary, Lloyd Lamborn.

Councilors were selected as follows: Ralph E. Lee, L. R. Seidell, F. D. Crane, L. W. Parsons, H. L. Lourie, Casimir Fink, L. J. Matos, Miss C. M. Hoke, Stanislaus Skowronski.

Membership of the new organization is to consist of fellows, associates and juniors. Fellows will comprise those who have had training equivalent to the B.S. degree in chemistry and a minimum of 5 years of experience. Associates must have the above educational training and juniors may be undergraduate students.

Personal

RICHARD V. AGETON, of the Bureau of Mines, who has been doing examination work for the War Minerals Relief Commission, is acting as assistant chief mining engineer of the bureau.

Prof. W. L. BADGER, professor of chemical engineering, University of Michigan, Ann Arbor, Mich., is taking a year's leave of absence beginning Feb. 1. He expects to continue his research work on evaporator design in Ann Arbor.

Dr. MARSTON T. BOGERT, professor of chemistry in Columbia University, gave a lecture at Connecticut College for Women, New London, Conn., on Jan. 23 on "Synthetic Dyestuffs and Their Bearing on the Life of the Individual and of the State."

HENRY T. CHANDLER, chemical and metallurgical engineer, has become connected with the Vanadium Corporation of America as metallurgical engineer, with headquarters at Detroit, Mich. He was formerly with the Ford Motor Co. as research engineer and more recently was connected with C. H. Wills & Co., Marysville, Mich., manufacturers of automobiles.

PERCIVAL CHRISTIE has been elected president of the Taylor-Wharton Iron & Steel Co., High Bridge, N. J., succeeding the late Knox Taylor. He has been vice-president and treasurer of the company for a number of years. Mr. Christie will also act as president of the William Wharton Co., Easton, Pa.; the Tioga Steel & Iron Co., and the Philadelphia Roll & Machine Co., both of Philadelphia, subsidiary organizations.

WIGGINGTON E. CREED, president of the Columbia Steel Corporation, Pittsburg, Calif., gave an interesting address on the progress of the steel industry at the weekly luncheon of the Down Town Association, San Francisco, on Jan. 25.

H. R. HANLEY has been appointed associate professor of metallurgy at the School of Mines and Metallurgy, Rolla, Mo.

Dr. ELLWOOD HENDRICK spoke at the Sterling Laboratory, before the New Haven section of the A.C.S., New Haven, Conn., Feb. 13, on "Obligations in Chemistry."

JOHN M. HOOD, JR., president of the Crown Cork & Seal Co., Baltimore, Md., has resigned.

HERMAN LIVINGSTON and PAUL MCMICHAEL, chemical and mechanical engineers, have opened an office in the Woolworth Building, New York City.

Dr. THOMAS MIDGLEY, JR., research engineer of the General Motors Research Corporation, has unfortunately contracted organic lead poisoning from his work on lead compounds used in preparing anti-knock motor fuels. Although Dr. Midgley's condition is not at all serious, he is on leave for an indefinite vacation to recuperate.

GEORGE SOUTHGATE has resigned from the Bureau of Soils, Washington, D. C., to accept a position with the Federal Phosphorus Co., Birmingham, Ala.

Dr. P. V. WELLS of the optics division of the Bureau of Standards, has resigned to take up research work for E. I. du Pont de Nemours & Co., Parlin, N. J.

Obituary

EVERETT C. BRITTON, an official of E. I. du Pont de Nemours & Co., Wilmington, Del., died at his local residence, Jan. 29, from pneumonia. He was 38 years old. His entire business career was spent with the du Pont organization, and for some time he acted as assistant to the director of the high explosives operating department.

DAVID COCHRANE, of the H. S. B. W. Cochrane Corporation, Philadelphia, Pa., the inventor, designer and first builder of the open-feed water heater which bears his name, died Jan. 24. Mr. Cochrane was born in Sawkey, Clackmanmonshire, Scotland, in 1850, and in his early years worked as a pattern maker on the Clyde. In 1879 he came to the United States, where he entered the employment of Ferris & Miles, but shortly afterward went with the Harrison Safety Boiler Works, then the builder of a sectional cast-iron boiler. His open heater, brought out in 1883, was specifically designed to protect boilers from the effects of cold, unpurified feed water, and was itself the first to be built of cast-iron plates, to avoid corrosion. Mr. Cochrane was also the first to design a successful oil separator, a heater and receiver, and other appliances which have since become standard practice. He was distinguished by great common sense in engineering matters and had a peculiar capacity for winnowing the wheat from the chaff and for simplifying construction. He was frequently consulted concerning the design of steam plants and his great contribution to steam engineering consisted in focusing attention upon the more efficient utilization of exhaust steam for heating buildings and for heating and purifying water to be used for feeding boilers and for industrial purposes. As early as 1894 he advocated the withdrawal of steam in course of expansion for feed heating and similar purposes, thus anticipating the present-day movement to provide all large turbines with bleeder connections.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

What Shall We Do About Immigration?

Leaders in Commerce, Finance and Industry Contribute Their Opinions to Symposium of National Manufacturers Association—Recommend Changes in Law

PROBABLY no single economic question in this country is being so widely discussed at the present time as the fundamental problem of immigration. Current shortages of labor, particularly in the metal industries and building trades, have served to focus attention on our present immigration law and its operation under conditions that may be regarded as approximately normal.

In view of the timely importance of the subject, the National Association of Manufacturers recently sent out an inquiry asking a large number of representative men the question: "What shall we do about our immigration?" Forty-six responses were received from presidents of corporations, agricultural leaders, heads of great rail and water transportation systems, bankers, college professors, financiers and immigration specialists. The replies were practically unanimous in recommending that the present 3 per cent quota law be amended.

Constructive Suggestions

In addition the following constructive suggestions have been picked out as summarizing the recommendations most generally agreed upon:

The quota should be determined with the ultimate object of obtaining net immigration, and not according to the present method which in many instances causes a deficit of labor.

The Secretary of Labor should be authorized, on the presentation of satisfactory evidence of a shortage of labor in any industry, to bring about the admission of desirable immigrants to fill the special need.

A scientific selection of immigrants should be made by United States officers, on the other side of the ocean, so that intending immigrants who do not qualify may be rejected at the port of embarkation.

A centralized bureau or commission should be set up, so that all matters respecting immigration may be handled by it in the most expeditious, efficient and practical way.

The adoption of a more definite policy in the registration and distribution of the immigrants.

The nation should extend and make more humane its method of receiving immigrants.

A broader method of immigrant education is needed; one that will take him from the time of his entry and guide him properly for his naturalization.

Abolition of the literacy test.

Among those who contributed to the symposium were Judge Elbert H. Gary, W. W. Husband, Commissioner of Immigration; Frederick A. Wallis, former Immigration Commissioner at the Port of New York; Prof. Albert Shields, of Columbia University; Frederick Underwood, president of the Erie Railroad; Lee J. Eastman, president of the Packard Motor Co. of New York, and C. H. Markham, head of the Illinois Central system.

Legislative Proposals

It is interesting to know that the Immigration Committee of the House of Representatives is now considering and is reported to be in practical agreement on a tentative redraft of the present immigration law. It is suggested by the committee that the 3 per cent quotas based on foreign nationals resident in this country in 1910 be changed to 2 per cent on the basis of the 1890 census. This would have the effect of sharply reducing the allotted number of immigrants from Italy, Greece and southeastern Europe, but it is reported that other features of the bill will so liberalize the present law that at least 200,000 more aliens than are now permitted will be allowed to enter. This would increase the present maximum to about 550,000 per year, it is estimated.

To meet any shortages of skilled labor which may develop after the quotas are filled the Secretary of Labor would be authorized to admit workers in the groups needed when labor of like kind can not be found in America.

Aliens returning from temporary visits to their home lands, the number of which may likely run as high as 75,000 a year, are not counted in the quotas, as is now provided.

Broad exceptions are established for the foreign kin of American citizens or the close relatives of permanently admitted aliens.

Another exception includes immigrants who have resided for 5 years in contiguous territory, with their wives and children, provided they accompany them.

The Immigration Committee abandoned the idea of introducing the examination of aliens at the source, as well as the literacy tests.

However, in order to obtain a consular certificate required for entry the alien must fill out a form which in itself is a sort of literacy test.

"Chem. & Met." Weighted Index of Chemical Prices

Base 100 for 1913-14

This week	175.64
Last week	175.08
February, 1922	148
February, 1921	166
February, 1920	252
April, 1918 (high)	286
April, 1921 (low)	140

As the result of a typographical error in our issue of Feb. 7, 1923, this index was reported as 175.08 for "last week" (Jan. 31, 1923) and the proper quotation for that week was omitted. Correct figures for this index since the first of the year are as follows:

Jan. 3, 1923	171.30
Jan 10, 1923	172.79
Jan 17, 1923	171.71
Jan. 24, 1923	174.21
Jan 31, 1923	175.15
Feb. 7, 1923	175.08
Feb. 14, 1923	175.64

Chemical Price Changes During January

Most of the price changes that occurred during January have not been of a fundamental character and in most instances were the result of current developments. The outstanding feature of the list was arsenic. The demand for calcium arsenate producers brought prices up from 15c. per lb. to 15½c. Bleaching powder was also advanced by leading producers to 2c. per lb. The resale market advanced from 2c. per lb. to 2¼c. Importers of caustic potash showed a strong tendency to increase quotations and prices recorded a net advance of 1c. per lb. during the month. Early in January quotations ranged around 6¼c. per lb. and during the latter part of the month prices advanced to 7¼c. per lb. Carbonate of potash also advanced from 5¼c. per lb. to 6c. Permanganate of potash showed a gain of 1½c. per lb. for the month. Quotations opened at 16c. per. lb. and gradually advanced to 17¾c. Producers announced an increase of 1c. per lb. on acetate of lead during January. Ammonium nitrate was sharply advanced due to the sold up condition of producers and the inability to import large quantities. Prices late in January were around 10¼c. per lb.

There were only a few declines. Oxalic acid, barium chloride, citric acid, red prussiate of potash, prussiate of soda and acetate of soda showed slight reductions during the month. The transportation situation has had a strong effect on many commodities. On the whole chemical prices have been well maintained and producers are confident that business will show material expansion in the next few months.

New York Chemical Market Lacks Important Features

But Few Significant Price Changes as Business Reflects an Unusual Lull —Shipping Conditions Improved

NEW YORK, Feb. 10, 1923.

Although on the surface the chemical market in New York City has been practically featureless during the past week, there is nevertheless abundant evidence that underlying conditions are fundamentally sound. The consuming trades continue their activity and the fact that there has been a temporary lull in buying does not necessarily mean that the consuming demand has been supplied.

The shortage of freight cars reported in these columns last week has been considerably relieved and as a result the alkali and heavy chemical producers are again able to make fair-sized shipments.

Arsenic and its compounds continue to be in demand and dealers are very firm in their belief that prices will reach much higher levels before spring. Lead arsenate has been advanced because of the strong demand from the insecticide trade. Importers of white sal ammoniac, sodium sulphide, lump potash, alum and sodium fluoride quoted fractionally lower prices in an effort to attract new business. Carbonate of potash, caustic potash, permanganate of potash, salt cake, prussiate of soda and bleaching powder continue along moderately active lines at former levels.

Principal Price Changes

Acetic Acid—The general tone was quite steady, with 28 per cent material quoted at $3.15 per 100 lb., carload lots. Glacial was held at $12 per 100 lb. in barrels.

Acetic Anhydride—Manufacturers announced lower prices for this material. The general range was around 36@38c. per lb. The demand, however, was somewhat unsteady.

Arsenic—Resale goods were reported firm at 15¾c. per lb. The general market is very strong, although a few odd lots are selling at slightly lower figures. Future shipments were held around 16c. per lb.

Barium Chloride—Leading importers offer spot goods at $90 per ton. Shipments quoted around $85. Domestic factors quote $95. Market rather irregular.

Bicarbonate of Soda—Producers quote the market around $1.75 per 100 lb. in barrels and $2 per 100 lb. in kegs, f.o.b. works. The general movement is of a routine nature.

Calcium Chloride—Manufacturers report transactions for the granular at 1½c. per lb. Fused material is quoted at $20@$21 per ton, f.o.b. works.

Carbonate of Potash—Imported material continues quite firm, with dealers quoting limited quantities of calcined 80-85 per cent at 6c. per lb. and 96-98 per cent at 7@7¼c. per lb.

Caustic Potash—Several fair-sized lots have been sold at 7¼@7½c. per lb. for the imported 88-92 per cent. Shipments are quite difficult to obtain below 7½c. per lb. c.i.f. N. Y.

Caustic Soda—Export business is without any special feature and prices for standard goods range around $3.45@$3.50 per 100 lb. Railroad shipments have been somewhat improved and consumers have been able to purchase at 3¾c. per lb. for prompt shipment. Contracts continue at 2½c. per lb., basis 60 per cent f.o.b. works.

Lead Arsenate—Producers report a very firm market, due to the increased demand from the insecticide trade. Sales of powdered recorded at 23c. per lb., with the paste at 12¾c.

Muriatic Acid—A slightly firmer market was noted for the lower grade and producers were not inclined to shade 90c. per 100 lb. for the 18 deg. acid in tank cars. The 20 deg. acid held at $1 per 100 lb.

Company Dividends and Financial Notes

Standard Oil Dividends. On Feb. 7 the Standard Oil Co. of Indiana announced a quarterly dividend of 62½c., which is an increase of $1 per year over the rate paid on its old stock prior to the recent 100 per cent stock dividend. The old rate was $4 a year; the new is $2.50, equivalent to $5 on the old stock.

On the same day the Imperial Oil Co., Ltd., of Canada, which is owned by the Standard Oil Co. of New Jersey, declared an extra dividend of $1 per share. If this is made a permanent quarterly feature the stock will be on a basis of $7 per year.

Ingersoll-Rand. The Ingersoll-Rand Co. has declared a quarterly dividend of 2 per cent on its common stock, payable March 1 to stockholders of record Feb. 17. This company had declared a 100 per cent stock dividend last December, prior to which time the quarterly rate had been 2½ per cent.

Eastman Kodak. The directors of the Eastman Kodak Co. recently declared the usual quarterly dividend of $1.25 a share and in addition an extra 75c. dividend on the common stock payable April 1.

American Hide & Leather Profits. The report of the American Hide & Leather Co. for the quarter ended Dec. 31, 1922, shows a net income of $294,875, which is equal to $2.35 per share on the $12,548,300 of preferred stock This compares with a net income of $268,209, or $2.13 per share, in the preceding quarter and $207,601, or $1.65 per share in the corresponding quarter of 1921.

In 1921 this company reported a deficit of $550,257, while in 1922 the net income amounted to $1,022,660. It should be pointed out, however, that the latter figure includes an extraordinary income for fire loss of $495,000.

Nitric Acid—Manufacturers report sales of the 36 deg. at 4½c. per lb. in carboys. Smaller lots command from 4½@5c. per lb. The 42 deg. test was held at 6c. per lb.

Prussiate of Soda—A slightly better tone was noted in this market and dealers were not inclined to shade 19c. per lb. for spot goods. Shipments from abroad held firm at 20c. c.i.f. N. Y.

Linseed and Cottonseed Oil Advance

The general tone of the market continued along very steady lines, due largely to the firmness in cottonseed and linseed oils. Most prices were unchanged, but dealers were quite certain that materially higher quotations would be seen before the spring season sets in.

Linseed Oil—Leading crushers announced another advance for February shipments, due to the pronounced scarcity of spot and nearby goods. Quotations range around 96c. per gal. Futures were advanced in proportion to the spot price.

Castor Oil—Prices showed practically no change for the interval, with AA quoted at 12¾c. per lb. and No. 3 at 12¼c. per lb. Demand continues along moderate lines.

China Wood Oil—Demand continued along very steady lines, with spot goods quoted at 18c. per lb. February-March shipments were held at 17½c. Nearby shipments from the coast in sellers' tanks were quoted at 15@15½c. per lb.

Satisfactory Business in St. Louis Market

Most Chemical Prices Are Firmly Maintained—Higher Alkali Prices in Prospect—Citric Acid Lower

ST. LOUIS, MO., Feb. 6, 1923.

A very satisfactory volume of business was transacted in this market during the month of January, and the activity has continued this month. The character of this business is very sound, which is accounted for by the firm market which has maintained for some time. Stocks in general are adequate, although a few articles are reported short in some directions. Transportation is still an obstacle confronting the shipper and very little improvement is expected before spring, as weather conditions during the winter months greatly hamper the operations of the railroads.

The chaotic condition in Europe has made no material change so far, but if the occupation of the Ruhr district is prolonged there will be a shortage of supplies of articles coming from this district, and consequently higher prices will be forthcoming.

Good Trading in Alkalis Reported

The market on alkalis continues firm, with a good volume of business being transacted. Prices have not changed, but a slight rise would not come as a surprise. *Caustic soda* is still being quoted at $3.90 per 100 lb. for the solid, and $4.25 per 100 lb. for the flake in 5-drum lots delivered to the buyer's door.

Quotations on carload lots would indicate about $3.40 per 100 lb. f.o.b. this market for the solid. *Soda ash*, 58 per cent light, is being quoted at $2.10 per 100 lb. in 5-bag lots, $2.30 per 100 lb. for 5 barrels. This has been shaded in one or two instances, but this price generally prevails. Carload lots sell around $1.55 per 100 lb. in bags f.o.b. shipping point. *Bicarbonate of soda* is holding firm and the best that can be done on less than carload quantities is $2.25 per 100 lb. on truckloads delivered. The 5-bbl. price is pretty generally $2.40 per 100 lb. *Sal soda* is in good demand at $1.55 per 100 lb. in barrels, $1.85 in kegs, $2 in cases—90 lb. in 2½-lb. packages.

General and Special Chemicals

Heavy mineral acids continue to move in good volume, particularly *muriatic*, and producers report being sold ahead over the next few months. Last week leading manufacturers announced an important reduction in the price of *citric acid* which was said to be due mostly to foreign competition. The reduction brought the price of crystals to 50c. per lb. and powdered to 51c. per lb., both in barrels, f.o.b. St. Louis, with the usual ½c. advance for kegs. *Citrates* remain unchanged, although citric acid declined. The demand for *tartaric acid* is nil, while *cream of tartar* has been more active. There are no special changes reported in *white arsenic*. Supplies are still very scarce and many users are buying as far ahead as 6 months so as to insure them of supplies when needed. *Carbon tetrachloride* and *bisulphide* are both moving in fair volume and remain unchanged in price. There is now a big demand for *creosotes* and *guiacols*. *Glycerine* continues in an unsettled state, and such a thing as an established market price does not exist—17@18½c. and anywhere between is considered a satisfactory price. *Cyanide of potash* is very firm, with a good demand. Red and yellow *prussiate of potash* are moving in larger volume. *Potassium permanganate* is very strong, with a good demand, and an advance in price in the very near future would not be surprising. *Sulphur* has not gained noticeable strength since our last report. A fairly good volume of business has not as yet brought about any strength in price, which continues very low. *Zinc sulphate* is quiet and very firm and the market is quoted at 3½c. f.o.b. St. Louis in carloads. *Zinc dust* is also quiet and firm with an increased inquiry, and the market is quoted at 10c. in carloads f.o.b. St. Louis.

Vegetable Oils and Paint Materials

Castor oil is maintaining its position of firmness attained a short time ago and a good volume of business is being done at 14c. in drums. *Turpentine* has declined sharply and is being quoted today at $1.43 in 5-bbl lots. *Linseed oil* has taken the expected advance, the prevailing price being $1.06 for the raw oil, $1.08 for boiled oil in single-barrel lots. In 5-bbl. lots a differential of 10c. per gal. prevails.

Advancing Tendency Continues in Steel Market

Increasing Strength the Result of Better Prices, More Business and Active Inquiry

PITTSBURGH, Feb. 9, 1923.

There is a still more pronounced advancing tendency in the steel market. In fact, the advancing tendency has been growing constantly since it first appeared about Jan. 1. Measured by prices, the steel market is stronger than ever. Measured by volume of business on books, it is likewise stronger than at any previous time in this movement. Measured by volume of inquiry, the market appears almost as strong as at any time. By still another symptom, the actual volume of sales and purchases, the market is decidedly quieter.

When the mills are not well sold up, inquiries and sales are much the same. When they are, the apparent volume of inquiry may greatly exceed the transactions, on account of many mills refusing to quote and an inquiry having to go the rounds before finding a seller, thus being magnified in apparent volume. A number of mills have been refusing more business than they have been accepting.

Production to Reach Maximum

Maximum steel production will probably be reached next month. Outputs have been increasing slightly in the past few weeks, with slowly increasing labor supply, due to intelligent employment effort, and with smoother operation of mills, from practice. March is almost always a month of high outputs, on account of weather conditions. After March labor shortage is likely to be a factor. A great deal of new construction is planned, and it is practically certain that not a few workmen will be drawn from mills by bonus wage rates.

Steel ingot production was at a rate of about 40,000,000 tons a year in each of the last 3 months of the old year. The rate has been increasing since December and it is far from improbable that a rate of close to 45,000,000 tons will be attained next month.

There is no particular scarcity of any finished steel commodity. The steel industry evidently has its old-time flexibility, with a finishing capacity well in excess of steel-making capacity, so that finishing departments can be operated in relation to the demands for the various products.

While no formal action seems to have been taken, it appears that the Carnegie Steel Co.'s price on shapes and plates has been advanced from 2.10c. to 2.20c. in the past week, following a definite advance in January from 2c. to 2.10c. The company's usual quotation on bars is 2.10c., but order books are so well filled that little tonnage can be taken. A large independent, on the other hand, is quoting 2.10c. on shapes and 2.20c. on bars. There is no single price quotable, much depending on tonnage, time of delivery and relation between mill and prospective buyer.

Late last week several independent pipe mills advanced prices two points on merchant steel pipe, three points on oil country goods and about $6 a ton on oil country goods. The Steel Corporation followed with similar advances. Nominally a point in merchant pipe discount is $2 a net ton, but on account of the trimmings it amounts to about $1.85. In the present advance one trimming, the last discount of 2½ per cent, was eliminated, so that the actual advance in merchant pipe averages slightly over $5 a net ton. The new basing discount is 64 per cent, the basing discount at the low point a year ago being 71 per cent. The total advance has been in the neighborhood of $15 a net ton.

For months past there has been some divergence in prices quoted on hoops and bands, according to width and gage. The divergence arose from the fact that with greatly advanced labor cost the old schedule of extras does not cover additional cost on the lighter material, weighing in some cases only a few hundred pounds per mile. Of late the irregularities have crystallized into two base prices, one, 2.75c., applying on bands and on hoops 1-in. and wider and 20 gage and heavier, the other, 3.50c., applying on lighter material. While this makes quite a difference between 20 and 21 gage, the mills are averse to tampering with established extras. A similar gap occurs between flats ¼-in. and $\frac{3}{16}$-in. respectively, the former being a bar and the latter a band.

Nearly all the independent sheet mills have now withdrawn from the market, being sold up to April 1 or later. These mills did not wish to fill up unduly prior to an advance in prices, but were not as ready as on former occasions to make formal announcement of advances. In a few cases mills have been quoting higher prices. It is taken practically for granted that prices will advance $3 or $5 a ton from the market level generally prevailing of late, 2.50c. for blue annealed, 3.35c. for black and 4.35c. for galvanized. Some mills have been disposed to increase the spread between black and galvanized from 1c. to either 1.10c. or 1.15c., on account of the high cost of zinc.

Coal and Coke

Market prices of Pittsburgh coal, Connellsville coal and Connellsville coke have declined slightly in the past week. In coal the decline is less than would be expected from the decreasing demand of the past few weeks, a supporting influence being car shortage, for car supplies in the Pittsburgh district have averaged decidedly less in the past 30 days than during December. Pittsburgh coal is now quotable at $2.75 for steam mine-run, $4.50 for nut and $4.25 to $5.00 for lump. Connellsville byproduct is quiet at about $3.50.

Demand for coke for heating purposes has been decreasing, but is still of fair volume. All prices are down about 50c. in the week, at $6.50@$7 for heating, $7.50@$8 for furnace and $8.25@$8.75 for foundry.

Current Prices in the New York Market

FOR CHEMICALS, OILS AND ALLIED PRODUCTS

Although these prices are for the spot market in New York City, a special effort has been made to report the American manufacturer's quotations whenever available. In many instances these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported and resale stocks are reported when of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb	$0 36 -	$0 38
Acetone, drums	lb	21 -	21½
Acid, acetic, 28%, bbl	100 lb	3 15 -	3 40
Acetic, 56%, bbl	100 lb	6 25	6 50
Glacial, 99½%, carboys	100 lb	12 00 -	12 50
Boric, crystals, bbl	lb	11½	11¾
Boric, powder, bbl	lb.	11 -	11½
Citric, kegs	lb	49	50
Formic, 85%	lb	15	17
Gallic, tech	lb	45 -	50
Hydrochloric, 18° tanks	100 lb	90 -	1.00
Hydrofluoric, 52%, carboys	lb	12 -	.12½
Lactic, 44%, tech, light, bbl	lb	11 -	11½
22% tech, light, bbl	lb	05 -	05½
Muriatic, 20°, tanks	100 lb	1 00 -	1 10
Nitric, 36°, carboys	lb	04½-	05
Nitric, 42°, carboys	lb	.06 -	06½
Oleum, 20%, tanks	ton	17.00 -	18 00
Oxalic, crystals, bbl	lb	.12½-	13
Phosphoric, 50%, carboys	lb.	08 -	09
Pyrogallic, resublimed	lb.	1 50 -	1 60
Sulphuric, 60°, tanks	ton	9 00 -	10 00
Sulphuric, 60°, drums	ton	12 00 -	14 00
Sulphuric, 66°, tanks	ton	14 50 -	15 00
Sulphuric, 66° drums	ton	19 00	20 00
Tannic, U S P, bbl	lb.	.65 -	70
Tannic, tech, bbl	lb.	.40 -	.45
Tartaric, imp crys, bbl	lb.	.30½-	31
Tartaric, imp, powd, bbl	lb.	.31 -	32
Tartaric, domestic, bbl	lb.		32
Tungstic, per lb of WO	lb	1 00	1 20
Alcohol, butyl, drums	gal	.18	23
Alcohol ethyl (Cologne spirit), bbl	gal	4 75	4 95
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 188 proof No 1	gal	38 -	.40
Alum, ammonia, lump, bbl	lb	03½	.03¾
Potash, lump, bbl	lb	03 -	.03½
Chrome, lump, potash, bbl	lb	05 -	05½
Aluminum sulphate, com, bags	100 lb	1 50	1 65
Iron free bags	lb	02½	.02¾
Aqua ammonia, 26°, drums	lb	06¼-	.07¼
Ammonia, anhydrous, cyl	lb	30 -	.30½
Ammonium carbonate, powd casks, imported	lb	09½	.10
Ammonium carbonate, powd domestic, bbl	lb	13	14
Ammonium nitrate, tech, casks	lb	10	11
Amyl acetate tech, drums	gal	2 80	3 05
Arsenic, white, powd, bbl	lb	15½	16
Arsenic, red, powd, kegs	lb	13	13½
Barium carbonate, bbl	ton	75 00	77 00
Barium chloride, bbl	ton	90 00	100 00
Barium dioxide, drums	lb	18	18½
Barium nitrate, casks		08½	.08¾
Barium sulphate, bbl	lb	04	04½
Blanc fixe, dry, bbl	lb	04	04½
Blanc fixe, pulp, bbl	ton	45 00	55 00
Bleaching powder, f.o.b. wks, drums	100 lb	2 00	2 50
Resale drums	100 lb	2 50	2 75
Borax, bbl	lb	05½	05¾
Bromine, cases	lb	25 -	27
Calcium acetate, bags	100 lb	3 50	3 60
Calcium carbide, drums	lb	04½-	04¾
Calcium chloride, fused, drums	ton	22 00	23 00
Gran drums	lb.	01½-	01¾
Calcium phosphate, mono, bbl	lb	06½	07
Camphor, cases	lb	86 -	88
Carbon bisulphide, drums	lb	07 -	07½
Carbon tetrachloride, drums	lb	09½-	10
Chalk, precip—domestic, light, bbl	lb	04¼	.04½
Domestic, heavy, bbl	lb	03½-	03¾
Imported, light, bbl	lb	04½-	05
Chlorine, liquid, cylinders	lb	06 -	06½
Chloroform, tech, drums	lb	35 -	38
Cobalt oxide, bbl	lb.	2 10 -	2 25
Copperas, bulk, f o b wks	ton	16 50	20 00
Copper carbonate, bbl	lb	20	20½
Copper cyanide, drums	lb	47 -	50
Copper sulphate, crys, bbl	100 lb	6 00	6 25
Cream of tartar, bbl	lb	24 -	25
Dextrine, corn, bags	100 lb	3 25	3 50
Epsom salt, dom., tech, bbl	100 lb	2 10	2.25
Epsom salt, imp., tech, bags	100 lb	1 10 -	1 25
Epsom salt, U.S.P., dom, bbl	100 lb.	2.50 -	2 75
Ether, U.S.P., drums	lb.	.13 -	.15
Ethyl acetate, com., 85%, drums	gal.	.80 -	.85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 -	1.00
Formaldehyde, 40%, bbl	lb.	$0 15½-	$0.16½
Fullers earth, f o b mines	net ton	16 00 -	17 00
Fullers earth—imp, powd	net ton	30 00 -	32 00
Fusel oil, ref, drums	gal	3 55 -	4 05
Fusel oil, crude, drums	gal	2 30 -	2 40
Glaubers salt, wks, bags	100 lb	1 20 -	1 40
Glaubers salt, imp, bags	100 lb	1 00 -	1 25
Glycerine, c p, drums extra	lb	18½-	19
Glycerine, dynamite, drums	lb	17 -	17½
Iodine, resublimed	lb	4 40 -	4 50
Iron oxide, red, casks	lb	12 -	.18
Lead:			
White, basic cabonate, dry, casks	lb	09½-	.10
White, in oil, kegs	lb	12 -	.13½
Red, dry, casks	lb	11½-	11¾
Red, in oil, kegs	lb	13 -	14½
Lead acetate, white crys, bbl	lb	13 -	13½
Lead arsenate, powd, bbl	lb	23 -	24
Lime-Hydrated, bbl	per ton	16 80 -	17 00
Lime, Lump, bbl	280 lb	3 63 -	3 65
Litharge, comm, casks	lb	09½	10
Lithophone, bbl	lb	06½-	07
Magnesium carb, tech, bags	lb	08 -	08½
Methanol, 95%, bbl	gal	1 23	1 25
Methanol, 97%, bbl	gal	1 25 -	1 27
Nickel salt, double, bbl	lb	10 -	10½
Nickel salts, single, bbl.	lb	11	11½
Phosgene		60 -	75
Phosphorus, red, cases	lb	35 -	40
Phosphorus, yellow, cases	lb	30 -	35
Potassium bichromate, casks	lb	09¾-	10
Potassium bromide, gran, bbl	lb	16 -	23
Potassium carbonate, 80-85%, calcined, casks	lb	06 -	06½
Potassium chlorate, powd	lb	07½-	08
Potassium cyanide, drums	lb	47 -	80
Potassium hydroxide (caustic potash) drums	100 lb	7 25 -	7 50
Potassium iodide, cases	lb	3 50 -	3 60
Potassium nitrate, bbl	lb	06½-	07
Potassium permanganate, drums	lb	.17½-	18
Potassium prussiate, red, casks	lb	.85 -	90
Potassium prussiate, yellow, casks	lb	38 -	39
Salammoniac, white, gran, casks, imported	lb	06½-	06¾
Salammoniac, white, gran, bbl, domestic	lb	08	.08½
Gray, gran, casks	lb	08½-	.08¾
Salsoda, bbl	100 lb	1 20 -	1 40
Salt cake (bulk)	ton	26 00 -	28 00
Soda ash, light, 58% flat, bags, contract	100 lb	1.60 -	1.67
Soda ash, light, basis, 48%, bags, contract, f o.b wks	100 lb	1 20 -	1 30
Soda ash, light, 58%, flat, bags, resale	100 lb	1 75 -	1 80
Soda ash, dense, bags, contract, basis 48%	100 lb	1 17½-	1 20
Soda ash, dense, in bags, resale	100 lb	1 85 -	1.90
Soda, caustic, 76%, solid, drums, f a.s.	100 lb	3 45 -	3 70
Soda, caustic, 76%, solid, drums, contract	100 lb	3 35	3.40
Soda, caustic, basis 60%, wks, contract	100 lb	2 50 -	2 60
Soda, caustic, ground and flake, contracts	100 lb	3 80 -	3 90
Soda, caustic, ground and flake, resale	100 lb	4 00 -	4 15
Sodium acetate, works, bags	lb	06½-	07½
Sodium bicarbonate, bbl	100 lb	1.75 -	1 85
Sodium bichromate, casks	lb	07¾-	08
Sodium bisulphate (niter cake)	ton	6 00 -	7 00
Sodium bisulphite, powd., U S.P, bbl	lb	04½-	04¾
Sodium chlorate, kegs	lb	06½-	07
Sodium chloride	long ton	12 00 -	13.00
Sodium cyanide, cases	lb	20 -	.23
Sodium fluoride, bbl	lb	.09 -	10
Sodium hyposulphite, bbl	lb	03 -	.03½
Sodium nitrite, casks	lb	08½-	09
Sodium peroxide, powd, cases	lb.	28 -	.30
Sodium phosphate, dibasic, bbl.	lb	03¾-	.04
Sodium prussiate, yel drums	lb	19 -	19½
Sodium silicate (40°, drums)	100 lb	80 -	1 15
Sodium silicate (60°, drums)	100 lb.	2 00 -	2 25
Sodium sulphide, fused, 60-62% drums	lb.	04 -	.04½
Sodium sulphite, crys., bbl...	lb.	.03½-	.03¾
Strontium nitrate, powd., bbl.	lb.	.09½-	.10½
Sulphur chloride, yel drums	lb.	.04½-	.05
Sulphur, crude	ton	18.00 -	20.00
Sulphur dioxide, liquid, cyl...	lb.	.08 -	.08½
Sulphur, flour, bbl	100 lb.	2.35 -	3.15
Sulphur, roll, bbl.	100 lb.	$2 00 -	$2.50
Talc—imported, bags	ton	30 00 -	40.00
Talc—domestic powd, bags	ton	18 00 -	25 00
Tin bichloride, bbl	lb	.11 -	11½
Tin oxide, bbl	lb	.45 -	.47
Zinc carbonate, bags	lb	14 -	.14½
Zinc chloride, gran, bbl	lb	.06 -	.07
Zinc cyanide, drums	lb	.38 -	.40
Zinc oxide, XX, bbl	lb.	.07½ -	.08
Zinc sulphate, bbl	100 lb	2.75 -	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl	lb	$0 80 -	$0.85
Alpha-naphthol, ref, bbl	lb	1 05 -	1 10
Alpha-naphthylamine, bbl	lb	27 -	.30
Aniline oil, drums	lb	16½-	.17
Aniline salts, bbl	lb	24 -	.25
Anthracene, 80%, drums	lb	75 -	1 00
Anthracene, 80%, imp, drums, duty paid	lb.	.65 -	.70
Anthraquinone, 25%, paste, drums	lb	70 -	.75
Benzaldehyde U S P, carboys	lb.	1.40 -	1.45
Benzene, pure, water-white, tanks and drums	gal.	.30 -	.35
Benzene, 90%, tanks & drums	gal.	.26 -	.32
Benzene, 90%, drums, resale	gal	.32 -	.34
Benzidine base, bbl	lb	.85 -	.90
Benzidine sulphate, bbl	lb	75 -	80
Benzoic acid, U S P, kegs	lb	72 -	.75
Benzoate of soda, U S P, bbl	lb	57 -	.65
Benzyl chloride, 95-97%, ref, drums	lb	25 -	.27
Benzyl chloride, tech, drums	lb	.20 -	.23
Beta-naphthol, subl, bbl.	lb	55 -	.60
Beta-naphthol, tech, bbl	lb	25 -	.26
Beta-naphthylamine, tech	lb	1 00 -	1.25
Carbazol, bbl	lb	.75 -	.90
Cresol, U S P, drums	lb	.25 -	.27
Ortho-cresol, drums	lb	.24 -	.26
Cresylic acid, 97%, resale, drums	gal.	1.60 -	1.75
95-97%, drums, resale	gal.	1 60 -	1.75
Dichlorbenzene, drums	lb	07 -	.09
Diethylaniline, drums	lb	.50 -	.60
Dimethylaniline, drums	lb	.40 -	.41
Dinitrobenzene, bbl	lb	20 -	.22
Dinitroclorbenzene, bbl	lb	.22 -	.23
Dinitronaphthalene, bbl	lb	.30 -	.32
Dinitrophenol, bbl	lb	.35 -	.40
Dinitrotoluene, bbl	lb	.22 -	.24
Dip oil, 25%, drums	gal.	.25 -	.30
Diphenylamine, bbl	lb	54 -	.56
H-acid, bbl	lb	.75 -	.80
Meta-phenylenediamine, bbl.	lb	95 -	1.00
Michlers ketone, bbl	lb	3 00 -	3.50
Monochlorbenzene, drums	lb.	.08 -	.10
Monoethylaniline, drums	lb.	95 -	1.10
Naphthalene, crushed, bbl	lb	.05½-	.06
Naphthalene, flake, bbl	lb	.06 -	.06½
Naphthalene, balls, bbl	lb.	.07 -	.07½
Naphthionate of soda, bbl	lb.	.58 -	.65
Naphthionic acid, crude, bbl.	lb.	.60 -	.65
Nitrobenzene, drums	lb.	.10 -	.12
Nitro-naphthalene, bbl.	lb.	.30 -	.35
Nitro-toluene, drums	lb.	.15 -	.17
N-W acid, bbl	lb.	1.15 -	1.20
Ortho-amidophenol, kegs	lb.	2.30 -	2 35
Ortho-dichlorbenzene, drums	lb.	.17 -	.20
Ortho-nitrophenol, bbl	lb.	.90 -	.92
Ortho-nitrotoluene, drums.	lb.	.10 -	.12
Ortho-toluidine, bbl....	lb.	.13 -	.15
Para-amidophenol, base, kegs	lb.	1.15 -	1.20
Para-amidophenol, HCl, kegs	lb.	1.20 -	1.25
Para-dichlorbenzene, bbl	lb.	.17 -	.20
Paranitraniline, bbl	lb.	.73 -	.75
Para-nitrotoluene, bbl	lb.	.55 -	.65
Para-phenylenediamine, bbl.	lb.	1.50 -	1 55
Para-toluidine, bbl.	lb.	.85 -	.90
Phthalic anhydride, bbl	lb.	.35 -	.38
Phenol, U S.P, drums.	lb.	.35 -	.37
Picric acid, bbl.	lb.	.20 -	.22
Pyridine, dom., drums	gal.	nominal	
Pyridine, imp, drums	gal.	3.00 -	3.10
Resorcinol, tech, kegs	lb.	1.50 -	1.55
Resorcinol, pure, kegs	lb.	2.00 -	2.10
R-salt, bbl	lb.	.55 -	.60
Salicylic acid, tech, bbl.	lb.	.40 -	.42
Salicylic acid, U.S P, bbl	lb.	.45 -	.47
Solvent naphtha, water-white, drums	gal.	.37 -	.40
Crude, drums	gal.	.22 -	.24
Sulphanilic acid, crude, bbl	lb.	.18 -	.20
Thiocarbanilide, kegs	lb.	.35 -	.38
Toluidine, kegs	lb.	1.20 -	1.30
Toluidine, mixed, kegs	lb.	.30 -	.35
Toluene, tank cars	gal.	.35 -	.37
Toluene, drums	gal.	.40 -	.43
Xylidines drums	lb.	.40 -	.45
Xylene, pure, drums	gal.	.45 -	.50
Xylene, com., drums	gal.	.40 -	.42
Xylene, com., tanks	gal.	.30 -	....

Naval Stores

Rosin B-D, bbl.......... 280 lb.		$5 75 –	...
Rosin E-I, bbl........... 280 lb.		5 90 –	
Rosin K-N, bbl. .... 280 lb.		6 10 –	$6 35
Rosin W.G.-W.W., bbl..... 280 lb.		7.75 –	8 25
Wood rosin, bbl.... ..... 280 lb.		6 25 –	
Turpentine, spirits of, bbl..	gal.	1 41 –	1 42
Wood, steam dist., bbl.....	gal.	1.35 –	
Wood, dest dist., bbl....	gal.	1.25 –	
Pine tar pitch, bbl ..200 lb		–	6 00
Tar, kiln burned, bbl....... 500 lb.		–	12 00
Retort tar, bbl. . ...500 lb.		... –	11.00
Rosin oil, first run, bbl. .. .	gal.	.43 –	.
Rosin oil, second run, bbl.. ..	gal.	.47 –	....
Rosin oil, third run, bbl...	gal.	.53 –	...
Pine oil, steam dist.	gal.	... –	.90
Pine oil, pure, dest. dist... .	gal.	.... –	.85
Pine tar oil, ref . .	gal.	.... –	.46
Pine tar oil, crude, tanks f.o b. Jacksonville, Fla...	gal.	.... –	35
Pine tar oil, double ref , bbl .	gal.	..... –	.75
Pine tar, ref., thin, bbl	gal.	..... –	.25
Pinewood creosote, ref , bbl	gal.	...... –	.52

Vegetable Oils

Castor oil, No 3, bbl	lb	$.12½–	$.12¾
Castor oil, AA, bbl.	lb.	.12½–	.13
Chinawood oil, bbl. .. .	lb	.18 –	18½
Coconut oil, Ceylon, bbl... .	lb	.09¼–	.9½
Coconut oil, Cochin, bbl... .	lb	.09½–	10
Corn oil, crude, bbl. .	lb	.11½–	.11¾
Cottonseed oil, crude (f.o.b. mill), tanks ..	lb	.09¾–	.10
Summer yellow, bbl	lb.	.12½–	12¾
Winter yellow, bbl.	lb	.13 –	13½
Linseed oil, raw, car lots, bbl	gal.	.96 –	97
Raw, tank cars (dom) ..	gal.	.92 –	93
Boiled, 5-bbl lots (dom.)	gal.	1 00 –	1 02
Olive oil, denatured, bbl . .	gal.	1 00 –	1 15
Palm, Lagos, casks	lb	08 –	08½
Palm kernel, bbl	lb	08¾–	09
Peanut oil, crude, tanks (mill)	lb	13½–	13¾
Peanut oil, refined, bbl	lb	16 –	16½
Rapeseed oil, refined, bbl .	gal.	.85 –	86
Rapeseed oil, blown, bbl	gal.	.90 –	.91
Soya bean (Manchurian), bbl.	lb.	.11½–	..
Tank, f o b. Pacific coast	lb	10 –.	.

Fish Oils

Menhaden, light pressed, bbl	gal	$0 60 –	.
White bleached, bbl	gal	64 –	65
Blown, bbl	gal	.68 –	69
Whale No. 1 crude, tanks, coast	lb	.06 –	06½

Dye & Tanning Materials

Divi-divi, bags	ton	$38 00	$39 00
Fustic, sticks ...	ton	30 00 –	35 00
Fustic, chips, bags	lb	04 –	05
Logwood, sticks .	ton	28 00 –	30 00
Logwood, chips, bags.	lb.	02½–	03½
Sumac, leaves, Sicily, bags...	ton	65 00 –	
Sumac, ground, bags. . .	ton	55 00 –	60 00
Sumac, domestic, bags.. ...	ton	35 00 –	
Tapioca flour, bags. ..	lb	.03½–	.05

EXTRACTS

Archil, conc , bbl.......	lb.	$0 17 –	$0 18
Chestnut, 25% tannin, tanks	lb	02 –	03
Divi-divi, 25% tannin, bbl	lb.	04 –	05
Fustic, crystals, bbl	lb	20 –	22
Fustic, liquid, 42°, bbl .	lb.	.08 –	09
Gambier, liq , 25% tannin, bbl.	lb	.08 –	09
Hematine crys , bbl. . .	lb	14 –	18
Hemlock, 25% tannin, bbl	lb.	04 –	.05
Hypernic, solid, drums .. .	lb	.24 –	26
Hypernic, liquid, 51°, bbl....	lb	14 –	.17
Logwood, crys., bbl	lb.	19 –	.20
Logwood, liq , 51°, bbl..... .	lb.	.09 –	.10
Quebracho, solid, 65% tannin, bbl.	lb.	.04½–	05
Sumac, dom , 51°, bbl. . .	lb.	.06½–	.07

Waxes

Bayberry, bbl . .	lb.	$0 28 –	$0 30
Beeswax, refined, dark, bags	lb	.30 –	.32
Beeswax, refined, light, bags..	lb	.34 –	35
Beeswax, pure white, cases.	lb.	.40 –	41
Candellila, bags .	lb	.34 –	.35
Carnauba, No 1, bags	lb	.38 –	40
No 2, North Country, bags	lb.	.24 –	24½
No 3, North Country, bags	lb	.17½–	18½
Japan, cases	lb	.15 –	15½
Montan, crude, bags..	lb.	.03½–	04
Paraffine, crude, match, 105-110 m p . ..	lb.	.04 –	04½
Crude, scale 124-126 m.p., bags	lb.	.02½–	02¾
Ref., 118-120 m.p., bags	lb.	.03¼–	03½
Ref , 125 m p , bags . .	lb.	.03½–	.03¾
Ref. 128-130 m p , bags . .	lb	.04 –	04¼
Ref , 133-135 m p , bags	lb.	.04½ –	04¾
Ref , 135-137 m p , bags	lb	.05 –	05½
Stearic acid, sgle pressed, bags	lb.	10 –	10½
Double pressed, bags. .	lb.	.10½–	.10¾
Triple pressed, bags .. .	lb.	.11 –	.11½

Fertilizers

Ammonium sulphate, bulk, f.o.b. works .... 100 lb.		$3.20 –	$3.25
F.a.s. double bags...... 100 lb.		3.85 –	3.95
Blood, dried, bulk..........	unit	4.60 –	......
Bone, raw, 3 and 50, ground..	ton	30.00 –	35.00
Fish scrap, dom., dried, wks..	unit	5.00 –	5.10
Nitrate of soda, bags...... 100 lb.		2.60 –	2.65
Tankage, high grade, f.o.b. Chicago...............	unit	4.70 –	4 80

Phosphate rock, f o.b. mines, Florida pebble, 68-72%....	ton	$3.50 –	$4 00
Tennessee, 78-80% .	ton	7 00 –	8 00
Potassium muriate, 80%, bags	ton	35 00 –	36.00
Potassium sulphate, bags	unit	1.00 –	......

Crude Rubber

Para—Upriver fine	lb.	$0 33½–	$0 34
Upriver coarse .	lb.	27½–	28
Upriver caucho ball	lb.	.29 –	.29½
Plantation—First latex crepe	lb	35½–	35¾
Ribbed smoked sheets	lb.	.35½–	.35¾
Brown crepe, thin, clean	lb.	31 –	.32
Amber crepe No 1 .	lb.	.31 –	.32

Miscellaneous Materials

Asbestos, crude No 1, f o b., Quebec	sh. ton	$450 00 –	$550.00
Asbestos, shingle, f o b , Quebec	sh ton	60 00 –	80 00
Asbestos, cement, f.o b , Quebec	sh. ton	15 00 –	17 00
Barytes, grd , white, f o b mills, bbl	net ton	16 00 –	20 00
Barytes, grd , off-color, f.o b. mills bulk .	net ton	13.00 –	21.00
Barytes, floated, f.o b St. Louis, bbl .	net ton	24.00 –	28 00
Barytes, crude f.o b mines, bulk	net ton	8 50 –	9 00
Casein, bbl , tech	lb.	.11 –	12
China clay (kaolin) crude, f o b Ga.	net ton	7 00 –	9 00
Washed, f o b Ga	net ton	8 00 –	9 00
Powd , f o b Ga	net ton	13 00 –	20 00
Crude f o b Va .	net ton	8 00 –	12 00
Ground, f o b Va..	net ton	13 00 –	20 00
Imp , lump, bulk.	net ton	15 00 –	20 00
Imp , powd	net ton	45 00 –	50 00
Feldspar, No. 1 pottery...	long ton	6 00 –	7 00
No. 2 pottery .. .	long ton	5 00 –	5 50
No. 1 soap	long ton	7 00 –	7 50
No. 1 Canadian, f o b mill	long ton	25.00 –	27 00
Graphite, Ceylon, lump, first quality, bbl	lb	.06 –	.06½
Ceylon, chip, bbl	lb	05 –	05½
High grade amorphous crude	ton	35 00 –	50 00
Gum arabic, amber, sorts, bags	lb	.15 –	16
Gum tragacanth, sorts, bags	lb	50 –	60
No 1, bags	lb	1 75 –	1 80
Kieselguhr, f o b Cal .	ton	40 00 –	42 00
F o b N Y	ton	50 00 –	55 00
Magnesite, crude, f o b Cal	ton	14 00 –	15 00
Pumice stone, imp , casks	lb	03 –	05½
Dom , lump, bbl	lb	05 –	05½
Dom , ground, bbl	lb.	.06 –	07
Shellac, orange fine, bags	lb	83 –	84
Orange superfine, bags	lb	85 –	86
A C garnet, bags	lb	80 –	81
T N , bags	lb	81 –	82
Silica, glass sand, f o b Ind	ton	2 00 –	2 50
Silica, sand blast, f.o b Ind	ton	2 50	5 00
Silica, amorphous, 250-mesh, f o b Ill	ton	17 00 –	17 50
Silica, bldg sand, f o b Pa	ton	2 00 –	2 75
Soapstone, coarse, f o b Vt , bags	ton	7 00 –	8 00
Talc, 200 mesh, f o b , Vt , bags .	ton	6 50 –	9 00
Talc, 200 mesh, f o b. Ga , bags .	ton	7.00 –	9 00
Talc, 200 mesh, f o b. Los Angeles, bags.	ton	16.00 –	20.00

Refractories

Bauxite brick, 56% Al_2O_3, f o b. Pittsburgh .	ton	$45–50
Chrome brick, f o b. Eastern shipping points .	ton	50–52
Chrome cement, 40-50% Cr_2O_3.	ton	23–27
40-45% Cr_2O_3, sacks, f o b. Eastern shipping points.. .	ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b Ky wks..... .	1,000	40–46
2nd quality, 9-in. shapes, f o b. wks.	1,000	36–41
Magnesite brick, 9-in. straight (f.o.b. wks)	ton	65–68
9-in. arches, wedges and keys.	ton	80–85
Scraps and splits .	ton	85
Silica brick, 9-in. sizes, f.o b. Chicago district .	1,000	48–50
Silica brick, 9-in. sizes, f o.b. Birmingham district .	1,000	48–50
F o.b Mt Union, Pa .	1,000	42–44
Silicon carbide refract. brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18% f o b. Niagara Falls, N Y. .	ton	$200.00 –	$225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11½	.11¾
4-6% C... .	lb.	.12 –	.13
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid.. . .	gr. ton	105.00 –	107 50
Spiegeleisen, 19-21% Mn..	gr. ton	35.00 –	37.00
Ferromolybdenum, 50-60% Mo, per lb Mo	lb.	1.90 –	2.15
Ferrosilicon, 10-15%.....	gr. ton	38.00 –	40.00
50%................	gr. ton	80.00 –	85.00
75%................	gr. ton	150.00 –	160.00
Ferrotungsten, 70-80%, per lb. of W........	lb.	$0.90 –	$0.95
Ferro-uranium, 35-50% of U. per lb of U .	lb.	6.00 –	....
Ferrovanadium, 30-40%, per lb. of V .	lb	3.50 –	4.00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o b. shipping points	ton	$6.50 –	$8.75
Chrome ore, Calif. concentrates, 50% min Cr_2O_3	ton	22 00 –	23.00
C i f Atlantic seaboard	ton	18 50 –	19.00
Coke, fdry , f o b ovens	ton	9 25 –	9.50
Coke, furnace, f o b ovens	ton	8 00 –	8.50
Fluorspar, gravel, f o b mines, New Mexico	ton	17.50 –	....
Fluorspar, No 2 Lump—Ky. & Ill mines .	ton	25.00 –	....
Ilmenite, 52% TiO_2 .	lb	.01½–	.01¾
Manganese ore, 50% Mn, c i f Atlantic seaport	unit	.33 –	....
Manganese ore, chemical (MnO_2)	ton	75.00 –	80.00
Molybdenite, 85% MoS_2, per lb MoS_2, N Y	lb	.65 –	.70
Monazite, per unit of ThO_2, c i f , Atl. seaport	lb.	.06 –	.08
Pyrites, Span , fines, c i f. Atl seaport .	unit	.11½–	.12
Pyrites, Span , furnace size, c i f Atl seaport .	unit	.11½–	.12
Pyrites, dom fines, f o b mines, Ga	unit	.12	
Rutile, 95% TiO_2	lb.	.12 –	....
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.00 –	8.50
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	7.50 –	8.00
Uranium ore (carnotite) per lb of U_3O_8 .	lb.	3.50 –	3.75
Uranium oxide, 96% per lb. U_3O_8	lb	2.25 –	2 50
Vanadium pentoxide, 99%	lb	12 00 –	14.00
Vanadium ore, per lb V_2O_5 .	lb.	1.00 –	.. ....
Zircon, washed, iron free, f o.b Pablo, Fla	lb	04½–	.13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic .	15 00
Aluminum, 98 to 99%	23.00
Antimony, wholesale, Chinese and Japanese .	7.15-7.50
Nickel, virgin metal . .	25 00 27.00
Nickel, ingot and shot	29 00
Monel metal, shot and blocks	32 00
Monel metal, ingots	38 00
Monel metal, sheet bars	45 00
Tin, 5-ton lots, Straits	40.50
Lead, New York, spot . .	8 00
Lead, E St Louis, spot	8 00 8.125
Zinc, spot, New York .	7 25–7.30
Zinc, spot, E St Louis	6.85–7.05

OTHER METALS

Silver (commercial) .	oz.	$0 64
Cadmium	lb	1 15
Bismuth (500 lb lots). . .	lb.	2.55
Cobalt ..	lb.	3 00@3.25
Magnesium, ingots, 99%....	lb	1.00@1 05
Platinum .	oz	114.00@116 00
Iridium . .	oz.	250 00@275.00
Palladium .	oz	65 00@ 70.00
Mercury	.75 lb.	71 50

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.75
Copper bottoms	30.75
Copper rods	20.50
High brass wire	19.50
High brass rods	17.00
Low brass wire	21.10
Low brass rods	22.00
Brazed brass tubing	24.25
Brazed bronze tubing	29.00
Seamless copper tubing	25.25
Seamless high brass tubing..	23.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible .	11.30@11.50
Copper, heavy and wire	11 25@11.50
Copper, light and bottoms	9 25@ 9.50
Lead, heavy	5.75@ 6.00
Lead, tea	3.50@ 3.75
Brass, heavy	6.25@ 6.40
Brass, light......	5.35@ 5.75
No 1 yellow brass turnings....	6.30@ 6.50
Zinc	3 50@ 4.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes..............	$3.29	$3.14
Soft steel bars	3.19	3.04
Soft steel bar shapes..........	3.19	3.04
Soft steel bands...............	3.29	3.19
Plates, ¼ to 1 in. thick..........	3.29	3.14

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

TALLADEGA The Talladega Pipe Co, manufacturer of cast-iron pipe, will make extensions and improvements in its foundry for considerable increase in capacity E O Norman is plant superintendent

CALERA -The O'Neals Lime Works Eureka, Ala, has plans in progress for the construction of a new plant in the vicinity of Calera for the manufacture of hydrated lime, with department for the production of agricultural lime It will consist of 10 kilns and complete operating facilities and labor-saving machinery for an annual production of 1,000,000 bbl The majority of the equipment will be electrically operated The new works is estimated to cost $500,000 The Schaffer Engineering & Equipment Co, 2818 Smallman St, Pittsburgh, Pa, is preparing plans The company has recently removed its general offices from Birmingham to the present plant at Eureka John H Adams is president

ANNISTON The Independent Soil Pipe Co, recently formed with a capital of $75,000, to manufacture cast-iron pipe, has acquired the local plant of the Ajax Foundry Co, and will operate at this location Extensions and improvements are planned in the present works R B Carr is secretary and R T House, general manager

Arkansas

BERRYVILLE H H Beal is organizing a company to construct and operate a local plant for the manufacture of lime products Work will be placed under way at an early date

ARKADELPHIA The Arkadelphia Milling Co is planning for the erection of a number of new buildings at its plant for the production of molasses and affiliated products W N Adams is general manager

Arizona

DOUGLAS The Calumet & Arizona Mining Co., Calumet Mich, has arranged an appropriation of $500,000 for extensions and improvements in its smelting plant at Douglas, including the installation of a new crushing, sampling and ore-treating plant It is expected to commence construction at an early date and complete the installation in the fall

California

EMERYVILLE The Westinghouse Electric & Mfg. Co, East Pittsburgh, Pa, and First National Bank Bldg, San Francisco has awarded a contract to the Ralph McLeran Co, Hearst Bldg, for the erection of the first unit of a new plant at Green and 62nd Sts, Emeryville, to be 1- and 2-story, estimated to cost close to $200,000, with equipment It will be operated by the Westinghouse High Voltage Insulator Co, a subsidiary organized, and used exclusively for porcelain insulator manufacture Four oil-burning kilns will be installed and this battery will ultimately be increased to 12 such kilns California clays will be utilized for the manufacture Ray P Jackson, formerly located at the East Pittsburgh works, will be general manager at the plant

HUNTINGTON BEACH -The Pacific Gasoline Co is planning for the installation of a large gasoline-absorption plant on local site, estimated to cost close to $100,000. Headquarters of the company are at Los Angeles W J Bower is president and general manager E T Hitchcock will be in charge of construction

LOS ANGELES- The American Agar Co, San Diego, operating a local plant for the manufacture of gelatin from seaweed, has been granted permission by the Board of Harbor Commissinooners to construct and operate a similar plant on site selected at Fish Harbor, San Pedro. It is estimated to cost close to $200,000, with machinery. A present experimental plant at Glendale, Calif., will be removed to the new location. Dr. C. F. Farrow is president.

PASADENA—The Art Concrete Works, 364 South Fair Oaks Ave, has plans under way for the erection of a 1-story addition to its cement composition plant, 36x80 ft.

SAN JOSE--The Pacific Gas & Electric Co., 445 Sutter St, San Francisco, will install a new artificial gas-generating plant on local site estimated to cost approximately $100,000

Colorado

DENVER—The Midwest Refining Co, First National Bank Bldg, will commence the immediate erection of a third unit at its gasoline-refining plant in the Salt Creek field, to increase the capacity to about 100,000 gal per day

Connecticut

HARTFORD The Hartford Rubber Works, a subsidiary of the United States Rubber Corp, is planning for the rebuilding of the portion of its plant, destroyed by fire, Feb 3 The bulk of the loss was confined to the machinery

Georgia

CEDARTOWN—The T J Rice Co, LaGrange, Ga, operating a local iron foundry, is planning for the immediate establishment of a new plant at Cedartown It is proposed to continue the present plant at LaGrange

Idaho

GLENNS FERRY - The American Mining & Development Co is perfecting plans for the installation of a new milling plant at its local properties Charles Alban is president

Illinois

CHICAGO The Goldsmith Brothers Smelting & Refining Co, 5841 Throop Ave, has commenced the erection of its proposed new plant additions, to consist of a 1-story structure, 15x135 ft., at Throop Ave and 58th St, to be used for the production of copper sulphate, and a similar 1-story building at Ada and 59th Sts, to be equipped as a smelting plant. The expansion will cost about $200,000, including machinery

GRANITE CITY -The Union Starch & Refining Co is completing plans for the construction of a new 1-story addition, 10x75 ft, to cost about $15,000 J E Irwin is secretary

CHICAGO -The Lake View Brick Co., 2758 Irving Park Blvd, has purchased property at Irving Park Blvd. and California Ave., 666x1320 ft., for a consideration of $45,000, to be used for an addition to its plant.

CHICAGO—The Northwestern Foundry Co., 662 West Roosevelt Rd, has awarded a contract to William F Solomon & Co., 175 West Jackson Blvd, for the rebuilding of a 1-story foundry at its plant, 50x126 ft, recently partly destroyed by fire The company manufactures grey iron castings.

CHICAGO—The Chicago Extruded Metals Co, recently organized, has commenced the construction of a new plant on 54th Ave, near 19th St, Cicero, for the manufacture of brass products It is estimated to cost in excess of $200,000, with machinery

Indiana

WARSAW—The Interstate Public Service Co, Board of Trade Bldg., Indianapolis, has plans in preparation for the installation of a new filtration plant at Center Lake, Warsaw, for the local water system, estimated to cost $75,000.

FORT WAYNE—The Dudlo Mfg. Co., Wall St, manufacturer of electric wire products, is said to be planning for the immediate rebuilding of the portion of its enameling department, destroyed by fire, Jan. 29, with loss approximating $10,000.

SHELBYVILLE—Fire, Jan 30, destroyed the local plant of the Kennedy Car Liner & Bag Co., manufacturer of paper products, with loss estimated at $200,000, including machinery. A temporary plant will be established pending the rebuilding of the works. The company maintains a branch at Greensburg, Ind. Fred W. Kennedy is president.

Kentucky

BOWLING GREEN—The Central Producing & Refining Co. has acquired property in Warren and Allen Counties, and has preliminary plans under consideration for the erection of a new oil-refining plant.

MARION—The Big Four Fluorspar & Ore Co, 903 Farmers' Bank Bldg, Pittsburgh, Pa., is perfecting plans for the erection of a new mining and milling plant on site near Marion, comprising a number of 1-story buildings, estimated to cost close to $100,000, including machinery. W. J Strassburger is president

Louisiana

NAPOLEONVILLE—The local refinery of the Oakley Sugar Co. has been acquired by new interests, headed by Geoffrey Barton and C. C Percy. A company will be organized to operate the plant, and a number of extensions and improvements made

Maryland

BALTIMORE — The Prudential Oil Corp., Fairfield, has filed plans for the erection of an addition to its local oil storage and distributing plant, 40x120 ft, estimated to cost $100,000 Four steel tanks will be installed.

Massachusetts

MALDEN — The Malden & Melrose Gas Light Co will soon commence the erection of an addition to its artificial gas plant to double the present capacity. The retorts will be designed for automatic coal-feeding The expansion is estimated to cost close to $400,000, including equipment.

SPRINGFIELD—The Springfield Gas Light Co. has tentative plans under consideration for the rebuilding of the portion of its artificial gas plant, destroyed by fire, caused by an explosion, Feb 1 with loss estimated in excess of $300,000, including equipment. It is said that new plant will be established in another location

Michigan

MANISTIQUE — The Manistique Brass & Bronze Co, recently established to manufacture a line of brass and bronze products, is arranging for the immediate erection of a new 1-story addition

IRON MOUNTAIN —The Ford Motor Co., Highland Park, is planning for the erection of a large chemical plant in this vicinity, to be used in connection with its iron ore and blast-furnace properties It is estimated to cost in excess of $750,000, with machinery

JACKSON -- Dr D Robinson, 108 South Jackson St, is taking bids through Architect H Graf, Chamber of Commerce Bldg, for the erection of a 2-story and basement chemical laboratory on West Main St, 56x75 ft., estimated to cost $50,000

WHITE PIGEON — The Eddy Paper Co., Three Rivers, Mich, will abandon plans temporarily for the proposed extensions and improvements at its local mills, used for carton production, estimated to cost close to $400,000. The plant will be utilized for other purposes, and a new 1-story building erected.

Minnesota

HIBBING—The Oliver Iron Mining Co., Duluth, is perfecting plans for the construction of a new crushing and screening plant, 89x105 ft., at its Hull Rust mining properties, estimated to cost close to $100,000 F. R Mott is general superintendent

Mississippi

GULFPORT -The Gulf Coast Refining Co. will take bids at once for the installation of additional equipment at its crude oil works, in connection with proposed extensions, estimated to cost about $35,000.

New Hampshire

NEWINGTON—Fire, Jan. 23, destroyed the chemical laboratory at the local plant of the Atlantic Dyestuff Co., Ames Bldg., Boston, Mass., with loss estimated at $25,000. It is planned to rebuild.

New Jersey

ELIZABETH—The Stanwood Rubber Co., Newark Ave., operating a local plant for the manufacture of automobile tires, recently reorganized, will install additional machinery for the manufacture of cord tires. The works have been idle for about a year and were acquired from the receiver. S. P. Woodard has been elected president of the new company and Charles K. Cooper assistant treasurer. C. O. Corey is superintendent.

ELIZABETH—The Standard Oil Co. of New Jersey, 26 Broadway, New York, has plans under way for the erection of an addition to its local Bayway refinery, 125x200 ft., to be used as a paraffin plant. It is estimated to cost close to $500,000, including machinery.

NEWARK—K. Kaufmann & Co., 169 Murray St., manufacturers of leather goods, are taking bids on a general contract for the erection of a 3-story addition, 65x100 ft., to cost about $35,000. William E. Lehman, 738 Broad St., is architect.

NIXON (New Brunswick)—Fire, Jan. 26, destroyed the vaporization department at the plant of the Nixon Nitration Co., which has been used for some time past for the production of celluloid products. An estimate of loss has not been made. It is planned to rebuild.

New York

SYRACUSE—Plans are being perfected for the organization of a new company to be known as the Syra-Cord Rubber Co., to take over and operate the local plant of the Syracuse Rubber Co. The new company will be capitalized at $1,000,000, and purposes to make extensions and improvements in the existing works. Production will be devoted to cord tires and kindred rubber products.

WATER VALLEY—The Water Valley Foundry Co. has tentative plans under consideration for the rebuilding of its foundry, destroyed by fire, Jan. 25.

North Carolina

STATESVILLE—The C. H. Turner Foundry Co., Inc., recently organized with a capital of $100,000, will commence the immediate erection of a new 1-story foundry, 75x135 ft., for the manufacture of iron castings. It will be equipped for an initial daily production of about 6 tons. C. H. Turner is president, and D. C. Ritchie, secretary and treasurer.

Ohio

ZANESVILLE—The Columbia Chemical Division of the Pittsburgh Plate Glass Co., Frick Bldg., Pittsburgh, Pa., is taking bids on a general contract for the erection of its proposed new plant at White Cottage, near Zanesville, estimated to cost about $1,500,000, including machinery. A total of eleven 1- and 2-story buildings will be constructed. F. A. Jones, Monumental Bldg., Zanesville, is engineer and local manager.

AKRON—Plans are being completed for the construction of a municipal plant for the production of alum for use at the city waterworks, estimated to cost about $15,000. W. F. Peters, city service director, is in charge.

Pennsylvania

WHITE HAVEN—The Peerless Powder Co. has construction under way on new plant buildings and plans to have the structures ready for the equipment at an early date.

GLENSIDE—The Gulf Refining Co., Frick Annex, Pittsburgh, has plans nearing completion for the erection of a 2-story oil storage and distributing plant at Glenside, estimated to cost $50,000.

CREIGHTON—The Pittsburgh Plate Glass Co., Frick Bldg., Pittsburgh, has acquired the foundry and shops of Yost Brothers, on site adjoining its Creighton works, known as the No. 1 Plant, to be used for proposed extensions.

Tennessee

CHATTANOOGA—The Tennessee Furniture Corp. is planning for the erection of a new building for enameling and porcelain work, in connection with other plant additions to cost about $165,000.

Texas

TEXAS CITY—The Texas Sugar Refining Co. has plans in progress for the erection of a new local refinery, estimated to cost in excess of $100,000, including machinery. It is purposed to have the mill ready for service early in the fall.

PORT ARTHUR—The Gulf Refining Co. has commenced the construction of a new oil plant on local site, to comprise a catalytic distillation unit of 32 stills and auxiliary equipment, re-run plant and other structures, estimated to cost in excess of $250,000, complete.

YOAKUM—The Texas Hide & Leather Co. has work in progress on extensions and improvements in its tannery for extensive increase in production. Plans are also being perfected for the erection of an addition to the sole leather department, for which a list of equipment to be installed will soon be arranged.

Virginia

ROANOKE—The Roanoke Tire & Rubber Co. is perfecting plans for the erection of a new 3-story plant for the manufacture of cord tires for automobile service and other rubber products. Charles H. Kieffer is assistant secretary and general manager.

Washington

OLYMPIA—The West Coast Pulp & Paper Co., recently organized as a subsidiary of the Hawley Pulp & Paper Co., Oregon City, Ore., is perfecting plans and will soon commence the erection of a new local mill, to consist of a paper manufacturing plant, sulphide mill and auxiliary structures, estimated to cost in excess of $500,000, with machinery.

West Virginia

CLARKSBURG—The Liberty Glass Co., manufacturer of window glass, is planning for extensions in its plant, including the remodeling of the present plant from hand to machine operated. Considerable additional machinery will be installed. Hugh Smith, an official of the company, is in charge of purchases.

Industrial Developments

PAPER—The Grass Fiber Pulp & Paper Corp., Leesburg, Fla., has commenced operations at its new pulp mill, recently completed, and expects to begin the production of paper in the other plant departments at an early date. The plant will be devoted to the manufacture of paper from saw grass.

Paper mills in the Michigan district are advancing production and adding to their working forces.

The American Writing Paper Co., Holyoke, Mass., is maintaining regular operations at its different mills in this section, giving employment to normal working forces.

GLASS—The Baker Brothers Glass Co., Okmulgee, Okla., manufacturer of window glass, has resumed operations at its plant at Sapulpa, Okla., and will develop capacity production. The Okmulgee works has been closed and the skilled employees have moved to the Sapulpa plant. Repairs and improvements will be made to the machinery at the idle plant during the coming weeks, and it is planned to reopen late in the spring. It is expected to resume production at the Augusta, Kan., factory at an early date, following a shut-down for some time past.

The Millville Bottle Works, Millville, N. J., has resumed service at one of its large glass tanks, recently closed down through failure of the furnace. Production will be advanced at the plant.

Glass plants in western Pennsylvania are running full, giving employment to regular working forces. Night shifts have been scheduled at a number of the factories.

LEATHER—The American Hide & Leather Co., New York, N. Y., has advanced production at its different tanneries, and is now running at close to normal. It is said that heavy incoming orders insure full capacity for some time to come.

Glazed kid plants at Camden, N. J., and Wilmington, Del., are operating at a pre-war basis, giving employment to regular working forces. It is expected that increasing orders now being received will advance production to maximum at an early date at the majority of the tanneries.

Burk Brothers, 923 North 3rd St., Philadelphia, Pa., manufacturers of glazed kid, are operating their tannery at about 75 per cent of normal. An early increase is expected.

V. & F. W. Filoon Co., Brockton, Mass., manufacturer of sole leather, is running full in all departments. Maximum output is being developed in the welting division.

Gensemer & Salem, operating two tanneries at Pine Grove, Pa., are maintaining full production at both plants, giving employment to regular working forces. No contract tanning is being handled at the present time.

CERAMIC—The Burton-Townsend Co., Zanesville, O., manufacturer of brick, is planning for an early increase in production and has extensions and improvements in progress for this purpose. The advance will average from 25 to 30 per cent. R. C. Burton, one of the heads of the company, is also planning for the construction of a new plant in this vicinity.

Potteries in East Liverpool, O., report increasing business and the majority of the general ware plants are now running on a full basis, with full working forces.

Brick-manufacturing plants in Georgia are operating at full capacity and expect to maintain this schedule for an indefinite period.

The Niloak Pottery Co., Benton, Ark., manufacturer of art and novelty ware, is maintaining full operations at its plant and plans for the early erection of a number of new kilns for increased manufacture. The working force will be enlarged.

Brick plants at Philadelphia, Pa., equipped with mechanical drying systems, are maintaining capacity production, with full working forces. About 25 per cent of the local plants, arranged for seasonal operation only, are closed down.

The Best Brick Co., Evansville, Ind., is running at full capacity and will maintain this schedule for an indefinite period. The company recently received an order for 500,000 face brick for the new works of the Ford Motor Co., at Chicago, Ill.

IRON AND STEEL—The Bethlehem Steel Corp. is arranging for the early blowing in of another blast furnace at its Steelton, Pa., works. Repairs are in progress at furnace E at the mills, and it is expected to have this unit ready for service at an early date. Other departments of the works will also advance operations at an early date.

The Thropp blast furnace at Earlston, near Bedford, Pa., has completed relining and other repairs, and plans are under way to blow in at an early date. The company's coke ovens in the Broad Top section will also be placed on the active list at the same time.

The Sloss-Sheffield Steel Co., Birmingham, Ala., will continue the employment of convict labor at its mills as a result of a bill signed by Governor Brandon, deferring any change in the present convict leasing system until March, 1927. The plant is continuing production at full capacity.

The Harrow Spring Co., Kalamazoo, Mich., is maintaining production at its two rolling mills and electric furnace, giving employment to a regular working force. The local plant will be included in the recent merger of the Steel & Tube Co. of America, Chicago, Ill., and the Youngstown Sheet & Tube Co., Youngstown, O.

The Reading Iron Co., Reading, Pa., has placed its universal mill on 9th St. in operation, after a shut-down since last November. The mill will give employment to about 100 men on single turn.

In the Sharon, Pa., district, the Carnegie Steel Co. has all departments of its mills running full with the exception of the by-product coke ovens, which have been idle for about 24 months. The American Sheet & Tin Plate Co. is operating at full capacity at its hot mills, while the American Steel & Wire Co. has a schedule of approximately 75 per cent of capacity. The Sharon Steel Hoop Co. is in active service at all of its local finishing mills, with the Youngstown, O., plant running at normal capacity. Six of 14 blast furnaces are on the active list, 3 of these being those of the Carnegie Company, 2 the Shenango Furnace Co. and 1 of the Reliance Coke & Furnace Co., at Sharpsville.

The Witherbee, Sherman Co., New York, has postponed the blowing in of its blast furnace at Port Henry, N. Y., scheduled for Feb. 1, owing to coke shortage. It is expected to apply the torch before the close of the month if coke now in transit is received at the plant. The plant has been idle for about 12 months, during which time a number of improvements and extensions have been made. The furnace operates on magnetic ore and has a rated production of 250 tons of pig iron per day. A new blast furnace is now in course of construction at the plant, to have an output of 500 tons per day; this unit is scheduled for blowing in during April.

The Carnegie Steel Co. has active construction under way on an addition to its byproduct plant at Clairton, Pa. The present plant, said to be the largest of its kind in the world, consists of 640 ovens, arranged in 10 batteries of 64 each. The extension will provide for 366 new byproduct coke ovens, a benzol motor fuel recovery plant and a byproducts plant.

MISCELLANEOUS—The Kansas City Malleable Castings Co., Kansas City, Mo., has resumed production at its plant after a shut-down of more than 18 months. The Dayton Malleable Iron Co., Dayton, O., is interested in the company.

Graphite mines in the vicinity of Burnet, Tex., are now producing at the rate of about 16,000 tons of ore per day.

Rubber mills at Akron, O., are operating on a basis of 85 per cent of capacity, including tires and other rubber products.

New Companies

THE CHLORIDE PRODUCTS, INC., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $1,000,000, to manufacture sodium, potash, magnesium and affiliated products.

THE STERLITE FOUNDRY & MFG CO, Auburn, Ind., has been incorporated with a capital of $75,000, to manufacture special metals, metal castings, etc. The incorporators are J. A. Rendel, R. J Schweitzer and A. L. Kuhlman, all of Auburn

THE FRANK SHINN CO., INC, Philadelphia, Pa, is being organized under state laws to manufacture paints, varnishes colors, etc Application for a state charter will be made on Feb. 19. The company is represented by John E. Gensemer, Crozer Bldg., Philadelphia.

THE SANDY RIVER OIL CO., Ashland, Ky., has been incorporated with a capital of $100,000, to manufacture petroleum products The incorporators are Harry L Claiborne and R D. Davis, Ashland The last noted represents the company.

VINCENT & CO, INC, 400 North Michigan Ave., Chicago, Ill., has been incorporated with a capital of $25,000, to manufacture cleaning fluids, compounds, etc The incorporators are John A. Vincent, Chauncey Blair and Leonard M Prince

THE STANDARD SMELTING & REFINING CO 819 Jersey Ave, Jersey City, N J, has filed notice of organization to operate a metal smelting and refining works. Harry M Cohan, 24 East 42nd St., Bayonne, N J, heads the company

THE STARK GLASS CO, Massillon O, has been incorporated with a capital of $30,000, to manufacture glass products The incorporators are John A. Vincent, Chauncey ford, both of Massillon.

CHARLES S WOOD & CO., East Orange, N. J., care of the New Jersey Registration & Trust Co, 525 Main St, East Orange, representative, has been incorporated with a capital of $125,000 to manufacture asbestos products The incorporators are Charles O. Geyer and associates.

THE NEWMAN-KOHN PAPER CO, Newark, N. J, has been incorporated with a capital of $100,000, to manufacture paper products The incorporators are Albert Newman, Leon A. and Sylvan H. Cohn, 790 Broad St, Newark The last noted represents the company

THE BETWK CORP, New York, N. Y, care of I L Dreeben, 50 Broad St., New York, representative, has been incorporated with a capital of $100,000, to manufacture chemicals and chemical byproducts, dyestuffs, etc The incorporators are J B Bateman and S D Cowl.

THE BEAR STATE OIL CO., Jefferson City, Mo., has been incorporated under state laws to manufacture petroleum products. The incorporators are R H. Muzzy, H C Welble and G. W. Foland, all of Jefferson City.

THE MELLINGER TIRE & RUBBER CO, care of the Corporation Trust Co. of America, du Pont Bldg, Wilmington, Del, representative, has been incorporated under Delaware laws with capital of $600,000, to manufacture tires and other rubber goods.

THE HOLMESBURG CONCRETE CO., Philadelphia, Pa., has been incorporated with a capital of $30,000, to manufacture cement and concrete products. B. F. Zimmerman, 7660 Frankford Ave, is treasurer and representative.

THE CUMBERLAND CARBON CO, Charleston, W. Va, has been incorporated under state laws to manufacture carbon products The incorporators are Roswell T Hapwood, George E Thomas and Oscar Nelson, all of Charleston.

THE FRAZIER DRAIN TILE CO, Bluffton, Ind, has been incorporated with a capital of $75,000, to manufacture clay tile, blocks and kindred products The incorporators are Luther M Frazier and W Hobart Frazier, both of Bluffton

THE NEWBURGH LIME MFG CO, Newburgh, N. Y, care of J V McKee, 51 Chambers St, New York N. Y, representative, has been incorporated with a capital of $20,000, to manufacture lime products The incorporators are W C Martin, M Gorchoff and A Lecheman, Newburgh

THE MOUNT VERNON LEATHER CO, INC, Philadelphia, Pa, has been incorporated with a capital of $36,000, to manufacture leather products Harvey Freeman, 2131 North 19th St, Philadelphia is treasurer and representative.

THE ASBURY STEEL PRODUCTS CO., Indianapolis, Ind., has been incorporated with a capital of $100,000, to manufacture steel specialties. The incorporators are Jerry A. Gallivan, Edward E. Asbury and Everett A. Marcy, all of Indianapolis.

THE MASTER GASOLINE CORP, Oklahoma City, Okla., has been incorporated with a capital of $250,000, to operate a gasoline extraction plant, manufacture refined oils, etc. The incorporators are Benjamin H. Mason, C. B Kendrick and J. E Crowder, all of Oklahoma City.

H LOOS & CO., 409 Ogden St, Jersey City, N. J., have filed notice of organization to manufacture grindstones and other abrasive products. Herman Loos heads the company.

THE GENESEE FELDSPAR CO Rochester, N Y, care of William Armstrong, Powers Bldg, Rochester, representative has been incorporated with a capital of $100 000, to operate a feldspar mill for commercial production The incorporators are S R Parry, W C. Fredericks and G E Worth, Rochester

THE GLEASONITE PRODUCTS CO, Boston, Mass, care of Edmund S. Hellings, Equitable Bldg., Wilmington, Del, representative, has been incorporated under Delaware laws with capital of $1,000,000, to manufacture synthetic rubber products, etc The incorporators are Charles Peters, Louis and Max Brown, Boston

THE MASON CITY BRICK & TILE CO., Mason City, Iowa, care of the Corporation Trust Co of America, du Pont Building, Wilmington, Del, representative, has been incorporated under Delaware laws with capital of $3,000,000, to manufacture brick, tile and kindred burned clay products

THE FANDANGO MILLS, INC Millburn, N J, has been incorporated with a capital of $125,000, to manufacture paper and binder board products The incorporators are M C Durr, Frank C Trubee and George J Berstler, Millburn The last noted represents the company

THE PHYMOS CHEMICAL LABORATORIES, INC, Pensacola, Fla, has been incorporated with a capital of $15,000 to manufacture chemicals and chemical byproducts W J MacIntire is president, and W A Pourties, secretary and treasurer, both of Pensacola.

THE LEIGHTON CHEMICAL CO, Colchester (Delaware County), N. Y, care of A. G. Patterson, Walton, N Y representative, has been incorporated with a capital of $150,000, to manufacture wood alcohol and kindred products. The incorporators are F Leighton, E L White and E. N Cary.

THE COMMONWEALTH MICA CO, care of the Colonial Charter Co, Ford Building, Wilmington, Del, representative has been incorporated under Delaware laws, with capital of $1,000,000, to manufacture mica products

Capital Increases, etc.

THE MERRIAM PAPER CO, Phoenicia, N Y., has filed notice of increase in capital from $20,000 to $101,000.

THE CONNECTICUT OIL CO, Waterbury, Conn, has arranged for an increase in capital from $150,000 to $250,000 for expansion

THE FRAZER PAINT CO, 2475 Hubbard St, Detroit, Mich, has filed notice of increase in capital from $100,000 to $250,000

THE PATTERSON GLASS MFG CO, Cameron, W Va, has arranged for an increase in capital from $50,000 to $150,000 for proposed expansion.

THE NEW YORK COLOR & CHEMICAL CO., 12 Gold St., New York, with plant at Belleville, N J, has filed notice of increase in capital from $100,000 to $350,000.

THE SIEMON HARD RUBBER CORP., Bridgeport, Conn, has filed notice of change of name to the SIEMON CO.

THE TRANSYLVANIA TANNING CO, Brevard, N C, has arranged for an increase in capital from $25,000 to $1,000,000 for proposed expansion.

THE NATIONAL HELFRICH POTTERIES CO, Evansville, Ind., has increased its capital from $200,000 to $250,000

THE PETERS PETROLEUM CORP, Tulsa, Okla, is disposing of a preferred stock issue of $2,500,000 a portion of the proceeds to be used for expansion Charles B. Peters is president

THE WEST HAVEN RUBBER CO West Haven, Conn, which recently took over the local plant of Kelley Tire & Rubber Co, is perfecting plans for reorganization, with increased capitalization.

THE UNITED STATES GLASS CO., South 9th and Bingham Sts., Pittsburgh, Pa., is arranging for the sale of a stock issue of $1,000,000, the proceeds to be used for general operations, expansion, etc. Ernst Nickel is secretary.

THE CLINCHFIELD PORTLAND CEMENT CO., Richmond, Va., has arranged for an increase in capital from $2,000,000 to $3,000,000 for general expansion.

THE AMERICAN CORRUGATED PAPER PRODUCTS CORP., 221 West 26th St., New York, N. Y., has filed notice of increase in capital from $300,000 to $500,000 for expansion.

THE INLAND WHITE LEAD CO., 741 Boston Ave., Chicago, Ill., manufacturer of paints, etc., has filed notice of increase in capital from $40,000 to $150,000.

THE SHAFFER OIL & REFINING CO., 208 South La Salle St, Chicago, Ill., is disposing of a note issue of $594,000, a portion of the proceeds to be used for extensions.

THE MIDLAND PAPER CO., 322 West Washington St, Chicago, Ill., has filed notice of increase in capital from $100,000 to $200,000.

THE NEW NIQUERO SUGAR CO., 129 Front St., New York, N. Y, operating sugar refineries, has filed notice of increase in capital from $1,500 000 to $5,000,000 for expansion.

THE GOODALE CO., Kalamazoo, Mich., has arranged for a change of name to the D. R C Foundry Co

THE HUMPHREYS OIL CO., Mexia, Tex., operating oil refineries, has filed notice of increase in capital to $15,000,000 for general expansion

THE F E REED GLASS CO, 860 Maple St., Rochester, N Y., manufacturer of hollowware products, has arranged for an increase in capital from $200,000 to $750,000 for expansion.

Coming Meetings and Events

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual convention in Norfolk, Va, May 7 to 9

AMERICAN CERAMIC SOCIETY is holding its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York.

AMERICAN FOUNDRYMEN'S ASSOCIATION will hold a meeting in Cleveland, O., April 28 to May 4.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its annual meeting in New York City during the week of Feb. 19, 1923.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W. Va., June 7, 8 and 9.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

IRON AND STEEL INSTITUTE (London) will hold its annual meeting May 10 and 11 at the House of the Institution of Civil Engineers, London, S W. 1.

NATIONAL FOREIGN TRADE COUNCIL has postponed its annual conference from April 25, 26 and 27, to May 2, 3 and 4. It will be held in New Orleans, La.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

A PAPER INDUSTRIES EXPOSITION will be held in Grand Central Palace, New York City, during the week of April 9, 1923, by the International Exposition Co.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St, New York City: March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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The Chauffeur Aspires

A GOOD reputation achieved through laborious effort and sheer merit has always been the envy of the near-worthy and the goal of the covetous. Those who are on the fringe of importance or greatness or distinction or respectability like to persuade themselves that they are, in point of fact, quite within the fold. And so it happens that periodical assaults are made on the citadel of engineering by various crafts and trades, conscious of the good name and reputation of the engineer and seeking as a trophy the use of the word "engineer" in describing their vocations. The plumber would be a sanitary engineer, the fireman a fuel engineer, the tailor a sartorial engineer, the barber a tonsorial engineer, and so on with the butcher, the baker and candlestick maker.

And now comes the chauffeur. A recent item in New York papers records the organization of chauffeurs into the Society of Professional Automotive Engineers. There is a slight distinction in the name from that of the well-recognized Society of Automotive Engineers, which is one of the great national engineering bodies. But undoubtedly the distinction, though slight, is significant in the minds of the chauffeurs. They, be it known, are *professional* automotive engineers while the others, forsooth, are doubtless only amateurs. Our new aspirants for engineering recognition probably look upon themselves as very *practical* men, while such theorists as produced the Liberty motor or who now design modern automotive mechanism are mere academicians. But there is a further distinction. We learn from the news item that "There is a great difference between an automobile driver and an automotive engineer." So there is; but not the one the reader has in mind. We learn further from the president that: "Our organization is composed of professional operators of automobiles in private employment. It aims to place the profession on a higher plane and to protect its members from increasing laws levied on operation of automobiles." We quote from the interview without editing. And we learn that taxicab drivers are not eligible for membership, while the lowly commercial truck driver is not even mentioned. Evidently the "great difference between an automobile driver and an automotive engineer" is principally one of vehicle. One has to sit at the steering wheel of a limousine in order to be eligible to the Society of Professional Automotive Engineers.

For the moment we can think of no title or designation that has suffered more from illegitimate use at the hands of aspiring craftsmen, unless it be that of "professor." Who used to make the balloon ascension and parachute drop at the county fair in the old days? None other than our old college friend Professor Blimp. And who now presides over the local parlor for manicuring and chiropody? Professor Foote, of course. Who teaches dancing, if not Professor Tango? And is not the favorite headliner on the vaudeville bill frequently Professor Aladdin with his black art? Finally there has been no more chronic aspirant than Professor Bump, the phrenologist. Small wonder that this title has almost fallen into disuse among those who earn and deserve it.

Reputation has been the theme of some of the finest gems of literature. We immediately recall the plaint of *Iago* in "Othello." when he says, "Who steals my purse steal trash . . . but he that filches from me my good name robs me of that which not enriches him and makes me poor indeed." Again he says that it is "Oft got without merit and lost without deserving." And in "Richard II" *Mowbray* says that without spotless reputation "men are but gilded loam or painted clay." We presume that the chauffeur will not be the last to filch the name and reputation of the engineer with which to gild the loam or paint the clay of his humble but useful calling. Nor have we any formula for preventing encroachment on the proper use of the title. We protest against it, but evidently it is something which, like the poor, we have always with us.

Another Problem For the Fertilizer Industry

IN OUR issue for Jan. 10 we published an editorial entitled "Long-Term Credits in the Fertilizer Industry." Some of the discussion which that editorial called forth has already appeared in Readers' Views and Comments, but we believe there are several points that are worth further emphasis. Perhaps the most significant has to do with the marketing of fertilizer. Certain localities seem to have become a kind of dumping ground for fertilizer. Perhaps they do not consume enough material to be classed as a field of major sales activity, but apparently they are the happy hunting ground for the disposal of surplus stocks of various kinds. "Sell at cost or even below, but sell anyway!" That is evidently the slogan.

What results is a veritable orgy of competition. A contract is signed with one salesman. Another calls who offers a better price. The customer then calls up the first company and demands a lower price or cancellation of the contract. Or, worse than that, he does not even notify the first company but buys from salesman No. 2. In a buyer's market the seller can do nothing but grin and bear it. If he sues he will lose a customer. So the net result is that contracts amount to nothing. The same is true of the price list.

Several solutions have been suggested. One is to

make consumption and production balance in the industry, either by controlling production or by increasing consumption. Of course the former is impossible except by a now illegal combination of producers, and the latter is a much-desired and sought-for end. It might, however, prove somewhat of a boomerang, for increasing demand would probably lure others into the field of production. The more practical solution is that of insisting through the National Fertilizer Association that contracts and sales agreements be strictly enforceable. It is distinctly within the power and province of the association to work for good business practices. It would be a principle easy to enforce through such an organization. No one is the gainer from present conditions except possibly the consumer and at the sacrifice of one of the cornerstones of business.

What's in The Ruhr?

SIX weeks ago Germany's largest and most tangible asset was the great industrial district lying in the valley of the Ruhr. Before its occupation by the French and Belgian troops, it was a principal source of coal, the seat of a tremendous iron and steel industry, the heart of Germany's industrial system. Today, production in that district is practically at a standstill. No man can predict the ultimate result of the French occupation nor its effect on the world's economic structure.

In the belief that more information about the economic and industrial aspect of this situation would be welcomed by our readers, an editorial survey has been made of available economic data bearing on the Ruhr district. In another place in this issue there will be found an attempt to answer, from a chemical and industrial viewpoint, the important question, "What's in the Ruhr?"

Notwithstanding present uncertainties in the situation, there have been a number of developments and apparent tendencies that are gradually helping to crystallize sentiment in this country and to aid in our appraisement of what the situation portends. For one thing, it is becoming increasingly apparent that the policy and plan which has guided the French is not one that will be consummated by the developments of a week or month. It is the building of a permanent structure, organizing for the long swing rather than for the immediate profit. This attitude is beginning to be shown in a number of ways, such as the strategic control of traffic with the idea of exacting taxes and tariffs. The only definite attempts so far to demand reparations in kind have been in the case of coal—which is, of course, merely the justifiable collection of a debt long overdue. The attitude toward the chemical plants has been less discernible, but underlying it is this same long-swing policy. Incidental interferences such as the confiscation of specific shipments of raw materials have been reported, it is true, but this can scarcely be regarded as the permanent plan. The coal-tar crudes and intermediates needed by the German dye industry will not find a ready market elsewhere, and for taxable purposes it would seem more logical that they be allowed to pass into consumption and taxes enacted on the finished goods—i.e., the dyes and reparation products already demanded by France and Italy.

But the most important tendency to become evident —the real riddle of the Ruhr—is the great political problem in bringing together in a workable unit the German interests of the Ruhr and the French interests of Lorraine. As long as the one controls the coal and the other the iron ore, they stand at loggerheads. To revert to pre-war conditions, with one country in command of both resources, would seem to be the first requisite for production. But it is evident, too, that insurmountable difficulties will crop up constantly in any co-operative arrangement in which France is the employer and Germany the worker. Therefore, it is obvious that peaceful economic settlement can come only with a solution of the political difficulties. To hazard a guess as to the effectiveness of the proposals of the separationists is perhaps immature, but it would seem that at times the coming of such an event is already clearly foreshadowed.

How is this trouble in the Ruhr going to affect us? Temporarily, at least, we are more likely to be benefited than harmed. Our export trade in foodstuffs and raw materials will probably suffer because of the district's loss of purchasing power, but this will undoubtedly be more than compensated by the gain in our exports of manufactured goods, of iron and steel products, and of similar commodities originally supplied by the industries of the Ruhr.

Our own organic chemical industries, as Dr. HERTY has pointed out with characteristic forcefulness, have fortunately insured us against a recurrence of the tragedy of 1916. We are prepared to supply the American consumer, or the world if necessary, with practically every dye and coal-tar chemical required for uninterrupted production. For the economic good of the world, it is to be hoped that the industrial prostration of Germany can be averted, but it is comforting to know that we are prepared for such an emergency if it does come.

Winged Errors in Chemical Literature

WHEN we chemists get hold of an error it often takes more than a mental crowbar to pry it loose from us. Start a wrong constant in a textbook and there it is, not only in that book but in nearly every one that comes afterward. Of such a defective record a chemist told us the other day that he had looked it up in three different textbooks, and since they all agreed he thought they must be right. But they were all wrong.

A few days ago in discussion with Professor KENDALL of Columbia, who is reviewing the textbooks of the late ALEXANDER SMITH, he referred to the melting point of ammonium sulphate as one of those winged errors that fly through the literature. It seems there was a Frenchman who had worked with ammonium sulphate and developed the facts back in the eighteen-forties or thereabout, and he published his findings, which were correct, in his book. Next somebody else wrote a textbook which became more popular and he was a bit hasty about getting the data on ammonium sulphate, or he may not have read French very well. At all events he put down the melting point as 140 deg. C. and there it started. Everybody else copied it, and now it is standard in the literature.

In point of fact, if ammonium sulphate is heated in a closed tube it does not melt until above 600 deg. C., whereas if heated in an open tube ammonia is given off, the acid salt is formed and it is the acid salt and not ammonium sulphate that melts at 140 deg. C.

The Psychology of Glass As Plant Equipment

THOSE who read Mr. MARSHALL'S interesting contribution on industrial glass in our issue for Jan. 31 must have been struck with the note of practical psychology that he sounded with respect to the use of this material in chemical plant construction. The very quality of glass—fragility—which might be expected to defeat its use as a material of construction has proved, in the case of Pyrex, to be the best insurance against breakage.

We have all grown up in the knowledge that glass is breakable, and this fact is connected in our minds with its quality of transparency. Of two pieces of apparatus, one of transparent glass and the other of opaque earthenware, there would be no question in the mind of a workman as to which he must handle with care and respect for its fragility. Earthenware looks tough and no amount of experience with breakage in clay products would give him the same instinctive respect for it that he would have for transparent, fragile glass. Consequently, although breakage might be expected to be high in plant apparatus made of glass, the reverse is found to be true, because a workman anticipates the likelihood of breakage and handles the transparent material more carefully.

While we can scarcely advocate the extension of this interesting example of psychology to the point of advising that plant apparatus be made fragile instead of rugged in appearance, we think that it does furnish one of the best evidences that glass has by no means reached its full utility as a material of plant construction. Its transparency is one of its greatest merits, and apparently its fragility is by no means the drawback that might have been expected.

An Opportunity For the Tanning Chemist

THERE is a good deal of talk going on about the destruction of wild animals for the fur industry. Until 10 or 12 years ago the wild birds were being killed to such an extent for feathers to decorate women's hats that Congress took measures to stop it, and these were successful. Now we have no brief to present on behalf of moles, squirrels, skunks or muskrats, which are threatened with extermination; we never cared for minks or weasels or foxes around the chicken yard—in fact, we have not yet added the salvation of fur-bearing animals to the reforms we support.

We are, however, always ready to join in any reasonable effort to eliminate rats. They threaten us with disease, they carry the bubonic plague and they are a nuisance to the whole world. Once, years ago, we ventured to suggest editorially that rat skins be tanned and brought into use, but this instigated such an amazing correspondence that it nearly got us into trouble. Nevertheless, we venture again to attack the subject from a somewhat different angle and to call in the aid of chemistry.

In regard to clothes, men wear what their tailors and their wives tell them to wear, so long as their raiment shall be without any distinguishing mark of individuality. Women think more about their clothes than men do, they aspire above all things to be in style and every woman wants her clothes to be "individual" in cut, in trimming and in fabric. But if anybody had told us when we were boys that women would be straining every nerve to possess and wear the skins of skunks, we should not have believed him, although today these very skins are a luxury.

Now rat skins make good leather. The pieces, of course, are small. What is called for is an advance in the art of tanning and in the discovery of a method of joining the edges of the separate pieces by some colloidal turn. Granted that such a material may be produced that is pleasant to wear and durable, we may expect it to become fashionable. Any amount of expense may be added to it by trimming, but even when worn plain, the wearer will achieve merit by encompassing himself or herself in a garment made of it.

Soft leather coats, vests and overcoats are very desirable for men in cold weather, and if they are in fashion women may be trusted to wear them, even in the hottest summer days if the Paris dressmakers should decree it. The main thing is to produce the material, and only a chemist familiar with the technology of leather can do this. The development of such an industry would make the destruction of rats a profitable enterprise—and that would be the end of one of the worst pests of our day and generation.

A Discriminating Benefaction to Science

CHEMISTRY in the West, professional and industrial, will be heartened by the news of a princely gift of over $4,000,000, by ARTHUR H. FLEMING, of Pasadena, to the California Institute of Technology—an act that marks a significant advance in the scientific life of the Los Angeles district in particular and of the Coast region in general. Such a gift is an indication and an appreciation of the vigorous growth and promising vitality of those Western industries whose prosperity depends in large measure on the provision of a sound scientific foundation and the unremitting application of technical research.

Benefactions often fail in their purpose because of a lack of discrimination and foresight on the part of the donor. It is refreshing, therefore, to note that Mr. FLEMING accompanies his gift with suggestions that should receive the careful consideration of all who are concerned with higher education. He earnestly advises that the California Institute limit its enrollment to 2,000 students; this we may interpret as an indorsement of the contention that mere bigness too often connotes emptiness. He recommends that the Institute "specialize in chemistry and physics, under the direction of the most competent men available, with the most liberal provision in the way of salaries and equipment, for the prosecution of such work; that it seek and invite the superior student; that it help and encourage those who are disposed to research, but that the utmost care be exercised in the manner of giving such help and encouragement, keeping always in mind that ill-advised or too free-handed assistance begets weakness rather than strength, and that a man should be helped to help himself."

With such a code of common-sense ideals, and with the financial support of public-spirited citizens such as Mr. FLEMING, the board of trustees of the Institute needs no more than competent scientific direction and the co-operation of the earnest student to insure for California an eminence in technology commensurate with the needs of her rapidly expanding industries.

Readers' Views and Comments

Dühring's Law Of Vapor Pressures

To the Editor of Chemical & Metallurgical Engineering

SIR:—There appeared in the Jan. 24 issue of your journal an article entitled "Theoretical Derivation of the Vapor Curve of Xylol." In this article there is presented what is termed a "novel" method of calculating the vapor pressure. I wish to call your attention to the fact that this method was probably first proposed in 1878 by Dühring, and his since appeared in most of the textbooks on physical chemistry, either under the name of Dühring's relation or as a special case of the more general Ramsay-Young vapor pressure relation. Furthermore, this same method of calculating vapor pressure has appeared recently in *Chemical & Metallurgical Engineering* in the articles by W. L. Badger on the properties of salt solutions. A recent article in the *Journal of Industrial and Engineering Chemistry* (vol. 14, No. 6, page 569, 1922) also called attention to this relation for the calculation of the vapor pressure of certain hydrocarbons derived from coal tar. In view of these facts I cannot but take exception to the statement that this is a novel method for the calculation of vapor pressure.

Newtonville, Mass. BARNETT F. DODGE.

Problems in Sodium Sulphide Manufacture

To the Editor of Chemical & Metallurgical Engineering

SIR:—Your article of Jan. 10, together with the interesting letter of Mr. Hart on "Problems in Sodium Sulphide Manufacture," has mentioned in a way the manufacture from salt cake and from barium chemicals. However, the process which I have developed here I hope will be sufficiently interesting to warrant a note.

We are using niter cake which we charge directly into the sodium sulphide reverberatory type furnace along with 20 to 30 per cent gas-house carbon. The reverberatories are oil fired. The reduction is carried on until approximately 70 per cent of the available Na_2SO_4 content is reduced to Na_2S and is then tapped from the furnace. This charge, after cooling, is ground and dissolved, giving a solution containing sodium sulphide, considerable proportion of Na_2CO_3, Na_2SO_4, $Na_2S_2O_3$, etc. This solution is filtered and barium sulphide added to complete precipitation. The precipitate settles rapidly, the supernatant liquid being decanted directly to the storage tank for the sodium sulphide evaporator. The precipitate, after settling, is filtered over an Oliver filter, then goes to wash tanks. After several washes removing the small amount of sodium sulphide remaining, sulphuric acid is added until all of the precipitate is converted to $BaSO_4$, or blanc fixe, and is sold as a standard article.

The chief features in this process are that what is not converted in the furnace to sulphide is later on converted by the addition of barium sulphide, giving a very pure sodium sulphide solution for evaporation and a high-grade blanc fixe as a byproduct. Moreover, by operating at a lower temperature and not endeavoring to secure such a high-grade sulphide in the furnace, the life of the furnace is more than doubled. The furnaces used have a hearth area of about 160 sq.ft. and produce about 6 tons per day of concentrated sulphide, 70 per cent of which is from the direct furnace reduction, the other 30 per cent from the barium sulphide precipitation.

Metal and Chemicals Extraction Co., Oakland, Calif. B. T. ROCCA.

Rapid Sorting Of Alloy Steel

To the Editor of Chemical & Metallurgical Engineering

SIR:—Having had occasion recently to sort a badly mixed stock of bar steel, I attempted to use the method described by M. Galibourg in your issue of Nov. 15, 1922, p. 992. This consisted in measuring the thermal emf. against pure iron wire, when the ends were immersed in a pot of warm mercury.

Our tests did not indicate that it is possible to use this method on a commercial scale. There is undoubtedly a difference in the emf. force for different analyses, but this is in fact so slight that we could not rely upon it. The results we obtained follow:

Steel	Temperature Deg F	Millivolts
Utica oil hardening steel	250	0.6
Swedish iron	248	0 2
Halcomb toolsteel	248	0.9
Ketos oil hardening steel	252	0 5
Clarite high-speed steel	252	0 25
S A E 5120 steel .	252	0 1
Machine steel	250	0 1

The suggestion in the article of using Brinell test was not carried out, but this will not make any material difference. The Brinell hardness of for instance the last two steels will at least under certain circumstances be similar and as the emf. is the same, it would not be possible to separate these two steels by this method. We realize of course that in other special cases it might be possible to use this method to advantage.

E. W. EHN,
Canton, Ohio Metallurgist, Timken Roller Bearing Co.

Long-Distance Hauling of Sulphuric Acid No Longer Feasible

As the transportation of sulphuric acid for long distances is difficult and expensive, the producing plants are located close to the points of consumption. Prior to the war a 200-mile haul for a regular contract delivery of acid over a long period of time was exceptional. Under the unusual conditions that prevailed during the war, the acid was shipped even from the Pacific coast to New York, but since the resumption of normal business, it is now hauled for only comparatively short distances. Moreover, few cargo boats are equipped to transport sulphuric acid in bulk and its corrosive action on metal containers makes it subject to high insurance and freight charges. There is, therefore, little international trade in the acid. Of the 6,407 tons exported from the United States in 1921, 2,895 went to Mexico, 1,389 to Cuba, 722 to Argentina and 110 to Canada.

Photo by Underwood & Underwood

VIEW OF THE COAL DOCKS AT THE GREAT KRUPP WORKS AT ESSEN IN THE RUHR DISTRICT OF GERMANY

What Is in the Ruhr?

An Attempt to Answer This Question From a Chemical and Industrial Viewpoint, Pointing Out the Economic Significance of French and Belgian Occupation and Possible Effects on the World's Chemical and Metallurgical Industries

WERE the Pittsburgh district to be isolated completely from the remainder of the United States and to be occupied by 50,000 troops and a large technical commission of foreign nationals intent upon controlling production and distribution of that district's basic industries, some idea might be gained of the present situation in the Ruhr district and of its possible economic consequences to Germany and the rest of the world. The Ruhr district is Germany's most important asset—the greatest industrial center of that country, if not of all Europe. From a commercial and economic viewpoint it is to Germany what the Pittsburgh district is to the United States, what the Sheffield region is to England and what the French departments of Nord and Pas-de-Calais were to France before their destruction during the war.

The Ruhr district is not a geographical division of Germany, but geologically it is a well-defined strip of land of about 400 square miles bordering on the Ruhr River. As may be seen from the map on page 341, it stretches across the northern part of the Prussian provinces of Westphalia and Rhineland.

The industrial development of this district may be said to have started about 1850, when coal began to be mined there on an extensive scale. In 1913 something over 114,000,000 tons of coal was mined in the Ruhr district, representing fully 60 per cent of the total German production. As is the case in the Pittsburgh district, the Ruhr does not contain any workable deposits of iron ore, but rather the abundance of coal has been the factor that has made it the principal seat of Germany's iron and steel industries. The industrial centers of Essen, Bochum, Mülheim, Dortmund, Gelsenkirchen, Duisburg, Oberhausen, Ruhrort, Hörde, Witten—to mention only the most important—are the strongholds of Germany's industrial magnates.[1] There Stinnes, the Thyssens, the Krupps, the Haniels, the Kloeckners, the Funkes, play economic roles analogous to those of the Carnegie, Rockefeller, Harriman, Vanderbilt and Gould interests in this country.

Increasing Industrial Population

A very illuminating survey of the economic importance of the Ruhr district was made not long ago by M. Dariac, a special commissioner of the French Government sent into the Rhineland in advance of the French and Belgian troops. He points out that in 1913 the industries of the territory now occupied employed one-fourth of all the factory workers in Germany. This includes 55 per cent of all workers engaged in mining, 27 per cent of those in metallurgy, 20 per cent of the chemical workers and 19 per cent of those in the textile industries.

[1] According to a press despatch on Feb. 13 there were 46,942 French troops (officers and men) in the Ruhr and 12,000 French and Belgian railway men and engineers were at the disposal of the Technical Commission. The position of the troops of occupation was given as follows: Belgian detachment at Sterkrade; 47th French Infantry Division at Recklinghausen; 11th Infantry Division north of Dortmund; 40th Infantry Division south of Bochum; 128th Infantry Division at Essen and south of Essen.

TABLE I POPULATION OF INDUSTRIAL CENTERS IN RUHR DISTRICT

City	Population 1910	Population 1919
Essen	194,653	439,297
Bochum	136,931	144,993
Dortmund	214,226	297,018
Oberhausen	89,900	98,677
Duisburg	218,400	241,788
Gelsenkirchen	169,513	179,785
Herne	57,459	64,135
Recklinghausen	59,283	60,498
Witten	37,450	37,189
Mulheim	112,580	127,353

The Krupp works alone, in 1913 employed 80,000 workers. During the war this number rose to 171,000, but by the end of 1922 had been reduced to about 100,000 employees.

While the total population of Prussia declined from 40,165,219 in 1913 to 36,771,951 in 1919, that of the Ruhr district showed a marked increase, due, probably, to the influx from the territories originally occupied by the Allied troops. The figures in Table I show the extent of this gain in some of the most important industrial centers in the Ruhr district.

An Index of Industrial Activity

An idea of the productive and distributive capacities of the Ruhr district may be gained from statistics of inland traffic, both by water and land. In point of mileage the railroads in the territory now occupied by the French and Belgian troops are but 12 per cent of the total in Germany, but they actually handle practically three-fourths of the traffic of the entire country. In addition, 60 per cent of Germany's water transportation is in the Rhine and Ruhr districts.

Industrial Resources

Coal.—It was previously stated that in past years the Ruhr district has accounted for over 60 per cent of the coal production of Germany. The output of the most important districts in Germany during 1913 and 1919 were as follows (in millions of tons):

	Ruhr District	Upper Silesia	The Saar District	Total for Germany
1913	114 49	43 43	12 22	190 11
1919	71 16	25 93	8 97	116 50

or in percentage of the total:

1913	60 22	22 85	6 43	100 00
1919	61 08	22 26	7 70	100 00

Since the the loss of the Saar basin to France, Germany's coal production has been concentrated in the Ruhr district, so that the present Ruhr output is probably in the neighborhood of 80 per cent of the total. Production during 1921 and 1922, although somewhat lower than the 1913 production, nevertheless considerably exceeds the 1919 figure.

Table III, recently printed in *Coal Age*, shows the total production of the last 2 years as compared with that of 1913.

The coal resources of the Ruhr district from the region that is now producing at the rate of about 100 million tons per year have been estimated[1] to be 31.9 billion tons to a depth of 1,500 m. or 37.5 billion tons to a depth of 2,000 m. The latter amount at the present rate of production would suffice for 375 years.

TABLE III COAL PRODUCTION IN RUHR DISTRICT BY MONTHS

	1913	1921	1922
January	9,786,005	8,072,912	8,132,763
February	9,194,112	8,174,606	7,737,974
March	9,181,430	7,685,185	9,014,278
April	9,969,560	7,894,985	7,512,646
May	9,261,448	6,954,607	8,081,951
June	9,586,385	7,753,350	7,078,361
July	10,150,347	7,782,676	7,864,200
August	9,795,236	8,068,065	8,336,773
September	9,696,397	7,853,871	8,265,688
October	9,895,090	8,047,353	8,837,126
November	8,932,276	7,772,658	8,596,214
December	9,101,858	8,054,517	7,900,000
Whole year	114,550,153	94,114,785	97,350,000

Iron.—The pig-iron production of Germany in 1913 amounted to 19,291,920 tons and was distributed among the various provinces as follows:

District	Percentage
Rhineland-Westphalia	42 5
Siegerland, Lahn, Hesse-Nassau	5 1
Silesia	5 2
Central and eastern Germany	5 2
Bavaria, Wurttemburg and Thuringia	1.2
Saar	7 3
Lorraine and Luxemburg	33 3

Coal-Tar Products.—Before the war the byproduct coke ovens in Germany consumed annually about 45 million tons of coal. Of this amount it was estimated by M. Dariac that 25 million tons came from the Ruhr district. This would account for an output of ammonium sulphate and coal tar in approximately the following proportions:

	Total Production (Tons)	Ruhr District (Tons)
Ammonium sulphate	500,000	400,000
Coal tar	1,200,000	1,000,000

Of this production the Hugo Stinnes group industries accounted for 129,000 tons of coal tar and 69,000 tons of ammonium sulphate.

Situation in the Dye Plants

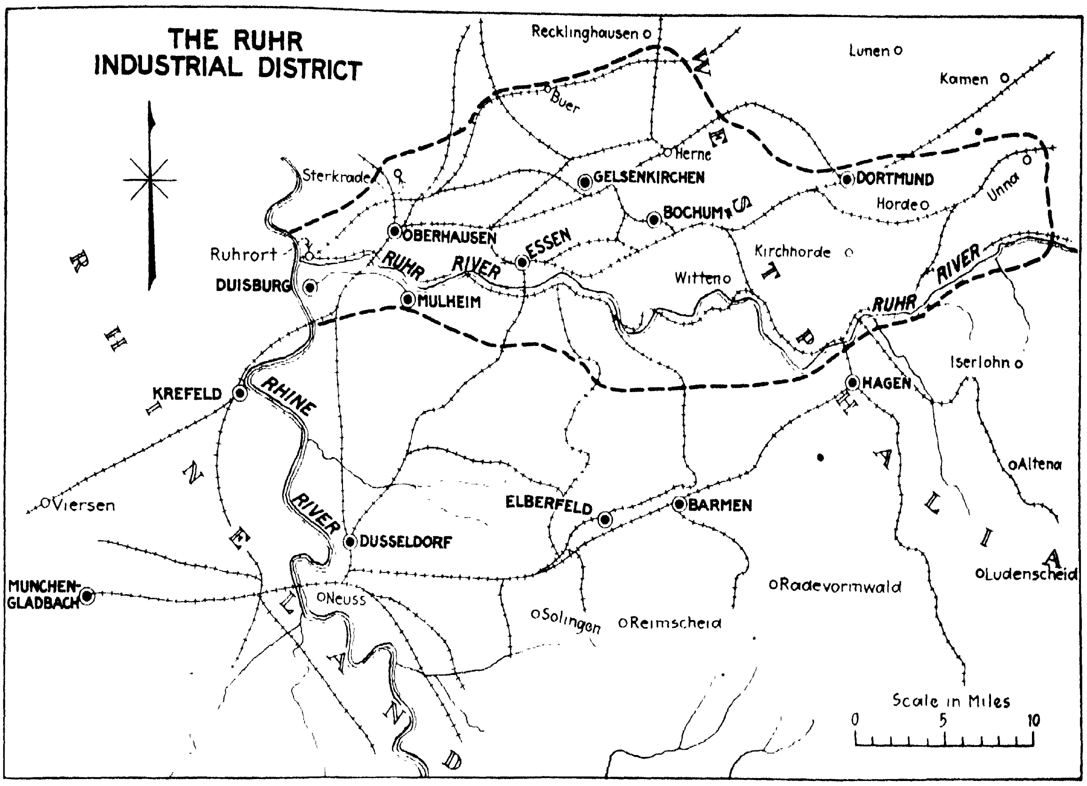
Chemicals.—Practically all of this coal tar passes into consumption in the form of the products of the German organic chemical industries—dyes, pharmaceuticals, color lakes, perfumes, photographic chemicals, etc. However, these industries for the most part lie outside of the Ruhr district as such, although at least 90 per cent of them are included within the territory which has been or is now occupied by the Allies. The great plants of the I.G. (Interessen Gemeinschaft) lie to the south of the Ruhr—Badische at Ludwigshaven-on-the-Rhine, Bayer at Leverkusen, Meister Lucius & Brüning at Höchst-on-the-Main, Cassella at Frankfort and Kalle at Biebrich-on-the-Rhine. Of the less important companies Griesheim-Election is at Offenbach-on-the-Main, Weiler-ter-Meer is at Uerdingen-on-the-Rhine and Leonhardt is at Muhlheim-on-the-Main.

The only important coal-tar dye plant in the immediate vicinity of the Ruhr district is that of Carl Jager, G.m.b.H., Anilinfarbenfabrik at Düsseldorf. This company was founded in 1823 and while small as compared with the ground organizations of the I.G., it is nevertheless a recognized factor in the German industry.

These plants, whether actually within the occupied territory or not, are nevertheless dependent largely on the Ruhr district for their chief raw materials—for coal tar and the so-called crudes form its distillation such as benzol, toluol, naphthalene, anthracene, carbolic and cresylic acids, etc. Naturally the course of their future production will depend on their supplies of these basic materials and for that reason they are vitally affected by the embargoes on coal and coal products which the French are enforcing with increasing severity.

It is scarcely to be believed that the French would voluntarily cut off supplies of these byproducts for any extended period. Little market exists for them elsewhere and from a revenue viewpoint it would be much

[1]"The Coal Resources of the World," vol. III, p. 887 (1913).



MAP OF RHINELAND AND WESTPHALIA, SHOWING THE RUHR DISTRICT AND PRINCIPAL INDUSTRIAL CENTERS

more desirable that they be fabricated into finished products of much greater taxable value. However, the decreasing coking operations due to labor troubles in the coal mines, on the railroads and at the ovens would automatically cut down the supply of raw materials for the dye factories. It is therefore entirely possible that these great industries will eventually come to a standstill unless supplies in the way of coal and coal products can be imported into Germany from England or America.

It has been reported on the authority of high German officials in this country that many of the large dye and chemical factories of Germany now have on hand stocks of crudes and intermediates sufficient to carry them over a period of 4 to 6 months. Just how much credence can be placed in such statements is, of course, largely a matter of conjecture.

Chemical Plants in the Occupied Territory

Names and Addresses of Important Factories in Rhineland and Westphalia and Adjacent Districts, Compiled by Department of Commerce

IN VIEW of the timely interest in the economic and industrial problems arising from the French occupation of the Ruhr Valley in Germany, the Commercial Intelligence Division of the Bureau of Foreign and Domestic Commerce has compiled a comprehensive list of chemical and allied factions within the occupied territory of Germany. This compilation is not as yet entirely complete, but it is believed that its publication, even in fragmentary form, will be worth while at this time. The list follows:

Name	Address	Manufactures
Aachener Chemische Fabrik für Textile Industrie, G m b H	Aachen	Textile chemicals
Aktiengesellschaft für Bergbau, Blei und Zinkfabrikation zu Stolberg und in Westfalen	Aachen	Pig lead, raw zinc, sheet zinc
F D Beizel	Aachen	Varnish and putty
Chemische Fabrik Rhenania, A G	Aachen	Sulphuric acid, muriatic acid, nitric acid, sulphur, barium sulphate and many other chemicals
Chemische Präparate G m b H	Aachen	Pharmaceutical preparations
Chemische und Textileseifen-Fabriken, Charles Schein	Aachen	Textile chemicals
Dr Deckers & Co., G m b H	Aachen	Chemicals and oils
Xav Goblet	Aachen	Soap, fullers soap
S Grauer & Co , G m b H	Aachen	Polishing preparations
Kamps & Janson	Aachen	Oils and lime
Albert Heinrich Kendall	Aachen	Soap and perfume
H Kloke	Aachen	Preparations for the textile industry
Dr Georg Koenig	Aachen	Pharmaceuticals
Cl Lageman	Aachen	Pharmaceuticals
Franz Lauffs	Aachen	Wax candles
Joh Jos Lauffs	Aachen	Wax candles
Medizinal-Werk G m b H	Aachen	Pharmaceuticals
Peter Ney	Aachen	Soap
Jos Preim	Aachen	Perfumery and soap
Reinland & Berns, Chemische Fabrik Optima	Aachen	Chemicals
S Saul	Aachen	Rubber ware
Schleipen & Cie	Aachen	Chemical products
Dr. Schlenter & Baum	Aachen	
Schreiber & Brandt	Aachen	Varnish
A Steenaerts Nachf	Aachen	Soap
H Trommsdorff, chemische fabrik	Aachen	Pharmaceuticals
Gebr Vossen G m b H	Aachen	Dyes
L Vossen G m.b.H	Aachen	Chemicals
Gebr Waeler G.m.b H	Aachen	Chemicals
Georg Heinrich Goebel	Ahrweiler, (Rheinpr.)	Varnish and wood stain
Wilhelm Wirz Nachf. H. Keefer	Ahrweiler. (Rheinpr)	Varnish
Zuendholzfabrik, Albersweiler . Benedick Haupt & Cie.,	Albersweiler (Pfalz)	Match
Eugen Wischner	Altenessen (Rheinpr.)	Chemicals
M. Dietrich	Alzey (Hessen)	Soap
Louis Fritz	Alzey (Hessen)	Soap
Carl M. Diener	Amberg (Oberpfalz)	Wax ware
Boegel & Michel	Annweiler (Pfalz)	

Name	Address	Manufactures
Arienheller Sprudel und Kohlen Saure A G	Arienheller bei Rheinbroh	Carbonic acid, mineral water
Duerkheimer Bade - und Salinen-verein	Bad Duerkheim (Pfalz)	Mother lye, bath salts
D Rathgeber	Bad Duerkheim.	Soap
Rudolf E Linkenbach	Bad. Ems	Soap
Dr Trost Nachf Inh August & Otto Roth, Chemische Fabrik	Bad Ems	Disinfectants and insect powder
Rheinische Kraeuter-Verwortung G m b H in liquidation	Bad Neuenahr (Rhpr)	
Chemische Fabrik Luettgen	Baerendorf b Bochum, Westfalia	
B Amann	Barmen	Dyes
Atlas-Werke Englels & Stracke, G m b H.	Barmen	Chemicals
Bayrisch-Rhein Farbenfabriken Knechtchel & Co	Barmen	Dyes
Bruno & Hoefinhoff	Barmen	Photographers' suppl's
Chemische Fabrik Einergraben	Barmen	Acid
Carl Dicke & Co, Chemische Fabrik	Barmen	Ferrous sulphate
W. Kopp	Bendorf a Rhein	Inks
Friedr Wilh, Remy & Cie	Bendorf a Rhein	Varnish and lead colors
Rheinische Gerbstoff-und Fabrholz Extract Fabrik, Gebr Mueller A G	Benrath (Rheinpr)	Tannic acid
Bensberg-Gladbacher Bergwerks und Huetten A G Berzelius	Bensberg (Rheinpr)	Lead, zinc ore and sulphuric acid
Bensberger Chemische Fabrik August Boeringer	Bensberg (Rheinpr)	Varnish, lacquer
Zuendertabrik Bensberg, G m b H	Bensberg (Rheinpr	Matches
Ceromitgesellschaft m b H	Bergisch-Gladbach	
Sprengkapsel-Fabrik Olpe G m b H	Bergisch (Rhpr)	
A W Andernach	Buel (Rhpr)	Asphalt and roofing supplies
Chemische Werk "Concordia" G m b H	Beuel (Rhpr)	Pharmaceutical prep
Dr Lambotte & Schattenverg G m b H	Buel (Rhpr)	Colors, varnish
Dr L O Marquart	Buel (Rhpr)	All drugs, acids, etc
Vaseline-Fabrik Rhenia, E Waserfuhr	Buel (Rhpr)	Vaseline
Brandscheid & Weyrach	Biebrich a R (Hess -Nass)	Varnish
Chemische Fabriken Dr Kurt Albert	Biebrich a R (Hess -Nass)	Organic chemical prod.
Chemische werke vorm H & E Albert	Biebrich a R (Hess -Nass)	Artificial fertilizers
Adam Hofmann	Biebrich a, R (Hess -Nass)	
Kalle & Co , A G	Biebrich a R (Hess -Nass)	Coal tar dyes, pharmaceutical preparations
Dr Th Steinkauler, Victoria, Vaseline-Fabrik	Biebrich a R (Hess -Nass)	Vaseline, oils, etc
Teerproduckten Biebrich, Seck & Dr. Alt, Jean Scholl	Bingen a R	Soap
Gebrueder Bier	Birkenfeld (Fuerstentum)	Perfumes and soap
Chemische Fabrik, Walter Bosch, G.m b H	Bochum (Westf)	Technical oils, fat
Chemische-Industrie, Act -Ges	Bochum (Westf)	Tar distillery, sulphuric acid, nitric acid
Deutsch Luxemburgische Bergwerks und Huetten A G	Bochum (Westf)	Benzol, tar, and ammonia
"Farbenmueller" Gesellschaft, G m b.H	Bochum (Westf)	Dyes
Gruemer & Grimberg, G m b H	Bochum (Westf)	
C. Jungkenn, G m.b.H	Bochum (Westf)	Varnish, lacquer and tar
Kupferhuette Bochum, G m b H	Bochum (Westf)	Copper and pyrites
Alf Lewin	Bochum (Westf)	Pharmaceuticals
Joh. Chr Leye G m b H	Bochum (Westf)	Asphalt, tar and rosin
Theo Schuecking	Bochum (Westf)	Oils
Westfaelische Zuendwaren Industrie, G m b H	Bochum (Westf)	Explosives, matches, etc
Zeche Ver Carolinenglueck	Bochum (Westf).	Technical fats
Bach & Bruecken	Bonn a R	Varnish
Carl Blank	Bonn a R	Bandages, rubber plaster
Bonner Chemischer Industrie, G m b.H	Bonn a R	Special soap, varnish
Gebr. Bornefeld	Bonn a R	Varnish
de Foy & Finking	Bonn a R	Varnish
Joh Hanstein	Bonn a R	Varnish and colors
Hoffman & Dewald	Bonn a R	Varnish
Kleine & Flume	Bonn a R	Artificial mineral water
J. W Pfankucken Sohn	Bonn a R	Ink powder
Pharmazeutische Fabrik Stein	Bonn a R	Hygenic rubber goods
Dr Pitschke's Chem Laboratorium	Bonn a R	Pharmaceuticals
Dr Schuetz & Co	Bonn a R	Pharmaceuticals
Schmithausen & Co	Bonn a R	Pharmaceuticals
Adam Segschneider	Bonn a R	Wax candles, tapers
Wilhelm Vollmar	Bonn a R	Waxen goods
Thomasschlacken-Mahlwerke Oberhausen, Gesellschaft m b H	Borbeck (Kr Essen)	Fertilizer
Fabrik-Chemische-Technischer Producte, Phillip Frank	Boppard (Rhpr)	Technical oils and fats
Pharmazeutische Fabrik Asta, G.m b.H	Boppard (Rhpr.)	Pharmaceuticals
Chr Rath	Boppard (Rhpr)	Soap, glycerine
Herm. Renckhoff	Boppard (Rhpr)	Pharmaceuticals
"Reinland" Fabrik für Asphalt pappe, Teer und chem Produkte G m b He		
Wilhelm Genenger, Nachf.	Breyll (Rhpr)	Asphalt, tar paper
Chemische Fabrik Bruehl Gottfried Kentenich & Co , m b H.	Bruehl (Bz Koln a, R)	Soda, rosin
Kohlensaeurewerk Burgbrohl G m b H	Burgbrohl (Rhpr)	Natural carbonic acid
Gebr Rhodius	Burgbrohl (Rhpr)	White lead, carbonic acid
Gustav Rhodius	Burgbrohl (Rhpr)	Chemicals
Fabrik pharmazeutischer Praeparate, A Stein	Burgwaldniel a Niederrhein	Pharmaceuticals
Bergische Kerzenfabrik G m b H.	Burscheid (Bz Dusseldorf)	Candles
Rheinische Kerzenfabrik August Pfeiffer	Burscheid (Bz Dusseldorf)	Candles
Clever Oelmuehle, G m b H	Cleve (Rhpr)	Linseed and rapeseed oil
Clivia Oelwerke, G m.b H	Cleve (Rhpr)	Linseed and rapeseed oil
Chemische Fabrik, Coblenz-Wallersheim, G Wilckens Nachfolger, Dr Kretzer	Coblenz a, R.	Fluorine, cobalt, etc.
Chemische Fabrik Luetzel G m b H	Coblenz a/R	Chemicals
Chemische Werke Rombach G m b H	Coblenz a/R	Chemicals
Louis Fischer	Coblenz a/R	Soap, candles
Franz Goerger	Coblenz a R	Waxen goods
Hermann Josef Krepele	Coblenz a/R	Soap
Radium Gummiwerk G m.b.H	Dellbrueck (Bz Koln)	Soft rubber goods
Thomas schlacken-Mahlwerk, G m b H	Dillingen a d Saar, (Rhpr)	Fertilizer
Rheinische Fabrik fuer Elektrische Bogenlichtkohle "Excelsior," W Gruedlbach	Dinslaken (Niederrhein)	
Gebr Mueller	Dorsten (Westf)	Soap powder
J E Ausbuettel	Dortmund	Surgical dressings
Franz Brunck	Dortmund	Tar and ammonia
Chemische Fabrik, Theo. Fincke	Dortmund	
Chemische Industrie Funk & Cie	Dortmund	Rosin, technical oils
Dorner Oelwerke, Creamer & Dahlmann	Dortmund	Oils
Dortmunder Thomasschlacken Mahlwerk, G m b H	Dortmund	Fertilizer
Th Fahnenstich Soehne	Dortmund.	Tar and roofing prod.
Heinr Flev	Dortmund	Soap
Dorstfeld Gewerkschaft	Dortmund	Ammonia, benzol, tar
Hermann Haueisen	Dortmund	Oil colors, varnish, putty
Wilh Klaas Soehne	Dortmund	Asphalt
H & E Kruskopf	Dortmund	Chemicals
Rud Kuepfer	Dortmund	Tar products
G & W Lambeck	Dortmund	Chemicals
Herm Meier	Dortmund	Soap, candles
Herm Meininghaus, jun	Dortmund	Soap, glycerine
Richard Meyer	Dortmund	Dyes
Moritz Nake, Dortmunder Kohlen-anzünder-Fabrik in Dortmund,		
Wilh Pahl, Dortmunder Gummiwaren Fabrik	Dortmund	Technical rubberware
C B Ranke, G m b H	Dortmund	Asphalt, tar products
Fr Sobbe, G m b H	Dortmund	Electric lighters
Ueter & Grenzdorfer G m b.H	Dortmund	Colors, varnish
Vereinigte Asbestwerk Danco, Wetzol & Cie , Gesellschaft m b H	Dortmund	Asbestos products
Westdeutsche Sprengstoff Werk, A G	Dortmund	Explosives
Westfaelische Essenzen-Fabrik, G m b H	Dortmund	Essences
Westfaelische Mineralöl, W H Schmitz	Dortmund	Resinous products, technical oils, and fats
J Beckers & Cie	Dueren (Rhld)	White lead
Brüning & Soehne	Dueren (Rhld)	White lead
Gebr Caesar	Dueren (Rhld)	Asphalt, tar
Chemische Fabrik Durania	Dueren (Rhld)	Chemicals
Chemische Fabrik K.Jas	Dueren (Rhld)	Chemicals
Dr Degan & Kuth	Dueren (Rhld)	Pharmaceuticals
Rudolph Horst	Dueren (Rhld)	Chemicals
Kino-Film Co , m b H	Dueren (Rhld)	Photo films
Schiesswollfabrik Dueren	Dueren (Rhld)	Explosives
Vialonga Werke Apotheker Fritz Schnell	Dueren (Rhld)	Pharmaceuticals
Actiengesellschaft der Remyschen Werke	Dusseldorf	Starch
Bauartikel Fabrik A Siebel	Dusseldorf	Asphalt and tar
Gebr Bauer, Chemische Fabrik	Dusseldorf	Chemicals
M D Baumann, Chemische Fabrik	Dusseldorf	Chemicals
Bergisches Kraftfutterwerke G m b H	Dusseldorf	Chemicals
Sali Blum, Chemische Fabrik	Dusseldorf	Chemical products
Ferdinand Braukmann & Co G m b H	Dusseldorf	Perfumery
Carl Ed Braun, G m b H	Dusseldorf	
Braun & Bloem, G m b H	Dusseldorf	Percussion caps
H Breithaupt	Dusseldorf	Rubber and gutta-percha goods
Heinrich Brinken	Dusseldorf	Varnish
Eugen Bruchhaus	Dusseldorf	Chemicals
Ernst Richard Buechner	Dusseldorf	Varnish
Rudolf Buenger, G m b.H	Dusseldorf	Dyes and varnish
Buechter & Co	Dusseldorf	Chemicals
P. H. Buschbell	Dusseldorf	Colors
C. A. Calmar Sohn.	Dusseldorf	Oils and fats
Chemische Fabrik fuer Huettenprodukte, A.G	Dusseldorf	Chemicals

Regional Meeting at Chicago A.S.S.T.

Measurement of Cooling Rate; Its Effect on Structure of High-Carbon Steel; Microphotography and Metallurgical Education Hold Attention of Members

PURSUANT to their admirable plan, the various local organizations near by Chicago united in a regional meeting on Feb. 8. Two technical sessions were held during the afternoon and evening, while the social animal was appeased by luncheon and supper served at the City Club. On the following day many members and their guests made inspection visits to nearby steel works or forge plants. In this way many men who have not the means or the opportunity to attend one of the national conventions held by the American Society for Steel Treating in some distant city can participate in all the convention activities near at home at least once a year.

Brief notes on the formal papers read at the session appear below.

Hot Bodies Cooling in Air

E. J. Janitzky, metallurgist of the Illinois Steel Co., noticed that cooling curves assume a shape approximately that of a rectangular hyperbola, and upon investigation found this indeed to be a fact. When plotting time against temperature at the center of a ⅞-in. cylinder of high-nickel steel 2½ in. long, cooling in air, he found that the correspondence was extremely good, and since then he has checked the same relation for very large masses, such as ingots or annealing furnaces, and has verified the assumption by figures already published by various investigators.

The entire matter can be generalized if a rectangular hyperbola be plotted, having the x axis as one asymptote, and the ordinate y — — 1 as the other. The equation for this curve is

$$y = \frac{K}{x + 1}$$

K is the intersection with the y axis and represents the temperature of the body at the beginning of the cooling; y is the temperature of the body at any time thereafter. The unit of x is the "time constant," or the time required (in minutes, seconds or hours) to cool the body half way to zero.

As an instance, for the small nickel steel specimen cooling in air at 80 deg. F., it required 4.7 minutes to cool from 1,750 to 875 deg. F. Call this time the first period. During the second period (or at the end of 9.4 minutes) it will cool to

$$y = \frac{1750}{2 + 1} = \frac{1750}{3} = 585 \text{ deg. F.}$$

At the end of the third period it will cool to ¼ of 1750 or 437, of the fourth period it will be at ⅕ of 1750 or 350 deg. F. and so on.

Computed and actual results follow:

	Pyrometer	Calculated	Time Interval x	Time Interval Minutes
Original temperature	1750		0	0
	875	875	1	4 7
	580	585	2	9.4
	445	437	3	14 1
	340	350	4	18 8
	285	290	5	23 5
	240	250	6	28.2

The matter of predicting the approximate time when the body will reach a given temperature resolves itself into a very simple arithmetical calculation, requiring only the experimental determination of the time required to cool one-half the distance to zero. This time (the "time constant") evidently varies with the material, its shape, mass and temperature to which heated; it cannot easily be predicted, but can very easily be measured.

If the cooling is delayed by transformations in the body—as for instance steel at the recalescence point—the cooling is merely interrupted the time necessary to complete the transformation—that is to say, the y axis is shifted to the right an equivalent amount.

Technique of Microphotography

An interesting set of micros, taken at very high magnifications, were shown by R. G. Guthrie, of the People's Gas Light & Coke Co., while recounting some of the precautions necessary before such work can be successful. He also cited the methods of producing sensibly monochromatic light and the reasons for its utilization; ray filters recommended by the manufacturers of the particular plates used by the operator will usually be most satisfactory. While a single filter will cut out a large number of wave lengths, a combination of two or more will be found very useful to narrow down the transmitted beam. He regards the panchromatic plate as the ideal for many purposes, despite the fact that it must be handled with the greatest care, owing to its sensitivity to infra-red rays.

In experimenting with polarized light, he attempted to use it in an ordinary Leitz metallurgical microscope to photograph opaque specimens. He mounted the polarizer just ahead of the sub-stage condenser, and the analyzer in the tube carrying the ocular. Using sensibly monochromatic light, it was easy to photograph the structure in its usual aspect when the prisms were set parallel to each other. Crossed Nichols should have showed the field dark, which was found to be true only when the beam consisted of an extremely small pencil of rays. Opening the diaphragm somewhat allowed a photograph to be made of the structure in extremely curious contrast, suggesting a badly overexposed print on blueprint paper. While the speaker was unable to point to any present utility of the method, it seemed to be in effect an example of the possibility of photographing metallic specimens at high magnifications and under oblique illumination—polarized light being essentially that.

Education

Remarks on the ways and means of capitalizing upon metallurgical achievements were made by E. E. Thum, associate editor of *Chemical & Metallurgical Engineering*. Noting that while there is doubtless much pseudo-engineering masquerading as technical control, a successful metallurgical or testing department was bound to contribute toward a reduction in manufacturing costs. The problem then is properly to show these savings in a way that the auditor, the manager and his board of directors cannot help but see. When that has been done, their services will be valued in direct proportion to the amount of profit they can show—they will become something more than a salary expense.

After recounting the wide variety of activities and interests occupying their attention, the speaker recommended that the best way to sum all these things in the ledger was to have a departmental account started for the testing or metallurgical department. Then it would be possible to charge the various manufacturing departments for services rendered at a fair rate, and to secure the proper book credit for new developments and econ-

omies suggested in the operations. These will easily be found to overbalance the salaries and expenses of the necessary investigations.

STRUCTURE OF HARDENED HIGH-CARBON STEEL

A 1.78 carbon steel, quenched from 1,080 deg. C., was examined by Howard Scott of the Bureau of Standards. He found the interior to consist of good-sized polygonal grains, shot through with feathery needles (plates) and containing a little massive cementite at the grain junctions—evidently unabsorbed excess constituent. Some decarbonization occurred at the very surface, since there was no massive cementite observed in the microsection; the appearance there was a typical granular martensite of hardened tool steel. In a thin intermediate zone the polygonal grains characteristic of the center contained zigzag apparitions, like lightning flashes, and few if any needles.

The interior grains are thought to be austenite, because they have a simple polyhedral outline. It is plastic, because squeezing in a vise developes twins and slip bands. Cooling to liquid air buckles the surface and develops a structure suggestive of martensite. When cooled from 1,080 slowly—i.e., in a mild air-blast—it develops small areas of a dark-etching constituent like troostite, and the grains completely transform to this material on tempering at 350 deg. C.

Massive cementite, free at the grain boundaries and envelopes, is easily identified by its characteristic color and shape and by darkening after the sodium-picrate etch. Feathery needles (plates in three dimensions) also etch dark in sodium picrate; they usually grow from the grain envelopes, and spheroidize on tempering to 600 or 700 deg. C. Scott therefore dubs them cementite, soluble in austenite at 1,080, but precipitated along cleavage planes during cooling.

Zigzags are thought to be thick plates of martensite. They appear in the austenitic grains after cooling in liquid air. On tempering to 250 deg. C. they etch much quicker, and when the structure is tempered to 600 deg. C. and becomes sorbite, the needles persist as white ghosts, and contain fewer cementite particles than their surroundings. Sometimes they occur in the same grain with a broad-banded twin, from which they can be easily distinguished by form and etching characteristics.

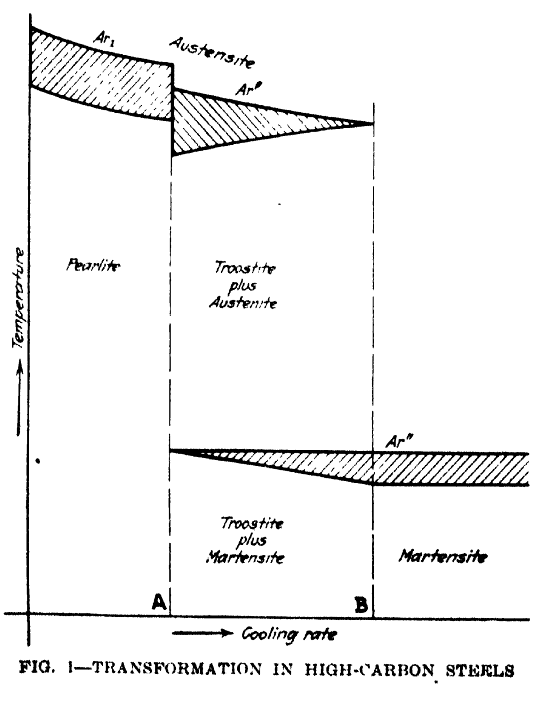


FIG. 1—TRANSFORMATION IN HIGH-CARBON STEELS

If these conclusions as to the identity of the structural constituents are correct, it follows that in a very high-carbon steel quenched from a very high temperature, an austenitic core is produced at a moderately slow cooling rate—slower in fact than that producing martensite in the lower-carbon steel at the edges. Furthermore, this austenite appears to transform directly into troostite (by slower cooling or mild tempering) without any intermediate martensitic stage appearing.

Such facts are generalized in a diagram of the "stepped" transformation (Fig. 1) as indicated by many recent researches on quenching. A eutectoid steel, cooled slowly, or at a rate less than that indicated at *A*, will transform abruptly at Ar_1 (in the neighborhood of 650 deg. C.) from austenite into pearlite. At somewhat faster rates, the transformation appears to split; some austenite appears to change to troostite at Ar' (650 deg. C. $\pm$) and the rest into martensite at Ar'' (250 deg. C. $\pm$). The final structure of eutectoid steel is a mixture of troostite and martensite. If the steel contains much more carbon, as the 1.78 C steel under discussion, and is quenched from a high heat, Ar' and Ar'' are lowered, Ar'' occurring below atmospheric temperature and therefore suppressed. Then the steel will be austenitic with some troostite. Supercooling in liquid air passes Ar'', and develops the structure expected in a eutectoid steel. For very rapid rates of cooling the steel is either austenitic or martensitic, depending upon whether Ar'' is above or below the lowest temperature attained during the quench.

Quenching experiments with lower-carbon steels—containing 1.16 and 1.04 per cent carbon respectively—were made to discover the rate at which the cooling must be effected in order to preserve the martensitic structure (*B* of Fig. 1). These developed a number of surprises, most notable of which is that it is easy to produce a specimen possessing a martensitic core and a muff partly or entirely of troostite. Evidently some other factor than rate of cooling is responsible for the ultimate structure. Consideration of the facts in this case led the author to discuss the effect of internal stress upon the transformations found in steel.

Mathematical analysis of the cooling at various regions in a steel ball was given to show how the rate of cooling, and therefore cooling stresses, varied at different times during the cooling. In this way it was possible to show that quenching from a high temperature at certain rates will throw high tensions in certain regions. Since the transformation austenite → troostite involves an increase in volume, pressure will lower the temperature at which it occurs (Ar') or restrict the transformation, and conversely tension will increase it, and cause troostite to appear in considerable masses where only austenite would be expected from a consideration of cooling rates only.

Production of Talc in Canada

In a report just published by the Canadian Department of Mines, the production of talc in Canada in 1920 amounted to 21,000 tons. Virtually the whole of this quantity was derived from the Madoc area of Onartio.

How to Save Money by Proper Methods of Barrel Handling

The Right and Wrong Methods of Storing Barrels Are Both Pictured and Described — A Number of Generalizations on the Care of Barrels Are Then Derived From the Examples

BY MATTHEW WILLIAM POTTS
Consulting Engineer, New York City

IN PREVIOUS article,[1] on "The Dollars and Cents of Careful Barrel Handling," we merely led up to the most important point—namely, the storage of barrels. The amount of care taken in storing, handling and filling of barrels has a great deal to do with the method of storage and the ultimate success or failure of the barrels as containers, providing it is necessary to store them for any length of time after they have been filled, and also has a great deal to do with how the barrel will stand up in storage after it is received at the consumer's plant.

There are certain fundamentals in barrel storage that apply in both the manufacturer's plant and the consumer's plant. Each branch of the industry has certain requirements that must be met. The pertinent questions which apply in most cases are:

1. How are the barrels received at the storage warehouse—i.e., conveyors, hand trucks, tractors and trailers, motor trucks, railway sidings, etc.?
2. How long will the barrels remain in storage?
3. What is the nature of their contents—i.e., liquid, powder, dangerous, neutral?
4. How many different products are to be stored?
5. Is there more than one grade of the same product—for instance, chemicals of different analysis?
6. How must the materials be taken out of stock—i.e., must the oldest stock be taken out first?
7. Is storage space plentiful or must every cubic foot be utilized?
8. Is it necessary to take a complete physical inventory? If so, how often?

There are numerous other questions which will present themselves such as, Is the warehouse space all on one floor, or on different floors which would necessitate the use of elevators? What is the allowable floor load? This last question will regulate the height of piling. It is difficult therefore to go into detail unless we could take into consideration some particular

[1] Chem. & Met., vol. 28, No. 7, Feb 14, 1923

FIG. 6—HOW NOT TO STORE BARRELS
Here is shown poor aisle space, absence of dunnage and thirty varieties of commodities. Question: How would you get at barrel "A"?

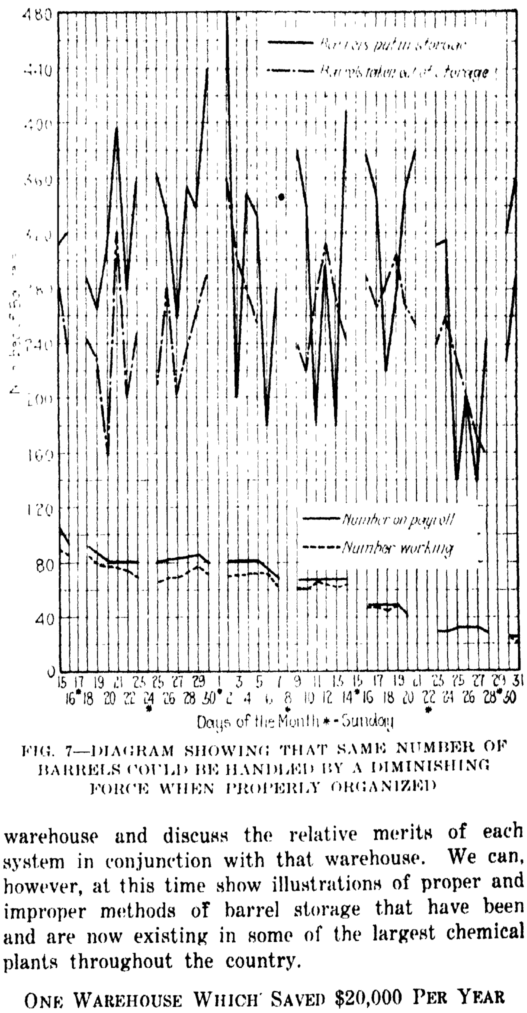


FIG. 7—DIAGRAM SHOWING THAT SAME NUMBER OF BARRELS COULD BE HANDLED BY A DIMINISHING FORCE WHEN PROPERLY ORGANIZED

warehouse and discuss the relative merits of each system in conjunction with that warehouse. We can, however, at this time show illustrations of proper and improper methods of barrel storage that have been and are now existing in some of the largest chemical plants throughout the country.

ONE WAREHOUSE WHICH SAVED $20,000 PER YEAR ON BARREL HANDLING

In the warehouse one of the most important points to consider is the layout of aisles; next, the piling of the barrels; third, the proper method of building the piles. Looking at Fig. 6 we see a condition that exists in over 50 per cent of the chemical plants throughout the country. This is a poor and wasteful method of storing barrels. First, there is poor aisle space; this runs up the labor cost. Second, there is no dunnage between the tiers of barrels; this causes damage to the heads of the bottom barrels and also runs up the labor cost. Third, the group contains about thirty different products, and the one marked *A* might be required first. There is also waste overhead space which could be utilized with a proper layout. When we consider that this same condition existed throughout 40,000 sq.ft. of floor space, we can picture a real problem. Only

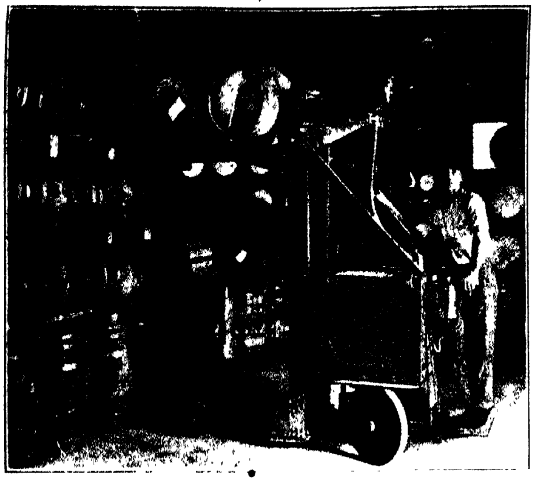


FIG. 8—TIERING TRUCK HANDLING AND PILING BARRELS OF LEAD OXIDE. AVERAGE WEIGHT OF BARREL 1,100 LB.

imagine the overhead space that could be utilized if the layout was proper. Taking this condition and making a rearrangement of aisles and products, the writer was able to reduce the labor force from fifty-three men to thirteen men in a month and a half; increase the capacity of the warehouse 50 per cent; and at the same time handle more barrels.

The trend of the improvement and the number of barrels handled per day are shown in Fig. 7. By adding the number of barrels put in storage and the number taken out of storage the reader can easily find the total number of barrels handled per day. For instance, on the 31st, or the last day shown on the chart, there were thirteen men working. These men placed 360 barrels in storage and removed 290 barrels from storage, making a total of 650 barrels handled in a 9-hour day. These thirteen men include the foreman, checkers, coopers and painters, but do not include the office force.

The main point in reducing the force was the layout of aisles, but the use of electric tiering machines played an important part also, and the installation of a ramp conveyor to carry the barrels to the car-loading platform was another great assistance. The new arrangement permitted the barrels to be tiered four high on the chimb.

This reduction in the force of labor required had several advantages. First, it reduced the payroll by $24,960 per year. The new equipment cost $5,000, so this meant a saving of $19,960 in the first year over and above the cost of the equipment. Second, it eliminated considerable labor trouble and made supervision easier, as thirteen men are easier to handle and keep satisfied than fifty-three men.

Three Methods of Storing Barrels

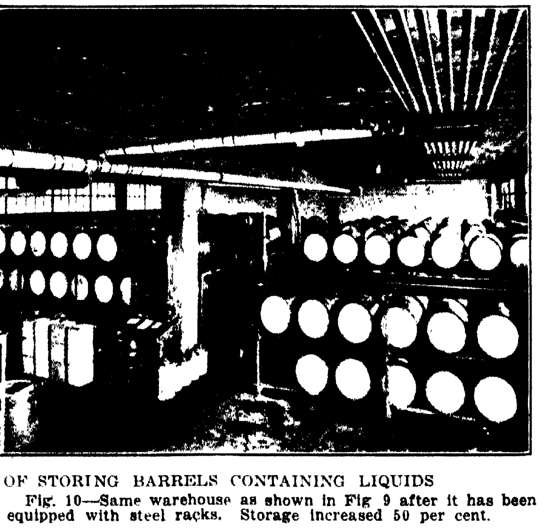
Looking at the problem of barrel storage in general, whether the amount stored is a small or a large quantity, there are only three distinct methods of storage. The best method to be used depends upon whether the product being stored is in dry or liquid form, and not on the quantity to be handled. The three methods are here given in their order of preference:

1. In racks on the bilge. (See Figs. 10 and 14.)
2. On the bilge with dunnage. (See Fig. 9.)
3. On the chimb with dunnage. (See Fig. 12.)

The rack system of storing is without a doubt the best method, as it allows systematic storage by groups, products, analysis, etc. The separate tiers makes lotting of stock simple, convenient and inexpensive. Each tier of barrels is separate and accessible, being held free from those above and below. This allows considerable flexibility of storage space and prevents pressure on the lower tiers—pressure which with the other methods results in parting of the staves and leakage.

With the rack system it is possible to take a complete physical inventory at any time, as all barrels are easily reached by leaving a foot of space between racks. If it should become necessary to remove any particular barrel it may be done easily, whether the barrel is in the uppermost or in the lowest tier, and at a minimum expense. Another advantage is the ability to utilize all overhead space. With racks it is possible to tier barrels as high as ten tiers or to a height of over 20 ft.

If the barrels contain liquids, it is often necessary to turn them slightly so as to keep all sides moist and prevent loss of content, through staves that have dried out, when the barrel is removed from stock. With the rack system this turning can be frequently done with little expense and effort.



FIGS. 9 AND 10—PROPER AND IMPROPER WAYS OF STORING BARRELS CONTAINING LIQUIDS

Fig. 9—All barrels should be stored on the bilge. The method of dunnage shown is correct.

Fig. 10—Same warehouse as shown in Fig. 9 after it has been equipped with steel racks. Storage increased 50 per cent.

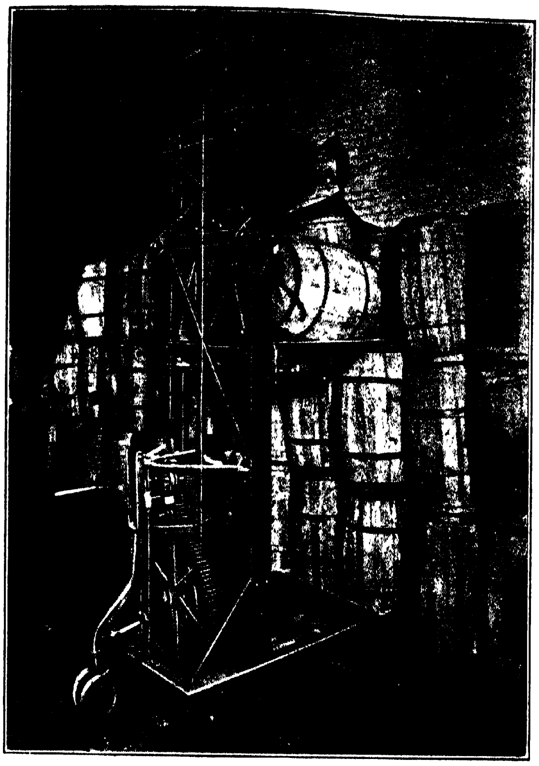


FIG 11 IMPROPER METHOD OF PILING BARRELS
Note uneven piles, which results in accidents. See text regarding position of tiering machine.

The economical advantage of the rack system is the small labor force required to operate a warehouse where racks are installed. In most cases one man with a portable elevator (or tiering machine) can do all the work of placing and removing the barrels from stock.

It is true that barrels can be stored without being placed in racks, but they will not be as accessible and there is more chance of damaging the barrels. Looking at Fig. 8 we see a good method of handling, tiering and storing barrels except that the bottom tier should be on the bilge and resting on dunnage placed on the floor. We can agree, however, that it would be impossible to remove the bottom barrels without taking down the whole pile. This means that this system is useful and practical only where the products are all the same grade. It would be impossible to pile the barrels in this manner if they contained liquids, as the excessive pressure would spread the staves and cause leakage. In this warehouse, if liquids were being stored instead of dry products, it would be impossible to pile the barrels more than two high, and the remaining 8 ft. of headroom would be wasted.

Fig. 9 shows the proper way to store barrels containing liquids, providing dunnage is being used in place of racks. Note the dunnage on the floor, which gives two points of contact on the staves of the barrels instead of placing all the pressure directly on the bilge. The two points of contact also hold the barrels steady and prevent accidents from a wabbly pile. The dunnage for the second tier is also shown. It is not recommended to pile liquids over two high with this system, but barrels containing dry products can safely be piled as high as four tiers.

Fig. 10 shows the same warehouse equipped with racks. Note the additional increase of 50 per cent by adding the third tier of barrels. If this warehouse had been built with the idea of using racks, a slight rearrangement of the overhead steam pipes would have permitted the placing of a fourth tier, which would have allowed an increase of 100 per cent over the old method. This photograph shows very clearly the narrow aisles that are possible with the use of racks and also how the bottom barrels can be removed without disturbing the upper tiers.

Practice in Handling Slack Cooperage

The illustrations so far have shown only tight cooperage. Figs. 11 and 12 show two ways of storage, a proper and an improper method. While these photographs show slack cooperage, it is only incidental.

Looking at Fig. 11 we see a good example of how not to pile barrels and also the wrong way to use a portable elevator (or tiering machine). First, there is no dunnage between tiers* of barrels; this makes a very unsteady pile which is dangerous and does not permit of the full use of the overhead space. If dunnage had been placed in this pile, it would have been possible to pile the barrels four high, thus increasing the storage capacity by 33⅓ per cent. It is plain to see that some of the barrels are resting directly on the heads of those beneath; this often causes breakage of the heads. The portable elevator should be placed with the pile or at right angles to the position shown in order to operate efficiently. Placed in its proper position the machine will work in narrower aisles and the barrels can be rolled on from the front of the machine and off at either side without moving the machine. This important point is often overlooked.

Fig. 12 shows the proper way to pile barrels and

FIG. 12—PROPER AND EFFICIENT METHOD OF PILING BARRELS CONTAINING DRY PRODUCTS

also the proper position of the portable elevator in relation to the pile. Note the dunnage beneath the bottom barrels so as to allow the moisture from the floor to escape, thus eliminating the swelling of the bottom heads. Observe the straight even piles, the placement of the dunnage, the nearness of the portable elevator to the face of the pile and the number of men used in piling this material.

Fig. 13 shows the wrong way to place a portable elevator and also shows how the contents of the barrels leak out between the staves when they are stored on the chimb. Fig. 14 illustrates the use of the rack system and the proper placing of the portable elevator when it is used in conjunction with racks. Note how some of the barrels from the bottom tiers have been removed without disturbing the upper tiers.

There are a number of points which have not been touched in this article, and a number that are found only in certain branches of the chemical industry. It will be found advantageous by most companies to look over their present methods of barrel storage and to correct the faults set forth in this article. It will also pay to have their engineering department or an outside consulting engineer make a study of their barrel storage. Often little items that are being daily overlooked will amount to a loss of thousands of dollars per year that could be saved without a very large investment. Under this heading comes the matter of space. Are you getting the maximum amount of storage possible in a given space?

A Few Axioms in Barrel Handling

In conclusion a few general points about the handling and storage of barrels should be listed and followed to obtain the maximum results and possible economies.

1. Keep the barrels dry; never leave them outdoors even for an hour without covering.

2. Never store barrels in a draught, in a sunny room, in a wet cellar or where temperature is in excess of 60 deg.

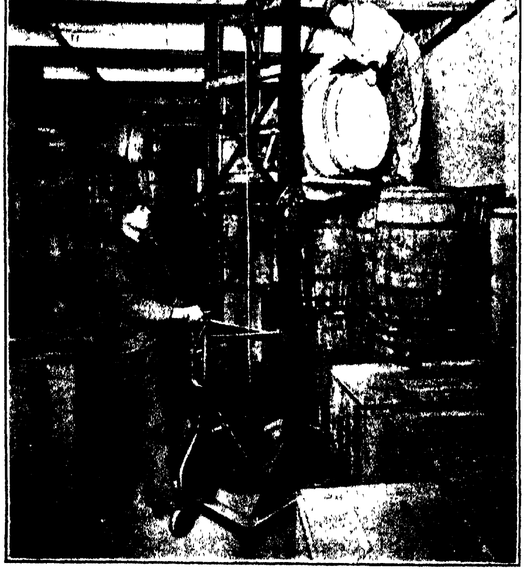
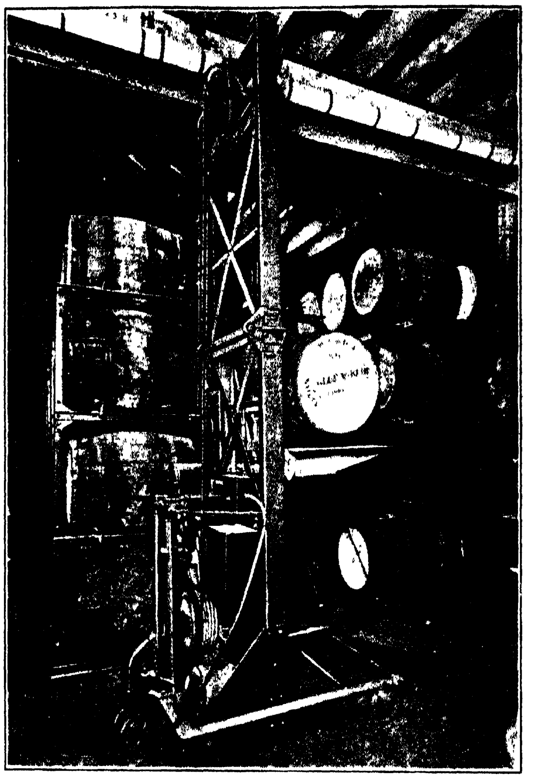


FIG. 13—POOR LAYOUT OF WAREHOUSE AND AISLES
Note contents of barrels leaking between the staves.



Courtesy of the Economy Engineering Co

FIG. 14—EXCELLENT LAYOUT OF BARREL RACKS
Proper method of storing barrels and proper location of tiering machine in placing barrels.

3. Maintain an even temperature in the warehouse.

4. Always store on the bilge with the bung stave up. This is the weakest stave in the barrel.

5. Never store on the chimb without placing dunnage between tiers.

6. Always cooper barrels by machinery. It gives a better and tighter job.

7. Never drop a barrel. To do so may break the staves.

8. Use a paper lining in barrels containing dry products.

9. Size (line) barrels that will contain liquids to prevent the wood absorbing the product.

10. Never fill barrels with products that are hot. The barrel will expand and develop leaky joints as soon as it cools.

Coke Byproducts of 1922

The U. S. Geological Survey has issued preliminary statistics indicating a production of 28,493,000 tons of byproduct coke and 8,033,000 tons of beehive coke during 1922. On the assumption that the yield of byproducts from coke ovens in 1922 bore the same relation to the coke production as in 1921, the following recoveries of various products are estimated:

Tar, gal.	365,000,000
Ammonia (sulphate equivalent of all forms), lb.	946,000,000
Gas M. cu ft.	447,000,000
Crude light oil, gal.	111,000,000

The Survey has issued preliminary figures by states and by months as a part of a recent weekly coal report. Those desiring these data can secure them on application to the Survey, Washington, D. C.

The Chemical Engineer's Part in the Rescue Work at the Argonaut Mine Disaster

How the Composition of Escaping Gases Was Used to Follow Progress in Controlling the Fire —Estimate of Extent of Destruction Based on Gas Analyses*

BY L. H. DUSCHAK
Chemical Engineer, San Francisco

WHEN the fire was discovered in the vicinity of the 3,000-ft. level of the Argonaut shaft in California shortly before midnight on Aug. 27, 1922, the mine was being ventilated in the usual manner by an exhaust fan situated near the collar of the Muldoon shaft, which with the communicating system of raises and connections formed the return airway. As no change was made in the system of ventilation after the fire started, a dense cloud of smoke was soon emitted by the fan. This continued for about 3 hours, after which the density of the smoke cloud materially decreased, but the fan discharge was still of a highly toxic character. Owing to the limitations of the oxygen-breathing apparatus, any attempt to reach the working levels of the mine through the Muldoon system was out of the question as long as the Muldoon atmosphere remained irrespirable. An accurate knowledge of the condition of this atmosphere was therefore essential in planning the rescue program.

Regular gas sampling at the Muldoon fan was commenced on Wednesday morning, Aug. 30. A typical analysis was as follows: O_2, 17.6 per cent; CO_2, 2.8 per cent; CO, 0.7 per cent. Analyses were made with a standard Orsat apparatus, following the procedure outlined by Kreisinger and Ovitz.[1] Carbon monoxide determinations were also made with the carbon monoxide detector,[2] manufactured by the Mine Safety Appliances Co. At this time the churning of the fan indicated that it was handling much less than the normal volume of air.

During Wednesday and Thursday the composition of the fan discharge remained practically unchanged, indicating that the efforts to extinguish the fire were unavailing. Exploration made Thursday afternoon by an apparatus crew under the direction of B. O. Pickard of the U. S. Bureau of Mines disclosed burning timbers below the 2,500-ft. level. These were extinguished without producing any material change in the gas discharged by the fan and it was evident that a vigorous fire was still burning considerably below this point. On Friday it was decided that further efforts to extinguish the fire by the application of water from above were useless and a tight bulkhead was constructed across the shaft below the 2,500-ft. level. Bulkheads in the drifts on the 2,400- and 2,500-ft. levels were also repaired and sealed with clay in order to prevent any fresh air from reaching the fire zone. The efficacy of these bulkheads was shown by an almost immediate decrease in the quantity of CO_2 and CO in the fan discharge.

On Sunday, Sept. 3, an exploring party crossed from the Argonaut shaft to the Muldoon end of the 2,400-ft. level. The raise coming up to this point carried all of the gas escaping from the lower levels of the mine. A sample taken at that time with the apparatus shown in Fig. 1 and analyzed later in the usual way had the following compositions: O_2, 13.0 per cent; CO_2, 6.2 per cent; CO, 0.9 per cent. A comparison of this and subsequent samples at this point with samples taken at the fan showed that between the 2,400-ft. level and the surface, the gas coming from the lower levels of the mine was diluted with approximately twice its volume of fresh air entering through superficial workings.

Systematic sampling was continued both at the fan and the 2,400-ft. level and anemometer and temperature readings were taken regularly at the latter point. Owing to the greater significance of the observations made at the 2,400-ft. level a selection from these data, given in Table I, will be sufficient to show the course of events.

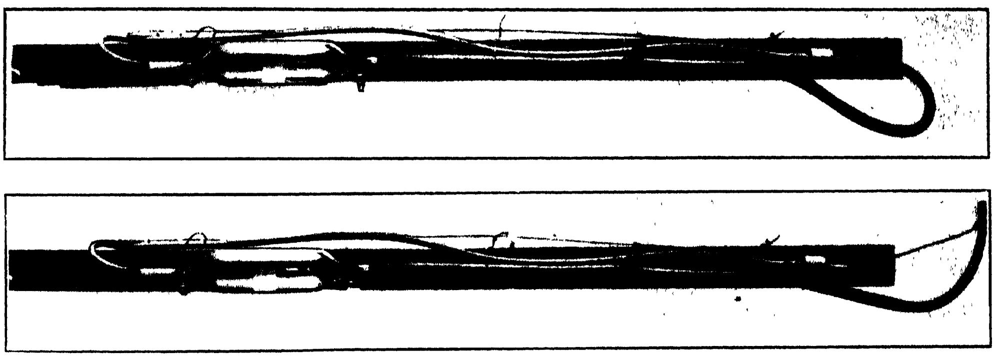


FIG. 1—GAS SAMPLING APPARATUS USED AT ARGONAUT MINE

TABLE I—COMPOSITION OF GASES AT 2,400-FT. LEVEL

				Gas Composition (in Per Cent)			
				By Orsat			By Detector
Date	Time	Temp., Deg. F.	Air Vol., Cu.Ft. Per Min.	C_2	CO_2	CO	CO
9-3	8:00 p.m.	....	...	13.0	6.2	0.9	....
9-6	11:00 a.m.	80	5,000	12 8	7.0	0.9	....
9-8	4:00 p.m.	....	4,000	13.6	6.3	0.5	....
9-12	3:00 p.m.	80.6	3,800	15 2	5.0	0.6	0.5
9-14	11:00 a.m.	79.7	3,900	15 5	4.6	0.4	0.5
9-16	11:15 a.m.	80 0	4,100	15.2	3.9	0.2	0.1
9-17	3:30 p.m.	80.6	4,500	16.1	4.0	0.1	0.05

*The writer spent 4 weeks at Jackson, Calif., as consulting engineer for the Industrial Accident Commission of California. He desires to acknowledge the assistance rendered by Orr Woodburn, of the Globe Miami District Mine Rescue and First Aid Association, and of various rescue men working under the direction of B. O. Pickard, of the U. S. Bureau of Mines.

[1]"Flue Gas Analysis by Means of the Orsat Apparatus," by Henry Kreisinger and F. K. Ovitz. Bulletin 97, U. S. Bureau of Mines.

[2]So far as the writer knows, this was the first time that the carbon monoxide detector has been used to any extent in connection with a mine fire. Its indications were checked repeatedly by the Orsat apparatus and also confirmed by tests with canary birds. It was found that the color scale of the instrument could be easily read underground in the concentrated beam of two carbide lights or two pocket flash lights. The simplicity of the instrument and the ease with which determinations are made suggest that it might be of use in connection with regular mining operations.

Accurate work with the anemometer was impossible and the variations in the gas volumes shown above are without significance. The gradual decrease in the CO_2 and CO showed that the fire was being slowly smothered owing to the continued effectiveness of the bulkheads. At times large quantities of water mist were present in the gas coming up the Muldoon raise at the 2,400-ft. level. The water mist was doubtless due to one or both of the following causes—namely: the penetration of the fire zone by water or the progress of the fire to a point where considerable water entered the shaft.

The diminution in the carbon monoxide was closely watched from day to day in the hope that the atmosphere in the Muldoon system below the 2,400-ft. level would clear sufficiently so that rescue parties could safely descend to the lower levels of the mine through this entrance. The atmosphere, however remained irrespirable up to the afternoon of Sept. 17, and early in the morning of the 18th, connection was made between the 3,600-ft. level of the Kennedy and the 4,200-ft. level of the Argonaut.

During the time of the exploration work and the removal of the bodies, gas samples were analyzed at frequent intervals, but there was no indication that the air entering the mine through the Kennedy connection caused any change in the fire zone.

Calculating the Extent of the Fire

One of the much-discussed subjects prior to the entrance of the Argonaut shaft through the Kennedy connection was the extent of the fire zone in the shaft and particularly the question as to whether the 4,200-ft. station in the Argonaut shaft would be found intact. On Sept. 4 the writer made a rough calculation of the amount of timber which had been burned up to that time, and at intervals after that this calculation was brought up to date. For the period covered by the gas analyses these calculations were based upon the volume and total carbon content of the gas coming up the Muldoon raise at the 2,400-ft. level. For the initial period of the fire, assumptions were made as to the volume of air entering the fire zone, and the extent to which the oxygen was consumed by the burning timber. According to data furnished by the management, the timber used in the Argonaut shaft corresponded to 1,200 lb. of wood per running foot of shaft. The wood was assumed to contain 50 per cent carbon. A summary of these calculations is given in Table II.

TABLE II ESTIMATE OF SHAFT TIMBERING BURNED

Date	Time Interval in Hrs	Assumed Air Vol Cu Ft Per Min	Basis of Calculation	Wood Consumed Lb. Per Min	Wood Consumed Total Tons	Corresponding Length of Shaft in Ft
8-28	4	30,000	50% oxygen utilized	200	24	40
8-28 to 8-29	20	15,000	50% oxygen utilized	100	60	100
8-30 to 8-31	72	10,000	50% oxygen utilized	67	144	240
9-1 to 9-10	216	4,000	6.5% $CO+CO_2$	17.6	114	190
9-10 to 9-19	216	4,000	5% $CO+CO_2$	12	77.8	130
Total length of shaft timbering entirely consumed						706

The assumptions used in calculating the quantity of timber consumed during the early period of the fire before exact gas data were available were considered to be liberal. The computations based on gas data are fair approximations, but indicate only the quantity of timber totally destroyed. There was no way of knowing whether the timbering in a single continuous section of shaft had been destroyed or whether partial destruction had occurred throughout a greater length of shaft. Balancing these several considerations, the writer expressed the opinion that not more than a thousand feet of shaft timbering had been involved and that consequently the 4,200-ft. station would be found intact. Subsequent explorations have shown that the shaft was not burned below the 3,700-ft. level, and it seems likely that the estimate will prove to be approximately correct.

The Value of Gas Analyses

As the events at the Argonaut were followed from day to day one was repeatedly impressed with the fact that the analyses and other observations of the gas stream coming up the return airway furnished the only means of judging what was going on in the fire zone. These observations not only showed that the fire had been placed under control by the bulkheads but also that it was being slowly extinguished. In this case the story told by the gas work is a relatively simple one. During the previous fire at the Argonaut in 1919 a somewhat similar program of gas sampling was carried out and on several occasions variations in the gas composition gave notice of occurrences underground which required immediate attention.

It is possible that the utility of the systematic determination of gas composition, gas volume, etc., in connection with mining operations has not been fully appreciated. Seepages of methane occur in certain formations and there are several cases on record where explosive mixtures of this gas with air have been formed in underground workings in California. Warning of such seepages might be obtained by analysis of the return air before dangerous quantities have collected. In a similar way, the influx of air high in carbon dioxide from old workings, due perhaps to movement of the ground or failure of an old bulkhead, might be detected. The underlying consideration is that an examination of the return air may yield information in regard to an occurrence at a remote point, thus giving notice of a condition which requires attention.

The New Chemical Element, Hafnium

In *Chemistry and Industry* for Jan. 26, we read of the discovery by Professors Coster and Hevesy, of Copenhagen, of a new element, called hafnium, after Hafniae, an ancient name for Copenhagen. The new element is homologous to zirconium and is apparently present in specimens of zirconium minerals to the extent of about 1 per cent. It has been discovered by means of its X-ray spectrum, and the method will in all probability be applied to advantage in the discovery of other elements.

For some years past the University of Copenhagen has made valuable contributions in the department of both physics and chemistry. The theories of Professor Bohr as to the structure of the atom and the calculations he has made of the orbits of the revolving electrons have gained recognition and have assisted in solving the difficulties of the emission of ordinary bright-line spectra. The output of accurate determination of X-ray spectra by Professors Hjalmar and Coster and others has been considerable, and a complete survey of this interesting field of research is now being undertaken. The Scandinavian men of science seem to abound in genius as do their minerals in elements!

What Happens During Fermentation?

Some Recent Developments Which Have Given Us a Better Insight Into Various Biochemical Processes of Industrial Importance

BY F. F. NORD
Doktor Ingenieur, Berlin

THE fermentation industries stand foremost in importance among the technical consumers of agricultural products. Tremendous quantities of alcohol, lactic acid, butanol, acetic acid and other chemical materials are prepared from carbohydrates with the help of micro-organisms. Although we are intimately acquainted with these final products and with the raw materials from which they are obtained, we have only begun the research which, with the aid of organic chemistry, will penetrate into the real nature of these reactions.

This work has, however, already led to significant and important results. Among the more recent developments I need mention here only the discovery of the pyroracemic acid fermentation and the sugar-free fermentations and the new theory of alcoholic fermentation arising from these discoveries. This work has led to supplementing Gay-Lussac's classic fermentation formula of 1810

$$C_6H_{12}O_6 = 2C_2H_6O + 2CO_2$$

by the two new equations:

$$C_6H_{12}O_6 = CH_3CHO + CO_2 + C_3H_8O_3$$

$$2C_6H_{12}O_6 + H_2O = CH_3COOH + C_2H_5OH + 2C_3H_8O_3 + 2CO_2$$

Expressed otherwise, it may be said that sugar is split up into acetaldehyde, glycerine and carbonic acid as well as transformed into alcohol, acetic acid, glycerine and carbonic acid.

THE INTERMEDIARY STAGE

From fermentation practice we know that one molecule of sugar yields two molecules of ethyl alcohol and two molecules of carbonic acid without so much as the slightest indication of either C_2H_5— or CO_2— groups existing in the sugar. This is a typical example of a reaction which is possible only by passing through intermediary stages. This view is not a novel one. It has obtained for 30 years and yet search for these intermediary stages was unsuccessful until the fermentability of pyroracemic acid was definitely established.

This study is bound up with that of the activity of the enzyme *carboxylase*, contained in the complex *zymase* that splits the sugar into alcohol and carbonic acid.

Pyroracemic acid, which might potentially be present in grape sugar and in other fermentable carbohydrates, is split into acetaldehyde and carbonic acid according to the following simple equation:

$$CH_3COCOOH = CH_3COH + CO_2$$

TABLE I—RELATION OF SODIUM SULPHITE CONTENT TO GLYCERINE YIELD

Proportion of Sodium Sulphite to Sugar (Per Cent)	Yield of Glycerine in Per Cent of Theoretical
40	23.1
67	24.8
80	27.3
100	30.1
120	33
150	34.6
200	36.7

Here then we have bodies in which carboxyl and ethyl remnants are found and how they came into existence is no longer a subject for speculation, but can be demonstrated experimentally. The facility with which pyroracemic acid yields to this characteristic division into acetaldehyde and carbonic acid makes it immaterial biologically whether, in fermentation processes, acetaldehyde and carbonic acid as such are assigned their function, or whether it be in the form of their union as pyroracemic acid.

COMMERCIAL PRODUCTION OF GLYCERINE

Outstanding among the practical achievements in the fermentation field is the commercial production of glycerine in Germany by Connstein and Ludecke. The great dearth of glycerine among the Central Powers (following the cutting off of imports of fats and oils) and the demand for military purposes prompted the theoretical researches which eventually led to this process.

Sugar was available as a raw material and accordingly every effort was concentrated on its fermentation. Previously this had been conducted only in neutral or faintly acid solution. Knowledge of the facile formation of acetaldehyde which has previously been referred to, and the work of Bunte and later of Kerp on sodium acetaldehyde sulphite, suggested the possibility that by successfully removing the acetaldehyde in the form of that compound

$$CH_3CHO + Na_2SO_3 + H_2O = CH_3CHOH.SO_3Na + NaOH$$

some glycerine might be formed provided suitable conditions for the fermentation were maintained. In the first experiments a number of compounds of alkaline reaction were used such as disodium phosphate, sodium carbonate, sodium acetate and sodium bicarbonate. However, these gave rise to the growth of a great many lactic-acid bacteria, which, while flourishing in the alkaline nutrient medium, not only consumed large quantities of sugar but also were the cause of an impurity which was difficult to remove from the resulting glycerine.

The alkaline salts were next replaced by disodium sulphite. This salt, when added to the mash even in very considerable quantities, does not inhibit fermentative action of the yeast and in addition is a valuable antiseptic.

The manner in which the yields of glycerine increase with increasing amounts of this salt may be observed from the figures in Table I.

It is of significance to note that during the war the monthly production of glycerine by this method exceeded 2,000,000 lb. and the yield was 20 to 25 per cent.

THE THEORY EXPLAINED

With such commercial results attained, fresh impetus was given to attempts at the theoretical explanation of the reactions involved. The way was shown by C. Neuberg and E. Reinfurth, who in their very extensive investigations proved that the secondary sulphites enter into a very loose combination with sugar which in aqueous solution undergoes almost complete dissociation. The resulting sulphite complexes with aldehydes are more stable, especially the sulphite-acetaldehyde combination. With any amount of sulphite employed, the quantities of acetaldehyde and glycerine produced are found to be in relation of 1:1 mol. As regards

the participation of the sulphite, the ideal fermentation equation now becomes (where M = alkali metal)

$$C_6H_{12}O_6 + M_2SO_3 + H_2O = CH_3CHOH.OSO_2M + MHCO_3 + C_2H_5O_3$$

The generation of acetaldehyde and glycerine may be said then to be represented by the following reactions:

$$C_6H_{12}O_6 + 2H_2O = C_6H_8O_4 \text{ (methylglyoxal-aldol)}$$
$$C_6H_8O_4 = 2CH_3COHCOH = 2CH_3COCOH \text{ (methylglyoxal)}$$
$$2CH_3COHCOH + 2H_2O = CH_2OHCHOHCH_2OH \text{ (glycerine)} + CH_3COCOOH \text{ (pyroracemic acid)}$$
$$CH_3COCOOH = CO_2 + CH_3COH \text{ (acetaldehyde)}$$
$$CH_3COCOH + CH_3COH + H_2O = CH_3COCOOH + C_2H_5OH$$

In normal alcoholic fermentation the final phase means a reduction of acetaldehyde to ethyl alcohol. By fixing the acetaldyhyde in the form of a sulphite complex ($CH_3CHOHOSO_2M$) it is withdrawn from the final phase of hydrogenation and inasmuch as free hydrogen is not being generated, another reduction product, glycerine, is formed in equivalent amount. The more sulphite present the more acetaldehyde is held and consequently the more glycerine can be produced.

In studying these reactions one is impressed with the strategic position held by the pyroracemic acid and by acetaldehyde. The whole series of equations is based on the assumption that initially two molecules of water are split off to form methylglyoxal—the first product with three atoms of carbon in the molecule. All further rearrangements amount to repeated transformations of methylglyoxal in conformance with the Cannizzaro reaction. In the first, pyroracemic acid is formed, and, taking up water, glycerine.

The pyroracemic acid having been dissociated into carbonic acid and acetaldehyde through the action of the enzyme carboxylase, acetaldehyde is present for the second reaction with methylglyoxal (also an aldehyde). After the single Cannizzaro reaction had been confirmed through a number of observations and the succeeding internal rearrangements established biochemically, it stood to reason that this reaction represented a step in the intermediary processes of alcoholic fermentation.

The question now arose as to whether the mixed transformations between simple aldehydes, such as are set forth in the preceding equations, could actually be effected. The author put the question to experimental proof and obtained an affirmative answer. He succeeded in bringing about this transformation between two aliphatic aldehydes and also between one aromatic and one aliphatic component. This was accomplished by employing a suitable catalyst, and a series of investigations completely confirmed this explanation.

Study of B. Coli Fermentation

With the successful use of disodium sulphite in yeast fermentation, a fresh impetus was given to investigations on the metabolic procedures in the case of other micro-organisms.

Nature offers in the widely occurring *B. coli* an instance of carbohydrate fermentation on a vast scale. This agency is not limited to the sugars proper, but is concerned with related substances as well—for instance, with mannite and glycerine.

It will be recalled that the yeasts are comparatively resistant to the alkaline sulphites, which, as we have seen in the case of glycerine, contribute to the mechanism of the reactions by assuming the rôle of a binding agent. In applying this principle in the case of bacteria, however, conditions were altered, in so far a the sulphite of an alkaline earth, such as calcium su phite (with a neutral reaction), was used instead o the secondary sulphites of sodium or potassium (o alkaline reaction).

Calcium sulphite offers advantages not only becaus of its neutral reaction but also because of the fac that, since it is insoluble in water, osmotic action harm ful to sensitive organisms is avoided. A disadvantage however, lies in diminished concentration of sulphite ion, although this may in a measure be overcome b agitation.

The rôle of acetaldehyde as a transition factor i fermenting dextrose and glycerine by means of *B. co* has been proved where the calcium sulphite modifica tion has been employed.

Here too acetaldehyde is formed (40 to 45 per cen of the corresponding amount of ethyl alcohol) plainl at the expense of the reactions

$$2C_6H_{12}O_6 + H_2O = 2CH_3CHOHCOOH + 2CO_2 + 2H_2 + CH_3COOH + C_2H_5OH$$
$$C_3H_8O_3 = HCOOH + C_2H_5OH$$

which in a normal coli fermentation result in th alcohol.

Similarly, acetaldehyde as an intermediate product i met with in other fermentation reactions such as thos responsible for putrefaction and also in the citric aci and fumaric acid fermentations.

All of the preceding fermentations by yeast or ba teria are of an anaërobic character. It should, there fore, be of interest to study the *modus operandi* in fermentation where atmospheric oxygen takes a par An example is the production of acetic acid, which i closely related to the different sugar fermentations. Thi is not only because many organisms will form acetic aci from carbohydrates, but also because in the aceti oxidation we see the alcohol, after certain organism had produced it from sugar, further transformed b means of another organism. And, too, the sulphit "blocking" of acetaldehyde in order to arrest the suga fermentation in an intermediary stage has also bee accomplished in the case of vinegar. From one-thir to three-fourths of the acetic acid formed by the rea tion could be removed in the form of acetaldehyd These results were obtained from extensive experime tal investigations with wine and vinegar bacteria, e pecially *B. ascendens* and *B. pasteurianum*.

In practical vinegar making traces of acetaldehyd not infrequently are found, especially in those case where by faulty operation there has been an accumul tion of alcohol with an insufficient air supply.

Butyric Acid and Alcohol Fermentation

The formation of acetaldehyde as an intermediate i butyric acid fermentation has been well proved. B using *B. butyricus Fitz* in the presence of disodiu sulphite, 11.8 per cent of the aldehyde has been show to have been formed. The acetaldehyde and its ald when acted upon by this bacillus yield ethyl alcohol an acetic acid instead of butyl alcohol and butyric aci Although the pyroracemic acid is fully utilized for su plying carbon, yet only traces of butyric acid are forme

The aldol of pyroracemic acid, the

α keto-γ-valerolactone-γ-carboxylic acid

$$\begin{array}{l} CH_3\text{—}C(OH)\text{—}COOH \\ \quad | \\ CH_2COCOOH \end{array}$$

(condensation product of two molecules of pyroracem

acid) yield considerable amounts of butyric acid when acted upon by the *B. butyricus Fitz.*

How pyroracemic acid functions as an intermediate product in this complex process is made apparent by the following reactions:

$$C_6H_{12}O_6 = 2CH_3COCOOH + 4H$$
$$2CH_3COCOOH = C_6H_8O_6 \text{ (aldolization)}$$
$$(a)\ C_6H_8O_6 = 2CO_2 + C_4H_8O_2 \text{ (butyric acid)}$$
$$(b)\ C_6H_8O_6 + 4H = 2CO_2 + H_2O + C_4H_{10}O$$
(butyl alcohol)

Thus it will be seen that acetaldehyde occupies a position of great biological importance.

It has been isolated from many different carbohydrate fermentations. There have been vague indications of the presence of aldehydes in physiological processes, but almost without exception evidence has been lacking as to the kind of aldehyde present. In cases where acetaldehyde has been definitely isolated its presence has been explained as a secondary oxidation of ethyl alcohol. It is well known that alcohol will form acetaldehyde under a number of circumstances, such as by contact with porous bodies, by exposure to light and by various metallic surfaces in presence of air. Such qualitative traces as were noted in normal fermentations were explained also as secondary oxidation of alcohol. However, this would not account for such amounts as are indicated in the sulphite fermentation—viz., 75 per cent of the alcohol present.

Volume Changes During Hardening

In the course of the investigations conducted by Howard Scott at the Bureau of Standards for the gage steel committee, an attempt was made to locate the principal source of distortion during hardening. Gage specimens made of a high-nickel steel, containing 0.11 C, 0.89 Mn, 0.19 Si and 31.0 Ni (which has no hardening transformation), were quenched in water from 800 deg. C. and the following changes noted:

	Length	Diameter (In × 10^{-3})		
No	(In × 10^{-3})	Left	Center	Right
I 21	—0 08	-0 16	0 14	-0 14
I 22	—0 11	-0 33	0 43	-0 46

I 21 was silver plated and I 22 unprotected, so it was necessary to pickle the latter specimen, which circumstance probably accounts for the greater decrease in size. The changes are, however, very small, perhaps within the limits of reproducibility, so the effective changes must be associated with the true hardening transformation called by Scott Ar″.

The hardening transformation occurs in tool steels at a temperature below 300 deg. C. and is sometimes not complete at ordinary temperatures. It involves a considerable change in volume of the steel and this suggests that the dimensional changes may be controlled by the rate of cooling through this range. An increase in volume cannot be avoided if high hardness is desired, so the problem of dimensional changes resolves itself into the problem of producing uniform dimensional changes in all directions. Two obvious courses are open for accomplishing this; either to use a deep hardening steel and cool slowly through the hardening transformation, thereby permitting it to progress uniformly through the whole mass, or to harden only the surface layers of the steel. The latter expedient introduces a variable which is very difficult to control.

A chromium-bearing steel containing 1.00 per cent carbon and 1.34 per cent chromium is much used for gages, and experiments were made as outlined in the following table:

Quenching Temperature, Deg C	Nature of Bath	Temperature of Bath, Deg. C.	Change in Length In. × 10^{-3}
825	Oil	130 to 90*	2 05
840	Oil	23	4.48
840	Liquid Air		6 22
830	Oil	140	5.47
840	Oil	140	8 27
800	Water	23	15 65

*Taking 2 hours

To reveal distortion, the change in length is calculated from the change in specific volume, giving the total length change for uniform change in all directions. Differences between these values and the values for length change are then a measure of distortion. The distortion for water quenching is very marked, the actual length change being more than twice the computed change. There is, however, little distortion on oil hardening, though cooling rapidly from the oil quenching bath at 140 deg. C. appears to cause greater distortion than cooling slowly from that temperature.

The conclusion should not be drawn, because the oil-quenched specimens show less distortion than the water-quenched specimens on hardening, that they will necessarily show less dimensional change with time. In fact, from the indications so far, the opposite appears to be true—i.e., that the water-quenched specimens change less with time.

The volume change is about 0 5 per cent for water quenching and probably represents the maximum for full hardening. Certain of the oil-quenched specimens show as great a volume change as this, but it is doubtful whether the hardening has penetrated to the center. 1¼-in. diameter specimens of this chromium steel quenched in oil from 1,000 deg. C. show only a surface layer of martensite, but penetration to the center on water quenching.

Oil quenching evidently produces little distortion, but that it gives maximum hardness is open to question. None of the specimens listed in the table showed full file hardness, while those quenched in oil from 800 deg. C. were distinctly soft and probably not martensitic even on the surface.

Fertilizer Industry Consumes the Largest Quantity of Sulphuric Acid

Eliminating the amount of sulphuric acid used for munitions and allowing about 200,000 tons for peacetime explosives, an indicated requirement of 5,010,000 tons for normal peace industries is arrived at. The normal amount of sulphuric acid used for explosives would thus be less than the quantity used in the metallurgical industry, including the manufacture of storage batteries, but more than the quantity used for paints, lithopone and glue. Fertilizers head the list as taking the largest quantity. However, the need for so much acid in the summer of 1918 operated to reduce the amounts used for other purposes, for pre-war consumption in the manufacture of phosphate fertilizer was about 2,300,000 tons a year and it has since grown to more than 2,500,000 tons, or over half the total. Moreover, it is to be noted that ammonium sulphate, and probably other products classified with "chemicals, drugs and ammonium sulphate," are themselves used for fertilizers or to make fertilizers, so that without doubt the fertilizer industry is normally by far the greatest user of sulphuric acid.

Structure of Chromium-Nickel Steel

BY H. B. PULSIFER AND O. V. GREENE
Assistant Professor Metallurgy, Lehigh University, and Metallurgist, Philadelphia & Reading R R Co

A Series of Micrographs Fail to Show Any Change in Structure in Quenched Cr:Ni Steel After Various Draws, Despite Large Differences in Physical Properties — Precautions Needed in Etching and Photographing

WE had available a series of 1-in. round bars manufactured in the basic open-hearth by the Bethlehem Steel Co., of the following analysis:

	Chromium-Nickel S.A.E. 3240	Chromium-Molybdenum
Carbon	0.38	0.46
Manganese	0.52	0.72
Phosphorus	0.018	0.028
Sulphur	0.031	0.031
Silicon	0.20	0.23
Chromium	1.08	1.07
Nickel	1.87	.....
Molybdenum		0.35

Physical properties after a variety of heat-treatments had been studied in a graduation thesis by former students, and found to be very similar to those given for similar material by H. J. French in *Metallurgical & Chemical Engineering* of Oct. 15, 1917, and in the Society of Automotive Engineers' Handbook. The chromium-molybdenum material is distinctly superior to the chromium-nickel.

Both steels were normalized by heating to 1,600 deg. F. during 16 hours, soaking 8 hours, and slow cooling. Preliminary fracture tests of quenched pieces heated to every 50 deg. interval from 1,400 to 1,600 deg. F. indicated 1,500 deg. as giving the finest grain and the smoothest fracture.

The test pieces were cut in 5-in. lengths; eight specimens were quenched in oil and eight were quenched in water after holding at 1,500 deg. F. for an hour. The pieces of each series were then drawn at 100 deg. intervals from 600 to 1,300 deg. F.

Preliminary examination at 100 diameters for structure was made after the usual brief etching with stock picric acid solution. These showed a martensitic structure with the grain boundaries imperfectly disclosed. (Fig. 6.) Archer's method[1]—etching in freshly prepared 4 per cent picric acid in ethyl alcohol for several minutes, and then rubbing off the carbonaceous smudge on moist broadcloth—was then used by Mr. Greene and each specimen was photographed at a thousand diameters magnification. The conspicuous development of the cellular structure requires several minutes immersion in the picric acid solution and either a too brief or a too long period fails to give the network clearly. The cellular texture is always present in the chromium-nickel series; we find in chromium-molybdenum steels it is more difficult to get the network sharply and it is also obscured by an apparent change of the martensitic stock to troostite about the grain boundaries.

The microscopic structure of the chromium-nickel samples appears to be a uniform cellular martensite; this means that the martensite obtained by the quenching has not been changed microscopically by the tempering operation. It is well known that the tempering operation alters the physical properties enormously and the tempered specimens etch more easily as the temperature of the drawing is increased, but in this chromium-nickel series the microscopic appearance at 1,000 diameters magnification is not changed. There is no evidence that the cellular nature, or the grain structure, has been affected in the slightest. Fig. 1 is a typical print. We fail to find any noticeable difference in the ground-mass, the size of the grains or the width of the grain boundaries as the drawing temperature

[1]Archer, *Trans.*, A.I.M.E., vol. 62, p. 754 (1920).

FIG 1—Cr-Ni, OIL QUENCHED AND DRAWN TO 1,200 DEG. F.
1,000 dia. 12 min. etch. Leitz microscope. Cellular martensite.

FIG. 2—Cr-Mo, WATER QUENCHED AND DRAWN TO 1,300 DEG. F.
1,000 dia. 5 min. etch. Pellin-Zeiss microscope. Shows dark troostite appearing in spots.

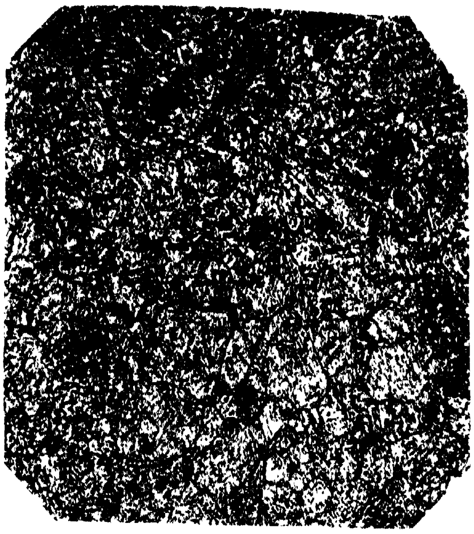


FIG. 3—Cr-Ni, WATER QUENCHED AND DRAWN TO 1,000 DEG. F.

250 dia. 15 min. etch. Pellin-Zeiss microscope. Cellular martensite.

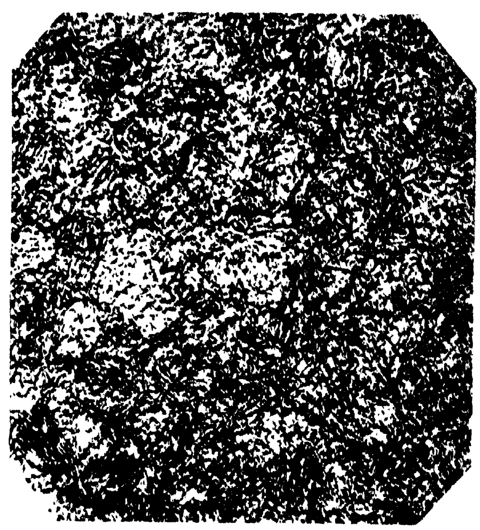


FIG. 4—Cr-Ni, OIL QUENCHED AND DRAWN TO 1,100 DEG. F.

500 dia. 11 min. etch. Pellin-Zeiss microscope. Cellular martensite.

has been raised. Since the physical and chemical properties have changed very greatly, we must infer that the atomic readjustments caused by the heating are submicroscopic.

We doubt if there is any component which could be called troostite in this series, even at draws as high as 1,300 deg. F. Thus Seidell and Horvitz[4] give a print of a very similar structure and call the ground-mass martensite "surrounded by troostite envelopes." If the grains were bounded by troostite, or if troostite began to form at the lower drawing temperature, the amount of that component should increase with the temperature of drawing.

In the chromium-molybdenum steel there is much more evidence of the formation of troostite. The two specimens drawn at 1,300 deg. F. after quenching in oil and water respectively show considerable amounts of a second component (Fig. 2). This second component etches out dark in the picric acid solution, its granules are extremely fine and it likely corresponds to the troostite of the simple carbon series.

Prolonged efforts were made to develop the cellular structure of the chromium-molybdenum stock as completely as was done with the chromium-nickel material. Although traces of units were always apparent and individual grains could easily be known from the arrangement of the striations, no particular success was obtained. Fig. 2 is characteristic of the general results in this respect. Possibly the suppression of the definite grain outlines of each particle has its physical expression in the enhanced strength of the steel[5].

Fig. 3 is a 250-diameter print from the water quench chromium-nickel bar drawn to 1,000 deg. F. This bar had a very perfect cellular texture, so that pictures were more easily obtained than from any other specimen.

[4]Seidell and Horvitz, "Physical Qualities of High-Chrome Steel." *Iron Age*, Jan 30, 1919.

[5]Elastic limit and ultimate strength for the quenched Cr:Ni steel, tempered at 1,300 deg. F., are 70,000 and 110,000 lb. per sq in., but 80,000 and 120,000 for the Cr:Mo steel.

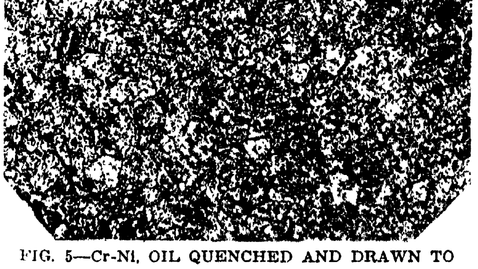


FIG. 5—Cr-Ni, OIL QUENCHED AND DRAWN TO 1,300 DEG. F.

100 dia. 8 min. etch. Pellin-Zeiss microscope. Cellular martensite.

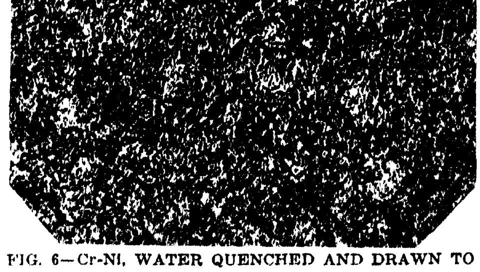


FIG. 6—Cr-Ni, WATER QUENCHED AND DRAWN TO 1,100 DEG. F.

Short etch with stock solution. 100 dia. Pellin-Zeiss microscope. Martensite grains imperfectly disclosed.

Fig. 4 is a 500-diameter print from the oil quench drawn to 1,100 deg. F. The grains appear less sharply defined, while there is slight evidence of any alteration of the martensite.

Fig. 5 is from a series of chromium-nickel specimens drawn to 900, 1,100, 1,200 and 1,300 deg. respectively. The fine-grained nature of all the stock is apparent from this print at 100 diameters; although the grain boundaries are sharp and distinct, it must be remembered that either a shorter or longer time in the etching than the optimum would leave the grains very indistinct. As evidence of how uniform the martensite is in the chromium-nickel series and to show the results of a brief picric acid etch we give Fig. 6 from the preliminary work. A casual inspection reveals that separate grains are present in the picture, but it is equally obvious that for sharpness or clean-cut delineation such etching cannot compare with that given in Figs. 1 to 5.

A final word may be offered as to pitting and tarnishing of the specimens during the etching, drying and photographing. The material is very prone to become pitted; round pit marks are only too conspicuous in Fig. 5. Only sharp and prompt work will keep them subordinated; it may often be necessary to repeat the final polishing and etching. Tarnishing is even more serious and difficult to overcome than the pitting. If any of the specimens stand exposed in the open air or even in a dessicator alteration of the surface begins quickly and spreads rapidly along the grain borders. The corrosion caused by exposure to air resembles a change to troostite; on this account all the specimens were photographed immediately after the polishing and etching. Specimens were resurfaced in case a photograph had to be repeated the next day.

It might be proposed that the extent of the tarnish might be used as an indication of a change from martensite to troostite, we do not doubt that the changes produced by the tempering have strongly altered some deep-seated forces in the chromium-nickel steel, and even the microscopic structure of the chromium-molybdenum steel, but it would be impossible to admit that a progressive tarnishing could define a structural constituent.

Patents and the Problem of Priority

An interesting aspect of the question of priority, reported in the Feb. 1 issue of *India Rubber World*, presented itself in the suit of the Dovan Chemical Co., Inc., plaintiff, against the National Aniline & Chemical Co., defendant. Judge Manton, in the United States District Court for the Southern District of New York, rendered decision in favor of the plaintiff, proclaiming that earlier and inadequate experiments should not be permitted to deprive the successful inventor of his due and just reward. The patent under discussion (No. 1,411,231) was applied for Nov. 12, 1921, and was granted March 28, 1922. It represents a method of improving rubber compounds so that the finished product shall be of superior quality and the time required for vulcanization be greatly lessened. The inventor of this process, Morris L. Weiss, has discovered that diphenyl guanidine not only hastens the vulcanization but results in a final product greatly improved in texture, durability and aging qualities to a much greater extent than when triphenyl guanidine is used.

The use of diphenyl guanidine results in greater elasticity and freedom from bloom. Moreover, it is also very valuable where it is desired to produce a harder or less elastic portion in an article, leaving other parts more elastic and flexible, as in the case of automobile tires.

The defendant, however, urged that others prior to Weiss have tested diphenyl guanidine as an accelerator. At a meeting of the Chemical Society of Philadelphia, in September, 1919, George D. Kratz read a paper in which diphenyl guanidine was referred to as an accelerator. It cannot be claimed, however, that a mere reading of the paper before this society constitutes a statutory publication. Later, in 1920, there appeared in the *Journal of Industrial and Engineering Chemistry* a complete publication by Kratz and others. Although this was previous to the filing of an application by Weiss, it has been shown that the Weiss tests recorded in the spring of 1918 were previous to the reading of the Kratz paper. A careful examination of these tests proves that Weiss was the first to make adequate experiments and to solve the problem of producing diphenyl guanidine in commercial form. Kratz, on the other hand, claims to have made laboratory tests and later to have mixed 30 grams of diphenyl guanidine with rubber stock made into tubes for automobiles. These tubes were sold as imperfect rubber. The amount of acceleration used, however, could have had no substantial effect in the curing of the rubber, as compared with that used in the plaintiff's process, and an invention, to be patentable, should be complete and capable of producing new and useful results.

Utilizing the Waste of Grape Fruit Factories

There is a possibility of the practical and profitable commercial utilization of the stems and pomace from the grape juice factories which are thrown away. The average quantity of grapes crushed for beverage purposes in the 5 years from 1914 to 1918 was 22,000 tons. In this period an average of 660 tons of stems and 4,400 tons of wet pomace was discarded. From this quantity of waste it is claimed that, where the stems yield 2 per cent of cream of tartar, it is possible to secure 13.2 tons of this material.

After the seeds are separated the pomace can be made into a good grade of jelly by a simple process. Experts have calculated that 3,300 tons of wet skins would be available annually from the wet pomace, and it is estimated that this amount of waste would produce 19,800,000 8-oz. glasses of jelly. From this operation about 1,435 tons of dry residue would result which is of value as stock feed.

The grape seeds, comprising 5 per cent of the total weight of fresh grapes, or about 1,100 tons, can, after hulling and grinding, be manufactured into oil by two different methods known commercially as the pressure method and the solvent extraction method. The total oil content of the seeds is estimated at 13 per cent, not all of which can be successfully recovered. It is estimated that by means of the pressure method about 89.3 tons of oil and 526.7 tons of oil cake can be obtained. The 484 tons of hulls made available by this process is calculated to yield 48.4 tons of tannin extract. The solvent extraction method yields about 132 tons of oil with 968 tons of meal possessing a lower market value than the press cake from the pressure method. Refining, bleaching and deodorizing of the oil produce a palatable condimental oil with properties similar to those of the soy bean and cottonseed oil.

Pyruvic Acid From Lactic Acid

Significance of This Problem in Electrolytic Oxidization Is Discussed and Elucidated

BY J. G. SMULL AND P. SUBKOW
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THE oxidation of lactic acid by purely chemical methods, not electrolytic, can be controlled so as to yield pyruvic acid, as represented by the equation

$$CH_3CH(OH)COOH + O = CH_3COCOOH + H_2O$$

This can be accomplished either with[1] $KMnO_4$ or with H_2O_2, using $Fe_2(SO_4)_3$ as an oxygen carrier. The pyruvic acid may be further oxidized by H_2O_2 with or without a catalyst,[2] with the formation of acetaldehyde and carbonic acid. The oxidation of lactic acid by electrolytic means has been shown to proceed in the following stages:[3]

$$2CH_3CH(OH)COO^- + 2(+) = CH_3CHO + CO_2 + CH_3CH(OH)COOH$$

$$CH_3CH(OH)COOH + O = CH_3CHO + CO_2 + H_2O$$

Rockwell[4] has found that in the electrolytic oxidation of pyruvic acid, acetaldehyde and CO_2 are the final products of the reaction.

It was decided to investigate more thoroughly the electrolytic oxidation of lactic acid to see whether its transformation to pyruvic acid could be accomplished. Ordinary electrolytic oxidation of lactic acid proceeds mainly with the formation of acetaldehyde, formic and acetic acids, together with a large amount of CO_2. The authors found that in acid solutions the aldehyde is oxidized to acetic acid, and in alkaline solutions to formic acid, corroborating the work of Heimrod and Leven.[5] In both acid and alkaline solutions a large amount of CO_2 is liberated. It was found in our experiments that if certain precautions were taken to remove any pyruvic acid formed from the sphere of oxidation, the latter acid can be prepared electrolytically.

The cell employed in these tests was composed of anode and cathode compartments separated by a semi-permeable diaphragm, consisting of an ordinary porous cup. Arrangements were made for cooling and for stirring the anode portion. In all but the last experiment the electrodes were of platinum. In the last experiment a perforated lead sheet was used as the anode and an iron gauze as the cathode. The anolyte was stirred vigorously in order that the electrolyte at the anode be not impoverished during the oxidation.

OXIDATION IN ACID SOLUTION

Anolyte—75 cc. consisting of 27 per cent lactic acid; 20 per cent sulphuric acid; platinum anode, 75 sq.cm.; anode current density, 0.04 amp. per sq.cm.

Catholyte—20 per cent sulphuric acid; platinum wire cathode.

The current was passed until theoretically one-half of the lactic acid should have been oxidized to pyruvic acid. The object was to keep the former in excess so as to favor its oxidation in preference to that of the reaction products. The depolarization was extremely poor and the current density had to be reduced to 0.0133 amp. per sq.cm. The oxidation proceeds with the formation of acetic acid and CO_2. No pyruvic acid was detected.

OXIDATION IN NEUTRAL SOLUTION

It was thought that if some soluble salt of lactic acid were used, insoluble when converted into the corresponding pyruvic acid salt, it might be possible to remove any pyruvic acid formed from the sphere of oxidation. Copper lactate is soluble six parts in one hundred parts of water. The copper pyruvate is insoluble. Otherwise it was believed that because of the vigor of the oxidation any pyruvic acid formed was burned to CO_2. The copper lactate was obtained by treating lactic acid with an excess of basic copper carbonate and filtering off the residue.

Anolyte—350 cc. of copper lactate, 6 parts in 100 cc.; enough $Cu(NO_3)_2$ was added to raise the copper concentration to 20 per cent; platinum anode, 150 sq.cm.; anode current density 0.04 amp. per sq.cm.; complete depolarization.

Catholyte—The catholyte contained 20 per cent copper as copper nitrate; platinum wire cathode.

The current was run long enough to oxidize theoretically one-half of the lactic acid to pyruvic acid. The copper concentration in the anolyte was kept high so that the copper lactate was not impoverished, in copper, during electrolysis. The oxidation products were acetaldehyde, acetic acid, formic acid and CO_2. An insoluble precipitate was obtained. This was filtered off, washed with water and dissolved in ammonia. The solution was made acid with acetic acid and phenylhydrazine added. The characteristic precipitate of the phenyl-hydrazine of pyruvic acid was obtained. Due to the slight solubility of copper lactate, the current efficiency was low. The oxidation of the lactic acid to CO_2 by the strong evolution of oxygen accounts for the complete depolarization noted.

OXIDATION IN ALKALINE SOLUTION

1. With insoluble anode:

Anolyte—125 cc. of 40 per cent sodium lactate solution containing 6 grams sodium hydroxide; platinum anode, 150 sq.cm.; anode current density 0.0133 amp. per sq.cm.; complete depolarization.

Catholyte—A 6 per cent solution of sodium hydroxide.

The current was passed long enough to oxidize theoretically one-half of the lactic acid to pyruvic acid. The concentration of sodium hydroxide in the anolyte was constantly diminished, due to electrolysis and to neutralization by the CO_2 liberated in the oxidation. The hydroxide concentration in the anolyte was maintained during the process by addition of caustic soda solution from time to time. The depolarization was complete. The oxidation proceeds, mainly, with the formation of acetaldehyde, formic acid and CO_2. No pyruvic acid was detected.

2. With attackable anode:

The use of platinum anodes which have a high oxygen overpotential insures an extremely vigorous oxidation. It was thought that a more mild oxidation might result in a greater yield of pyruvic acid. Lead is at the other end of the electromotive series from platinum with respect to its oxygen overpotential. For the same current density, the lead would give a very much milder

NOTE: The authors wish to acknowledge their indebtedness to the Callender-Carnell Fellowship in Chemistry which made this investigation possible.

[1] Beilstein and Wiegand, *Ber. der Deutsch. Ch. Gesell*, 1884, vol. 17, p. 840.

[2] Fenton and Jones, *J. Chem. Soc.*, 1900, vol. 77, pp. 70-71.

[3] Kolbe, *Liebig Annalen*, 1860, vol. 113, p. 244. Miller and Hober, *Ber. der Deutsch. Ch. Gesell.*, 1894, vol. 27, p. 468. Walker, *J. Chem. Soc.*, 1896, vol. 69, p. 1278.

[4] Rockwell, *J. Chem. Soc.*, 1902, vol. 24, p. 719.

[5] Heimrod and Leven, *Ber. der Deustch. Ch. Gesell.*, 1908, vol. 41, p. 4446.

oxidation.[6] The lead is oxidized to PbO, which is dissolved by sodium hydroxide. This oxidation would further reduce the oxygen concentration at the anode and thus reduce the vigor of oxidation. Lead is made more useful, since, though lead pyruvate is soluble in water, it was found that it is converted on standing into a basic salt, insoluble in water or acetic acid. This hydrolysis would be facilitated by an alkali, and thus insure the removal of the pyruvic acid from the zone of oxidation.

Anolyte—27 per cent sodium lactate solution made alkaline with sodium hydroxide; perforated lead anode; anode current density 0.0074 amp. per sq.cm.

Catholyte—A 6 per cent sodium hydroxide solution; iron wire gauze cathode.

The depolarization in this experiment was complete. The current was passed until the lead was entirely corroded. This happened when only one-quarter of the lactic acid could have been theoretically oxidized. The lead was converted into $PbCO_3$ which analyzed 74.3 per cent Pb. The current efficiency of corrosion was about 95 per cent.

The lead carbonate was washed clean, decomposed with acetic acid and the insoluble residue treated with strong caustic soda in which it was soluble. The solution was made acid with acetic acid and gave the test for pyruvic acid with phenyl-hydrazine.

The anolyte after filtering contained no acetaldehyde. On extraction with ether no acetaldehyde ammonia could be detected when NH_3 was passed through the cooled ether solution. Upon evaporation of the ether a reddish resin of the type formed by the polymerization of acetaldehyde in alkaline solution was obtained. Acetic and formic acids were found. The anolyte no doubt contained some pyruvic acid due to the solution of some of the basic lead pyruvate in the alkali. An attempt to remove the pyruvic acid by acidification with acetic acid and steam distillation gave uncertain results, with the phenyl-hydrazine test.

Importance of Process

It has been shown[7] that the simultaneous electrolysis of the alkali salts of pyruvic acid and other fatty acids yields higher ketones, in satisfactory amounts. The technical importance of the higher ketones as organic solvents has long been appreciated. However, the commercial significance of the above electrolysis depends on a cheap source of pyruvic acid.

Another use for pyruvic acid is found in the synthesis of "atophan," or as it is sometimes called, "cincophan," one of the most important remedies for rheumatism. "Atophan" is a condensation product of pyruvic acid, benzaldehyde and aniline. The cost of pyruvic acid, made by the present method of the dry distillation of tartaric acid, is one of the large items in the cost of this pharmaceutical.

The above considerations make a source of relatively cheap pyruvic acid of prime importance. The present supply of lactic acid, at a low cost, increases its interest as an intermediate in the preparation of pyruvic acid. With this view in mind, this investigation was begun. The results included in this paper are given only as preliminary, indicating that pyruvic acid can be obtained by an electrolytic oxidation of lactic acid, the yields being dependent upon careful control.

Summary

1. The electrolytic oxidation of lactic acid in acid, neutral and alkaline solutions has been studied. In the latter case both soluble and insoluble anodes were used.

2. It was found that if care is taken to remove any pyruvic acid formed from the sphere of oxidation as an insoluble salt or if care is taken that the oxidation is kept mild, or, better, if both conditions are combined, pyruvic acid is obtained.

[6] Coeh and Osaka, *Z anorg. Chem*, vol. 34, p 86, Russ, *Z. phys. Chem.*, 1903, vol. 44, p 641.

[7] Hofer, *Ber. Deutsch Chem Ges*, pp. 33, 650 (1900); Mayr, "Electrosynthese aliphatischer und Aromatischer Kentonverbindungen," Dissertation, Munchen Technische Hochschule (1904), and Rockwell, *J. Chem. Soc.*, vol. 24, p 719 (1902).

Properties and Tests of Tar Creosotes

Creosote is widely used as a preservative because of its chemical, physical and toxic properties. The literature on it, however, is widely distributed in technical periodicals, society proceedings and government reports. It is very fortunate, therefore, to have available a comprehensive résumé of the information in all this literature in the publication of the U. S. Department of Agriculture Bulletin 1036, entitled "Coal-Tar and Water-Gas Tar Creosotes: Their Properties and Methods of Testing," by Ernest Bateman, chemist of the Forest Products Laboratory.

This bulletin not only gives a most comprehensive, well-organized review of previous work, but also includes the first publication of the results of research which have been carried out for the purpose of obtaining a broader knowledge of the variations of creosote with different processes of manufacture.

The bulletin is divided into four parts. Part I includes the introduction, a description of tars, and an account of the manufacture of creosote. Part II is a presentation for the first time of the results of research by the author and his co-workers in the Forest Products Laboratory. Part III gives a summary of the chemical, physical and toxic properties of creosotes as a whole. Part IV is concerned entirely with methods of testing and specifications.

Copies of the bulletin can be obtained from the Government Printing Office, Washington, at 20 cents each.

Molding Sands

An investigation on molding sands, its reclamation and re-use, has been under way for some time under the active co-operation of a number of members of the American Foundrymen's Association. Standardization of tests for determining size, shape, cohesiveness, permeability, water content, thermal properties and analyses (including rational, chemical, mineralogical) are still under way and some of them are completed. The Ohio Brass Co. is making investigations for the use of clay in retaining bond strength in molding sand heaps. The Sivyer Steel Casting Co. of Milwaukee, is studying the effect of clay additions on the grain size of sand heaps. The American Steel Foundries Co. has reported on the method and equipment designed, which permits a recovery of about 70 per cent of refuse sand used in steel foundry work. Cost figures show that reclaimed sand costs about $1 per ton, against new sand at the plant at $2.65 to $3.85 a ton. The process involves cleaning the sand grains of adhering fused material, then separating by air currents the good sand from the bad material.

Fundamentals of Rectification

Methods of Operating Which Affect Limiting Composition of Binary Liquids

For Example, the Introduction of Liquid or Gaseous Compounds at Intermediate Levels

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UP TO this point in our discussion we have not considered the ways and means available for producing either the liquids descending or the vapors ascending in the column.

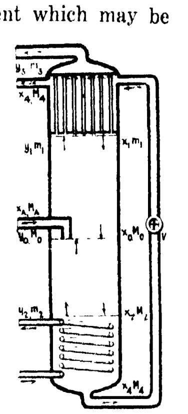
In the actual operation of a rectification system, particularly when we are dealing with a gaseous mixture which must be liquefied at a temperature much below atmospheric, it is of very great importance that the liquefaction be accomplished as far as possible by permitting the heat necessary to be abstracted to flow into the liquids to be evaporated.

One common method of providing both the liquid descending and the vapor ascending in the column is that of admitting the mixture, either liquid or gaseous, at an intermediate level and condensing directly in the upper regions thereof a portion of the ascending vapors and vaporizing directly in the lower regions thereof a portion of the descending liquid.

We shall later on show how this condensation and evaporation must be distributed along the length of the column in order to cause the relation between x and y at all levels to be that for phase equilibrium. Actually to accomplish this result exactly is always impracticable, however, on account of the impossibility of distributing in the required manner in the column the various coils required to furnish or abstract the heat necessary at the various levels. For this reason it is usual to concentrate the vaporizing or condensing effect in certain limited regions in the column by the use of condensers and vaporizers therein.

The arrangement and location of these parts of the apparatus is always a matter of the greatest importance, inasmuch as some possible arrangements may impose severe restrictions upon the compositions possible to be attained in the separated products.

An example of such an arrangement which may be considered with profit in the present connection, where liquid is supposed to be admitted at an intermediate point in the column, is the one illustrated.



In this case, we have a liquid of mass M_A, composition x_A, entering a rectification column at the top of which is a condenser formed of parallel vertical tubes through which the ascending vapor passes, being partly liquefied therein. This liquefaction is accomplished by surrounding said tubes with a liquid M_4 of composition x_4, constituted by the liquid leaving the vaporizer of the column after the pressure thereof has been lowered sufficiently in valve V to cause that condensation. The vapor ascending in the column is produced by evaporating at the bottom thereof a portion of the descending liquid M_2 by means of a coil therein. As before, x_0 is the composition of the liquid M_0, descending in the column at the level of admission of M_A, and we assume, furthermore, that the composition y_0 of the vapor m_0 ascending at this level is that for phase equilibrium with the liquid of composition x_0, if $x_0 > x_A$, or with those liquids combined if $x_0 < x_A$. As before, M_1 represents the liquid entering the top of the rectification column proper, in this case delivered by the tubes of the condenser, while m_1 represents the vapor of composition y_1 entering the tubes of said condenser.

Let m_3 be the mass of uncondensed vapor residue leaving the top of the condenser and y_3 its composition. Then with the arrangement shown in the figure, eleven equations may be written, all homogeneous in the nine (M, m)'s. Ten of these equations are as follows:

$$m_1 = m_3 + M_1$$
$$y_1m_1 = y_3m_3 + x_1M_1$$
$$m_0 + M_1 = m_1 + M_0$$
$$y_0m_0 + x_1M_1 = y_1m_1 + x_0m_0$$
$$J_0m_0 + I_1M_1 = J_1m_1 + I_0M_0$$
$$m_2 + M_A + M_0 = m_0 + M_2$$
$$y_2m_2 + x_AM_A + x_0M_0 = y_0m_0 + x_2M_2$$
$$J_2m_2 + I_AM_A + I_0M_0 = J_0m_0 + I_2M_2$$
$$M_2 = m_2 + M_4$$
$$x_2M_2 = y_2m_2 + x_4M_4$$

These ten equations hold independently of the method employed to accomplish the condensation in the tubes of the condenser and are true even were that condensation produced by the employment of an extraneous liquid surrounding the tubes of the condenser. If the liquid M_1 is produced in the condenser by thermal contact of the ascending vapors therein with the evaporating liquid M_4 as shown in the figure, an additional equation may be written which states that the heat abstracted from M_1 during condensation thereof equals the heat added to M_4 during the evaporation thereof after its pressure has been lowered in valve V.

The heat required to evaporate the liquid M_4 before the pressure thereof has been lowered in the valve V is L_4M_4, where L_4 is the latent heat at constant pressure of the liquid M_4 at the pressure in the rectification column proper. The result of this evaporation would be the fluid M_4 in a condition of saturated vapor at the pressure P_1 before passing through valve V. If this saturated vapor were then throttled in valve V, and if after throttling it were neither superheated nor partly liquefied—i.e., still saturated—it would be in the condition in which it is in the actual case as it leaves the condenser after being evaporated therein.

In that case, if L_1 denotes the latent heat at constant pressure of the liquid M_1 at the pressure P_1, our eleventh equation would be:

$$L_1M_1 = L_4M_4$$

since the total heat of M_4 remains constant during its passage through valve V.

If, however the saturated vapor M_4 at the pressure P_1

*The first three articles in this series were published in the issues of Jan. 31 and Feb. 7 and 14, 1923.

should be partly liquefied when its pressure is released to that prevailing around the tubes of the condenser, then the heat required to evaporate M_1 in the condenser is greater than L_1M_4, the latter being that required to evaporate the liquid M_4 at the higher pressure P_1, and our eleventh equation would be:

$$L_1M_1 = (L_4 + \Delta)M_1$$

where Δ is a quantity depending upon the change of the latent heat of the liquid M_1 when its pressure is *decreased under conditions of constant "total" heat. We shall therefore take our eleventh equation to be:*

$$M_1 = KM_4$$

where, with the arrangement shown in the figure,

$$K = \frac{L_1 + \Delta}{L_1}$$

If, however, the condensation of the liquid M_1 in the condenser be accomplished independently of the liquid M_4, K may be regarded as a quantity whose value is determined by the amount of that condensation.

Now, since we have eleven homogeneous equations among nine (M, m)'s, we may by elimination of all (M, m)'s obtain three independent equations not containing any (M, m).

These three equations are as follows:

$$J_1\frac{x_1 - y_3}{x_1 - y_1} - I_1\frac{y_1 - y_3}{x_1 - y_1} = J_0\frac{x_0 - y_3}{x_0 - y_0} - I_0\frac{y_0 - y_3}{x_0 - y_0}$$

$$\frac{y_1 - y_3}{x_1 - y_1} + K\frac{x_1 - y_1}{x_4 - x_1}$$

$$J_1 - I_1 + (J_1 - I_1)\frac{x_1 - y_1}{y_1 - y_3} = \frac{1}{K}$$

$$(J_2 - I_2)\frac{x_4 - x_2}{x_2 - y_2} + I_1 - I_2$$

We note that the first one of these relations must be satisfied independently of the value of K—that is to say, independently of the method employed to produce the condensation in the condenser.

This being true, we may assume that the mass of liquid M_1 produced in the condenser is the minimum possible amount for a given mass M_1, or what is the same thing, that the mass M_1 is the greatest possible for a given M_1. We have shown above that under these conditions, if we are dealing with a mixture having the property of proportionality latent heats, $x_1 = x_0$, and also that x_0 and y_0, and also x_1 and y_1, are compositions of liquid and vapor in phase equilibrium. In the particular case where $y_3 = 0$, the first of our three independent relations takes the form:

$$\frac{J_1x_1 - I_1y_1}{x_1 - y_1} = \frac{J_0x_0 - I_0y_0}{x_0 - y_0}$$

That is to say, if the points (x_1, y_1) and (x_0, y_0) on the x, y curve are not coincident, the function

$$\frac{Jx - Iy}{x - y}$$

must have the same value at the two points. For a mixture whose latent heat at constant pressure follows the proportionality relation as defined, the two points (x_1, y_1) and (x_0, y_0) necessarily coincide, whatever be the value of y_3. In that case, the first relation becomes:

$$L_1\frac{y_1 - y_3}{x_1 - y_1} = L_0\frac{y_0 - y_3}{x_0 - y_0}$$

where

$$L_1 = L_Bx_1 + L_A(1 - x_1)$$

and

$$L_0 = L_Bx_0 + L_A(1 - x_0)$$

But under these conditions,

$$\frac{y_0}{1 - y_0} = a\frac{x_0}{1 - x_0}$$

and

$$\frac{y_1}{1 - y_1} = a\frac{x_1}{1 - x_1}$$

Eliminating y_1 and y_0, the first relation becomes

$$(x_0 - x_1)[L_Bax_0x_1(1 - y_3) + L_A(1 - x_0)(1 - x_1)y_3] = 0$$

which in general can be true only if $x_0 = x_1$.

This result shows that in general the section of the column between the lower end of the condenser and the level of inlet of M_4 is inoperative and therefore the same result would be obtained if the liquid M_4 be admitted just below the condenser.

With the notation indicated in the figure below our system of equations then becomes:

$$m_1 = M_1 + m_3$$

$$y_1m_1 = x_1M_1 + y_3m_3$$

$$M_4 + M_1 + m_2 = M_2 + m_1$$

$$x_4M_4 + x_1M_1 + y_2m_2 = x_2M_2 + y_1m_1$$

$$I_4M_4 + I_1M_1 + J_2m_2 = I_2M_2 + J_1m_1$$

$$M_2 = m_2 + M_4$$

$$x_2M_2 = y_2m_2 + x_4M_4$$

$$M_1 = KM_4$$

This system of eight equations is homogeneous in the seven (M, m)'s and by elimination of all (M, m)'s, two independent equations may be obtained between the various (x, y, J, I)'s and K. These two equations are as follows:

$$\frac{y_1 - y_3}{x_1 - y_1} = K\frac{x_1 - y_1}{x_4 - x_1}$$

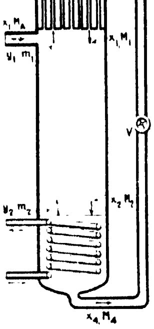
$$(J_1 - I_1)\frac{x_1 - y_3}{y_1 - y_3} = \frac{1}{K}(J_2 - I_2)\frac{x_4 - x_2}{x_2 - y_2} + I_1 - I_2$$

If we eliminate K from the second equation by means of the first equation, the second equation takes the form:

$$\frac{J_1(x_4 - x_1) - I_1(x_4 - y_1)}{x_1 - y_1} = \frac{J_2(x_4 - x_2) - I_2(x_4 - y_2)}{x_2 - y_2}$$

The value of x_4 as determined by the first equation is

$$x_4 = x_1 + K\frac{(x_1 - y_1)(x_1 - y_1)}{y_1 - y_3}$$



The equation shows that for given values of x_1 and y_3, x_4 is greatest when K is as great and y_1 is as small as possible. Whatever be the value of K, the minimum possible value of y_1 is that for phase equilibrium with the liquid of composition x_1, while for the arrangement as shown in the figure, the value of K is of the order of unity. Hence, under these conditions, the value of x_4 is limited and in general it will be impossible to make $y_3 = 0$ and $x_4 = 1$ together.

As an example, assume the mixture we are dealing with is of oxygen and nitrogen and let $x_1 = 0.21$. According to Baly's curves, $y_1 = 0.06$. Then if we assume that $y_3 = 0$ and $K = 1$, the maximum possible value of x_4 is

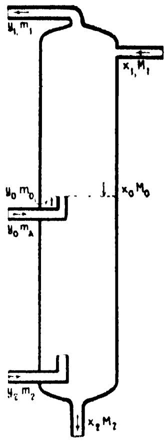
$$x_4 = 0.21\frac{(0.21)(0.15)}{0.06} = 0.73\tfrac{1}{2}$$

This limitation upon the composition of lower end product obtainable is present only in case the reflux liquid is produced in the manner exhibited in the figure and does not exist if we have available any desired amount of some extraneous liquid cold enough, when fed into the condenser, to cause condensation of the vapor m_1 as the latter ascends in the condenser tubes.

The example discussed in the preceding paragraphs is instructive in that it shows the importance of analyzing the relations existing in any proposed arrangement of apparatus.

Rectifier With Vapor Feed at Intermediate Level

Let us now consider the case where we admit a saturated vapor of composition y_0 at an intermediate point of the column, its mass m_A being the maximum amount possible under conditions of perfect rectification as heretofore defined. In what follows, we shall assume that the vapor m_A is added at a point in the column such that after it has been flowing steadily, the composition at this point of the vapor ascending from below is the same as the composition y_0 of the vapor admitted to the column at that point.



We shall find that, under these conditions, the quantity m_A is a maximum when the composition x_0 of the descending liquid at the level of admission of m_A is the same as that of the liquid having phase equilibrium with the vapor of composition y_0.

Under these conditions the six following equations hold, in which M_0 is the mass of descending liquid passing per unit time the level of admission of the vapor m_A, and m_0 is the mass of vapor ascending from below at this level.

$$M_1 + m_0 + m_A = M_0 + m_1$$
$$x_1M_1 + y_0(m_0 + m_A) = x_0M_0 + y_1m_1$$
$$I_1M_1 + J_0(m_0 + m_A) = I_0M_0 + J_1m_1$$
$$M_0 + m_2 = M_2 + m_0$$
$$x_0M_0 + y_2m_2 = x_2M_2 + y_0m_0$$
$$I_0M_0 + J_2m_2 = I_2M_2 + J_0m_0$$

These equations may be readily solved by properly interchanging subscripts in the solution of our three orginal equations for a simple rectification column. In this manner we obtain the following:

$$m_0 + m_A = \frac{(J_1 - I_1)(x_0 - x_1) + (I_0 - I_1)(x_1 - y_1)}{(J_1 - I_0)(y_0 - y_1) + (J_0 - J_1)(x_0 - y_0)} M_1$$

$$m_0 = \frac{(J_2 - I_2)(x_2 - x_0)(J_1 - J_2)(x_2 - x_0) +}{(J_2 - I_2)(y_2 - y_0) + (J_2 - J_0)(x_2 - y_2)} M_0$$

$$M_0 = \frac{(J_1 - I_1)(y_0 - y_1) + (J_0 - J_1)(x_1 - y_1)}{(J_0 - I_0)(y_0 - y_1) + (J_0 - J_1)(x_0 - y_0)} M_1$$

whence

$$[(J_2 - I_2)(y_2 - y_0) + (J_2 - J_0)(x_2 - y_2)]$$
$$[(J_0 - I_0)(y_0 - y_1) + (J_0 - J_1)(x_0 - y_0)]m_A$$
$$= \{[(J_1 - I_1)(x_0 - x_1) + (I_0 - I_1)(x_1 - y_1)]$$
$$[(J_2 - I_2)(y_2 - y_0) + (J_2 - J_0)(x_2 - y_2)]$$
$$-[(J_1 - I_1)(y_0 - y_1) + (J_0 - J_1)(x_1 - y_1)]$$
$$[(J_2 - I_2)(x_2 - x_0) + (I_2 - I_0)(x_2 - y_2)] M_1$$

In the special case where we are dealing with a mixture for which the total heat I at the boiling point and also the total heat J at the dew point follow the proportionality law indicated by the equations,

$$J = J_Bx + J_A(1 - x)$$
$$I = I_Bx + I_A(1 - x)$$

the above equations take the form

$$M_A = \left[\frac{x_0 - x_1}{y_0 - y_1} \cdot \frac{L_By_1 + L_A(1 - y_1)}{L_Bx_0 + L_A(1 - x_0)} - \frac{x_2 - x_0}{y_2 - y_0} \cdot \frac{L_Bx_1 + L_A(1 - x_1)}{L_Bx_0 + L_A(1 - x_0)} \cdot \frac{L_By_2 + L_A(1 - y_2)}{L_Bx_2 + L_A(1 - x_2)}\right] M_1$$

Now consider the special case where the incoming vapor m_A is a mixture of nitrogen and oxygen, and assume that we obtain pure liquid oxygen at the bottom of the rectification column and pure nitrogen vapor at the top, so that

$$x_2 = y_2 = 1$$

and

$$x_1 = y_1 = 0$$

Substituting these values in the equation just written giving the value of m_A, we obtain

$$m_A = \frac{x_0 - y_0}{y_0(1 - y_0)} \frac{L_1}{L_2x_0 + L_1(1 - x_0)} M_1$$

Now taking $y_0 = 0.21$, $x_0 = 0.47$, we obtain:

$$m_A = \frac{0.26 \times 598}{0.21 \times 0.79 \times 660} M_1 = 1.42M_1$$

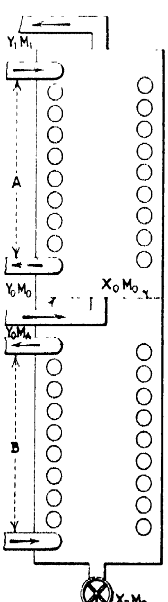
or

$$M_1 = 0.704M_A$$

From this result we conclude that if the liquid "reflux" nitrogen M_1 employed at the top of the rectification column is derived from an incoming mixture of air composition, it will be necessary to liquefy as liquid nitrogen about 70 per cent of that mixture in order to obtain complete separation.

The equations we have obtained in this section are very similar in form to those derived for the rectifier with liquid feed at intermediate level and may be utilized in a similar manner to obtain the conditions for minimum reflux.

A similar method may be easily applied to cases where any number of either vapor or liquid feeds are admitted at various levels in the column.



Rectifier With Distributed Condensation and Evaporation

In case the liquid descending in the column is formed by partial liquefaction of the ascending vapors themselves above the point of admission of the incoming vapor m_0, the above equations are modified. In the figure let A be a liquefying coil distributed throughout the portion of the column above the level of entrance of m_0 and let B be a vaporizing coil distributed in the column below that entrance level. The question as to the distribution of the condensing and vaporizing effects along the rectifier in order that the compositions of liquid and vapor in contact at all levels shall approach the relation for phase equilibrium we shall consider later in connection with a study of rectification as a reversible process. As before, let M_0 be the total mass of descending liquid at the entrance level of m_A and x_0

its composition. Let m_0 be the mass of vapor ascending from below at the same level and y_0 its composition, the latter being assumed to be the same as that of the incoming vapor m_A. Let M_2 be the mass of mixture leaving the bottom of the column and x_2 its composition, while m_1 is the mass of the mixture leaving the top of the column and y_1 its composition. Then between the five m's as defined, the four following equations hold:

$$m_0 + m_A = m_1 + M_0$$
$$y_0(m_0 + m_A) = y_1 m_1 + x_0 M_0$$
$$M_0 = m_0 + M_2$$
$$x_0 M_0 = y_0 m_0 + x_2 M_2$$

From these four equations the ratio between any two m's desired may be obtained.

Eliminating m_1, m_0 and M_2 from these four equations, we obtain as the relation between m_A and M_0:

$$m_A = \frac{x_0 - y_1}{y_0 - y_1} \cdot \frac{x_2 - x_0}{x_2 - y_0} M_0$$

which reduces to:

$$m_A = \frac{(x_2 - y_1)(x_0 - y_0)}{(x_2 - y_0)(y_0 - y_1)} M_0$$

or

$$M_0 = \frac{(x_2 - y_0)(y_0 - y_1)}{(x_0 - y_0)(x_2 - y_1)} m_A$$

Inspection of the equation last written shows that, since x_0 occurs only in the denominator and $x_0 > y_0$ the amount of descending liquid passing the entrance level of the vapor m_A and thus the mass of ascending vapor necessary to be liquefied in the column is least when x_0 is as great as possible.

The maximum value of x_0 possible to attain at the entrance level of m_A is the composition of that liquid having phase equilibrium with the incoming vapor of composition y_0, since the descending liquid at this point is in contact with that incoming vapor. Hence, if we assume that the compositions at this level are those necessary for phase equilibrium, the value of M_0 thus obtained—i.e., the mass of vapor necessary to be liquefied in the column—will be the least possible.

Continuation of this series of articles will be published in a subsequent issue.

Leaching Oxidized Ores by SO_2 Solution

A great deal of work has been done by the Tucson station of the Bureau of Mines on the leaching of copper ores by weak H_2SO_4 solutions, and the process has been determined to be commercially feasible. It is now planned to use this equipment for a series of trial runs on several types of oxidized ores from the Western states—starting on a complex ore from the Miami Copper Co.

Leaching of oxide copper is to approximate plant conditions as closely as possible. Precipitation will be by sponge iron manufactured at the Southwest station. Flotation for the recovery of cement copper will be by both violent agitation and pneumatic agitation type of cell. Re-use of discard solutions will supply all the ferrous sulphate required and the building up of impurities in the mill solution will be studied for possible adverse results. The plan calls for continuous daily plant operation. Several types of ores will be selected and representative samples carefully prepared such that each day of a particular run will have the same ore condition.

Legal Notes

BY WELLINGTON GUSTIN
Of the Chicago Bar

Chemical Use of Palladium Alloy

Court Holds It Was Conceived by F. A. Fahrenwald and His Right to Patent Is Indisputable

In interference proceedings between Charles A. Overmire and one Flynn, junior applicants, and Frank A. Fahrenwald, senior applicant, on applications for an invention for a utensil for chemical use, or a chemical resistant ware formed of an alloy, the Commissioner of Patents decided in favor of the application of Dr. Fahrenwald and his decision was affirmed on appeal to the Court of Appeals of the District of Columbia.

The invention was described in the opinion of the Commissioner of Patents as follows:

"The invention covered by the counts is a device variously denominated 'a utensil for chemical use' (count 1), 'a container for laboratory use' (count 2), 'chemical apparatus' (count 3), or 'chemical resistant ware' (count 4), made of an alloy of gold and palladium in proportions of about 1 of palladium to 5 of gold or silver."

USE OF PALLADIUM:GOLD ALLOY FOR OTHER PURPOSES IS OLD

The court found that the use of an alloy of palladium and gold for dental purposes, points of pencil cases, lancets and for numerous other purposes where strength and elasticity, coupled with the non-tarnishing quality, are required is old in the art. Hence the parties here were held strictly to the thing found to be patentable—that being "a utensil for chemical use."

The issue of the interference was set out in four counts, as follows:

"1. A utensil for chemical use consisting of an alloy of palladium and one or more of the noble metals of lower melting point in homogeneous solid solution, wherein the palladium forms not less than about 20 atomic per cent of the whole.

"2. A container for laboratory use, consisting of an alloy of palladium 10 to 40 per cent and gold 90 to 60 per cent in homogeneous solid solution.

"3. Chemical apparatus having a working surface consisting of an alloy of palladium and one or more of the noble metals, gold or silver, in homogeneous solid solution, wherein the palladium forms between 10 and 40 per cent of the whole.

"4. A heat and chemical resistant ware formed of a metal alloy of approximately 80 per cent gold and 20 per cent palladium."

Dr. Fahrenwald filed his application for patent July 13, 1916, which the court says constituted a constructive reduction to practice. The court found that this date is prior to any date to which Overmire and Flynn could lay claim. The latter, to substantiate their claim of priority, produced testimony to establish a production of a palladium:gold alloy in 1913 for use as a solder. But the court points out that that is not the invention of the issue. There was evidence, also, that prior to Fahrenwald's filing date they had produced a palladium:gold alloy for use as weights; but the court found

that such an alloy was old in 1880. Further they produced evidence to establish that as early as Nov. 25, 1914, they made an anode and a cathode, and these electrodes were successfully tested; but the court found there were publications showing the use of this alloy for electrodes as early as 1911. But, says the court, even if this were not old in the art, electrodes are neither "chemical ware" nor "chemical utensils."

And the Court of Appeals of the District of Columbia was convinced that Overmire and Flynn had "totally failed to prove reduction to practice, or even conception, of the use of the alloy of the issue for 'a utensil for chemical use' prior to Fahrenwald's filing date."

Hence the right to patent was found to be in Fahrenwald. (277 Federal, 618.)

Delay in Shipping Goods

When No Definite Time Is Specified for Delivery Circumstances Determine Reasonableness

Where the date fixed for delivery of goods under contract is important—that is, an essential part of the contract--a delay in the delivery is dangerous. Often such delay may be taken advantage of to refuse acceptance of the goods when laid down, and again the buyer may accept and use the goods and then set up damages caused by the delay as a counterclaim when sued for the purchase price. Again, the circumstances of the delay and the acts of the buyer may excuse the delay, or the buyer may have waived the requirement as to delivery under the contract.

Where no date for delivery has been set by the parties to a sales contract, the law makes delivery within a reasonable time sufficient. What is a reasonable delivery time is a question of fact arising out of the agreement and understanding of the parties at the time of entering into the engagement. Reasonable delivery might be a day or many weeks according to the circumstances of each contract.

In a recent action brought by the Lebanon Valley Iron & Steel Co. against the American Shipbuilding & Dock Corporation to recover the contract price of a quantity of galvanized iron spikes manufactured by the plaintiff for the defendant on the buyer's order, the United States Circuit Court of Appeals has held that a delay in delivering an article to be manufactured does not entitle the buyer to rescind without notice to the seller of such recision.

Buyer Gave No Notice of Intention to Rescind

In this case the order was given for galvanized spikes and other products of the steel plant. The order contained the following: "Please ship this material at the earliest possible date."

The order was given in September and the spikes were not shipped until the following March, 6 months afterward. Correspondence between the parties 3 months after the order was placed showed that more or less of the material was yet to be delivered, and the court said it implies acquiescence by defendant buyer in such future shipments. Neither then nor afterward, until the spikes were actually shipped, did the buyer give any notice, formal or informal, that they would be refused on account of delay in making delivery. The court further found that although the order called for shipment "at the earliest possible date," the buyer at no time thereafter requested prompter deliveries than were actually made, gave no intimation that it objected to the delay, but impliedly assented thereto in its letters to the manufacturer and otherwise, allowed the manufacture of the spikes to be completed without protest or notice of any sort, and then, when they arrived, refused acceptance on the ground that plaintiff had broken the contract by failing to ship at an earlier date. Buyer's sole defense for non-payment was the time that elapsed between the order and the delivery.

Under the above-stated facts and circumstances the District Court gave judgment for the buyer against the manufacturer and seller, but the Court of Appeals reversed the judgment and awarded a new trial to the seller. It says buyer's defense cannot be sustained under these facts. The contract in question fixed no definite date for performance. It says the buyer understood that the articles ordered were to be made by the seller and therefore could not have expected immediate delivery. A substantial period of time, sufficient for the manufacture, was necessary in contemplation. Moreover, under conditions then prevailing and of which the buyer was fully aware, delays in filling such orders were often unavoidable and always to be taken into account. This being so, the higher court says that buyer "could not remain silent, accept partial deliveries 3 and 4 months after the order was given, make no objection to further delay in shipping the balance of the order, seemingly acquiesce in what plaintiff was doing, and then upon tender of the spikes, barely 6 weeks later, refuse to receive them for no other reason than the lapse of time since they were ordered."

The Law Defined

The settled rule of law is that when the contract fixes no definite date for performance, notice of the intention to rescind the contract is a prerequisite to the right to rescind. And the right to rescind because of delay must be asserted promptly.

The rule is stated in volume 6, "Ruling Case Law," page 932, as follows: "The failure of a party to perform his part of a contract does not *per se* rescind it; the other party must within a reasonable time give notice of his intention to rescind. A formal or written notice is not necessary, but the law requires, on the part of him who would rescind, some positive act which shows such an intention."

And it is laid down in 9 Cyc., 613: "When no time has been fixed for the performance of a contract, either party may limit a reasonable period within which it must be performed by giving the other party a reasonable notice."

In the case as set out above the court says the fact that the goods were to be manufactured, to say nothing of the conditions then existing in the industry, made shipment "at the earliest possible date" a plainly indefinite, if not uncertain, time. The mere lapse of time did not serve to relieve the buyer from obligation, and the indefinite date for delivery did serve to put upon him the duty of giving reasonable notice of its intention to rescind the order. Its continued silence carried the implication of assent to the delay.

As to whether delivery was made within a reasonable time the court said the difficulties attending the manufacture of the spikes and their delivery at that particular time were proper and necessary as bearing directly on the question of reasonable time. So 6 months' delay was not unreasonable time for delivery in this case.

Electric Enamel Furnace Lowers Rejections on Stove Parts

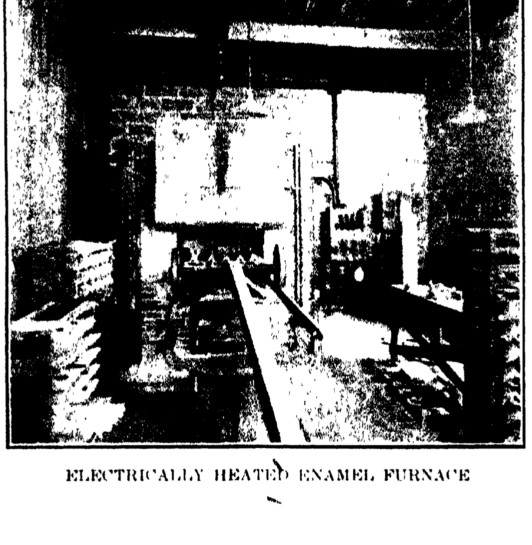
Cast Iron and Sheet Steel Enameled in Electric Furnace Operating on Schedule Which Insures Minimum Power Rate

AN installation of heating equipment that is interesting both as a new application of the electrically heated vitreous enamel furnace and because of some of the factors connected with its operation has recently been made by the Galusha Stove Co., of Rochester, N. Y., maker of high-grade enameled gas and combination ranges. The furnace is used for two classes of work, that of baking vitreous enamel on cast-iron stove parts, and on sheet steel. It operates at from 1,200 to 1,400 deg. F., with a maximum temperature range of 2,000 deg. F., and has a connected load of 118 kw. at 230 volts, three phase, sixty cycles. Its capacity is normally estimated at approximately 7 lb. of metal per kw.-hr.

Furnace Construction Insures Uniform Heat Distribution

The equipment consists of the furnace proper and the automatic control panel and instrument. The furnace is constructed of brick, with a refractory lining, having a sliding door that gives access to the upper compartment from the front. The dimensions of the overall working space are 5 ft. deep by 3½ ft. wide by 23 in. high. The interior is divided horizontally into two compartments by narrow shelves on each side wall, which support the sides of the tray on which the work to be baked is set. The nickel-chromium heat units are mounted away from the side walls and are about evenly distributed between the upper and lower compartments. This arrangement, together with the curved roof, causes the heat to strike the charge from all directions, and makes for a very uniform heat distribution throughout the furnace interior. The temperature is automatically controlled by a Leeds & Northrup temperature control instrument and an automatic control panel carrying contactors and overload relays. The heating elements and the control panel are of General Electric Co. manufacture.

The two classes of material require for their baking two temperature settings and durations of baking. The cast-iron stove parts are baked for 9 minutes at a temperature of 1,250 deg. F. and the sheet steel for 4 minutes at 1,400 deg. F. The company operating the furnace buys power from the central station on what is known as a three-rate schedule, whereby power used at a steady demand for 24 hours a day earns the lowest power rate. A schedule has been worked out for the operation of the furnace so that its running periods are dovetailed with those of the other power-using devices in the foundry of the plant, with the result that no additional demand is created during the daytime. By this method the operating expenses of the furnace itself are held to a very low level. Also, by not running the furnace in peak hours through the winter months, further economy has been effected in the operating cost. The overall economy that has resulted from the use of the furnace is due, in addition to the factors already mentioned, to the speed with which the material is finished, the reduced attendance necessary, and, most important, to the perfection of the finished product.



ELECTRICALLY HEATED ENAMEL FURNACE

Percentage of Rejects Small

In regard to the latter item, the percentage of rejects from the electric furnace is only about 4 per cent by weight of all the material baked. This percentage is remarkable in this special case, because a large portion of the work baked is enameled in white or light gray, colors that are very susceptible to spoilage from a contaminated atmosphere, either in the furnace itself or in the neighborhood. It has been possible, in the case of this factory, to save both space and time by installing the spraying equipment in the same room with the furnace and to assemble the sprayed parts on trucks in close proximity to the furnace, where they are left until their turn comes. Furthermore, the furnace has been operated by men who previously had little or no experience, either with electric furnaces or with enameling itself.

Present Situation in Rubber Sundries Trade

In a paper entitled "A Bigger and Better Sundries Trade," given by Fordyce Jones in Manchester recently, it was stated that the rubber industry at present might be described as being at the crossroads. In order that it might advance, it was essential to create demand and, through salesmanship and systematic advertising, to increase sales. Although the industry was originally founded in England, British rubber sundries are inferior to those of other countries in many instances. British manufacturers have acquired the reputation of regarding innovation with disfavor and of possessing very little knowledge of the development of the industry in other countries. Moreover, very few inventions were really taken up by the public and frequently the dealers who attempted to sell them were heavy losers. The consequent fear of failure was in reality the chief deterrent to the advancement of the industry in Great Britain.

As an example of the differences existing between British and American rubber sundries, surgeons' gloves were discussed. For this purpose, hard rubber is essential and must not be overmilled. It is important also to use a solvent free from residue. To be sure, solvent is very much cheaper in America, where, moreover, there is no amateur dipping or curing. Every operation is mechanical there and the glove is never touched; the cure is by vapor. In many respects, therefore, Great Britain could learn considerable from America concerning the rubber sundries trade.

Synopsis of Recent Chemical & Metallurgical Literature

Character and Uses of Peat

A very fine bulletin has just been issued by the U. S. Geological Survey describing the peat industry of the United States and its opportunities. This is Bulletin 728, entitled "The Occurrence and Uses of Peat in the United States," by E. K. Soper and C. C. Osbon.

In this bulletin are summarized very completely the chemical and physical properties of peat deposits, including those of commercial importance and others that at present offer no promise of economic development. The application of peat in fertilizers, as a filler in feeding stuffs and as a fuel for local use in territory where coal is scarce or very high will justify careful consideration of the bulletin by anyone interested in this business. It may be obtained on application from the U. S. Geological Survey, Washington, D. C.

Important Articles in Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem & Met.* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. Those that are of unusual interest will be published later in abstract in this department, but since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage. The magazines reviewed have all been received within a fortnight of our publication date.

THOMAS AND PETREE PROCESS IN HAWAII. S. S. Peck. *Internat Eng Jour.*, January, 1923, p. 12.

LOW-TEMPERATURE COKING BY THE MOSCICKI PROCESS. R. Moritz. *Chim et Ind.*, December, 1922, pp. 1172-1174.

SEWAGE DISPOSAL. Leonce Fabre. *Chim et Ind.*, December, 1922, pp. 1180-1200.

TOP SIZING WITH RUBBER LATEX AND CASEIN. *India Rub World*, Feb. 1, 1923, pp. 283-289.

CHEMICAL ASPECTS OF AGRICULTURE. E. Holmes. *Chem Age* (London), Jan. 27, 1923, pp. 80-83.

THE PROBLEM OF DUST EXPLOSIONS IN INDUSTRY. W. E. Gibbs. *Chem Age* (London), Jan. 20, 1923, and Jan. 27, 1923.

FACTORS INFLUENCING THE YIELD OF AMMONIA IN THE CARBONIZATION OF COAL. Part II. Dissociation, the Influence of Water Vapor and the Character of Contact Materials. R. A. Mott and H. S. Hodsman. *J. Soc. Chem. Ind.*, Jan. 5, 1923, pp. 1-12T.

SELECTIVE HYDROGENATION. Thomas Percy Hilditch and Charles Watson Moore. *J. Soc. Chem. Ind.*, Jan. 12, 1923, pp. 15-17T.

CATALYTIC HYDROGENATION WITH NICKEL. Factors Determining Catalytic Activity. R. Thomas. *J. Soc. Chem. Ind.*, Jan. 19, 1923, pp. 21-26T.

EXPLOSIONS IN LIQUID AIR RECTIFICATION PLANT. Ernest Fyleman. *J. Soc. Chem. Ind.*, Jan. 26, 1923, pp. 37-39T.

THE LESSER USED DRYING OILS. POPPY SEED OIL. Glenn H. Pickard. *American Paint J.*, Feb. 12, 1923, pp. 18-22.

PROMOTING HEALTH IN INDUSTRY. III. Industrial Dusts and Poison Hazards. C.-E. A. Winslow. *Iron Trade Review*, Feb. 8, 1923, pp. 410-1.

Thomas and Petree Process of Sugar Clarification in Hawaii

A discussion of a sugar process by S. S. Peck deserves respectful consideration and therefore the January number of the *International Sugar Journal* received unusually careful attention. The application of Dorr thickeners to sugar clarification by means of the Thomas and Petree process has been carried out in over forty plants in various parts of the world, but never before has there been an installation in Hawaii. The process involves a different routing of juice from the mills and a strategic insertion of two thickeners. The limed juice from the first mill passes through a preheater and thickener and goes immediately to the evaporators. Along with this there goes the clarified juice from the second mill. The strained juice from the second mill is limed separately and the mud from the first juice thickener is added to it. This mixture is preheated and clarified, the juice as indicated then going in with first mill juice and the mud is returned and added to the third mill juice, which in turn is returned to the first mill.

Thus it will be seen that there are three closed cycles, the mud finally going to waste (or fuel) with bagasse and the plant delivering one grade of clear liquor to the evaporators.

The advantages are many and will be briefly listed.

1. Character of the mud. The process calls for a slightly alkaline settling first and then an acid clarification at a somewhat higher temperature. This produces what is described as a stabilized mud which is more firmly fixed by the bagasse with a consequent diminution in the solution of insolubles.

2. Clarification of the juices. The juice from the first mill settles much better. Thus the Thomas and Petree process make use of this fact in returning the first mill mud to the second mill juice to aid in its clarification. This is a distinct improvement and in settling the first mill juice the Dorr equipment reduces the per cent of suspended matter and a more brilliant juice is obtained.

3. Automatic liming equipment.

4. Diminution in the percentage of juice in the mud from 10 to 25 per cent to 5 per cent.

5. The return of the mud to the rolls produces no ill effects on them due to the continuous nature of the process. Other attempts to add mud to the cane have been unsuccessful because of the unevenness of the addition and to the different character of the mud.

6. No definite data on extraction were available, but calculations indicated the return of 5 per cent juice to the second mill would result in a slight drop in extraction. An actual increase is mentioned in some instances by the inventors.

7. Effect on boiling. Clearer juices should make for less evaporation troubles.

8. Effect on fuel. Unexpectedly the clinker in the furnaces disappeared with the return of the mud.

In addition to the already enumerated items the undetermined losses will be fewer; some fuel will be saved, because of the elimination of the water used in sweetening of the cake; considerable labor will be saved, including all of the press men and some of the settling tank force. Finally, there will be a saving of material such as filter press parts, mud pumps and cars, etc.

A DISADVANTAGE WHICH MAY DEVELOP

This has to do with the value of the filter press cake as fertilizer. Although data on this point are a little confusing, there semes to be no doubt that the press cake has distinct fertilizer value, and an estimate of the economic value of the material should be subtracted from the financial gains which the process can show.

The financial advantage of an installation has been carefully estimated for a plant of assumed capacity and operating methods. The specifications are given in full in the article; there is need, however, only for a summary here. The plant grinding 200,000 tons of cane and producing 25,000 tons of sugar should make a total saving of \$41,478. If we subtract from this the interest on the investment in the Dorr equipment, the value of press cake as a fertilizer, etc., we should have a net gain of \$23,428, or 39 per cent on the investment over and above the normal interest rate.

An Interesting Note on Propyl Alcohol

The *Pharmazeutische Zentralheften* (No. 31, 1922) declares that propyl alcohol is of unusual merit as a disinfectant to be used on the skin. It is said to be at once a strong germicide and harmless to the skin and is used in solutions of from 35 to 50 per cent strength with good results on facial acne and disorders of the scalp. Poultices containing 10 to 20 per cent solutions are said to have been successful in treating bacterial eczema.

Recent Chemical & Metallurgical Patents

American Patents Issued Feb. 6, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,443,983—Process for Obtaining Paraffine and Highly Viscous Lubricating Oils From Bituminous Masses. Ernst Erdmann, Halle-on-the-Saale, Germany.

1,444,051—Fire Resisting Composition. Charles Ridgely Allison, Peekskill, N. Y.

1,444,068—Process of Manufacturing Anthraquinone and Phthalic Anhydride. Harry D. Gibbs, Pennsgrove, N. J., assignor to E. I. du Pont de Nemours & Co., Wilmington, Del.

1,444,129—Method of Converting Hydrocarbon Oils. William F. Muehl, Kansas City, Mo.

1,444,160—Method for the Precipitation of Iron in Aluminous Solutions. Thor Mejdell, Skoien, near Christiania, Norway, assignor to Aktieselskabet Labrador, Christiania, Norway.

1,444,162—Ceramic Bonded Carbide Article and Method of Making Same. Milton F. Beecher and MacDonald C. Booze, Worcester, Mass., assignors to Norton Co., Worcester, Mass.

1,444,178—Method for Commercially Obtaining Water-Soluble Milk Albumen and Milk Sugar. Adolph D. Fest, Chicago, Ill.

1,444,208—Process of Fractionation. Harry F. Perkins, Pittsburgh, Pa., assignor to Rosanoff Process Co., Pittsburgh, Pa.

1,444,250—Preparation of Active Animal Amylase and Process of Making Same. Richard Kern and Georges Jenny, Basel, Switzerland, assignors to Swiss Ferment Co., Ltd., Basel, Switzerland.

1,444,255—Method of Producing Cyanamide. Johan Hjalmar Lidholm, Wargon, Sweden.

1,444,257—Process of Producing Colloidal Soluble Substances and Suspensions. Leon Lilienfeld, Podhrace, Poland.

1,444,276—Manufacture of Wine-Yeast Preparation. Friederich Sauer, Gotha, Germany.

1,444,277—Manufacture of Dyestuffs. Maximilian P. Schmidt and Heinrich Roese, Biebrich-on-the-Rhine, Germany, assignors to Kalle & Co., Germany.

1,444,309—Manufacture of Cement Mixtures. Fabio Ferrari, Rome, Italy, assignor to the Company Bombrina Parodi-Delfino, Rome, Italy.

1,444,331—Cellulose Ether Composition. Stewart J. Carroll, Rochester, N. Y., assignor to Eastman Kodak Co., Rochester, N. Y.

1,443,333—Nitrocellulose Composition. Hans T. Clarke, Rochester, N. Y., assignor to Eastman Kodak Co., Rochester, N. Y.

1,444,406—Cellulose Ether Composition. William R. Webb, Rochester, N. Y., assignor to Eastman Kodak Co., Rochester, N. Y.

1,444,421—Process and Apparatus for Burning Powdered Coal. Alonzo G. Kinyon, Chicago, Ill., assignor to Fuller Engineering Co., Allentown, Pa.

1,444,484—Metallurgical Process for Treatment of Zinc Compounds. Earl P. Stevenson, Cambridge, Mass., assignor to Arthur D. Little, Inc., Cambridge, Mass.

1,444,527—Furnace Refractory. Charles A. Scharschu, Pittsfield, Mass., assignor to General Electric Co.

1,444,548—Process of Manufacturing Leather From Intestines. Eugene Markus, Budapest, Hungary.

1,444,594—Process of Impregnating Plant Tissues With Ammonium Nitrate for Explosive Purposes. William M. Lehn, Seattle, Wash.

1,444,623—Method of Producing Carbonates of the Alkaline Earth Metals. James H. MacMahon, Saltville, Va., assignor to the Mathieson Alkali Works, Inc.

Complete specifications of any United States patent may be obtained by remitting 10c to the Commissioner of Patents, Washington, D. C.

Chlorinating Hydrocarbons — In the direct chlorination of organic compounds, by the use of a catalyst, such as activated carbon, it has been found that certain undesirable chlorinated compounds with a boiling point higher than that of the compound which it is desired to make are formed during the early stages of the reaction, and these compounds are believed to impede the action of the catalyst by condensing on it in liquid phase. Herbert H. Dow has patented a procedure to overcome this difficulty, the patent being assigned to the Dow Chemical Co., Midland, Mich. In a specific illustration of the improved process the patentee describes the chlorination of the acetylene. Upon bringing chlorine in contact with acetylene in the presence of a porous catalyst, such as activated carbon, a number of substitutions or addition compounds are formed, the most conspicuous as well as the most desirable being the tetrachloride. The formation of these compounds begins at a temperature as low as from 40 to 50 deg. C., whereas the boiling point of such compounds ranges from approximately 60 to 200 deg. C., and upward, the boiling point of acetylene tetrachloride, for example, being approximately 140 deg. C. As a result of the initial reaction taking place in this process of chlorination, compounds may be formed which will not be in the vaporous state at the temperature at which the reaction occurs, and even though the temperature may be raised quite frequently they may still continue present in the carbon or other catalyst to such an extent as to affect its activity materially. When the activity of the catalyst has been reduced to a certain point, the flow of the reacting substance is shut off and the reaction chamber is placed under a vacuum so that the high-boiling compounds are vaporized. After such evaporation the reaction is resumed under the former conditions. The undesirable products are, of course, withdrawn in the vaporous condition and may be condensed and separated by fractional distillation or by chemical means. (1,437,636. Dec. 5, 1922.)

Rubber Vulcanization—S. M. Caldwell of Leonia, N. J., has assigned this patent to the Naugatuck Chemical Co., together with patents 1,440,962 and 1,440,963. All of these patents have to do with the vulcanization of rubber and the product obtained thereby. They are continuation of a number of serials filed previously. In the three patents there are a total of 150 claims, and all of them deal with the use of various types of vulcanizing agents, starting with compounds like zinc ethylxanthogenate. Various metal salts, such as zinc, mercury lead, copper, etc., are used and organic compounds having a general structural formula represented by

$$\begin{array}{c} RCSM \\ \| \\ X \end{array}$$

They are divided into three general groups, the first group being the metal thiol salts, the second group being bisulphides, and the third group being monosulphides. It will hardly pay to go into this elaborate patent more thoroughly, for it seems to be basic for a wide variety of products belonging to this group. (1,440,961. Jan. 2, 1923.)

Smokeless Powder—Tenney L. Davis, of Somerville, Mass., has patented the use of certain nitrogen compounds of the type known as heterocyclic for gelatinizing agents for the manufacture of smokeless powder. Specifically mentioned among such substances are the substituted pyrazolones and pyrazolidones. The formulas of the unsubstituted parent substances are as follows:

$$\begin{array}{ll} CH - N & \\ |\qquad\quad > NH & \\ CH_2 - CO & \end{array} \qquad \begin{array}{ll} CH_2 - NH & \\ |\qquad\quad > NH & \\ CH_2 - CO & \end{array}$$

Pyrazolone Pyrazolidone

Phenyldimethylpyrazolone, which is extensively used in medicine under the name of antipyrine, is also claimed to be excellent for the purpose. The advantages claimed for this invention reside in the fact that powders coated with the substance will be less hygroscopic than ordinary smokeless powder and will show a greater degree of progressive burning, giving higher velocity to the projectile while producing lower gas pressures in the barrel of the gun. (1,439,505. Dec. 19, 1922.)

Cellulose-Ether Solvent—Samuel E. Sheppard, of Rochester, N. Y., has taken out a patent covering the use of a solvent mixture for use in the plastic arts such as sheet or film and varnish manufacture. The feature of the patent is the employment of hydrogenation productions of the hydrocarbons and homologs. The hydrogenated substances are individual solvents of the cellulose ethers, but they may also be

employed in conjunction with other compounds, such as chloroform, ethyl alcohol, etc. Typical examples of the compounds used are tetrahydronaphthalene, or tetraline, and dekahydronaphthalene, or dekaline. These are high-boiling solvents and consequently can only be used in film dope in a mixture with other low boilers. A typical formula is given as 100 to 200 parts cellulose ether in a mixture containing 600 to 900 parts of chloroform, 300 to 450 parts ethyl alcohol, and 15 to 30 parts dekaline or tetraline, or mixture thereof. (1,441,181. Jan. 2, 1923.)

British Patents

For complete specifications of any British patent apply to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Briquet Fuel—A composition fuel which is molded into block form is made up of 10 parts by weight of asphalt or pitch, 800 parts of fuel oil, 25 parts of shale and 45 parts of coal or coke, with or without 160 parts of tar, and 20 parts of peat impregnated with fuel oil. The shale and coal are finely ground and stirred in a mixing vessel into which steam is injected. Finely divided peat impregnated with oil may be added. The asphalt, and sometimes tar, and fuel oil are heated in a separate vessel and the mixture when liquid is combined with the shale, etc., the incorporated mass being molded on cooling (Br. Pat. 187,351. H. J. Franklin, London, and J. Pettingall, Chinford, Essex. Dec. 13, 1922.)

Bottle Capping Solution—A composition particularly adapted for sealing bottles consists of an agglutinant such as glue or silicate of soda, an earthy filling material such as talc, and an aqueous solution of soap and wax. A capsuling mass consists of 10 parts of leather glue diluted to 28 to 35 deg. Bé. mixed with 20 parts of talc and 3 parts of a solution containing 25 grams of hard soap and 40 to 50 grams of carnauba wax per liter. Coloring matter may be added. (Br. Pat. 187,611; not yet accepted. H. H. Warmund, Berlin. Dec. 13, 1922.)

Hydrogen Peroxide—Hydrogen peroxide of more than 10 per cent strength is obtained in one operation by treating an alkali perborate or a suspension in water of an alkali perborate with a mineral acid, such as sulphuric, hydrochloric or phosphoric acid, with agitation. Boric acid and the salt produced, such as sodium sulphate, separate. The perborate may be added to the concentrated acid, or the acid to a suspension of the perborate. (Br. Pat. 186,871. Deutsche Gold- und Silber-Scheideanstalt vorm. Roessler and O. Liebknecht, Frankfurt-on-Main. Nov. 29, 1922.)

Methane—Methane is produced by passing a mixture of water vapor with carbon monoxide or a gas, such as water-gas, containing carbon monoxide over two nickel contacts or sets of contacts in series, the water vapor being removed from the mixture between the two contacts. After elimination of carbon dioxide, the product consists of pure methane or methane admixed with a little hydrogen. For the second contact, nickel obtained from calcined nickel nitrate and maintained at a temperature of 350 to 400 deg. C. may be used; preferably, however, the nickel is prepared from nickel carbonate or organic nickel compounds and is employed at a temperature of about 300 deg. C.

In a second specification by the same patentee, the process described in the parent specification for the production of methane from carbon monoxide and hydrogen is modified by introducing carbon dioxide into the gas mixture either before the reaction starts or before it is completed. The theoretical proportions of carbon monoxide and hydrogen, namely 1: 3, may then be employed. According to the examples, (1) a mixture of carbon dioxide, carbon monoxide, hydrogen and nitrogen is passed over heated nickel, prepared by reducing precipitated nickel carbonate; water is then eliminated and the resulting gases are passed over a second nickel contact; after removal of water and carbon dioxide, the product consists of methane and nitrogen; (2) ordinary illuminating gas, completely desulphurized and freed from cyclic hydrocarbons, is mixed with a little carbon dioxide and circulated over reduced nickel with periodic separation of the water formed; the gas is then conducted over a further nickel contact and after cooling, the carbon dioxide is removed; a mixture of methane and nitrogen remains. Specifications 146,114 and 161,924 are referred to. (Br. Pat. 186,899. Farbwerke vorm. Meister Lucius und Brüning, Hoechst-on-Main. Nov. 29, 1922.)

Plastic Compositions—Four compositions containing peat are described for the manufacture of bricks, building blocks, etc.; (1) 70 parts by volume of peat, 25 parts of lime, 5 parts of sulphate of zinc; (2) 75 parts of peat, 20 parts of lime, 1 part of alum, 2 parts of tar, 2 parts of gypsum or silicate of soda; (3) 45 to 50 parts of peat, 45 parts of clay, 5 to 10 parts of silicate of soda; (4) 30 to 35 parts of peat, 60 parts of clay, 5 to 10 parts of silicate of soda. The peat as it comes from the bog is macerated, the other ingredients are added, and articles are molded. In the case of compositions 1 and 2, articles harden without artificial heat, other articles are burned. Reinforcements may be inserted during molding. (Br. Pat. 186,355. C. L. Hamon, Ballycumber. Nov. 22, 1922.)

Tungsten—In a process for the manufacture of tungsten suitable for electric lamp filaments, there is added to the tungsten compound before its reduction to metal a combination of two substances, one of which will introduce into the resulting metal an oxide irreducible by hydrogen, such as thoria or silica, and the other an alkali metal compound. For example, there may be left in the tungstic acid before its reduction 0.5 to 1 per cent of thoria and 0.03 to 0.3 per cent of sodium chloride, or 0.05 to 0.5 per cent of caesium chloride, the subsequent reduction, pressing, sintering, swaging and drawing being carried out in the usual manner. Specification 155,851 is referred to. (Br. Pat. 186,497. General Electric Co., Ltd., and C. J. Smithells, London. Nov. 22, 1922.)

Dyes—Triarylmethane dyes containing a thiazole ring are prepared by condensing tetramethyldiaminobenzhydrol or equivalent tetra-alkyldiaminobenzhydrol (in which one or two alkyl groups may be replaced by benzyl groups) with an arylbenzthiazole and oxidizing the resulting leuco compound. According to examples, tetramethyldiaminobenzhydrol is condensed with 1-phenyl-5-methylbenzthiazole, 4'-methoxy-1-phenyl-5-methylbenzthiazole, or dehydrothiotoluidine, and the leuco bases oxidized; the leuco base from dehydrothiotoluidine may be acetylated, or, according to the provisional specification, it may be alkylated or treated with phosgene. The products dye wool or tannin-mordanted cotton and also unmordanted cotton or paper, bright green shades.

1-Phenyl-5-methylbenzthiazole is prepared by heating benzyl-p-toluidine with sulphur.

4' - Methoxy - 1 - phenyl - 5 - methylbenzthiazole is prepared by methylating 4'-oxy-1-phenyl-5-methylbenzthiazole with methyltoluene sulphonate. (Br. Pat. 186,517. J. Braddiley, E. H. Rodd and H. H. Stocks, assignors to British Dyestuffs Corporation, Ltd. Nov. 22, 1922.)

Nickel—Nickel is deposited from nickel carbonyl by passing the gases containing the nickel carbonyl between a number of parallel heated surfaces arranged close together, say from ½ to 1 in. apart. Two forms of apparatus are described in the two specifications. (Br. Pat. 186,457 and 186,458. H. E. Fierz, Zurich. Nov. 22, 1922.)

Fatty Acids—Waste cellulosic materials such as wood waste are hydrolyzed to impure sugary worts, which, after purification, are subjected to symbiotic bacterial fermentation to produce fatty acids, mainly butyric acid. The hydrolysis of the disintegrated wood waste is effected by means of dilute sulphuric acid and superheated steam; the acid liquors are then neutralized with lime or chalk, the sugar solution extracted from the product by exhaustion, and purified from gums, resins, mucilages, etc., by adding excess of milk of lime, followed if necessary by passage of the decanted solution through animal charcoal. The purified wood wort is then treated with the ferments obtained by inoculating sugar solutions containing mineral salts with bacilli of the intestinal digestion of herbivora or contained in garden earth; by this means, all the reducible sugars of the wood wort are converted into acids—viz., butyric, acetic, propionic, valeric and caproic acids. The fermented wort is concentrated to a sirup preferably *in vacuo* and treated in a

still with sulphuric or hydrochloric acid or preferably sodium bisulphate to liberate the free organic acids which distill off and are fractionally separated. The carbon dioxide of the fermentation is recovered by absorption in sodium carbonate, from which it is freed by boiling. (Br. Pat. 186,572. Lefranc et Cie., Paris Nov. 22, 1922.)

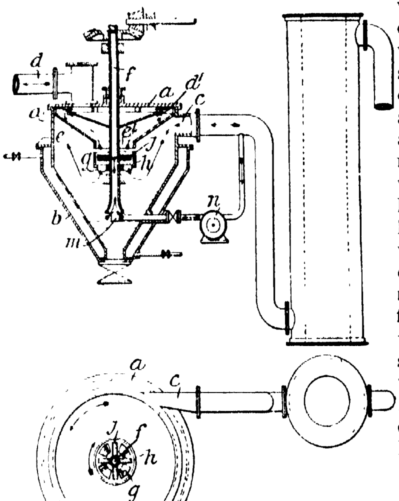
Desulphurizing Petroleum—In desulphurizing petroleum or petroleum distillates in the liquid state by adsorptive treatment with a dehydrated natural or artificial inorganic gel, the desulphurizing agent is used when freshly ignited and while still warm. Varieties of fullers earth such as floridin, or bauxite, or metallic hydroxides of a colloidal character, such as iron and aluminum hydroxides, may be used. The oil is mixed with the adsorptive substance or filtered through it. Means such as a steam-jacket may be provided to maintain the oil and adsorptive substance warm during contact. In treating benzine, 4 lb. of floridin or 9 lb. of bauxite per gallon is used. (Br. Pat. 186,955. A. E. Dunstan and F. B. Thole, Sunbury-on-Thames. Dec. 6, 1922.)

Soap—The lime sludge obtained by the action of soda on a lime soap is treated to remove residual soap by adding soaps of palm kernal oil, copranut oil or resin. The sludge is then lixiviated with water or weak salt solution and the lime carbonate filtered from the soapy solution. Palm kernel oil soap or copranut oil soap is added in such quantities as to amount to not less than 25 per cent of the total soap in the sludge after the addition, and resin soap to a corresponding minimum amount of 20 per cent. If the residual soap is wholly or mainly palm kernel oil soap or copranut oil soap, this addition is unnecessary. (Br. Pat. 186,960. P. Krebitz, Munich. Dec. 6, 1922.)

Iron Alloys—Workable low-carbon iron alloys containing chromium in smaller proportion than iron are made by blowing in a converter molten metal containing carbon, intentional overblowing being avoided. The charge to be blown may consist of ferrochromium diluted with pig iron, scrap steel, or other form of iron; or high-carbon iron may be mixed with low-carbon ferrochromium or high-carbon ferrochromium may be mixed with low-carbon iron; or both materials may contain carbon. Silicon is preferably present in or added to the charge in sufficient proportion to raise the temperature by oxidation during the blowing. The finished alloy is deoxidized by means of manganese or other deoxidizer. (Br. Pat. 186,982. J. C. Gillot, Sheffield. Dec. 6, 1922.)

Explosives—Mixtures of lead azide and lead trinitroresorcinate for use as explosive priming compositions are prepared by the simultaneous precipitation of the two salts or by the precipitation of one salt from a solution containing the other salt in suspension. *For example, lead azide is precipitated by the addition of sodium azide to a solution of acetate of lead containing lead trinitroresorcinate in suspension.* (Br. Pat. 187,012. E. von Herz, Berlin. Dec. 6, 1922.)

Treating Gases—Relates to the treatment of gases or vapors with a liquid medium, which may contain catalytic or other solids in a mechanical or colloidal state in suspension therein, in centrifugal or cyclonic apparatus in order to cause the liquid or the suspended solid to absorb one or more constituents of the gases or else to promote a reaction between the gases and the liquid or the solid. The process may be employed for the simultaneous desulphurization and hydrogenation and oxidation of gases or oil vapors by means of catalysts and oxidizing agents in the presence of ammonia, which may be supplied by means of producer gas.



The centrifugal or cyclonic apparatus may be so constructed that the reaction may take place at a pressure above or below atmospheric.

In the preferred apparatus the gas or gases to be treated enter the treating vessel a tangentially and at great speed through an inlet c, the liquid containing the desired solid being kept at the desired temperature by means of a heating or cooling jacket b. The gas travels spirally around the inner surface of the chamber a and is forced by incoming gas downward toward the center of the apparatus, where it is forced by rapidly rotating propellers g vertically upward through a rotating basket or mixing chamber h carried by a central tube f, the gas being eventually forced through openings e^1, d^1 in baffle plates to the outlet d. While in the vessel a and during its passage through the basket h, the gas is mixed intimately with a portion of the liquid and contained solid which is forced up the center tube f by an injector m supplied with a portion of the gas by a compressor n, the liquid being discharged into the basket through radial pipes j and sprayed through perforations in the basket across the vessel a. Fresh liquid may be fed into the apparatus and spent liquid discharged continuously during the operation.

Any desired number of baskets may be mounted on the tube f, and two or more complete apparatus may be arranged in series or in parallel, the gases or vapors receiving the same or different treatment in each. The basket is preferably rotated in the direction opposite to that of the incoming gases, but where two or more baskets are employed in the same or different apparatus, they may be arranged to rotate in opposite directions. (Br. Pat. 186,945. J. F. Ward and H. Nielsen, London. Dec. 6, 1922.)

Lubricants, Cosmetics and Leather Dressing—Wax or crude bitumen, such as ozokerite, beeswax, montan wax, carnauba wax or Japan wax, is treated with an aldehyde, such as formaldehyde or furfural, in presence of an alkali, with or without addition of a ketone, such as acetone or methyl ethyl ketone, or a divalent or trivalent alcohol, such as glycerol or glycol. The product, after removal of the alkali by washing, may be added to mineral, tar, animal or vegetable oil, yielding viscous or paste-like products, which may be used as lubricants or cosmetics, or emulsified with water, forming salves or leather-dressing compositions. It may be mixed with 20 to 30 per cent of paraffine wax, ceresin, ozokerite or the like without affecting its properties. Instead of aldehydes, their polymerization products or substances, such as hexamethylene tetramine, capable of liberating aldehyde may be used. (Br. Pat. 186,950. Plauson's, Ltd., London. Dec. 6, 1922.)

Sulphuric Acid—The process described in the parent specification is modified as follows in order to obtain an acid of higher concentration. In one modification a solution of nitrosylsulphuric acid of above 58 deg. Bé. is supplied to each unit of the plant, a more elevated temperature being employed if necessary. In a second method, the central part of the plant is irrigated with a solution of nitrosylsulphuric acid of a lower concentration than that used in the fore and rear parts of the plant. The second method may be further modified by adding water to the units in the middle of the plant, the nitrogen oxides consequently liberated being recovered by subsequently irrigating with acid of the same concentration as that employed in the fore part of the plant. (Br. Pat. 187,016. T. Schmiedel, Nurnberg, and H. Klencke, Frankfurt-on-Main. Dec. 6, 1922.)

Turpentine Substitute—An oil, having the properties of oil of turpentine, is obtained by heating rubber waste to about 220 deg. C., condensing the vapors given off, and rectifying this liquid by distillation, preferably with steam. (Br. Pat. 188,008. C. Lefebvre, Seine, France. Dec. 29, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Tentative Program Arranged for A.C.S. Spring Meeting

Important Papers Announced by Divisions and Sections —Membership of Local Committees

THE spring meeting of the American Chemical Society will be held with the New Haven and Connecticut Valley sections, at New Haven, Monday, April 2, to Saturday, April 7, inclusive. All divisions and sections are planning extensive meetings with the exceptions of the divisions of Fertilizer Chemistry and Leather Chemistry. The local committees have nearly completed their arrangements and an interesting program, together with instructive excursions, is assured.

The dedication of the Sterling Chemistry Laboratory of Yale University will be held on Wednesday, April 4, and all members of the society are invited to attend the ceremonies and to inspect the splendid new building.

Divisional Programs

All divisions and sections, as enumerated below, will meet. All divisions and sections will have two full days at their disposal if needed.

Before the general meeting of the Division of Industrial and Engineering Chemistry there will be presented papers by men of national reputation dealing with various phases of industrial chemistry. A whole day will be devoted to a symposium on "Materials of Chemical Equipment Construction." Subject matter will include cement, galvanized coatings, paints, rubber, glass, enamels, stoneware, wood, iron alloys, synthetic resins, laboratory construction, lead, etc. Philip A. Singer is chairman of the symposium.

The Water, Sewage and Sanitation Division announces no special features, but enough titles of papers have been received to insure a good program for that Division.

The Agricultural and Food Chemistry Division will discuss general papers and especially those on jams, jellies, pectin, etc., the first day of the meeting, and the second day will be given over to a symposium on "Insecticides and Fungicides." This symposium will be in charge of F. C. Cook, Bureau of Chemistry, Washington, D. C.

The Division of Cellulose Chemistry is planning a symposium on the subject of "Oxycellulose, Cellulose Hydrate and Hydrocellulose."

The Division of Chemistry of Medicinal Products is planning an interesting meeting. Applicable papers in the related fields of organic chemistry and biology are particularly requested.

The Division of Organic Chemistry is planning a symposium on "Catalysis."

The Division of Dye Chemistry considers this an opportune time to describe and record the accomplishments and the trials of the American dye industry prior to the war and accordingly there has been arranged a symposium on "The Coal-Tar Dye Industry in the United States Prior to 1914." The secretary of the division asks anyone who has any facts bearing on this matter to write him at once. A complete picture is desired.

The Division of Physical and Inorganic Chemistry is arranging an interesting program.

There will be no meeting of the divisions of Fertilizer Chemistry and Leather Chemistry.

The Division of Petroleum Chemistry will hold a joint symposium with the Gas and Fuel Section on "Motor Fuels." The division also hopes to take part in the symposium on "Materials of Chemical Engineering Construction" to be held by the Division of Industrial and Engineering Chemistry.

The Gas and Fuel Section will have a program, including a symposium on "Motor Fuels."

A meeting of the local section chairman and secretaries will be held at New Haven, at an hour and place to be announced on the final program. Round table discussion will take place on the following topics: Sectional programs, sectional finances, sectional community service, employment, and intersectional meetings. The committee on a standard set of local section bylaws will make its report. Chairmen and secretaries are asked to come prepared to take part in this informal discussion. W. Lee Lewis will preside and E. M. Billings will act as secretary.

Papers for the Meeting

Titles for papers should be sent to the secretary of the appropriate division or section and not to the secretary of the society. Titles to appear on the final program must be in the hands of the individual secretaries not later than March 15. It should be stated whether or not a lantern will be required.

Those desiring to present papers should communicate with the proper division or section immediately in order to obtain any special instructions which may apply.

The Council recently empowered officers of divisions to request any paper in advance, in order that it might be passed upon and an indication made to the author as to whether he is to read the entire paper or to abstract it in order to give time for discussion.

By vote of the Council no papers may be presented at the meeting titles for which are not printed on the final program.

"By Title" should be placed on the announcement of any paper where the author is to be absent, so that members may understand in advance that the paper will not be read.

The following are the addresses of the divisional and sectional secretaries:

Divisions

Agricultural and Food Chemistry, C. S. Brinton, U. S. Food Insp. station, 134 S. 2nd St., Philadelphia, Pa.

Biological Chemistry, W. V. Bovie, 332 Elliot St., Milton, Mass.

Cellulose Chemistry, L. F. Hawley, Forest Products Laboratory, Madison, Wis.

Dye Chemistry, R. Norris Shreve, 43 5th Ave., New York City.

Fertilizer Chemistry, H. C. Moore, Armour Fertilizer Works, 209 W. Jackson Blvd., Chicago, Ill.

Industrial and Engineering Chemistry, E. M. Billings, Kodak Park, Rochester, N. Y.

Leather Chemistry, Arthur W. Thomas, Department of Chemistry, Columbia University, N. Y. C.

Chemistry of Medicinal Products, E. H. Volwiler, 4753 Ravenswood Ave., Chicago, Ill.

Organic Chemistry, R. R. Renshaw, Chemistry Department, N. Y. University, University Heights, New York City.

Petroleum Chemistry, W. A. Gruse, Mellon Institute, Pittsburgh, Pa.

Physical and Inorganic Chemistry, Graham Edgar, University of Virginia.

Oil Chemists to Meet in Hot Springs

The fourteenth annual meeting of the American Oil Chemists Society will be held at the Eastman Hotel, Hot Springs, Ark., on Monday and Tuesday, April 30 and May 1, 1923.

Tentative Program Arranged for A.C.S. Spring Meeting

Rubber Chemistry, Arnold H. Smith, Rubber Service Laboratories Co., 611 Peoples Savings & Trust Bldg., Akron, O.

Sugar Chemistry, Frederick J. Bates, Bureau of Standards, Washington, D. C.

Water, Sewage and Sanitation Chemistry, W. W. Skinner, Bureau of Chemistry, Washington, D. C.

Sections

Chemical Education Section, Prof. Neil E. Gordon, University of Maryland, College Park, Md.

Gas and Fuel Section, R. S. McBride, Colorado Bldg., Washington, D. C.

History of Chemistry Section, Dr. L. C. Newell, 688 Boylston St., Boston, Mass.

Section of Local Section Chairmen and Secretaries, Erle M. Billings, 481 Woodbine Ave., Rochester, N. Y.

Local Committees

Edward W. Morley, Honorary Chairman.

Ralph W. Langley, Chairman Hotels and Transportation Committee.

Treat B. Johnson, Chairman Executive and Program Committees.

Julian S. Gravely, Chairman Finance Committee.

C. H. Mathewson, Chairman Entertainment and Reception Committees.

A. J. Hill, Chairman Divisional Programs and Room Committee.

W. T. Read, Chairman Publicity Committee.

W. H. Whitcomb, Chairman Excursions Committee.

Blair Saxton, Secretary and Chairman Registration Committee.

P. T. Walden, Chairman Smoker Committee.

Mrs. John Johnston, Chairman Ladies' Entertainment Committee.

Reduced Railroad Rates

Reduced railroad rates to the New Haven meeting are assured, as in view of the expected large attendance the railroads have agreed to sell round trip tickets at one and one-half fare on the identification certificate plan applicable to all parts of the United States. Tickets may be purchased March 29 to April 6 on presenting an identification certificate obtained from the secretary of the society or from the secretary of any local section, and will be good returning until midnight of April 13. From Colorado (except Julesburg), Idaho, Montana, New Mexico, Utah and Wyoming, Oklahoma and Texas the limits are March 28 and April 14. From Arizona, British Columbia (on Great Northern Railway only), California, Nevada, Oregon and Washington, the limits are March 27 and April 15. Tickets must be validated at New Haven by agents at the regular ticket offices of the lines over which tickets read into New Haven. When validated they will be good for return leaving on any day within final limit. Passengers must reach original starting point within transit time shown on ticket, and in no case later than midnight of April 13, or, in case of special exceptions above stated, April 15.

Tentative Program

MONDAY, APRIL 2

10 a.m. Registration bureau opens in Byers Memorial Hall, Yale University, corner College and Grove Sts.

2:30 p.m.—Council meeting in Y.M.C.A. auditorium, second floor, Byers Memorial Hall.

7:30 p.m.—Councilors' dinner in Ball Room of Hotel Taft.

TUESDAY, APRIL 3

9 a.m.—Registration and reception of members and guests at Byers Memorial Hall.

10 a.m.—General public meeting, Woolsey Hall, Yale University. Addresses of welcome.

Response, E. C. Franklin, president, American Chemical Society.

General addresses by John W. Weeks, Secretary of War, and Francis P. Garvan, president, Chemical Foundation. Complete list on the final program.

1 p.m.—Dutch treat luncheon for ladies and men at University Dining Hall.

2:30 p.m.—General scientific meeting, Woolsey Hall, Yale University. Special addresses will be given, of which the following is one: Carl A. Alsberg, "Chemistry and Our Food Resources."

2:30 p.m.—Ladies will visit Harkness Memorial Quadrangle, Yale Art School, Yale Library or New Haven Historical Society Building. (Guide service will be provided.)

4:30 p.m.—Tea for ladies and men at Faculty Club on Elm St.

8:30 p.m.—Smoker for men at Yale University Dining Hall (special features). Admission by ticket.

8:15 p.m.—Theatre Party, complimentary to visiting women.

WEDNESDAY, APRIL 4

Dedication of the Sterling Chemistry Laboratory. John Johnston, chairman dedication committee. This day will be devoted to functions arranged by Yale University, the chief of these being the dedication of the new Sterling Chemistry Laboratory. The order of the day's program will be as follows:

11 a.m.—Dedication ceremony in the Sterling Chemistry Laboratory. The building will be presented to the university by the Sterling trustees and accepted by President Angell, who will turn the building over to the American Chemical Society for its divisional and sectional meetings. After a reply by President Franklin there will be a special address by Dr. Edgar F. Smith dealing with the history of chemistry in America, with especial reference to Yale.

1 p.m.—Luncheon in the University Dining Hall complimentary to invited guests, ladies and members of the American Chemical Society.

2 p.m.—During the afternoon the laboratory will be open for inspection.

4:30 to 6:30 p.m.—Informal tea in the Sterling Chemistry Laboratory.

8:30 p.m.—Public meeting in Woolsey Hall, open to men and women.

Award of the Joseph Priestley Gold Medal.

Address by a speaker of national reputation (to be announced in the final program).

THURSDAY, APRIL 5

9:30 a.m.—Divisional and sectional meetings—Sterling Chemistry Laboratory, Sloane Physics Laboratory, Osborne Memorial Laboratory and Hammond Metallurgical Laboratory.

2 p.m.—Divisional and sectional meetings—Sterling Chemistry Laboratory, Sloane Physics Laboratory, Osborne Memorial Laboratory and Hammond Metallurgical Laboratory.

3 to 6 p.m.—Ladies will be entertained with an automobile drive to places of interest around New Haven, and with a tea at the Country Club, opposite Lake Whitney.

6:30 p.m.—Fraternity and college alumni dinners, University Dining Hall.

8:30 p.m.—Indoor polo game by Yale University R.O.T.C. given in the Yale Armory, off Derby Ave., near the Yale Bowl. (This contest open to ladies and men and admission will be by ticket.)

FRIDAY, APRIL 6

9:30 a.m.—Divisional and sectional meetings—Sterling Chemistry Laboratory, Sloane Physics Laboratory, Osborne Memorial Laboratory and Hammond Metallurgical Laboratory.

1 p.m.—Luncheon for ladies at the Lawn Club, on Whitney Ave.

2 p.m.—Divisional and sectional meetings—Sterling Chemistry Laboratory, Sloane Physics Laboratory, Osborne Memorial Laboratory and Hammond Metallurgical Laboratory.

8:30 p.m.—Reception tendered by the New Haven Section to the visiting members of the American Chemical Society and their guests. An evening of informal sociability in Memorial Hall of Yale University. Dancing from 9:30 p.m. to 12. Supper will be served at 10:30 p.m.

SATURDAY, APRIL 7

Excursions to industrial plants, informal inspections, etc.

Final Program

The final program will be sent about March 24 to the secretaries of local sections, to the Council, to members of the New Haven Section, and to all members making special request therefor by mailing a postal card or the form printed herein.

N. Y. Chemists Discuss European Situation

W. S. Landis' Observations on Conditions in Germany Arouse Much Discussion

The American Electrochemical Society was host at a joint meeting of the four chemical societies having sections in New York City, in Rumford Hall on Feb. 9. There were two speakers on the program, Harold E. Bishop, of the Radium Company of Colorado, who spoke on the present situation in the radium industry, and W. S. Landis, chief technologist of the American Cyanamid Co., who gave some impressions gathered on his recent trip to Europe.

As Mr. Bishop explained in his introductory remarks, there was no particular connection between the two subjects of the evening's discussion unless it might be found in the fact that the present status of the radium industry in the United States is due to European competition. The original source of radium was the pitchblende deposits in Bohemia, which were finally abandoned in favor of the more extensive, although poorer, carnotite deposits in Colorado. Now the Colorado deposits have in turn been abandoned because of the discovery of some extensive deposits of a very high-grade ore in the Belgian Congo. A plant has been erected near Antwerp which will have a capacity of about 15 mg. of radium per month. The capacity of existing American plants has ranged from 1 to 1.5 mg. of radium per month.

Problems in the Sale of Radium

The sale of radium presents some very extraordinary problems. Its commercial development is comparatively recent, dating back only about 15 years It has been necessary for the radium companies to educate the public to the therapeutic value of radium and to educate the physicians of the country in its intelligent use. In the hands of an unskilled physician, radium is a dangerous agent. The sales organizations that have been built up by the American companies will be kept intact by a working agreement with the Belgian producers under which the American companies will market their product in this country.

Mr. Bishop outlined the method of mining and working the Colorado carnotite and the method of preparing the finished radium bromide for application in the treatment of cancer.

Conditions in Europe

Dr. Landis, after apologizing for the presumption of a chemist who attempts to discuss problems that puzzle economists, gave a very interesting discussion of conditions in Europe as he observed them on a recent 5 weeks' trip. England, he said, has not yet recovered from the post-war depression. Prices there are very high. The most encouraging sign in industry is the recent revival of the shipbuilding. The spinning industry is in bad shape because of German competition, serious on account of the low cost of labor in Germany.

Dr. Landis spoke enthusiastically of the industrial prosperity of Italy. Since the Fascisti have restored the industries to their rightful directors and are gradually driving the Communists out of power in the elections, industries are flourishing. The hydro-electric development of Italy's natural resources is being carried out on a large scale, he said.

Dr. Landis recounted the ludicrous complications arising in Germany from the wild fluctuations of the value of the mark. Wherever possible, he said, wages are being paid in advance, because otherwise, after working for 2 weeks at a certain wage, the workman finds that the value of the mark has depreciated to such an extent that he is unable to purchase even the necessities of life with his wages. Some of the German companies are paying wages in food and necessary supplies. Selling prices, wages and overhead are rising to keep pace with the fall of the mark. German business men are afraid of any attempt to stabilize the mark, because the upward momentum of selling prices, wages and overhead would soon carry the cost of production higher than the selling price and a panic would undoubtedly follow.

Dr. Landis emphasized the fact that since railroad rates are so ridiculously low there must be a tremendous drain on the capital of the railroads. Similarly, tremendous demands are made on capitalists to meet their payrolls, etc. He predicted that the occupation of the Ruhr will cut off the coal supply of Germany and shut down all the steel and chemical plants in Germany, except those south of Berlin.

Much Discussion Aroused

J. S. Negru, managing editor of *Chem. & Met.*, who led the discussion of Dr. Landis' paper, disagreed with the latter on several points. He pointed out that the figures quoted by Dr. Landis showing that in 1913 Germany exported 75,000,000 tons of material while in 1922 this total fell to 20,000,000 tons were deceptive, because they do not show the value of the goods. He inclined to the opinion that the 20,000,000 tons of material exported in 1922 was of far greater value in dollars per unit weight than was that of the 1913 exports. Paper and discussion aroused unusual interest and after the adjournment of the meeting informal discussion continued late into the evening, in the dining room.

Brick Kiln Laboratory Car Dismantled

The railroad car "Holmes," equipped with a field ceramic laboratory and used by the ceramic experiment station, Bureau of Mines, Columbus, Ohio, has been dismantled. The car has been making efficiency tests on fuel-burning practice at different brick kilns in the central district, and has recently completed its survey.

To Investigate Basis for Changes in Chemical Tariff

The Tariff Commission has begun work on a questionnaire to be used in field investigation of eight chemical commodities regarding which applications for changes in tariff rates under the flexible section of the new law have been submitted and which have reached this stage. The identity of the commodities involved will be announced about March 1, when the questionnaires have been prepared and are ready to be sent to the interests involved, according to present plans.

It is the intention of the commission to send agents into the field following these questionnaires, to assist in their preparation and to secure other data needed by the commission. When the field work is advanced sufficiently to form the basis for judgment as to the merits of the applications, those cases which present costs of production making it appear that the tariff rate is either too high or too low will be docketed for public hearing. It is not believed that any hearing will be held before April 15.

More applications for changes in the chemical schedule have been received than for any of the other schedules of the new tariff act, it is announced by the Tariff Commission.

Compiles Useful Data on "Where to Buy"

With the purpose of helping to meet the growing demand for information on research equipment and instruments the Research Information Service of the National Research Council has assembled catalogs and lists of research appliances issued by makers and dealers. Publications of nearly 500 domestic firms and nearly 200 foreign firms are now on file. They have been classified for effective use and a subject catalog of apparatus has been prepared. The Service has also an up-to-date list of manufacturers and distributors of research chemicals. If the Service cannot supply just the information desired, it can generally suggest some useful source of information —manufacturer, dealer or designer.

Chemical engineers and directors of chemical research who desire assistance in locating special instruments, apparatus or supplies for use in their laboratories are invited to avail themselves of the resources of this organization. The appropriate address for inquiries is Information Service, National Research Council, Washington, D. C.

Oil Refineries as Public Utilities

The State Legislature of California is considering a bill introduced by Assemblyman S. L. Helsinger of Sema, classing oil refineries in the state as public utilities and placing them under the jurisdiction of the State Railroad Commission.

Women's Clubs Urge Appreciation of Chemistry

Appeal to American Women Points Out Importance of Chemistry in Home and Everyday Life

A new and important phase of the growing appreciation of chemistry by the American public is emphasized by a pamphlet just issued by a committee of women representing various national women's organizations. The pamphlet is addressed to American women as members of the responsible American public. It urges that women assess anew the value of the intimate and unending service of chemistry to home, community and country and that they assume the obligations resting upon them to bring America abreast of the world's foremost nations in this branch of knowledge which literally underlies our physical and our economic life. The brochure is sent out under the names of Mrs. Thomas G. Winter, president of the General Federation of Women's Clubs; Miss Maude Wetmore, chairman of the women's department of the National Civic Federation; Mrs. Herbert Hoover, national president of the Girl Scouts; Miss Ada L. Comstock, president American Association of University Women, and Mrs. George Maynard Minor, president general of the Daughters of the American Revolution.

Behind in Organic Research

The burden of the message as set forth in the pamphlet is to the effect that this nation has fallen behind in the promotion of research in that branch of chemistry on which rests the preservation of health, the practice of medicine, the elimination of waste from the home and industry by the conversion of that waste into humanly usable products, the improvement and increase in our food supplies, and the conservation of our resources through a wider and more effective utilization of materials.

The pamphlet goes on to give a "sweeping glance over the broad fields of human concerns in which chemistry plays a part." The nitrogen cycle, the formation of coal, the synthesis of perfumes and dyes, fertilizers, rubber and other important chemical products and raw materials are described in simple language. Special emphasis is placed on the chemist as a civic beautifier, particularly in reference to smoke prevention and recovery of industrial waste products.

Pointing out that the growth of organic chemical research in America has been retarded by the lack of public appreciation, the plea concludes with suggested steps to remedy this national fault as follows:

Get the educators and scientists in your own communities in touch with the objective of your organization activity. Find out what bearing the development of chemical research has upon that objective.

Find out what research equipment personnel in your community and state and in the nation are devoted to the subjects in which you are interested.

Look into the educational systems of your own community and state, and learn what place is assigned in the curricula to chemistry. See what your local libraries have in the way of authoritative and interesting literature on organic chemistry.

Study carefully and decide for yourselves whether the organic chemical industries are necessary as an assurance of support of the American young men and women who may be induced to choose a career in the field of organic chemistry as a result of your enlivening activities.

When you have gathered this information through group study, take counsel with other groups of women who have been studying the same subject and with the men who are concerned and active in the development of organic chemistry and an organic chemical personnel in America.

With this information and with this counsel, formulate your own idea as to what national and state policies should be put into effect for the surest development and maintenance of an American organic chemical personnel adequate to our national needs.

Act in accordance with the judgment you have thus formed, and demand of those opposing your course of action a clear explanation of the motive and grounds of their opposition.

In concluding, the brochure voices a thought which is worthy of consideration. It is pointed out that it is the general sympathetic understanding of the creative achievements and purpose of chemistry which furnishes the favorable condition for the growth of creative research. "There are but a few great musicians, poets, painters and sculptors, but there are millions of lovers of music, poetry, painting and sculpture. The appreciation of the millions is the life-sustaining if not life-creating atmosphere of the masters of science as well as of art."

Paper Show Will Attract Many to New York

Feature Days and Educational Attractions Make Up Elaborate Schedule for Paper Week

A series of special days for different groups of visitors to the Paper Industries Exposition is being arranged for the paper show which will be held at Grand Central Palace the week of April 9. In arranging these special days, care is being taken to avoid conflict with the conventions of the American Paper and Pulp and National Paper Trade and their affiliated associations. On each of the special days, special programs will be arranged, with authorities on various lines of activity as the chief speakers.

Printers' and Publishers' Day has been set for Friday, April 13. Thursday will probably be selected as Clean Food Day, with the program devoted to the utilization of paper and pulp containers for the protection of food from filth. Thursday will also be a special day for the manufacturers and merchants in attendance at the conventions to be held during paper week at the Waldorf-Astoria. The tentative program for the American Paper and Pulp Association, which will have its annual meeting and banquet on Thursday, April 12, provides for the holding of a strong forenoon program, but leaves the afternoon open for those in attendance at the convention to visit the Paper Industries Exposition. The manufacturers will then be able after their visit to the exposition to return to the annual banquet in the evening. The holding of Printers' and Publishers' day on Friday gives the merchants and manufacturers an opportunity to spend the day in visiting with their customers at the exposition.

Badges to Admit to Show

In order to facilitate the attendance of the merchants and manufacturers at the exposition, the management has arranged to make the badges of the different associations the only requisite for admission, those wearing association badges being admitted free as guests of the managers of the big paper show. In order still further to facilitate their attendance, the American Paper and Pulp Association has arranged that not only the badges but the registration cards of those in attendance at convention sessions be recognized as passes to the exposition.

While these arrangements for the program of the Paper Week have been in the process of completion, the work of assigning exhibits to space in the exposition has not been lagging. There are now upward of fifty-five exhibitors who have either closed contracts for space or made reservations of space pending the closing of formal contracts. Two or three of the biggest of the paper-manufacturing companies are among those which are now planning to place exhibits, and one of these at least is considering the taking of several booths in order effectively to show its product.

Educational Features

The latest of the educational exhibits to be definitely closed is that of the Bureau of Foreign and Domestic Commerce, which has accepted the offer of space made by the exposition management and which is planning to make an effective presentation of the work done by the whole bureau in general and more specifically the activities of the paper division of the bureau.

Basing its plans on the belief that the exposition is to be an educational exhibit for the public, as well as a special showing of paper to printers and publishers and of paper-making machinery and supplies to the paper manufacturers, special invitations are being sent to the various schools interested in paper, either by its use or in its manufacture, to have their students attend. The students of Columbia University's chemical engineering course, for instance, will be invited to take advantage of the exposition.

Not the least notable of the student group to be invited will be the pupils in the printing schools conducted in New York and vicinity. They will probably be invited to attend on Printers' and Publishers' Day, when the printers will be invited to bring their questions, with the manufacturers of paper on hand ready to answer the questions of the printers, who after all are the largest group of customers of the paper industry.

"Tell Ford Yes or No," Sentiment in Senate

Proposal of Appropriation for Experimental Work on Plant No. 1 Brings Up Muscle Shoals Again

While the probabilities are much against any action on Henry Ford's Muscle Shoals proposition at this session of Congress, the friends of that offer contend that they still have a chance to obtain a vote not only in the House but in the Senate as well. The unexpected happens many times during the closing days of a Congress when unexpected alignments are formed in the frenzied efforts to get certain legislation through the jam. It is entirely conceivable that some trade may be effected which would permit of a vote on the Ford offer.

It is known that Senator Underwood's contention, made recently on the floor of the Senate, that since Mr. Ford's bid was submitted as a result of a formal request from the government it should be accepted or rejected, has impressed a number of Senators who are not advocates of the Ford proposal. During that debate it was contended that it is a universal rule of business ethics that when bids are invited, the bidders must be told whether their proposals are accepted or rejected. Senator Underwood characterized the long delayed action on the Ford offer as being a very cavalier way in which to treat any bidder. Senator Williams said it was worse than cavalier and suggested "puritanical" as the proper adjective.

No Excuse for Delay

Senator Underwood called attention to the fact that there no longer is any controversy about the completion of the Wilson dam, since each house has authorized the engineers to make the final contract for its completion. He pointed out that within 3 years at most a great electrical plant will be ready for operation at Muscle Shoals, and the issue before Congress is whether it is to be operated by private effort or as a government institution.

The debate in the Senate was brought about by an amendment proposed by Senator Norris suggesting an appropriation of $2,000,000 for the installation of new machinery in Nitrate Plant No. 1, so that the plant could be used for experimental purposes. He argued that such a proposal should not be objectionable to Mr. Ford, since he would have to conduct such experiments if his offer were accepted. The amendment was opposed on the ground that it would complicate the situation by additional expenditures, additional experimentation and additional contracts. The trend of the debate made it clear to Senator Norris that the amendment could not prevail and he therefore withdrew it.

Ladd Thinks Haber Process Hopeless

Senator Edwin F. Ladd, the only chemist in the Senate, rose to discuss the proposed appropriation. He urged speedy decision on the disposal of the Muscle Shoals property, but opposed the expenditure for experiments on the Haber process at Plant No. 1. He declared that the plant was built upon an assumption and resulted in a failure.

The Senator from North Dakota then went into considerable detail regarding explosions that have occurred in plants where the Haber process is used. He quoted newspaper accounts of the Oppau explosion and dwelt upon accidents which have occurred in the Haber plants in this country.

"Only a volcano could be compared with the Oppau explosion," he declared. "I maintain, Mr. President, that the science of nitrogen fixation has progressed far enough so that it is not necessary to erect a volcano in a civilized community to supply this country with nitrogen for its military explosives."

Equipment Association Appoints Committees

Announcement is made from the headquarters of the Chemical Equipment Association, 1328 Broadway, New York City, of the appointment of the following standing committees:

Ethics: D. W. Sowers, Sowers Manufacturing Co.; A. B. McKechnie, Parks-Cramer Co.; W. B. Tardy, Schutte & Koerting Co.

Standardization: E. H. Froman, Fuller-Lehigh Co.; Hamilton Allport, E. B. Badger & Sons Co.; Hubert Royer, General Ceramics Co.

Membership: J. George Lehman, Bethlehem Foundry & Machine Co.; M. A. Knight, Maurice A. Knight; T. C. Oliver, Chemical Construction Co.

Industrial Relations: Edward J. Fowler, Pacific Foundry Co.; E. J. Sweetland, United Filters Corporation; J. W. Bodman, William Garrigue & Co.

Business Extension: J. W. Spotten, United Lead Co.; H. N. Spicer, Dorr Co; H. P. MacGregor, Merrill Co.

Statistics: R. Gordon Walker, Oliver Continuous Filter Co.; C. W. Pearson, Buffalo Foundry & Machine Co.; P. S. Barnes, Pfaudler Co.

Legislation and Publicity: Irving Fellner, *Chem. & Met.*; H. T. Matthew, Quigley Furnace Specialties Co., Inc.; Paul O. Abbé, Inc.

Some of these committees are not yet active, because their members have not yet been able to get together, but the scope of activity and the methods to be followed by each of the committees are nearing final definition, and within the next few weeks it is hoped to have undertakings under way which will involve the co-operation of government officials and bureaus, leading figures in the various equipment using industries, and the members of the association.

The association has adopted insignia for use on the stationery of members and in advertising, etc. The insignia consist of a monogram of the initials of the association and the motto, "Better to Serve Industry."

To Fight Ford in Defense of Waterpower Act

National Committee Formed for the Purpose Points Out Evil of Establishing Precedent

Declaring that the terms proposed by Mr. Ford to the government for the leasing of the Muscle Shoals power site are in flagrant violation of the principles of the federal waterpower act of 1920, a voluntarily organized committee including in its personnel many of the men who, in official positions, worked for the passage of the waterpower act has voiced strong disapproval of the Ford proposal. The committee includes former Secretaries of War Garrison, Stimson and Baker; former Secretaries of the Interior Garfield and Fisher; former Secretaries of Agriculture Meredith and Houston; Governors Parker of Louisiana, Dixon of Montana, Gifford Pinchot of Pennsylvania, former Governors Allen of Kansas and Pardee of California.

A pamphlet is being circulated, written by Herbert Knox Smith of Hartford, Conn., who was Commissioner of Corporations under the Roosevelt and Taft administrations and who conducted an exhaustive investigation of the waterpower problem. In this article the original objects of the waterpower act are set forth and contrasted with the provisions of the Ford Muscle Shoals proposal. It is pointed out that the real vice of this proposal is not in the immediate money loss, but that it is a flagrant violation of the waterpower act, which was passed purely for the protection of the public. The points of violation are enumerated as follows:

> It is a grant for 100 years
>
> It provides for no rental payments whatsoever for the use of the site, and only an absurdly small rental for the use of the works built with government money.
>
> There is no provision whatsoever to prevent the making of excessive profit on the Ford company's actual investment, nor to require any transfer of such excess to the public.
>
> There is no regulation whatsoever of the distribution or use of the power.
>
> There is no provision that it shall be used for public service in any way.
>
> The Ford company is not required in any way to contribute to the cost of storage reservoirs hereafter built upstream Such reservoirs would enormously increase the value of the Ford company's site, and the government is now making a survey for such storage developments

The point made in the article is that the real danger of the scheme lies in its force as a precedent, since it would apply to all other developments, existing and future.

Germany to Pay Italy in Books

Italy has agreed to accept as part of the reparations due her from Germany books and scientific publications to the value of 4,000,000 gold marks. Italy will furnish a list of her requirements. The gaps in the collections in her public libraries have been carefully cataloged, and it is these gaps that Germany will fill. Many valuable scientific works published before the war will be assigned to Italy's scientific institutions and museums.

Liquid Oxygen as an Explosive

As an appropriation will be available July 1 for a further study of liquid oxygen explosives by the Bureau of Mines, the tests made recently at Martinsburg, W. Va., by Adolf Messer, a German manufacturer, were of particular interest to the specialists of the bureau who were present. George S. Rice, the bureau's chief mining engineer, who has done a great deal of work on liquid oxygen and who will be in immediate charge of the work to be done under the new appropriation, attaches great significance to the Martinsburg tests, since they show how successfully liquid oxygen can be used in deep holes. He believes that the use of liquid oxygen in shallow holes has been worked out thoroughly and demonstrated to be entirely practicable. For that reason he plans to devote most of the bureau's appropriation to the study of the technique involved in the shooting of deep holes with liquid oxygen.

Mr. Rice has no idea that there will be any extensive supplanting of dynamite by liquid oxygen, but under certain conditions he believes liquid oxygen can be used to greater advantage than other explosives. This is particularly the case in cities and congested areas, where the transportation of ordinary explosives is undesirable. He expects it to appeal to users where there is difficulty in preventing thefts of ordinary explosives and at times when outrages might follow the availability of explosive supplies which could be pilfered by misdirected persons.

Under some conditions, however, Mr. Rice believes liquid oxygen will be used in mining operations. He calls attention to the fact that nearly two-thirds of the iron ore mined in Lorraine is shot down with liquid oxygen. It is his opinion that conditions are ideal for the use of this explosive in Alabama iron mines. That it is reaching the point of practical use may be judged from the fact that a plant is about to be installed at a mine in northern New York. He does not believe its use is desirable in any coal mine, whether gaseous or not.

New Jersey Third State in Clay Production

According to a preliminary report compiled by the State Department of Conservation and Development, New Jersey, that state stands third among those of the Union producing clay and burned clay materials. The total value of pottery production for 1920, the year which the report covers, was $24,597,376, while that of brick and tile aggregated $15,423,652, a total of $40,021,028. According to the statistics, Ohio ranks first in the line of ceramic production with a total of 21.9 per cent of the aggregate output of clay products in the United States; Pennsylvania comes next with 13.6 per cent; and New Jersey follows with 10.7 per cent.

Personal

William Barr, formerly with the Los Angeles branch of the Hughes Tool Co., is now production manager for the Regan Forge & Engineering Co., San Pedro, Calif.

John A. Coe has been re-elected president of the American Brass Co., Waterbury, Conn., and Charles F. Brooker has been re-elected chairman of the board.

A. Clayton Clark, superintendent at the plant of the Raritan Copper Works, Perth Amboy, N. J., has been elected president of the local board of education.

W. D. Collins, of the U. S. Geological Survey, delivered an address before the Washington Academy of Sciences, Feb. 15, on the subject "The Industrial Aspects of Modern Methods of Water Purification."

L. C. Cooley has accepted a position as plant engineer with the United States Industrial Chemical Co., Baltimore, Md.

Edward A. Dieterle has resigned his position as chief chemist of the Chicago By-Products Coke Co. and is resuming consulting engineering work with headquarters in Chicago.

W. E. Emley of the Bureau of Standards recently delivered a paper before the Sand-Lime Brick Association.

Albert P. Matthews, professor of biochemistry, College of Medicine, University of Cincinnati, gave an interesting address at the meeting of the Indianapolis, Ind., section of the American Chemical Society, Feb. 9, at the Indianapolis Chamber of Commerce on the subject of "New Light on the Origin of the Organic Substances on the Earth's Surfaces"

George S. Rice, the chief mining engineer of the Bureau of Mines, has been selected as the bureau's delegate to attend the Mining Exposition and Conference which will be held in London, June 1 to June 14. He will sail from New York on May 12. Following the exposition he will visit other countries of Europe to continue his study of mining methods. He also will devote a considerable portion of his time to a study of the improvements made in the manufacture and use of liquid oxygen.

Dr. Hugo Schlatter will deliver a lecture before the Philadelphia Section of the A.C.S. on "The Manufacture of Artificial Silk" and will also be the principal speaker at the March meeting of the N. J. Chemical Society.

Dr. Edwin E. Slosson of Washington, D. C. recently addressed the Technology Club of Syracuse N. Y. on "Creative Chemistry."

James Vail of the Philadelphia Quartz Co. gave a paper last week before the American Ceramic Society. He will shortly sail for Europe to be gone about 2 months.

Obituary

Robert W. Hilton, president of the Hilton-Davis Co. and formerly vice-president of the Ault & Wiborg Co., died Feb. 5, following a 3-day illness at his home in Cincinnati. He was 49 years old. A complication of influenza and pneumonia caused his demise.

Lysle R. Kraus, secretary of the Kraus Research Laboratories, Inc., died Tuesday, Feb. 6, from the result of a railroad accident. Mr. Kraus was born Nov. 21, 1893, at Cockeysville, Md., was graduated from the Sparks Agricultural College in 1914 and was one of the founders of the Kraus Research Laboratories, Inc., and associated himself with the company in the capacity of ceramic engineer. In the ceramic field Mr. Kraus invented several processes for the plasticizing of clays and developed many bonding clays of exceptional value. His research work in refractories was very exhaustive—making improvements over present-day methods and producing several new refractory bases.

H. J. Seaman, for many years general superintendent of the Atlas Portland Cement Co., of 30 Broad St., New York City, died on Feb. 9, in Atlantic City. Mr. Seaman was a graduate of Lafayette College, Easton, Pa., and had played an important part in the building up of a very essential manufacturing industry, which has always been classed as a chemical industry since the early stages of its development. Previous to his connection with the Atlas Portland Cement Co., Mr. Seaman was associated with Mr. Hurry, a prominent English engineer, and together they introduced the use of pulverized coal for burning portland cement clinker in rotary kilns.

Arthur C. Stallman, president of Arthur Stallman & Co., crude drug merchants of New York, died Feb. 8, at his home in Mt. Vernon, N. Y., from pneumonia, at the age of 52. He was born Sept. 22, 1871, in New York. Mr. Stallman was the son of the late John Henry Stallman and Sophie M. C. (Frentz) Stallman. He became associated with his father in the crude drug firm of Stallman & Fulton, one of the earliest and best-known houses in that trade. His father died in 1908 and the firm was dissolved. In 1912 Mr. Stallman started the business that now bears his name.

Milton Franklin Williams, president of the Williams Patent Crusher Co., St. Louis, Mo., died Feb. 8, from septic pneumonia, although he had been confined to his home for the past 18 months suffering from diabetes. Mr Williams went to St. Louis more than 50 years ago and started as a millwright in a small machine shop. He originated the swing hammer crusher and pulverizer in 1895, and in 1897 incorporated his machine works under the present name.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

Chemical Exports Show Gradual Recovery in 1922

Improvement at a Time When Total Exports Show Marked Decline Is Generally Regarded as Indicative of Better Business Conditions in Chemical and Allied Industries

CHEMICAL and kindred industries showed a surprising improvement in export trade during 1922. In the face of a decrease in general exports from $4,378,928,024 in 1921 to $3,765,192,135, the shipments of American chemicals showed a gain in aggregate value of 1.4 per cent. The figure for the year was $106,101,562, as contrasted with $104,639,941 during 1921. The chemical division of the Commerce Department points out that among the subsidiary commodity groups contributing to this gain, explosives rose 50 per cent in value over 1921, perfumery and cosmetics increased 33 per cent, medicinals and pharmaceuticals 11 per cent and fertilizers 3 per cent.

Pigments, paints and varnishes, it is also pointed out, have shown a steady although rather sluggish tendency to improve. However, the total for 1922 is 5 per cent below last year's. It is of interest to note that the 26 per cent decrease (from corresponding 1921 values) that marked the first half was compensated in large measure by the 31 per cent increase of the last half of 1922. The exports for December, 1922 ($1,096,320), were the greatest for any one month since February, 1921.

Encouraging Comment

Only three groups of American exports in 1922 showed an increase over the previous year; "chemicals and allied products" was one of the three. True, the gain was only 1.4 per cent, yet when this is set off against decreases ranging from 8 to 31 per cent for other groups, a feeling of satisfaction at the year's outcome is not unwarranted.

With a continuance of the spirit of organization and co-operation manifested during the past year there would seem to be no reason why the chemical industry should not now go steadily forward.—*C. C. Concannon, Acting Chief, Chemical Division, Department of Commerce.*

Coal-Tar Products Lagging

General chemicals failed to reach their 1921 level by 4 per cent, exports for 1922 having a total value of $51,712,005, contrasted with $54,041,996 a year ago. Foreign sales of benzol (64,740,402 lb., valued at $2,362,821) were 10 per cent in quantity and 21 per cent in value below those of 1921 (72,030,400 lb., worth $3,007,086). Coal-tar colors, dyes and stains other than color lakes likewise lost ground, dropping from $5,067,000 to $3,981,217, but crude coal tar increased from $191,482 (92,406 bbl.) to $208,666 (99,960 bbl.). Carbolic-acid exports decreased from $35,994 (219,658 lb.) in 1921 to $23,223 (223,146 lb.) in 1922.

Among other coal-tar products, $65,636 worth (341,820 lb.) of aniline oil and salts, $224,546 worth (554,166 lb.) of medicinals, and $103,853 worth (248,119 lb.) of photographic chemicals were shipped from the United States to foreign countries in 1922. The corresponding 1921 figures for these items are not available.

Foreign sales of wood and denatured alcohol doubled in value and tripled in quantity, rising from $454,584 for 412,110 gal. in 1921 to $922,700 for 1,270,314 gal. in 1922. A large decrease occurred in exports of other alcohol—from $2,338,838 for 5,611,897 proof gallons to $497,955 for 2,090,666 proof gallons.

Heavy Chemicals Show Important Gains

Heavy chemicals showing important expansions in quantity in 1922 over 1921 included copper sulphate, which increased 46 per cent, acetate of lime 51 per cent, bleaching powder 123 per cent, glycerine 20 per cent, potassium chlorate 50 per cent, sodium silicate, or water glass, 40 per cent, sal soda 10 per cent, and sodium bicarbonate 35 per cent; but the largest increases of all under this classification were in borax, which increased more than 300 per cent, and caustic soda, which rose nearly 200 per cent. Specific figures of the exports of these and other chemicals are given in Table I, which will be found on page 376.

Exports of sulphuric acid dropped off from $317,720 (12,814,344 lb.) in 1921 to $201,267 (12,470,389 lb.) in 1922.

Throughout 1922 the foreign demand for explosives was encouraging, growing until during December the peak was reached with 2,939,283 lb., valued at $504,942, exported. Total shipments abroad for the year were 19,212,449 lb., worth $3,400,391, compared with 10,433,830 lb., worth $2,285,849, in 1921. Of this group, the only class for which comparative figures are available is dynamite, with increases of 47 per cent in quantity (from 9,567,442 to 14,105,017 lb.) and 33 per cent in value (from $1,815,999 to $2,406,398). There were also shipped abroad during 1922 925,840 lb. ($369,848) of smokeless powder, 410,705 lb. ($129,216) of other gunpowder, 3,227,956 lb. ($366,686) of blasting powder, and 125,308 lb. ($54,267) of cordite, guncotton, etc.

Phosphate Rock Competition Expected

The expected drop in foreign demand for phosphate rock as a result of the recent development of the Moroccan phosphate mines has not yet materialized. The development of the Moroccan phosphate deposits is receiving serious attention, and competition with American phosphates is expected. During the next few years it will be interesting to observe the actual effect on American exports. Although sales of high-grade phosphate rock rose in quantity from 182,594 tons (value $2,592,541) in 1921 to 202,300 tons (value $2,548,587) in 1922, those of land pebble declined from 544,425 tons ($4,267,875) to 512,777 tons ($3,269,179) and of other phosphate rock from 6,293 tons ($99,721) to 4,217 tons ($40,401).

In addition to these fertilizers and fertilizer materials, there were shipped abroad in 1922 2,556 tons ($26,112) of calcium cyanamide 1,576 tons ($78,047) of other nitrogenous materials and 14,416 tons ($600,972) of prepared fertilizer mixtures.

"Chem. & Met." Weighted Index of Chemical Prices

Base 100 for 1913-14

This week	176.31
Last week	175.64
February, 1922	148.00
February, 1921	166.00
February, 1920	252.00
April, 1918 (high)	286.00
April, 1921 (low)	140.00

Included in this index are acetic, citric, hydrochloric, nitric, and sulphuric acids, ethyl and methyl alcohols, anhydrous ammonia, ammonium sulphate, barium chloride, bleaching powder, borax, caustic potash, caustic soda, copper sulphate, formaldehyde, glycerine, potassium carbonate, salt cake, soda ash, sulphur, benzine, aniline, and cottonseed and linseed oils.

Coal-Tar Products Show More Activity

Crudes in Scarce Supply—Intermediates in Fairly Good Demand—Material Improvement Generally Noted

The general market for coal-tar products appeared rather steady, and prices throughout the list were well maintained. Crudes continued in limited supply and producers reported a heavily sold up condition at the works. Phenol, cresylic acid, solvent naphtha and pyridine were in strong demand, but sales were rather small, due to the scarcity of stocks. Intermediates were held in strong producing hands and prices were fairly well sustained. Alpha-naphthylamine, aniline oil, H acid and beta naphthol showed considerable activity at prevailing quotations.

Dull Market for Chemicals

However, a Few Bright Spots Were Noticed—Calcium Acetate Selling in Good Quantity

Trading in industrial chemicals last week was rather dull in the New York market, due undoubtedly to the intervening holiday and the extreme conservatism shown by leading consumers. The transportation situation was slightly improved, but still far below normal.

Producers of oxalic acid announced another decrease in price, said to be due to the sharp foreign competition and the lack of consuming interest. Arsenic and its compounds continued to feature the spot market. Buyers experienced some difficulty in procuring any round lots for March shipment, due to the heavily sold up condition abroad and at the works. The alkali market is progressing along moderate lines and with some improvement resulting from the better railroad transportation. Buyers have been able to transact considerable additional business. Bleaching powder, caustic potash, prussiate of soda, sal ammoniac and barium chloride continued along fairly active lines at prevailing quotations. Slightly lower prices were noted for formaldehyde and carbonate of potash.

Price Changes

Bleaching Powder—Producers continued to quote \$2 per 100 lb., f.o.b. works, in large drums. Resale goods were held around 2½c. per lb. Demand was rather active, in view of the sold-up condition at the works.

Calcium Acetate—Leading producers quoted 3½c. per lb., f.o.b. works in bags. The demand was said to be good and the dealers expressed their satisfaction at the general volume of business.

Caustic Potash—The market appeared somewhat slower than previously noted, although prices were well maintained around 7¼@7½c. per lb. Shipments from abroad were quite firm at 7½c. per lb., c.i.f. N. Y.

Caustic Soda—Domestic consumers continued to purchase in fair-sized tonnages at \$3.75 per 100 lb. ex-store N. Y. Export business was quiet, with odd lots selling around \$3.40@\$3.45 per 100 lb. f.a.s.

Carbonate of Potash—Prices were fractionally lower, due to the lack of consuming interest. Calcined 80-85 per cent was quoted around 5¾c. per lb., with 96-98 per cent at 7¼@7½c. per lb.

Formaldehyde—Resale material was quoted somewhat lower, due to surplus stocks. Producers continue to quote 16c. per lb. in carlots and 16½c. in smaller quantities. Resale goods was quoted at 15½c. per lb.

Soda Ash—Leading dealers were quoting standard goods at \$1.75 per 100 lb., f.o.b. N. Y. in carload lots, single bags. The demand was merely routine, with actual transactions rather limited. Contracts continued at \$1.20 per 100 lb., basis 48 per cent, f.o.b. works in single bags.

TABLE I—EXPORTS OF CHEMICAL AND ALLIED PRODUCTS, 1921 AND 1922

Article	Unit of Quantity	1921 Quantity	1921 Value	1922 Quantity	1922 Value
Chemicals and allied products (total)			\$104,639,941		\$106,101,562
Coal-Tar Products					
Crudes—					
Benzol	Lb	72,030,400	3,007,086	64,740,402	2,362,821
Crude tar	Bbl	92,406	191,482	99,960	208,666
Toluol	Lb			180	24
Solvent naphtha	Gal			170,373	62,803
Other crude distillates	Lb		509,508	4,147,866	91,342
Intermediates					
Carbolic acid	Lb	249,658	35,994	223,146	23,223
Aniline oil and salts	Lb			341,820	65,636
Naphthalene	Lb			109,514	12,657
Nitrobenzol	Lb			42,980	5,296
Other intermediates	Lb			847,311	168,228
Finished products					
Color lakes	Lb			28,228	19,928
Other colors, dyes, and stains	Lb		5,067,000	8,324,209	3,981,217
Medicinals	Lb			554,166	224,546
Synthetic phenolic resins	Lb			128,153	13,183
Photographic chemicals	Lb			248,119	103,853
Other coal tar finished products n.e.s.	Lb			6,280,989	285,914
Acids and Anhydrides					
Acetic	Lb			5,080,519	367,717
Sulphuric	Lb	12,814,344	317,720	12,470,389	201,267
Nitric	Lb	177,580	26,176	675,025	48,478
Boric	Lb			1,968,996	197,265
Lactic	Lb			198,674	14,221
Picric	Lb	1,742	927		
All other acids and anhydrides	Lb		1,171,992	9,518,087	626,057
Alcohols					
Wood and denatured	Gal	412,110	454,584	1,270,314	922,700
Other alcohol	Pf Gal	5,611,897	2,338,838	2,090,666	497,955
Aluminum and Ammonium Compounds	Lb			7,247,480	990,111
Aluminum sulphate	Lb			26,450,657	388,447
Baking powder	Lb	3,888,875	1,493,202	3,428,395	1,515,735
Calcium Compound					
Acetate of lime	Lb	18,239,740	404,528	27,596,106	591,599
Calcium carbide	Lb	11,808,252	606,999	12,835,916	633,297
Chloride of lime or bleaching powder	Lb	18,447,579	483,752	41,069,188	679,775
Chloroform	Lb			54,897	20,282
Copper sulphate (blue vitriol)	Lb	3,582,933	217,491	5,250,556	256,432
Dextrine	Lb			16,239,474	536,027
Formaldehyde (formalin)	Lb		349,089	1,940,577	209,386
Glycerine	Lb	2,394,714	361,507	2,870,463	425,891
Magnesium sulphate	Lb			1,420,877	35,947
Potassium Compounds					
Chlorate	Lb	375,401	49,709	562,986	51,066
Bichromate	Lb			4,430,208	433,552
Other	Lb		286,284	7,483,175	296,378
Sodium Compounds					
Cyanide	Lb			1,250,566	235,298
Borax	Lb	4,061,633	269,771	17,242,571	867,417
Soda ash	Lb	35,042,791	850,369	29,627,574	678,983
Silicate	Lb	20,789,095	247,761	29,131,925	302,511
Sal soda	Lb	10,354,513	204,616	11,463,418	186,284
Caustic soda	Lb	49,865,219	2,041,236	146,739,406	5,271,528
Bicarbonate	Lb	11,703,183	307,138	15,853,945	341,385
Other	Lb		2,584,953	97,518,488	2,439,228
Thorium nitrate	Lb			1,103	3,149
Zinc chloride	Lb			268,503	16,873
Chemical Pigments					
Zinc oxide	Lb	5,021,509	\$426,253	7,953,847	\$593,128
Lithopone	Lb			3,231,722	169,982
Sublimed lead (basic sulphate)	Lb			524,975	36,584
White lead (basic carbonate)	Lb	10,321,415	993,130	9,196,656	710,765
Paints, Stains, and Enamels					
Enamel paints	Lb			1,501,520	418,521
Flat interior paints	Gal			14,503	34,807
Other ready mixed paints	Gal	1,397,043	3,150,804	1,337,393	2,734,325
Other paints	Lb		3,339,610	10,188,353	1,720,360
Varnishes	Gal	665,437	1,399,110		
Spirit varnishes	Gal			46,348	80,127
Oil varnishes	Gal			376,416	657,117
Other varnishes	Gal			352,331	533,844
Calcium cyanamide	Ton			2,556	26,112
Sulphate of ammonia	Ton	102,614	6,098,406	147,331	8,736,611
Phosphate Rock					
High-grade hard rock	Ton	182,594	2,592,541	202,300	2,548,587
Land pebble	Ton	544,425	4,627,875	512,777	3,369,179
Other phosphate rock	Ton	6,293	99,721	4,217	40,401
Superphosphates (acid phosphates)	Ton	4,278	96,303	24,373	360,402
Explosives (total)	Lb	10,433,830	2,285,849	19,212,449	3,400,391
Dynamite	Lb	9,567,442	1,815,999	14,105,017	2,406,398
Nitrocellulose (cordite, guncotton, etc.)	Lb			125,308	54,267
Vegetable Oils:					
Cottonseed oil	Lb	252,548,666	24,361,974		
Crude	Lb			31,712,143	2,508,696
Refined	Lb			43,590,678	4,778,446
Peanut oil	Lb.	1,708,335	183,433	963,102	100,691
Linseed oil	Lb	3,512,228	406,460	2,702,634	332,781
Soya-bean oil	Lb.	1,943,768	176,753	2,458,080	207,288
Corn oil	Lb.	4,399,789	491,499	5,732,993	678,180

Smaller Volume of Business in Chicago Market

Prices Are Well Maintained, but Dealers Are Showing Concern Because of General Inactivity

CHICAGO, ILL., Feb. 15, 1923.

Business in industrial chemicals has not been so good during the past 2 weeks and dealers displayed some concern over the change. The dullness of the market brought on some price cutting from worried holders, but in general prices were fairly well maintained. Spot stocks were in fair condition, but the poor freight service made shipments slow. Conditions abroad were getting worse instead of better and it is expected that in the near future material of foreign origin would be both high priced and scarce.

Principal Price Changes

The spot price on *caustic soda* was reduced 10c. per 100 lb. by leading factors. This reduction brings ground caustic to \$4.15 per 100 lb. and solid \$3.40. *Caustic potash* was very firm due to the scarcity of supplies and the situation in Germany. Spot material of the 88-92 per cent grade was held at 8@9c per lb., price according to quantity and the seller. *Soda ash* was in fair demand and was unchanged at \$2.25 per 100 lb. for material in cooperage.

Potash alum was scarce on spot and only small lots were available at 4½@5c per lb for the iron-free lump. The powdered grade was available only in one direction and was quoted at 8½c per lb. *Ammonium carbonate* was quiet and unchanged at 9@10c. per lb. for the lump. *Sal ammoniac* was available from one source at 7¾c. per lb., but the general quotation was 8c. *Barium chloride* was quiet at \$110 per ton. *Barium carbonate* of foreign origin was quoted in small lots at \$100 per ton, but with a fair-sized order this could have been shaded considerably. *White arsenic* was well maintained in price and only small lots were to be had at 17@17½c. per lb. *Carbon tetrachloride* was available from one dealer at 9½c. per lb., although the general asking price was 10@10½c. *Carbon bisulphide* was unchanged at 7½c. per lb for spot goods. *Copper sulphate* was quoted in some quarters at 6¼c. per lb., but odd lots were still available at 6c. *Formaldehyde* displayed no signs of weakness and was quoted at 17c. per lb. *Glycerine* was not so firm and there was less talk of an advance; c.p. material in drums was quoted at 18½c. per lb. delivered. *Lead acetate* was quiet and unchanged at 12½c. per lb. for white crystals.

Potash Salts Advancing

Practically all potash salts were very firm, with advances noted in several cases. *Potassium bichromate* was in fair demand and supplies were quoted at 12½@13c. per lb. *Potassium carbonate* 96-98 per cent was quoted at 9@10c. per lb. for delivery from stock. *Potassium cyanide* 96-98 per cent was to be had only in one direction and was quoted at 55c. per lb. in single-case lots and 2c. less for five cases. *Yellow prussiate of potash* was available at 40c. per lb and the red was generally quoted at 90@92c. per lb. *Potassium permanganate* was firm, with moderate lots of the U.S.P. crystals available at 18@19c. per lb.

Sodium bisulphite was in fair request and powdered material was generally quoted at 6c. per lb. Material for shipment from the East was somewhat cheaper. *Sodium fluoride* was quiet at 10@10½c. per lb. *Zinc chloride* granulated was quiet at 8c. per lb. for domestic material and foreign slightly lower.

The demand for *linseed oil* was far from heavy but the price continued to advance. Boiled oil was quoted today in single-drum lots at \$1.06 per gal., with similar quantities of the raw at \$1.04.

Turpentine was in a position similar to that of linseed oil. The movement was only fair, but the price was well maintained at \$1.53 per gal. in single-drum lots.

Advancing Market for Steel Products

Tendencies That Became Evident in January Have Resulted in Numerous Price Advances

PITTSBURGH, Feb. 16, 1923.

Many sellers of steel liken present conditions in the steel industry to those obtaining in 1920, on the eve of an enormous advance in steel prices for early delivery. In that period the mills received a great deal of money, but afterward, with various losses and adjustments, it was found that they had retained very little. Accordingly the mills profess anxiety to avoid a repetition of the 1920 performance. Possibly there is an ambition, however, to repeat in a more moderate way the price advances but avoid entirely the subsequent losses.

Thus far, at any rate, steel prices have not been pegged, the market showing fully as much advancing tendency as in the past 3 or 4 weeks, and more advancing tendency than in the first 2 or 3 weeks of January.

Numerous Price Advances

Bars, shapes and plates, quotable for 2 or 3 weeks past at a range of 2.10@2.20c., are now practically at 2.20c. as minimum, with the usual exception of large lots for late delivery against construction jobs.

While most of the independent sheet mills remain out of the market, refusing to commit themselves on second quarter business, there is enough buying and selling to indicate that the market is likely to be established at advances of \$4 to \$7 a ton over prices lately ruling and at which the Steel Corporation has sold for second quarter, these prices being 2.50c. for blue annealed, 3.35c. for black and 4.35c. for galvanized. The spread between black and galvanized may increase from the recent 1c. to 1.15c.

The American Steel & Wire Co. has advanced its prices on nails and plain wire \$2 a ton, this being its first advance of the year on nails and its second on wire. Independents had previously been obtaining the higher prices. The market is now at 2.65c. for plain wire and \$2.80 for nails. Barb wire has also been advanced, also woven wire fence, the discount on which is now 69 per cent, in carload lots to jobbers.

Hoops and bands have been stiffening, the base price on heavy material advancing from 2.75c. to 2.90c., while light material, under 20 gage or 1-in. width, is 3.25@3.50c., base, against 3@3.25c. recently.

Semi-Finished Steel Higher

Recent transactions in billets, slabs and sheet bars appear to have cleaned up all steel available at the old price of \$38.50, and while recently some mills have been naming \$40 as their objective it seems doubtful now whether any steel could be bought at that figure. One seller of a large tonnage has had trouble in making scheduled deliveries and has been endeavoring to buy from other producers to apply on his obligation. The market in December was \$36.50, first quarter contracts being chiefly at that figure.

Latest developments suggest that possibly the decline in Connellsville coke is over, without prices reaching as low a level as expected. The theory has been that with the ending of winter the disappearance of buying for domestic consumption would cause further declines, but the new outlook is that increased consumptive demand will take up the expected slack. The change in basic conditions has been very decided. Not more than 2 months ago many steel producers were willing if not anxious to sell basic pig iron, as with their byproduct coke they could make it cheaper than merchant furnaces. The Republic Iron & Steel Co. was one of these, but now Republic has decided to blow in its Hannah furnace, a sort of reserve stack, and has bought coke, 500 tons a day to July 1, to take care of the stack, the company's byproduct coke covering only the Haselton stacks. The price paid is reported to be \$6.75. The market for spot furnace coke has declined 50c. in the week, being now quotable at \$7@\$7.25. This makes a total decline of \$2 since the end of December, but leaves the market 50c. higher than early in December, before the advance caused by buying of coke for domestic use.

Pig iron, expected by the majority of consumers for some time past to decline, now seems more likely to advance. Consumers must buy very soon now and an advance may easily be precipitated. The market is, indeed, a trifle stronger on the whole this week, as a result of a few transactions. Bessemer, formerly quotable at \$27.50@\$28 valley, is now firm at \$28 as minimum, while basic, quotable lately at \$25@\$26 valley, is now well established at \$26. Foundry remains at \$27@\$28. Freight to Pittsburgh is \$1.77.

Current Prices in the New York Market

FOR CHEMICALS, OILS AND ALLIED PRODUCTS

Although these prices are for the spot market in New York City, a special effort has been made to report the American manufacturer's quotations whenever available. In many instances these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported and resale stocks are reported when of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb.	$0 36 -	$0 38
Acetone, drums	lb	21 -	21½
Acid, acetic, 28%, bbl.	100 lb	3 15 -	3 40
Acetic, 56%, bbl	100 lb	6 25 -	6 50
Glacial, 99½%, carboys.	100 lb	12 00 -	12 50
Boric, crystals, bbl	lb	11½-	11¾
Boric, powder, bbl	lb	11 -	11½
Citric, kegs	lb	49 -	50
Formic, 85%	lb.	15 -	17
Gallic, tech	lb	45 -	50
Hydrochloric, 18° tanks,	100 lb	90 -	1 00
Hydrofluoric, 52%, carboys	lb	.12 -	12½
Lactic, 44%, tech, light, bbl	lb	11 -	11½
22%, tech, light, bbl	lb	05 -	05½
Muriatic, 20°, tanks,	100 lb	1 00 -	1 10
Nitric, 36°, carboys.	lb	04½-	05
Nitric, 42°, carboys	lb	06	06¼
Oleum, 20%, tanks	ton	17 00	18 00
Oxalic, crystals, bbl	lb	12½	13
Phosphoric, 50%, carboys	lb.	08 -	09
Pyrogallic, resublimed	lb	1 50 -	1 60
Sulphuric, 60°, tanks	ton	9 00	10 00
Sulphuric, 60°, drums	ton	12 00	14 00
Sulphuric, 66°, tanks	ton	14 50	15 00
Sulphuric, 66° drums	ton	19 00	20 00
Tannic, U S P, bbl	lb	65 -	70
Tannic, tech, bbl	lb.	40 -	45
Tartaric, imp crys, bbl	lb	.30½	31
Tartaric, imp, powd, bbl	lb.	31 -	32
Tartaric, domestic, bbl	lb	-	32
Tungstic, per lb of WO	lb	1 00 -	1 20
Alcohol, butyl, drums	gal.	.18 -	23
Alcohol ethyl (Cologne spirit), bbl	gal.	4.75 -	4 95
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 188 proof No 1	gal.	.38 -	40
... bbl	lb	03½-	03¾
Alum, ammonia, lump	lb.	03 -	03¾
Potash, lump bbl ... bbl	lb.	05 -	05¼
Chrome, lump, potash ... com,			
Aluminum sulphate,	100 lb	1 50 -	1 65
bags	lb	02¼-	02¾
Iron free bags		06½-	07¼
Aqua ammonia, 26°, drums	lb		30½
Ammonia, anhydrous, cyl	lb.	30 -	
Ammonium carbonate, powd casks, imported	lb.	.09½-	10
Ammonium carbonate, powd domestic, bbl	lb.	.13 -	14
Ammonium nitrate tech, casks	lb	10 -	11
Amyl acetate tech, drums	gal.	2 80 -	3 05
Arsenic, white, powd, bbl	lb.	15¼-	16
Arsenic, red, powd, kegs	lb	13 -	15
Barium carbonate, bbl	ton	70 00 -	75 00
Barium chloride, bbl	ton	87.00 -	95 00
Barium dioxide, drums	lb	18 -	18½
Barium nitrate, casks		08½-	08¾
Barium sulphate, bbl	lb.	04 -	04¼
Blanc fixe, dry, bbl	lb	04	04½
Blanc fixe, pulp, bbl	ton	45 00 -	55 00
Bleaching powder, f o b wks, drums	100 lb	2 00 -	2 50
Resale drums	100 lb	2 50 -	2 75
Borax, bbl	lb	05½-	05¾
Bromine, cases	lb	25 -	27
Calcium acetate, bags	100 lb	3 50 -	3 60
Calcium carbide, drums	lb	04½	04¾
Calcium chloride, fused, drums	ton	22 00 -	23 00
Gran drums	lb.	01½	01¾
Calcium phosphate, mono, bbl	lb	06½	07
Camphor, cases	lb.	91 -	93
Carbon bisulphide, drums	lb.	07 -	07¼
Carbon tetrachloride, drums	lb.	09½-	10
Chalk, precip—domestic, light, bbl	lb.	04¼-	04½
Domestic, heavy, bbl	lb	03½	03¾
Imported, light, bbl	lb.	.04½-	05
Chlorine, liquid, cylinders	lb.	06 -	06½
Chloroform, tech, drums.	lb	35 -	38
Cobalt oxide, bbl	lb	2 10 -	2 25
Copperas, bulk, f o b wks.	ton	16 50 -	20 00
Copper carbonate, bbl	lb	19	20
Copper cyanide, drums	lb.	47 -	50
Copper sulphate, crys, bbl,	100lb.	6 00 -	6 25
Cream of tartar, bbl	lb.	24 -	25
Dextrine, corn, bags	100 lb.	3 25 .	3 50
Epsom salt, dom., tech, bbl.	100 lb.	2.10 -	2 25
Epsom salt, imp, tech, bags	100 lb	1.10 -	1.25
Epsom salt, U S P, dom, bbl	100 lb.	2 50 -	2 75
Ether, U.S P, drums	lb.	.13 -	.15
Ethyl acetate, com, 85% drums	gal.	.80 -	85
Ethyl acetate, pure (acetic ether, 98%, to 100%)	gal.	95 -	1 00
Formaldehyde, 40%, bbl	lb	$0 15¾-	$0 16½
Fullers earth, f o b mines	net ton	16 00 -	17 00
Fullers earth—imp, powd	net ton	30 00 -	32 00
Fusel oil, ref, drums	gal	3 55 -	4 05
Fusel oil, crude, drums	gal	2 30 -	2 40
Glaubers salt, wks, bags	100 lb	1 20 -	1 40
Glaubers salt, imp, bags	100 lb	1 00 -	1 25
Glycerine, c p, drums extra	lb	18½-	19
Glycerine, dynamite, drums	lb	17 -	17½
Iodine, resublimed	lb	4 40 -	4 50
Iron oxide, red, casks	lb	.12 -	.18
Lead:			
White, basic carbonate, dry, casks	lb	09½-	10
White, in oil, kegs	lb	12 -	.13½
Red, dry, casks	lb	11¼-	11½
Red, in oil, kegs	lb	13 -	14½
Lead acetate, white crys, bbl	lb	13 -	13½
Lead arsenate, powd, bbl	lb	23 -	24
Lime-Hydrated, bbl	per ton	16 80 -	17 00
Lime, Lump, bbl	280 lb	3 63 -	3 65
Litharge, comm, casks	lb	10½-	10¾
Lithophone, bbl	lb	06½-	07
Magnesium carb, tech, bags	lb	08 -	08½
Methanol, 95%, bbl	gal	1 23 -	1 25
Methanol, 97%, bbl	gal	1 25 -	1 27
Nickel salt, double, bbl	lb	10 -	10½
Nickel salts, single, bbl	lb	11 -	11½
Phosgene		60 -	75
Phosphorus, red, cases	lb	35 -	40
Phosphorus, yellow, cases	lb	30 -	35
Potassium bichromate, casks	lb	09⅞-	10
Potassium bromide, gran, bbl	lb	16 -	23
Potassium carbonate, 80-85%, calcined, casks	lb	05½-	06
Potassium chlorate, powd	lb	.07½-	08
Potassium cyanide, drums	lb	45 -	50
Potassium hydroxide (caustic potash) drums	100 lb	7 25 -	7 50
Potassium iodide, cases	lb	3 50 -	3 60
Potassium nitrate, bbl	lb	06½-	.07
Potassium permanganate, drums	lb	18½-	19
Potassium prussiate, red, casks	lb	.85 -	.90
Potassium prussiate, yellow, casks	lb	.38 -	39
Salammoniac, white, gran, casks, imported	lb	06½-	06¾
Salammoniac, white, gran, bbl, domestic	lb	.08 -	.08¼
Gray, gran, casks	lb	08½-	.08¾
Salsoda, bbl	100 lb	1 20 -	1 40
Salt cake (bulk)	ton	26 00 -	28 00
Soda ash, light, 58% flat, bags, contract	100 lb	1 60 -	1 67
Soda ash, light, basis, 48%, bags, contract, f o b wks	100 lb	1 20 -	1 30
Soda ash, light, 58%, flat, bags, resale	100 lb	1.75 -	1.80
Soda ash, dense, bags, contract, basis 48%	100 lb.	1 17½-	1 20
Soda ash, dense, in bags, resale	100 lb	1.85 -	1 90
Soda, caustic, 76%, solid, drums, f a s	100 lb	3 45 -	3 70
Soda, caustic, 76%, solid, drums, contract	100 lb	3 35	3 40
Soda, caustic, basis 60%, wks, contract	100 lb	2 50 -	2 60
Soda, caustic, ground and flake, contracts	100 lb	3 80 -	3 90
Soda, caustic, ground and flake, resale	100 lb	4 00 -	4 15
Sodium acetate, works, bags	lb	06 -	06½
Sodium bicarbonate, bbl	100 lb	1 75 -	1 85
Sodium bichromate, casks	lb	07¾-	08
Sodium bisulphate (niter cake)	ton	6 00 -	7 00
Sodium bisulphite, powd., U S P, bbl	lb	04½-	04½
Sodium chlorate, kegs	lb	06½-	07
Sodium chloride	long ton	12 00 -	13 00
Sodium cyanide, cases	lb	20 -	23
Sodium fluoride bbl	lb	09 -	.10
Sodium hyposulphite bbl	lb.	03 -	03¼
Sodium nitrite, casks	lb	08½-	09
Sodium peroxide, powd, cases	lb.	.28 -	30
Sodium phosphate, dibasic, bbl	lb	.03¾-	04
Sodium prussiate, yel drums	lb	.19 -	.20
Sodium silicate (40°, drums)	100 lb.	80 -	1 15
Sodium silicate (60°, drums)	100 lb.	2.00 -	2.25
Sodium sulphide, fused, 60-62% drums	lb	.04 -	.04½
Sodium sulphite, crys, bbl	lb	03½-	03¾
Strontium nitrate, powd, bbl.	lb.	09½-	10⅛
Sulphur chloride, yel drums.	lb	04½-	.05
Sulphur, crude	ton	18.00 -	20 00
Sulphur dioxide, liquid, cyl	lb.	08 -	.08½
Sulphur, flour, bbl	100 lb.	2 35 -	3.15
Sulphur, roll, bbl	100 lb.	$2 00 -	$2 50
Talc—imported, bags	ton	30 00 -	40 00
Talc—domestic powd., bags	ton	18 00 -	25 00
Tin bichloride, bbl	lb.	11 -	.11½
Tin oxide, bbl	lb.	47 -	.48
Zinc carbonate, bags	lb.	.14 -	.14½
Zinc chloride, gran, bbl	lb.	06 -	.07
Zinc cyanide, drums	lb.	.37 -	.38
Zinc oxide, XX, bbl	lb	07½-	08
Zinc sulphate, bbl	100 lb.	2 75 -	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl	lb	$0 80 -	$0 85
Alpha-naphthol, ref, bbl	lb	1 05 -	1.10
Alpha-naphthylamine, bbl	lb	27 -	.30
Aniline oil, drums	lb.	16½-	.17
Aniline salts, bbl	lb.	24 -	25
Anthracene, 80%, drums	lb	.75 -	1 00
Anthracene, 80%, imp., drums, duty paid	lb.	.65 -	70
Anthraquinone, 25%, paste, drums	lb	70 -	75
Benzaldehyde U S P, carboys	lb.	1 40 -	1,45
Benzene, pure, water-white, tanks and drums	gal	30 -	.35
Benzene, 90%, tanks & drums	gal	26 -	.32
Benzene, 90%, drums, resale	gal.	32 -	.34
Benzidine base, bbl	lb.	85 -	90
Benzidine sulphate, bbl	lb.	75 -	80
Benzoic acid, U S P, kegs	lb.	72 -	.75
Benzoate of soda, U S P, bbl	lb.	57 -	.65
Benzyl chloride, 95-97%, ref, drums	lb.	25 -	27
Benzyl chloride, tech, drums	lb.	20 -	.23
Beta-naphthol, subl, bbl	lb.	55 -	.60
Beta-naphthol, tech, bbl	lb.	24 -	.25
Beta-naphthylamine, tech	lb.	1 00 -	1 25
Carbazol, bbl	lb.	.75 -	.90
Cresol, U S P, drums	lb.	25 -	27
Ortho-cresol, drums	lb.	.24 -	.26
Cresylic acid, 97%, resale, drums	gal	1 50 -	1 75
95-97%, drums, resale	gal	1 50 -	1 75
Dichlorbenzene, drums	lb.	07 -	09
Diethylaniline, drums	lb	50 -	60
Dimethylaniline, drums	lb	41 -	.42
Dinitrobenzene, bbl	lb	20 -	.22
Dinitroclorbenzene, bbl	lb.	.22 -	.23
Dinitronaphthalene, bbl	lb	30 -	32
Dinitrophenol, bbl	lb	35 -	40
Dinitrotoluene, bbl	lb	22 -	24
Dip oil, 25%, drums	gal.	.25 -	.30
Diphenylamine, bbl	lb.	53 -	.55
H-acid, bbl	lb.	.80 -	85
Meta-phenylenediamine, bbl	lb.	95 -	1 00
Michler's ketone, bbl	lb.	3 00 -	3 50
Monochlorbenzene, drums	lb	08 -	10
Monoethylaniline, drums	lb	95 -	1 10
Naphthalene, crushed, bbl	lb	05½-	.06
Naphthalene, flake, bbl	lb	.06 -	06½
Naphthalene, balls, bbl	lb	07 -	07½
Naphthionate of soda, bbl	lb	58 -	65
Naphthionic acid, crude, bbl.	lb	.60 -	.65
Nitrobenzene, drums	lb.	10 -	12
Nitro-naphthalene, bbl	lb.	.30 -	.35
Nitro-toluene, drums	lb.	.15 -	.17
N-W acid, bbl	lb.	1 15 -	1.20
Ortho-amidophenol, kegs	lb.	2.30 -	2.35
Ortho-dichlorbenzene, drums	lb	17 -	.20
Ortho-nitrophenol, bbl	lb.	.90 -	.92
Ortho-nitrotoluene, drums	lb	10 -	.12
Ortho-toluidine, bbl	lb	13 -	.15
Para-amidophenol, base, kegs	lb.	1 15 -	1.20
Para-amidophenol, HCl, kegs	lb.	1.20 -	1.25
Para-dichlorbenzene, bbl	lb.	.17 -	.20
Paranitraniline, bbl	lb.	74 -	.75
Para-nitrotoluene, bbl	lb.	55 -	.65
Para-phenylenediamine, bbl.	lb.	1 50 -	1.55
Para-toluidine, bbl	lb.	.85 -	.90
Phthalic anhydride, bbl	lb.	.35 -	.38
Phenol, U S P, drums	lb.	35 -	.37
Picric acid, bbl	lb.	.20 -	.22
Pyridine, dom, drums	gal.	nominal	
Pyridine, imp, drums	gal.	2 75 -	3.00
Resorcinol, tech, kegs	lb.	1.50 -	1.55
Resorcinol, pure, kegs	lb.	2 00 -	2.10
R-salt, bbl	lb.	.55 -	.60
Salicylic acid, tech, bbl	lb.	.40 -	.42
Salicylic acid, U S P, bbl	lb.	.45 -	.47
Solvent naphtha, water-white, drums	gal.	.37 -	.40
Crude, drums	gal.	.22 -	.24
Sulphanilic acid, crude, bbl	lb.	.18 -	.20
Thiocarbanilide, kegs	lb.	.35 -	.38
Toluidine, kegs	lb.	1.20 -	1.30
Toluidine, mixed, kegs	lb.	.30 -	.35
Toluene, tank cars	gal.	.35 -	.37
Toluene, drums	gal.	.40 -	.43
Xylidines drums	lb.	.40 -	.45
Xylene, pure, drums	gal.	.45 -	.50
Xylene, com., drums	gal.	.40 -	.42
Xylene, com., tanks	gal.	.30 -	....

Naval Stores

Rosin B-D, bbl.	280 lb.	$6 25 – ....
Rosin E-I, bbl.	280 lb.	6 25 – $6.40
Rosin K-N, bbl.	280 lb.	6 55 – 6 90
Rosin W.G.-W.W., bbl.	280 lb.	7 40 – 8 10
Wood rosin, bbl.	280 lb.	6 25 –
Turpentine, spirits of, bbl.	gal.	1 50 – 1 51
Wood, steam dist., bbl.	gal	1 35 –
Wood, dest. dist., bbl.	gal	1 25 –
Pine tar pitch, bbl.	200 lb	– 6 00
Tar, kiln burned, bbl.	500 lb	– 12 00
Retort tar, bbl.	500 lb.	– 11 00
Rosin oil, first run, bbl.	gal	.43
Rosin oil, second run, bbl.	gal.	.47
Rosin oil, third run, bbl.	gal	.53
Pine oil, steam dist.	gal.	– .90
Pine oil, pure, dest. dist.	gal.	– 85
Pine tar oil, ref.	gal.	– 46
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal	– 35
Pine tar oil, double ref., bbl.	gal	– 75
Pine tar, ref., thin, bbl.	gal	– 25
Pinewood creosote, ref., bbl.	gal.	– 52

Vegetable Oils

Castor oil, No. 3, bbl.	lb	$ 12¼ – $ 13
Castor oil, AA, bbl.	lb	13¼ – 13½
Chinawood oil, bbl.	lb	18 – 18½
Coconut oil, Ceylon, bbl.	lb	.09½ – 9¾
Coconut oil, Cochin, bbl.	lb	.09¾ – 10
Corn oil, crude, bbl.	lb.	.11¼ – 11½
Cottonseed oil, crude (f.o.b. mill), tanks	lb	09¾ – 10
Summer yellow, bbl.	lb.	.12 – 12¼
Winter yellow, bbl.	lb	13 – 13¼
Linseed oil, raw, car lots, bbl.	gal	96 – 97
Raw, tank cars (dom.)	gal	92 – 93
Boiled, 5-bbl. lots (dom.)	gal	1 00 – 1 02
Olive oil, denatured, bbl.	gal.	1 00 – 1 15
Palm, Lagos, casks	lb	08 – 08¼
Palm kernel, bbl.	lb.	08¼ – 09
Peanut oil, crude, tanks (mill)	lb.	13 – 13½
Peanut oil, refined, bbl.	lb	16 – 16¼
Rapeseed oil, refined, bbl.	gal	85 – 86
Rapeseed oil, blown, bbl.	gal.	90 – 91
Soya bean (Manchurian), bbl.	lb.	.11½ – ..
Tank, f.o.b. Pacific coast	lb	.10 – ..

Fish Oils

Menhaden, light pressed, bbl.	gal	$0 60 – ..
White bleached, bbl.	gal	64 – 65
Blown, bbl.	gal.	68 – 69
Whale No. 1 crude, tanks, coast	lb	.06 – 06½

Dye & Tanning Materials

Divi-divi, bags	ton	$38 00 – $39 00
Fustic, sticks	ton	30 00 – 35 00
Fustic, chips, bags	lb	04 – 05
Logwood, sticks	ton	28 00 – 30 00
Logwood, chips, bags	lb.	02½ – .03½
Sumac, leaves, Sicily, bags	ton	65 00 –
Sumac, ground, bags	ton	55 00 – 60 00
Sumac, domestic, bags	ton	35 00 –
Tapioca flour, bags	lb.	.03¼ – 05

EXTRACTS

Archil, conc., bbl.	lb	$0 17 – $0 18
Chestnut, 25% tannin, tanks	lb.	.02 – 03
Divi-divi, 25% tannin, bbl.	lb	.04 – 05
Fustic, crystals, bbl.	lb	.20 – 22
Fustic, liquid, 42°, bbl.	lb	.08 – 09
Gambier, liq., 25% tannin, bbl.	lb	.08 – 09
Hematine crys., bbl.	lb.	.14 – 18
Hemlock, 25% tannin, bbl.	lb.	.04 – .05
Hypernic, solid, drums	lb	.24 – 26
Hypernic, liquid, 51°, bbl.	lb	.14 – .17
Logwood, crys., bbl.	lb.	.19 – 20
Logwood, liq., 51°, bbl.	lb.	.09 – 10
Quebracho, solid, 65% tannin, bbl.	lb.	.04¾ – 05
Sumac, dom., 51°, bbl.	lb.	.06½ – 07

Waxes

Bayberry, bbl.	lb	$0.28 – $0 30
Beeswax, refined, dark, bags	lb.	30 – 32
Beeswax, refined, light, bags	lb.	34 – 35
Beeswax, pure white, cases	lb	40 – 41
Candelilla, bags	lb.	.33 – 34
Carnauba, No. 1, bags	lb	38 – 40
No. 2, North Country, bags	lb	24 – 24½
No. 3, North Country, bags	lb.	17½ – 18½
Japan, cases	lb.	15 – 15½
Montan, crude, bags	lb.	.03½ – 04
Paraffine, crude, match, 105-110 m.p.	lb.	.04 – .04½
Crude, scale 124-126 m.p., bags	lb.	.02½ – 02¾
Ref., 118-120 m.p., bags	lb.	.03¼ – 03½
Ref., 125 m.p., bags	lb.	.03½ – .03¾
Ref., 128-130 m.p., bags	lb.	.04 – .04¼
Ref., 133-135 m.p., bags	lb.	.04½ – .04¾
Ref., 135-137 m.p., bags	lb.	05 – 05¼
Stearic acid, sgle pressed, bags	lb	10 – 10½
Double pressed, bags	lb	.10½ – 10¾
Triple pressed, bags	lb.	.11 – .11½

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb.	$3 20 – $3 25
F.a.s. double bags	100 lb.	3 85 – 3 95
Blood, dried, bulk	unit	4 60 –
Bone, raw, 3 and 50, ground	ton	30 00 – 35.00
Fish scrap, dom., dried, wks.	unit	5.00 – 5.10
Nitrate of soda, bags	100 lb.	2.60 – 2.65
Tankage, high grade, f.o.b. Chicago	unit	4.70 – 4.80

Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$3.50 – $4.00
Tennessee, 78-80%	ton	7.00 – 8.00
Potassium muriate, 80%, bags	ton	35 00 – 36.00
Potassium sulphate, bags	unit	1.00 – ....

Crude Rubber

Para—Upriver fine	lb.	$0 33 – $0 33½
Upriver coarse	lb	27 – 27½
Upriver caucho ball	lb	28½ – 29
Plantation—First latex crepe	lb	35 – 35¼
Ribbed smoked sheets	lb.	35 – .35¼
Brown crepe, thin, clean	lb.	31 – 32
Amber crepe No. 1	lb.	.31 – .32

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh. ton	$450 00 – $550 00
Asbestos, shingle, f.o.b., Quebec	sh. ton	60 00 – 80 00
Asbestos, cement, f.o.b., Quebec	sh. ton	15 00 – 17 00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	16 00 – 20 00
Barytes, grd., off-color, f.o.b. mills bulk	net ton	13 00 – 21 00
Barytes, floated, f.o.b. St. Louis, bbl.	net ton	24.00 – 28 00
Barytes, crude f.o.b. mines, bulk	net ton	8 50 – 9 00
Casein, bbl., tech.	lb.	.11 – 12
China clay (kaolin) crude, f.o.b. Ga.	net ton	7 00 – 9 00
Washed, f.o.b. Ga.	net ton	8 00 – 9 00
Powd., f.o.b. Ga.	net ton	13 00 – 20 00
Crude f.o.b. Va.	net ton	8 00 – 12 00
Ground, f.o.b. Va.	net ton	13 00 – 20 00
Imp., lump, bulk	net ton	15 00 – 20 00
Imp., powd.	net ton	45 00 – 50 00
Feldspar, No. 1 pottery	long ton	6 00 – 7 00
No. 2 pottery	long ton	5 00 – 5 50
No. 1 soap	long ton	7 00 – 7 50
No. 1 Canadian, f.o.b. mill	long ton	25 00 – 27 00
Graphite, Ceylon, lump, first quality, bbl.	lb.	06 – .06½
Ceylon, chip, bbl.	lb.	05 – .05½
High grade amorphous crude	ton	35 00 – 50 00
Gum arabic, amber, sorts, bags	lb.	15 – 16
Gum tragacanth, sorts, bags	lb.	50 – 60
No. 1, bags	lb.	1 75 – 1 80
Kieselguhr, f.o.b. Cal.	ton	40 00 – 42 00
F.o.b. N. Y.	ton	50 00 – 55 00
Magnesite, crude, f.o.b. Cal.	ton	14 00 – 15 00
Pumice stone, imp., casks	lb	03 – 05½
Dom., lump, bbl.	lb	05 – 05½
Dom., ground, bbl.	lb	06 – 07
Shellac, orange fine, bags	lb	82 – 83
Orange superfine, bags	lb	84 – 85
A. C. garnet, bags	lb	79 – 80
T. N., bags	lb	80 – 81
Silica, glass sand, f.o.b. Ind.	ton	2 00 – 2 50
Silica, sand blast, f.o.b. Ind.	ton	2 50 – 5 00
Silica, amorphous, 250 mesh, f.o.b. Ill.	ton	17 00 – 17 50
Silica, bldg. sand, f.o.b. Pa.	ton	2 00 – 2 75
Soapstone, coarse, f.o.b. Vt., bags	ton	7 00 – 8 00
Talc, 200 mesh, f.o.b., Vt., bags	ton	6 50 – 9 00
Talc, 200 mesh, f.o.b. Ga., bags	ton	7 00 – 9 00
Talc, 200 mesh, f.o.b. Los Angeles, bags	ton	16 00 – 20.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	ton	$45–50
Chrome brick, f.o.b. Eastern shipping points	ton	50–52
Chrome cement, 40-50% Cr_2O_3	ton	23–27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23 00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	40–46
2nd quality, 9-in. shapes, f.o.b. wks.	1,000	36 41
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65–68
9-in. arches, wedges and keys	ton	80 85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9 in. sizes, f.o.b. Birmingham district	1,000	48–50
F.o.b. Mt. Union, Pa.	1,000	42 44
Silicon carbide refract. brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y.	ton	$200.00 – $225 00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11½ – 11¾
4-6% C	lb.	.12 – 13
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	105.00 – 107 50
Spiegeleisen, 19-21% Mn.	gr. ton	35.00 – 37.00
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb.	1.90 – 2 15
Ferrosilicon, 10-15%	gr. ton	38.00 – 40 00
50%	gr. ton	80.00 – 85 00
75%	gr. ton	150.00 – 160.00
Ferrotungsten, 70-80%, per lb. of W	lb.	$0.90 – $0.95
Ferro-uranium, 35-50% of U, per lb. of U	lb.	6.00 – ....
Ferrovanadium, 30-40%, per lb. of V	lb.	3.50 – 4.00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$6.50 – $8.75
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22 00 – 23 00
C.i.f. Atlantic seaboard	ton	18 50 – 19 00
Coke, fdry., f.o.b. ovens	ton	8 00 – 8 50
Coke, furnace, f.o.b. ovens	ton	7 00 – 7.50
Fluorspar, gravel, f.o.b. mines, New Mexico	ton	17 50 – ....
Fluorspar, No. 2 Lump—Ky. & Ill. mines	ton	25 00 – ....
Ilmenite, 52% TiO_2	lb	.01½ – .01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.33 – ....
Manganese ore, chemical (MnO_2)	ton	75.00 – 80.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N. Y.	lb.	.65 – .70
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb.	.06 – .08
Pyrites, Span., fines, c.i.f. Atl. seaport	unit	.11½ – .12
Pyrites, Span., furnace size, c.i.f. Atl. seaport	unit	.11½ – .12
Pyrites, dom. fines, f.o.b. mines, Ga.	unit	.12
Rutile, 95% TiO_2	lb.	.12 – ....
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.00 – 8.50
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	7.50 – 8.00
Uranium ore (carnotite) per lb. of U_3O_8	lb	3.50 – 3.75
Uranium oxide, 96% per lb. U_3O_8	lb	2 25 – 2 50
Vanadium pentoxide, 99%	lb.	12 00 – 14.00
Vanadium ore, per lb. V_2O_5	lb	1.00 – .....
Zircon, washed, iron free, f.o.b. Pablo, Fla.	lb	.04½ – .13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	15 25
Aluminum, 98 to 99%	23 00
Antimony, wholesale, Chinese and Japanese	7 15-7.50
Nickel, virgin metal	25 00 27.00
Nickel, ingot and shot	29 00
Monel metal, shot and blocks	32 00
Monel metal, ingots	38 00
Monel metal, sheet bars	45 00
Tin, 5-ton lots, Straits	41 00
Lead, New York, spot	8 05
Lead, E. St. Louis spot	8.00–8.15
Zinc, spot, New York	7 35–7.45
Zinc, spot, E. St. Louis	6.95–7.15

OTHER METALS

Silver (commercial)	oz	$0.64
Cadmium	lb	1 15
Bismuth (500 lb. lots)	lb	2 55
Cobalt	lb	3 00@3 25
Magnesium, ingots, 99%	lb.	1 00@1 05
Platinum	oz	116 00
Iridium	oz	260 00@275 00
Palladium	oz	79 00
Mercury	75 lb.	71 00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb
Copper sheets, hot rolled	20 75
Copper bottoms	30 75
Copper rods	20.50
High brass wire	19 50
High brass rods	17.00
Low brass wire	21.10
Low brass rods	22.00
Brazed brass tubing	24 25
Brazed bronze tubing	29 00
Seamless copper tubing	25.25
Seamless high brass tubing	23.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.30@11 50
Copper, heavy and wire	11 25@11.50
Copper, light and bottoms	9 25@ 9 50
Lead, heavy	5.75@ 6.00
Lead, tea	3.50@ 3.75
Brass, heavy	6.25@ 6.40
Brass, light	5.35@ 5 75
No. 1 yellow brass turnings	6 30@ 6 50
Zinc	3.50@ 4.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3 29	$3.14
Soft steel bars	3.19	3.04
Soft steel bar shapes	3.19	3.04
Soft steel bands	3.29	3.19
Plates, ¼ to 1 in. thick	3.29	3.14

Industrial

Financial, Construction and Manufacturers' News

Industrial Developments

CEMENT—The Petoskey Portland Cement Co., Petoskey, Mich., is operating at full capacity with regular working force. It is purposed to create all possible reserves for spring distribution, totaling approximately 250,000 bbl., as now estimated.

Cement mills in the vicinity of Nazareth, Pa., are running at maximum and have sufficient orders on hand to continue on this basis until well into next fall.

The Bessemer Limestone & Cement Co., Bessemer, Pa., is planning for the early resumption of activities at its cement mill, closed down on Feb. 1 for necessary machinery repairs. The plant was completed a little over a year ago and has been in steady operation since that time. It is proposed to perfect arrangements for increased production.

All cement mills in the vicinity of Coplay, Pa., are running full, and purpose to maintain this basis of production for an indefinite period.

CERAMIC—The O. Zimbal Brick Co., Sheboygan, Wis., is perfecting plans for immediate increased production at its plant.

The Southern Brick & Tile Co., Louisville, Ky., has resumed production at its plant after a brief curtailment. It is planned to develop maximum output at an early date.

The Coral Ridge Clay Products Co., Louisville, Ky., manufacturer of brick and tile products, is operating at full capacity, with output about equally divided between brick and tile. It is purposed to continue operations throughout the winter.

Sanitary ware plants at Philadelphia, Pa., and vicinity are running on a curtailed schedule owing to the unsettled strike of the operative sanitary potters. A number of potteries are breaking in new men and expect to advance production at an early date.

The Tri-City Brick Co., Carbon Cliff, Ill., is operating at full capacity and has plans maturing for extensions to provide for early increase in output. Additions will be made in the working force.

LEATHER—The Griess-Pfleger Tanning Co., Waukegan, Ill., is running under good capacity at its local tannery, producing calfskins, splits and kindred specialties. The company also operates a tannery in Chicago, and is maintaining regular production at this point.

The Mississippi Valley Tanning Co., St. Louis, Mo., is maintaining regular production at its local tannery, giving employment to a normal working force. Operations are devoted to black glazed kid.

OIL—The Sinclair Oil Corp., New York, is pushing construction on its new oil refinery at Trainer, near Marcus Hook, Pa., and the present building force of 500 men will be increased to 1,000 men at an early date. Foundations are being laid for 24 stills, each with capacity of 1,000 bbl. When completed, the plant will give employment to approximately 600 workers, and will represent an investment of close to $1,000,000.

The American Cotton Oil Co., 65 Broadway, New York, has closed a number of its cottonseed crushing mills for the season. Several plants will remain shut down permanently, while operations at the others will be resumed as soon as conditions warrant. The company expects to maintain its cottonseed oil business at the present status, with possible increase in the future; it will not abandon this branch of operation, as currently reported.

The Producers' & Refiners' Corp., California Bldg., Denver, Colo., is planning for an early increase in production at its refining plants in Wyoming, advancing from 10,000 to 15,000 bbl. per day. Before the close of the year, it is expected to develop a capacity of 20,000 bbl. per day.

Employees of the Vacuum Oil Co., Bayonne, N. J., have asked an increase in wages aggregating 12 per cent. The request will be considered at an early meeting of the board of directors. Employment is now being given to about 600 operatives.

Workers at the refining plant of the Tidewater Oil Co., Bayonne, N. J., has been granted a wage advance of about 2 per cent. The men recently asked for an increase approximating 12 per cent. About 2,000 employees are affected.

PAPER—The Fort William Paper Co., Ltd., Fort William, Ont., is planning for an early increase in production at its new newsprint mill, recently placed in service. The present output approximates 75 tons daily and this will be advanced to a continuous run of 150 tons per day some time in March.

The Plainfield Paper Co., recently organized to take over and succeed the Childs Paper Co., Childsdale, near Rockford, Mich., is planning for early operations at the local mill, giving employment to a regular working force. Burke M. Baxter has been elected president.

The River Raisin Paper Co., Monroe, Mich., is operating on a full capacity schedule, giving employment to a regular working force, and expects to continue on this basis for an indefinite period. The bulk of production is devoted to corrugated and fiber paper specialties.

Paper mills in the state of Washington devoted to newsprint are all running at maximum production, with advance orders to insure the continuance of this schedule for more than 12 months to come.

IRON AND STEEL—The Alabama Co., Birmingham, Ala., is arranging for the immediate blowing in of its blast furnace at Gadsden, Ala., for pig iron production.

The Penn-Seaboard Steel Corp., Philadelphia, Pa., is operating at about 55 per cent of normal plant capacity, and purposes to advance this schedule at an early date.

The Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., is completing repairs to its Oxmoor blast furnace, and plans to have the unit ready for service by the close of the month. The company is operating its four furnaces at Bessemer, Ala., for pig-iron production while six furnaces at Ensley and one furnace at Birmingham are running on basic iron. The company is said to have heavy orders on hand.

The Youngstown Sheet & Tube Co., Youngstown, O., has blown in its second blast furnace at Hubbard, near Sharon, Pa.

The blast furnace at the lower works of the Glasgow Iron Co., Pottstown, Pa., idle for a number of years, has been sold to other interests and will be dismantled at an early date.

Eight of eleven furnaces at the Edgar Thomson Works of the Carnegie Steel Co., North Braddock, Pa., are now in operation. Furnace H, which has been idle since March, 1921, has just been blown in.

MISCELLANEOUS—The Interstate Glass Co., Huntington, W. Va., manufacturer of window glass, has resumed operations at its plant after a shutdown for more than a year. It is expected to develop maximum capacity at an early date, giving employment to about 300 persons.

The Cadillac Lumber & Chemical Co., Sault Ste. Marie, Mich., is pushing construction on its new local plant and plans to inaugurate production late in April or early in May. Two more buildings will be erected and equipped.

Paint and varnish manufacturers in the Philadelphia, Pa., district are operating from 75 to 100 per cent capacity, with full working forces.

The International Nickel Co., New York, is operating in certain departments at its new plant at Huntington, W. Va., and expects to increase production gradually until the works are running full. The plant represents an investment of close to $3,000,000.

The Tennessee Copper & Chemical Co., 61 Broadway, New York, is operating at full capacity at its new sulphate plant, and will continue on this basis for an indefinite period. It is said that the entire output for the present year has been sold.

Construction and Operation

Alabama

ANNISTON—The Independent Soil Pipe Co., has awarded a contract to the Ogletree Construction Co., Anniston, for the erection of a 1-story addition to its foundry, 70x108 ft., comprising the former works of the Ajax Foundry Co., lately acquired. It will be used for the production of cast-iron pipe. R. B. Carr is secretary.

BESSEMER—The Imperial Pipe Co., manufacturer of cast-iron pipe, will make extensions and improvements in its plant to increase production about 50 per cent. Facilities will be provided for the employment of 50 additional men.

BIRMINGHAM—The United States Cast Iron Pipe & Foundry Co., 71 Broadway, New York, will soon commence enlargements in its local plant for considerable increase in capacity. Considerable new machinery will be installed, including equipment for the de Lavaud process of cast-iron pipe production. The company is also planning for extensions in its foundry at Burlington, N. J., for the installation of similar machinery.

California

SAN FRANCISCO—The Los Angeles Soap Co., 633 1st St., Los Angeles, manufacturer of soaps, washing powders, etc., has awarded a contract to H. N. McClure, San Francisco, for excavation for its proposed new plant at 2nd and Brannan Sts., to be 2-story and basement, estimated to cost $80,000. Work will be placed under way at once. Other contracts for erection will be let immediately. W. H. Crim, Jr., 425 Kearny St., San Francisco, is architect.

PITTSBURG—The Columbia Steel Corp., San Francisco, has awarded a contract to the Union Construction Co., Key Route Fill, Oakland, for the erection of five new buildings at its local plant, estimated to cost in excess of $150,000, inclusive of equipment. Work will be placed in progress at once.

Colorado

DENVER—The Producers' & Refiners' Corp., California Bldg., is planning for the immediate construction of a large oil-refining plant in the vicinity of its present works at Greenville, Wyo. A new pipe line, pumping plants and other structures will be built. A stock issue of $7,500,000 has been arranged, a portion of the proceeds to be used for the expansion.

Connecticut

BRIDGEPORT—Jenkins Brothers, Inc., 80 White St., New York, will install a new foundry in connection with additions to its local plant for the manufacture of valves and other kindred engineering products, to be equipped for cast-steel and cast-iron production heretofore secured from outside plants. The extensions, with equipment, will cost approximately $250,000. The company is arranging for a bond issue of $1,000,000, the expansion appropriation to be taken from this fund. Lockwood Greene & Co., 101 Park Ave., New York, are engineers. Bids will be called at once.

Delaware

NEW CASTLE—The Wilmington Fibre Specialty Co. has acquired the fiber plant of the Johns-Manville Co., Lockport, N. Y., and will remove the equipment to its local plant. Enlargements will be made in the New Castle works to accommodate the expansion, including the installation of fiber-making machinery, rolling machines and auxiliary equipment. The work is estimated to cost about $190,000. John W. Morris is president.

Florida

TAMPA—The Tampa Gas Co. is planning for extensions and improvements in its artificial gas plant to cost about $200,000, including equipment.

JACKSONVILLE—William Nusbaum has arranged for the establishment of a local plant for the production of sisal fiber products. It will be operated under the name of the Cordova Hat Co.

Georgia

VALDOSTA—The Walker-Wood Products Co., manufacturer of turpentine, etc., has

plans under way for extensions in its plant, to include the installation of additional equipment.

SYLVESTER—The Tomlinson-Haddock Co., Albany, Ga., has acquired a local tract of land and plans for the installation of a local plant for the production of turpentine. The initial still capacity will be extended at an early date.

Idaho

PRIEST RIVER—The Spokane Soap Products Co., Spokane, Wash., manufacturer of soaps, washing powders, etc., has concluded negotiations for a local site and plans for the early erection of a new plant.

Illinois

OTTAWA—The National Plate Glass Co., General Motors Bldg., Detroit, Mich., affiliated with the Fisher Body Co., same address, manufacturer of automobile bodies, has acquired a tract of land of about 200 acres at Ottawa, adjoining the plant of the Federal Plate Glass Co., a subsidiary organization. Plans are under way for the erection of a new plant, to be operated under the Federal name, with capacity of close to 15,000,000 sq.ft. of polished glass per annum, practically doubling the present works capacity. The buildings with machinery are estimated to cost approximately $5,000,000. L. P. Fisher is vice-president of the National company.

MT. VERNON—The Mt. Vernon Car Mfg. Co. has preliminary plans in progress for the rebuilding of its foundry, recently destroyed by fire. The new structure will cost approximately $25,000. Neiler, Rich & Co., 431 South Dearborn St., Chicago, are engineers.

CHICAGO—L. A. Malchor, formerly connected with the Oxweld Acetylene Co., will commence the immediate erection of a new 1-story welding plant at 2613-17 State St., estimated to cost approximately $25,000, including equipment.

CHICAGO—The Detroit Copper & Brass Rolling Mills, 111 North Jefferson St., have purchased property at Washington Blvd. and Ada St., 50x170 ft., for a consideration of about $42,000. The site will be used for the erection of a new plant in the near future. Construction will be deferred for several months, owing to existing property leases.

Indiana

INDIANAPOLIS—The Indianapolis Terra Cotta Co., 1241 Consolidated Bldg., is considering plans for the erection of a new plant at Roosevelt and Olney Sts. George H. Lacy is general manager.

INDIANAPOLIS—The National Malleable Castings Co. has filed plans for the erection of an addition to its plant at Holmes and West Michigan Sts.

SEYMOUR—The Silverstone Stucco & Plaster Products Co., 220 Indiana Pythian Bldg., Indianapolis, is taking bids on a general contract for the erection of its proposed new local plant, the first unit to be 1-story, 50x96 ft. Merritt, Harrison & Turnock, 500 Board of Trade Bldg., Indianapolis, are architects. L. M. Briggs is secretary.

Kansas

WICHITA—The Derby Refining Co. is planning for additions in its local oil-refining plant to increase the present output about one-third. The rated capacity is 5,000 bbl. per day. The work is estimated to cost approximately $300,000, including machinery.

LEAVENWORTH—The Bonner Portland Cement Co. is having plans prepared for extensions in its plant to cost approximately $1,500,000, including machinery. Headquarters of the company are in the Victor Bldg., Kansas City, Mo.

Kentucky

LOUISVILLE—The Standard Sanitary Mfg. Co., Bessemer Bldg., Pittsburgh, Pa., manufacturer of sanitary ware, has tentative plans under consideration for the erection of a new addition to its local pottery on Shipp Ave., to be 2-story and basement, 125x500 ft. The company recently completed an extension to the works.

Maryland

BALTIMORE—The United States Asphalt Refining Co., Fairfield Rd., Wagner's Point, will install a number of new steel tanks and auxiliary equipment at its plant.

NORTH EAST—The North East Porcelain Co., recently organized, has acquired a local works, previously used for porcelain manufacture, and will establish a new plant. The structure will be remodeled, and extensions and improvements made, including the installation of new machinery. It is expected to have the plant ready for service early in April. E. Kirk Brown, Charles A. Ferguson and J. Wesley McAllister head the company.

BALTIMORE—The Standard Oil Co. has completed plans for the installation of additional steel tanks and auxiliary equipment at its plant at 1st Ave. and 3rd St., to cost about $30,000.

Massachusetts

NEW BEDFORD—The New Bedford Gas & Edison Light Co. will install experimental machinery at its artificial gas works for the manufacture of gas from crude oil. The equipment will replace the retorts heretofore used. It is expected to install additional apparatus of the character noted at a later date.

Michigan

BATTLE CREEK—Philip Ruxton, Inc., 220 West 42nd St., New York, manufacturer of printing inks, has acquired the local plant of the F. A. Rigler Ink Co., and plans for the early erection of a large addition to the plant to double, approximately, the present capacity.

DETROIT—The Unique Brass Mfg. Co., 123 Military Ave., is planning for the rebuilding of the portion of its plant, destroyed by fire, Feb. 5. An official estimate of loss has not been announced.

MONROE—The Monroe Paper Co. has awarded a contract to August Radtke, 528 South Smith Ave., for the rebuilding of the portion of its plant recently destroyed by fire, estimated to cost about $50,000. Leonard Mitchell is manager.

DETROIT—The Schroeder Paint & Glass Co., 119 Cadillac Sq., has construction under way on a new 4-story plant at 12th and Antoinette Sts., 125x195 ft., estimated to cost approximately $300,000, including equipment.

Missouri

WEST PLAINS—The National Rendering Co., 5th St. and the Kaw River, is completing plans and will soon commence the erection of a new local plant for reduction service, with departments for the manufacture of tallow and kindred products, estimated to cost about $25,000. W. R. Ross is president.

Montana

LEWISTOWN—The Gordon Campbell-Kelvin Syndicate is planning for the organization of a subsidiary company, with capital of $1,000,000, to construct and operate an oil refinery and topping plant. A site for the proposed refining plant is being selected in the vicinity of Seattle, Wash., while the new topping plant will be situated near Spokane. A pipe line will be constructed to the Kelvin oilfields of the parent organization. Gordon Campbell is head of the company.

New Hampshire

PORTSMOUTH—The Bureau of Supplies and Accounts, Navy Department, will take bids until Feb. 27 for furnishing and installing an annealing furnace at the local navy yard.

New Jersey

ROOSEVELT—Fire, Feb. 3, destroyed a portion of the local plant of the Armour Fertilizer Works, with loss estimated at about $75,000, including equipment. It is planned to rebuild. Headquarters of the company are at 209 West Jackson Blvd., Chicago, Ill.

BAYONNE—The Vacuum Oil Co., foot of East 22nd St., will erect a new building at its local refining plant to cost about $110,000. Headquarters of the company are at 61 Broadway, New York.

BERKELEY HEIGHTS—The J. H. Stone Corp., manufacturer of cork insulation products, has tentative plans under consideration for the rebuilding of the portion of its local plant destroyed by fire, Feb. 6, with loss estimated at close to $150,000, including machinery. The company also operates a plant at Port Colburn, Ont.

New York

LONG ISLAND CITY—The Atlas Novelty Co., 722 East 11th St., New York, manufacturer of celluloid and composition products, has acquired property at Hancock St. and Freeman Ave., Long Island City, 38x112 ft., as a site for the erection of a new plant. Plans will be prepared at an early date.

POTSDAM—Hollis W. Martin, Norwood, N. Y., is organizing a company to construct and operate a paper mill on site recently acquired on the Requette Rd. T. L. Tomlines, City Bank Bldg., Syracuse, engineer, has been commissioned to prepare plans for a 1-story plant, estimated to cost approximately $100,000, with machinery. It is expected to call for bids at an early date.

WATERFORD—The Little Falls Fibre Co., Little Falls, is planning for the rebuilding of the portion of its local plant destroyed by fire, Feb. 9, with loss approximating $50,000, including equipment.

North Carolina

WILMINGTON—The Seminole Phosphate Co., Goldsboro, N. C., has leased a building at the foot of Hanover St., Wilmington, for the establishment of a new plant for the manufacture of fertilizer products.

Ohio

RITTMAN—The Ohio Box Board Co., Wadsworth, O., is completing plans and will soon commence the erection of a new plant at Rittman, comprising a 1-story building, 110x800 ft., estimated to cost about $200,000, including equipment for the manufacture of cardboard and boxboard products. Christian, Schwarzenberg & Gaede, Euclid Bldg., Cleveland, are engineers. E. J. Young is president.

LOWELLVILLE—The Republic Iron & Steel Co., Youngstown, O., has plans under way for the construction of a new byproducts coke plant addition, estimated to cost approximately $5,000,000. The Koppers Co., Union Arcade, Pittsburgh, Pa., is engineer and contractor.

Oklahoma

OKLAHOMA CITY—The Dead Shot Chemical Co., 103 West Noble St., has preliminary plans under consideration for the rebuilding of the portion of its plant destroyed by fire, Feb. 3, with loss approximating $75,000, including equipment and stock.

PONCA CITY—The Marland Refining Co. has tentative plans in progress for the construction of an addition to its local oil-refining plant, to increase the capacity from 12,000 to 15,000 bbl. per day. E. W. Marland is president.

Oregon

ASTORIA—The Union Oil Co., Mills Bldg., San Francisco, Calif., is planning for the construction of a new refining and distributing plant on local site, estimated to cost $500,000, including equipment.

Pennsylvania

NEW CASTLE—The United States Steel Corp., Pittsburgh, Pa., has plans under way for additions and improvements in its local Carnegie works, including power and other equipment installation, estimated to cost in excess of $500,000.

ALLENTOWN—The Lehigh Soap Works, Water St., has acquired factory property at Hanover Ave. and Sherman St., and will remodel the structure for a new plant. The present works will be removed to the new location. Enoch Painter heads the company.

YORK HAVEN—Fire, Feb. 8, destroyed a portion of the plant of the York Haven Paper Co., with loss estimated at about $50,000. It is planned to rebuild.

PHILADELPHIA—The C. H. Boley Co., 3726 North Randolph St., manufacturer of chemical products, has awarded a contract to Charles H. Schaefer, Otis Bldg., for the erection of a 1-story plant addition, estimated to cost about $15,000.

South Carolina

HARTSVILLE—T. H. Coker, Hartsville, is planning for the installation of a local clay-grinding plant for commercial kaolin production. Inquiries are being made for equipment for grinding 80 per cent fine, through a 100-mesh screen.

Tennessee

CHATTANOOGA—The Dixie Portland Cement Co. is arranging a program for extensions and improvements at its plant to cost about $200,000, including additional equipment.

Texas

TEXAS CITY—The Texas Sugar Refining Co., lately formed with a capital of $5,500,000, has been organized with Alexander Smith, of Peabody, Houghteling & Co bankers, 366 Madison Ave., New York, as president. Plans for the proposed local refinery have been extended from a proposed investment of $100,000 to one of close to $1,000,000, including machinery. The works will consist of a number of buildings for an initial capacity of about 1,000,000 lb. of refined sugar per day, which will be increased in the future It is purposed to have the first units ready for service before the close of the present year, giving employment to about 400 operatives.

West Virginia

PARKERSBURG—The General Porcelain Co has tentative plans under consideration for the establishment of a new branch plant on site to be selected on the Pacific Coast It is understood that preference will be given to a location in the vicinity of Portland, Ore.

CHESTER—The Cord Tire Co. has plans in progress for the erection of an addition to its plant to increase the output from 650 to 3,000 tires a day. It is estimated to cost in excess of $125,000, with machinery

New Companies

THE KESITE CHEMICAL CO., New York, N. Y., care of D. K. Shappiro, 276 5th Ave, representative, has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are H Johnson, N. Kessel and W T. Sandall

THE SUSSEX CHEMICAL PRODUCTS Co, 169 Sussex St, Jersey City, N. J., has been incorporated with a capital of $100,000, to manufacture chemicals and kindred products. The incorporators are Louis S Hirsch, Paul B. Ducas and Edward Dreyfus.

THE HOLYOKE BRICK Co, Holyoke, Mass, has been incorporated with a capital of $100,000, to manufacture brick, tile and other burned clay products. Patrick J Kennedy, Jr. is president; and Henry H Parsons, 69 Locust St, Holyoke treasurer

THE MIDWEST SUGAR REFINING Co, 326 Madison St, Chicago, Ill., has been incorporated with a capital of $1,000,000, to construct and operate sugar-refining plants. The incorporators are John W Davis, Arthur E. Dike and Ira H. McKinney.

THE AGO CHEMICAL CO., 1301 Fidelity Bldg, Baltimore, Md., has been incorporated with a capital of $150,000, to manufacture chemicals, soaps and kindred products The incorporators are A J. Sherman, E. A. Hummer and J. C Hamburger

THE OPALESCENT PAPER Co., Providence, R I., has been incorporated with a capital of $150,000, to manufacture paper products The incorporators are William H. Hamlyn, Sr. and Jr, both of Providence; and Harold C. Pearl

THE H R JEFFERDS Co., New York, N Y, care of J I. Perry, 84 William St., representative, has been incorporated with a capital of $52,700, to manufacture chemicals and rubber products. The incorporators are J. C Treadwell and H R. Jefferds.

THE CHEMICAL ENGINEERING Co Cambridge, Mass, has been incorporated with a capital of 200 shares of stock, no par value, to manufacture chemical specialties and operate as chemical engineers. Porter O. Robinson is president; and J. Denison Kenyon, 8 Midland St, Worcester, Mass, treasurer. The last noted represents the company.

LEHMAN BROTHERS, INC, Jersey City N J., has been incorporated with a capital of $50,000, to manufacture paints, oils, etc The incorporators are David I. Goldstein, Hart and Earl Lehman, 22 Halladay St., Jersey City. The last noted represents the company

THE ECONOMY OIL Co., Clarendon, Va, has been incorporated with a capital of $200,000, to manufacture petroleum products The incorporators are John Sallen and R. R. Allen, both of Clarendon

THE PRISM SOAP & CHEMICAL Co, New York, N. Y., care of Samuel Falk, 291 Broadway, representative, has been incorporated with a capital of $50,000, to manufacture chemicals, soaps and kindred products The incorporators are J. Jordan, F. Mancuso and F. C. Battistella.

THE TEASDALE GLUE Co., Grand Rapids, Mich., has been incorporated with a capital of $20,000, to manufacture glue, paste and kindred specialties. The incorporators are John H. Nind, Jr, E. U. Kettle and Clyde H. Teasdale, 1517 Robinson Rd., Grand Rapids.

THE SPONGE RUBBER PRODUCTS Co., New Haven, Conn., has been incorporated with a capital of $50,000, to manufacture rubber specialties The incorporators are Frederick M. Daley, William R. Todd and Lowell Smith, all of Naugatuck, Conn.

THE R. D. BURCHARD CHEMICAL Co, St. Louis, Mo, has been incorporated with a capital of $100,000, to manufacture chemicals and chemical byproducts The incorporators are R. D. Burchard, J. W. Walsh and Benjamin M. Carriso, all of St. Louis.

THE UNITED STATES TURPENTINE Co, care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws, with capital of $5,000,000, to manufacture turpentine and affiliated products.

THE FRIEDLANDER SUPPLY CORP., 1212 Roosevelt Blvd., Chicago, Ill., has been incorporated with a capital of $25,000, to manufacture chemicals, waxes, colors, etc. The incorporators are Samuel J. Friedlander, Charles K. Schwartz and Herbert Friedlander.

THE MASTER PRODUCTS Co, Newark, N. J., has been incorporated with a capital of $75,000, to manufacture polishes for wood and metal work. The incorporators are Lorenzo A. Crowley and James Hilton, 99 Peshine Ave., Newark The last noted represents the company.

THE DADE CITY BRICK Co., Dade City, Fla, has been incorporated with a capital of $10,000, to manufacture brick, tile and other ceramic products The incorporators are F M Ackerman, S H Ackerman and D D Faulkner, all of Dade City.

THE MCLAUGHLIN PAPER Co, San Francisco, Calif, has been incorporated with a capital of $100,000, to manufacture paper products. The incorporators are F M McAuliffe, Samuel B. Stevens and Jerome B. White, Nevada Bank Bldg., San Francisco. The last noted represents the company.

THE SINCLAIR & CARROLL Co, New York, N Y, has been incorporated with a capital of $100,000, to manufacture printing inks and kindred products The incorporators are R Bennett, P. G Brennan and W. J. Ryan The company is represented by Wing & Russell, 14 Wall St. New York

THE ARTHUR DOVE Co, 5850 Forsyth St., Detroit, Mich, has been incorporated with a capital of $50,000, to manufacture paints and enamels for industrial service. The incorporators are Fred W. Grundman, Henry P Zapp and Arthur Dove, 3017 East Grand Blvd., Detroit.

THE L. H. HAMEL LEATHER Co., Haverhill, Mass, has been incorporated with a capital of $50,000, to operate a local leather-tanning plant. Arthur A. Hamel is president, and Louis H. Hamel, 49 Lexington Ave, Bradford, Mass., treasurer. The last noted represents the company

THE PATAPSCO OIL & GREASE Co., 109-11 Chesapeake St., Baltimore, Md., has been incorporated with a capital of $50,000, to manufacture oils, greases and compounds. The incorporators are John and David L. Ryan, and Harry E. Parkhurst.

THE GENERAL FOUNDRY Co., Fort Worth, Tex, has been incorporated with a capital of $25,000, to manufacture iron, steel and other metal castings. The incorporators are B N. Wadley, R. A. and F. M. Stewart, all of Fort Worth.

THORNE & Co, INC., Elizabeth, N. J., care of Albert Ehinger, 658 Van Buren Ave, Elizabeth, representative, has been incorporated with a capital of 1,000 shares of stock, no par value, to manufacture chemicals and chemical byproducts. The incorporators are S. Reinhart, Irving Eiseman and E. Horowitz

Capital Increases, etc.

THE VICTORIA PAPER MILLS Co., Fulton, N Y, has filed notice of increase in capital from $100,000 to $250,000 for general expansion

THE STERLING BRICK Co, 5201 12th St., Detroit, Mich., has arranged for an increase in capital from $25,000 to $75,000.

THE JOHNSON OIL REFINING Co. 208 South LaSalle St., Chicago, Ill., has arranged for an increase in capital from $2,000,000 to $3,000,000 for expansion.

PRICE BROTHERS & Co., Quebec, Can., operating pulp and paper mills, is disposing of a bond issue of $10,000,000, a portion of the proceeds to be used for expansion and general financing.

THE GORDON PETROLEUM Co., Eastland, Tex., has arranged for an increase in capital from $150,000 to $1,000,000 for proposed expansion.

THE HUDSON BRASS WORKS, INC., 16 Nassau St., Brooklyn, N. Y., has filed notice of increase in capital from $150,000 to $250,000 for expansion.

THE GEORGETOWN OIL Co., Georgetown, Del., has arranged for a change of name to the Union Oil Corp., at the same time increasing its capital from $50,000 to $300,000

THE INLAND ENGINEERING Co, Chicago, Ill., has filed notice of change of name to the Standard Alloy Steel Co.

THE CONNECTICUT CHEMICAL Co., Hartford, Conn., has filed notice of dissolution under state laws. William H. Barnum, 111 Broadway, New York, is president and represents the company.

THE COLUMBIA STEEL CORP., San Francisco, Calif., with plant at Pittsburgh, Cal., a Delaware corporation, has arranged for an increase in capital from $20,000,000 to $110,000,000 for general expansion.

THE STANDARD SANITARY MFG. Co., Bessemer Bldg., Pittsburgh, Pa., manufacturer of enameled iron and clay products, a New Jersey corporation, has filed notice of increase in capital from $20,000,000 to $30,000,000 for general expansion.

THE OLBURY ELECTRO CHEMICAL Co., Harrison, N. Y., has filed notice of decrease in capital from $1,500,000 to $1,000,000.

THE GASKILL CHEMICAL CORP., 157 Spencer St., Brooklyn, N. Y., has filed notice of increase in capital to $65,000.

Coming Meetings and Events

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual convention in Norfolk, Va., May 7 to 9

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York.

AMERICAN FOUNDRYMEN'S ASSOCIATION will hold a meeting in Cleveland, O., April 28 to May 4.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS is holding its annual meeting in New York City this week.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W. Va., June 7, 8 and 9.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

IRON AND STEEL INSTITUTE (London) will hold its annual meeting May 10 and 11 at the House of the Institution of Civil Engineers, London, S W. 1.

NATIONAL FOREIGN TRADE COUNCIL has postponed its annual conference from April 25, 26 and 27, to May 2, 3 and 4. It will be held in New Orleans, La.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

A PAPER INDUSTRIES EXPOSITION will be held in Grand Central Palace, New York City, during the week of April 9, 1923, by the International Exposition Co.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

Volume 28 New York, February 28, 1923 Number 9

The Outlook For Rubber

WHETHER rubber shall soar to exorbitantly high prices or maintain a stable market depends principally on the decision of the East Indian Government and the British planters either to maintain or to remove the present restriction on production. The United States is in a peculiar economic position with respect to rubber. Our industries consume about 75 per cent of the world's output, but British planters in the East Indies control 75 per cent of the world's production. Consequently unless there is close accord between these two great factors of supply and demand, it is quite evident that the rubber market will be upset to the detriment of producer as well as consumer. In this industry, as in all others, stabilization is the great desideratum.

From the point of view of the United States the present obstacle to stabilization is legislation in the East Indies restricting the output of rubber to 60 per cent of plantation capacity. It is true that the law makes provision for increases in production by increments of 10 per cent whenever certain prices are maintained for 90-day periods, thus making possible 100 per cent production in 12 months. But the fatal objection to this plan is that our capacity to consume rubber is increasing at such a rate that before these restrictive measures can be carried out our demand will entirely overtake the productive capacity of the planters. In fact the world demand for rubber probably warrants 100 per cent production at the present time.

With a view to bringing about a better understanding, representatives of the British plantation owners have recently visited this country and, it is believed, have been duly impressed with our capacity to consume rubber. We understand they have returned prepared to recommend that the restrictive measures be removed immediately in order to avoid a shortage and consequent high prices. They realize that a stabilized market at a fair average price, year in and year out, will be best for all concerned.

In the meantime the Department of Commerce evidently believes that it is just as well to show a lively interest in the possibility of stimulating the production of rubber elsewhere than in the East Indies. It is true that conditions there are almost ideal: cheap labor, healthy surroundings and liberal land laws, coupled with a cultivated skill in the production of plantation rubber. Nevertheless there is no reason why equally favorable conditions cannot be found or created elsewhere for the purpose of bringing competition into the plantation rubber industry. This explains the request of the Secretary of Commerce for a special appropriation of $500,000 to investigate the possibility of rubber production in other tropical countries, including the Philippine Islands. Probably too much has been made of the prospect of raising rubber in the Philippines, because economic conditions there are not favorable to the development of a large industry. The land laws restrict ownership of areas to 2,500 acres or less, and labor is expensive. But more important perhaps than either of these factors is the question of the future political destiny of the islands. It is doubtful if American capital would be freely invested in rubber developments in the Philippines unless there was assurance of continued United States control.

But there are other tropical countries closer at hand that would be more suitable sources of rubber as far as the United States is concerned. Brazil, for example, might prove satisfactory if the land laws were liberalized and health conditions improved. Our Department of Agriculture thinks that there is even a possibility that rubber may yet be produced in the temperate zone; but this is a remote contingency—something that may come to pass in 25 or 30 years.

Any measures looking to the development of new sources of plantation rubber cannot be of assistance in the present crisis. Under the most favorable conditions new plantations cannot come into production for 7 years, and it would probably be a decade before their product would be a material factor in the market. The immediate hope of an adequate supply at a reasonable price is intelligent action by the British with respect to their present restrictions. If our laws permitted combinations of American firms in import trade, it would be possible to control such markets as rubber and other commodities of which we are the world's largest consumers but for which we are dependent on some other nation for our supply. Since this is impossible, the most hopeful prospect lies in a friendly understanding between the producing and consuming industries.

Standards for Heavy Chemicals

STANDARD specifications for heavy chemicals have been discussed from time to time, but no one seems to have made any very striking progress on the subject. For some reason the manufacturers have been unwilling to take the initiative in drafting such specifications. And the users have been scattered through so many industries and have been so poorly organized as to preclude any effective action on their part. However, a movement that is steadily gaining ground promises to remedy this defect.

The Federal Specifications Board of the United States is constituted of representatives of various government departments interested in purchases. Sub-committees of this board are appointed to draft specifications for the various commodities that the government buys in quantities. One of these commodities now receiving attention is sulphuric acid for storage batteries. No sub-committee has as yet been appointed, but it is proposed

that there shall be such a committee to consider the specifications now being drafted for this purpose by the Bureau of Standards. Certainly some definite specifications can be expected during the next few months.

Sulphuric acid is produced in many qualities and sold under many trade designations. One of the principal uses of sulphuric acid which demands a staple and uniform product is the storage battery. It is estimated that from 50,000,000 to 100,000,000 pounds of sulphuric acid goes into batteries every year and that there is no particular reason why there should not be a uniform requirement as to the quality of this acid. The Bureau of Standards proposes to find out what can reasonably be required and what is essential for proper service from this material.

The specifications which the bureau proposes will doubtless find wide application and it is almost certain that they will eventually become the official requirement for all acid purchased by the government. When that is done, hundreds, if not thousands, of other purchasers are likely to copy the government requirements. This, therefore, is a movement which the manufacturers of acid cannot ignore. It is a movement which is more than likely to determine what quality of acid they will have to make sooner or later in order to supply the demand. It is another case in which the manufacturers will do well to take steps for active co-operation with the government, in order that the most effective and the most workable requirements may be fixed to the mutual advantage of producer and user. It is not too much to hope that such co-operation can be arranged at once for this material. And one may even expect that this co-operation will demonstrate some workable scheme for the drafting of standards of quality for many other important heavy chemicals.

Patent Office Records in Danger

FOR many years the government has been grossly careless of its irreplaceable, invaluable records of public business. During the present session of Congress, the House of Representatives decided that an archives building should be constructed and authorized an appropriation for that purpose. But the Senate thought otherwise, and for the present the opportunity has passed for undertaking the plans and construction of such a building.

Among the most serious problems of this sort that demand immediate consideration is the protection of Patent Office records. These original documents are of inestimable value to industry, yet they are stored on rough wooden shelving along the public corridors of the building, forming a fire hazard of almost unparalleled magnitude. In this matter the Department of Interior and the Commissioner of Patents are helpless, for Congress has persistently declined to give adequate storage space or provide any facilities for the care of these documents.

There is now proposed a special Congressional commission of investigation. The problem is so clear that it seems absurd to have such a commission appointed; but it appears to be necessary that the Congressmen see with their own eyes and pass upon the question in their official capacity. Let us hope that this commission will be authorized at once, and that it will be so thoroughly convinced of the need that it will overcome Congressional negligence and provide at an early date adequate housing and filing facilities for these documents. Certainly no one will deny that something must be done to safeguard these records.

Journalism— Technical and Otherwise

WRITING and reading are complementary, both are essential to what is still the most satisfactory method of transferring thought despite modern invention. Skill is acquired by practice, aided by an appreciation of common-sense principles. Facility in reading is governed by the limited service of the human eye, with or without artificial aid to sight, although it is probable that future generations will read more by the ear and less by the eye.

A good writer is recognized by two dominant characteristics: economy in words and an absence of ambiguity in the message. To convey the facts tersely, without the remotest possibility of misinterpretation, without necessitating any mental choice as to meaning on the part of the reader, and without inviting literary criticism this is the essence of good journalism. Effective writing is so unobtrusive that its virtues often pass unobserved. How often need an item or an account in a daily newspaper be read more than once, or any part of it more than once, to appreciate the message? If clarity and brevity be the essence of good journalism, have we not been tardy in paying tribute to the daily press? Is it not somewhat pathetic that a veteran journalist, CHESTER A. LORD, should feel obliged to take up his pen to defend and give credit to newspapers in "The Young Man in Journalism," recently published by the Macmillan Co.? A little retrospection and analysis will show that the bouquet is well deserved.

The main characteristics of contemporary newspaper journalism form an excellent example of the application of common-sense principles, principles that are so logical that they can be commended to the attention of all writers, especially those who contribute to the technical press. The primary essentials are clarity and brevity, in the order named. Ambiguity is not tolerated; there is no justification for excusing it in scientific literature. As to brevity: it may take one man—the author or the editor—a few hours to condense a manuscript 5 per cent, but this may save ten thousand hours of profitless reading by others, besides enhancing the contribution by increasing its clarity. A recognition of these common-sense facts by newspapermen has been responsible for the supremacy of the English-speaking press today. For clarity, there is nothing to surpass the news items in the great dailies; for literary merit, the editorials.

It is well, therefore, that we take the opportunity to pause from our allotted tasks to pay tribute and give credit where both are due. We appreciate the striving for efficiency and accuracy that has marked the journalistic career of men such as Mr. LORD; and we welcome the sane and sensible advice he gives. Although intended primarily for the would-be newspaper journalist, the book we have mentioned should be read by all who put pen to paper. The chapter on composition should be especially valuable to the technical writer. One quotation from an address by LAFCADIO HEARN is worth repeating: "To produce even a single sentence of good literature requires that the text be written at least three times." Repeated revision is essential. It is only by patience that the non-essential can be eliminated, and the simple, direct message framed to take the place of the verbose interpretation of first thought.

The Struggle On the Ruhr

WITH the French grip tightening on the industries of the Ruhr and temporarily strangling the industrial life of that region, and with German resistance intensified to the utmost, the outcome has become largely a question of endurance. It is quite evident, as intimated in our editorial of last week, that the French are in for a long siege that will be terminated only by German capitulation or the introduction of side issues not now in evidence. The important question, then, becomes one of endurance and we may profitably inquire into the respective resources of the contestants.

In Germany fuel and food are the critical factors. Our information is that as far as fuel is concerned, German industry outside the Ruhr can continue to function normally to about the middle of April. After that date the country will be dependent on outside sources for from 50 to 65 per cent of its needs. Food supplies, of course, are growing short; and the situation is strained by reason of the fact that Germany's credit is poor, being limited to the value of her exports. Inasmuch as the latter are decreasing from day to day, it is readily seen that the possibility of providing food from this source is rapidly waning. This means that the government may have to draw on its internal gold reserve, which we are informed amounts to about $175,000,000. Should the situation become desperate enough to warrant expenditure of part of this reserve for food, it is doubtful if even France could or would prevent it.

In France conditions are none too good. Coal is short, credit has been somewhat damaged and commodity prices are rising. Nevertheless from a material point of view the resources of the French are more comprehensive and flexible than those of the Germans and consequently the former probably can last longer in the present struggle. On the other hand, France has to contend with the influence of public opinion on the acts of the government. Whether the French officials entertained any delusions on the immediate outcome of the occupation of the Ruhr, it is certain that the French nation believed that economic relief would be an immediate consequence. What will be the reaction in France when people realize that no great recovery of reparations is to flow from the Ruhr itself and that there is no immediate economic relief in sight? There must be inevitable disappointment; and it is a question how long the government can withstand that reaction. Other questions also may arise to modify the French program, such as outside and independent agitation for the establishment of the Ruhr as a separate state. In addition there are those who believe that the present occupation may extend indefinitely, even to the acquisition of territory. As to this, the French policy is no clearer than when the Ruhr was first occupied.

There has been some talk of intervention by Great Britain or the United States, but it is doubtful if this will come about without invitation. Reliable advices indicate that there is a stronger spirit of unity among the German people than at any time during or since the war. Apparently the French also are at present a unit in support of their government. Under these conditions it must be evident that no successful intervention could be made, as it would not be welcome by either side. Until one or the other or both of the contestants ask for outside aid it is quite likely that no nation will interfere with the present French plans.

Why Should We Be Interested in European Conditions?

BACK in 1920 one of the common plaints of industry was the lack of raw materials. The threat of a world shortage of crude stuffs for our factories was a subject of grave concern. Now, of course, we realize the fallacy of our vision; we were working up the raw materials of the world and when the break came in the world's economic equilibrium we were not long in finding out that industrially we were organized on much too large a scale.

In the process of liquidation that followed it was the producer of raw materials who was the first to be affected. Wherever possible the production of basic materials was curtailed and the industries drew upon existing stocks. The more effectively this process was carried out by the raw material producer, the sooner the consuming industry completed its readjustment. In the case of copper the mines were closed down and it is only with the recent revival in prices that the copper industry has been at all active. Cotton production was curtailed, not voluntarily by the producer, rather through the ravages of the boll weevil. As new rubber plantations came into bearing it became apparent that our supply of this raw material could not be diminished, at least not without the drastic measures which have since been instigated by the British growers. Steel, the most important of all raw materials, was seriously restricted in the latter part of 1919 by the steel strike and later by the walkout in the bituminous coal fields. However, it was the great producer of foodstuffs, the American farmer, that has suffered most acutely. He was not so successful in curtailing his output and the market for his produce had disappeared over night. We awoke to the fact that we had been selling too much on credit to Europe, that our debtors were not working nor was there evidence of their intention to do so. Our loans to European countries, with the exception of England, had been dissipated in military expenditures, in speculation over reparations. Thrift had given way to extravagance.

Dr. B. M. ANDERSON, a noted economist and the chairman of the conference on European rehabilitation which was held by the Institute of Politics at Williamstown last summer, has recently said that there are two ways to straighten out the present situation. In the first place we can sit passively by and watch the process run its course. Gradually the farmers and the industries in this country which are dependent upon a world market for their goods will be forced by foreclosure to contract their operations to the point where production will be balanced by our own consumption. This process will prove long and tedious—10 years is Dr. ANDERSON'S estimate—and it will be consummated only at the expense of sacrificing much of our present industrial system. The other way, and the more fruitful course for us to pursue, is to help get Europe back on her feet. We must assist in restoring the world's economic equilibrium by making a good debtor out of a bad debtor. Drastic reforms are necessary, and they will come only when we can tie together into one settlement the currency, financial and reparation problems of the former belligerents. Additional loans, proposals of debt concellation and intervention in the present political situation will be ineffective unless there is a return to the gold standard, so that national expenditures, in some way or other, can be measured in terms of actual production and enterprise.

Readers' Views and Comments

The Chauffeur Aspires

To the Editor of Chemical & Metallurgical Engineering

SIR:—Your editorial in the issue of Feb. 21 about the Society of Professional Automotive Engineers overlooked the fact that these aspiring chauffeurs were about to jump from the frying pan into the fire. The society aims "to protect its members from increasing laws levied on operation of automobiles," and since its headquarters are in New York, presumably the onerous laws of which it complains are the laws of the State of New York. The laws of New York about automobiles are mild compared to the law which goes into effect after April Fools' Day regulating and defining the practice of professional engineering. This law requires professional engineers to be licensed and sets up certain standards of training and experience requisite to the issuance of a license. This is clearly meddlesome interference with the inalienable rights of those who drive cars of the better sort, and no doubt the society will use the full power of its 4,000 votes to see that its members are not compelled to pay another $25 fee in addition to the heavy burdens they already bear.

On reading Chapter 581, Article IV-A, of the laws of New York, some may have wondered how the Legislature came to couple professional engineering and land surveying in the same breath. As the law is worded, one might think that surveying is the highest form of engineering with which the Legislature was acquainted. The Society of Professional Automotive Engineers might well begin its educational work in Albany before it is too late.

LOUIS WEISBERG.

New York City

Marketing Ideas

To the Editor of Chemical & Metallurgical Engineering

SIR:—He who can solve the problem of marketing ideas, according to E. H. in your Jan. 3 issue, will bring fame to the successful aspirant, and peace and contentment to many inventors who know the ways of matter but not the ways of men. To this sentiment there should be ready concurrence. If the technician negotiates with a business man, continues our informant, the chances are that the idea he propounds will die. To prove the truth of this one need only record the experiences of thousands; but the remark contains the germ of an idea that, in my opinion, should be fruitful of result or, at least, is worthy of discussion.

The trouble with the majority of inventors is that they have no commercial instinct and cannot bring themselves to acquire it—they can never become business men. One can admit the ability of the ordinary technician to develop an idea through the laboratory stage, but few there are like the chemical engineer of whom E. H. speaks—who can adequately protect an invention from plagiarism or theft. Patenting is a business; it cannot be successful unless ample financial backing is available, unless each and every possibility of business competition is anticipated, unless a suspicious eye is kept on the legal sagacity of competitors.

The marketing of an idea should also be viewed as a business proposition, to be put through by a business man. This is the crux of the matter. Every movie star employs an attorney or a business manager, to arrange, to argue and to bargain—always with an eye to adequate financial return—although his principal usually lacks none of the push required to advance his or her claims to distinction. How much more necessary is it for the scientist or the technician, absorbed in his work and living above the atmosphere of commercial greed, laboring for the love of achievement, as averse to bargaining for remuneration as he is to compromising with facts—how much more necessary is it for him to have a business manager to see that proper protection is secured for ideas evolved, that adequate recompense is arranged for personal services, that fair and equitable agreements only are signed.

I suggest that there is scope for an organization of professional men with commercial training to act as intermediaries between the man of science and the man of business. As the matter stands at present, the inventor-technician has to fight against elements with which he is unfamiliar—against shrewd and highly paid attorneys and patent experts who represent business interests anxious to get ideas for nothing and professional service for next to nothing. The chemical engineer will come into his own when he is protected by the same type of business acumen that has deprived him of his just reward in the past.

ALPHITA.

San Francisco, Calif

Lime Production Statistics for 1922

It has been estimated by the United States Geological Survey that during 1922 there was a material increase in the production of lime. Statistics show that approximately 3,528,000 short tons of lime, valued at $33,057,000, was sold during the past year in the United States, including Hawaii and Porto Rico. These figures represent an encouraging increase of 39 per cent over the previous year, when the production of 34 states decreased and only 8 reported a larger output. Producers of lime on a small scale who supply markets largely dependent upon local demand report a decrease.

Although the scarcity of coal has resulted in the use of wood for fuel by many manufacturers, approximately the same number of plants are reported still in operation. Economic conditions are such that the demand for lime has improved, but prices show a distinct downward trend. Labor has been easily secured, but many transportation difficulties had to be overcome.

Lime for building purposes has reported the largest increase in production, ranging from 3 to 75 per cent among the various manufacturers. Chemical lime has also increased appreciably, reaching a record output of 300,000 short tons, as compared with 107,664 short tons sold in 1921. These figures, however, apply only to refractory lime (dead-burned dolomite) used for patching and lining basic open-hearth furnaces. Agricultural lime, on the other hand, does not report a similar improvement as construction and chemical lime, owing to the farmers' inability to buy the raw material.

The Sterling Chemical Laboratory of Yale University

Description of the Building Erected as a Memorial to John W. Sterling and Which Will Be Dedicated During the Spring Meeting of the American Chemical Society in New Haven—Construction is Planned to Meet Immediate Needs, With Flexibility for Changing Requirements

THERE was John W. Sterling, who went to Yale, took the good old prescribed course, "made Bones," was called Jack by his fellow students, according to the class-book, and was graduated in 1865. He was a quiet man, not addicted to display; he studied law, settled down to practice in New York, did well at solving the problems of corporations and practiced the philosophy of Coué in gaining day by day more and more affluent clients, among whom were finally included the late James J. Hill and Lord Strathcona. He attended strictly to business, did not even take the trouble to marry, lived quietly, and in the course of time went the way of all flesh. When his will was read, after a number of minor provisions, a board of trustees for the residuary estate was named, who should administer it to provide chiefly memorial buildings and professorships for Yale University. And the residuary estate footed up to nearly twenty millions of dollars. It was a cheerful surprise.

The first building to be constructed was the Sterling Chemical Laboratory, which we are about to describe. This is now completed, and will be formally dedicated during the spring meeting of the American Chemical Society, on the one hundred and nineteenth anniversary of the first lecture delivered in Yale by Benjamin Silliman, Sr. Its cost is said to be about two million dollars. The next building will be the Sterling Hall of Medicine and a Museum, both of which are now being erected, and there will follow a new library.

The Sterling laboratory is designed to house all major chemical activities of the university except the department of physiological chemistry, under Professor Mendel and his associates, which remains with the Medical School and will later be provided for in the Hall of Medicine. The work in metallurgy and allied subjects is well cared for by the Hammond Metallurgical Laboratory, a gift to Yale by John Hays Hammond.

At the very outset there was a difficult problem to be met. The site was provided on a hillside, with the front and main entrance at the lower, and the back at the higher, part of the slope. The university corporate authorities and the trustees of the fund desired it to be as a memorial laboratory, monumental in design, and Delano & Aldrich, an eminent firm of architects, distinguished for its good taste in form and line and color, was engaged.

On the other hand, the faculty of chemistry knew very well that the merit of a laboratory consists, aside from needful equipment and the convenience of its arrangements, in good light and a great measure of flexibility. It should be more of a factory than an office. Saw-tooth roofs with overhead northern lighting over a single story appealed to them as the most desirable form of building for this purpose. This is the same conclusion as that reached by Sir James Walker when the new laboratory of the University of Edinburgh was built, to the amazement of the Scotchmen.

Some eminent chemists hold that in building a laboratory one should not aspire to set up more than temporary structures, because much of what is within is bound to suffer corrosion and deterioration, and requirements are sure to change with everchanging and

always new problems to be solved. A perfect layout for one kind of work is wholly inconvenient for that of another type which it may be desirable to take up shortly afterward. So the faculty had the problem to meet to include, in a memorial building, a factory plant which may be changed and shifted about to meet the needs. Now the faculty of chemistry at Yale is a very intelligent body of men, and the same may be said of the corporate authorities of the university and also of the architects. Therefore they did not quarrel over it. They studied the problem, and arrived at a remarkably practical solution.

The front, which extends over the whole width, is a building by itself, divided from that which is back of it by a large hall, of which we show a cut. Here, in the front building, is the vestibule, to the right of which is the office of the chairman of the department, Prof. John Johnston. Coat rooms and class rooms take up the rest of the space on the ground floor. On the floor above are two large auditoriums, one on each side of a great window above the entrance and vestibule, with a preparation room between them, as shown on the main floor plan. The lecture rooms are flanked by two class rooms on either side.

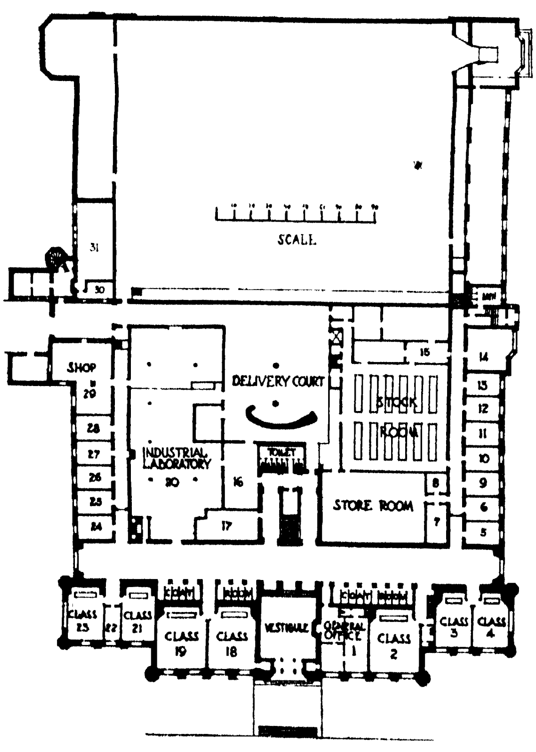
A railway runs through the preparation room and over the platform in each auditorium, so that the set-up for each lecture is made in room 159, and then wheeled either into 160 or 110, as desired. All the platform desks for these two lecture rooms are on wheels. Therefore lectures which involve wholly different apparatus may be given in consecutive hours in the same auditorium, because everything in front of the professor is wheeled away as soon as he is finished, and another train of desks, all prepared and joined together, is wheeled in for the next.

The dividing walls which separate the various rooms in this front building are not structural, so that any change may be made in the size or the arrangement of rooms without affecting the building proper.

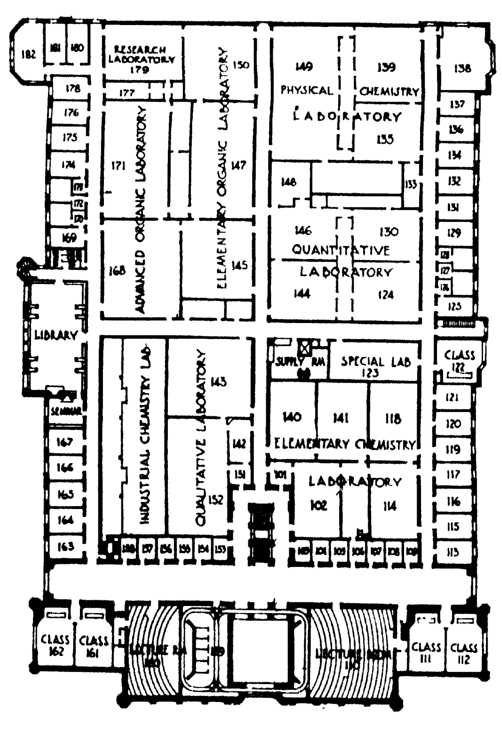
In order to preserve architectural unity and to hide the factory construction within, a narrow structure extends back the full length on each side from the front building. On the lower floor the excavation extends only half way back, owing to the side-hill formation, and in these narrow side buildings are contained offices and research laboratories. Half way back on each external side is a bay, and these include on one side a machine shop, and on the other a larger research laboratory. On the main floor throughout the full length are research laboratories and offices, with the library in the right-hand bay and a class room in that on the left. These two outside buildings constitute a so-called "architectural screen," and extend up one flight above the main floor, providing sleeping apartments for research students on one side, and more research laboratories or additional sleeping quarters on the other.

The above three structurally independent but connected buildings constitute a great U, 328x256 ft. at maximum. Within the U is the undergraduate laboratory proper. The lower floor, which, as we have noted, extends only half way back, contains a delivery court with driveway and store room, stock room and other conveniences, all artifically lighted, and also the laboratory of industrial chemistry. This extends in part through the main floor and is equipped with two galleries and a traveling crane running over the greater part of its length. A connecting room is provided for grinding machinery and furnaces.

The main floor is of two stories in front and one at the back, covered with saw-tooth roof and light from northern exposure. The glazing is heavy wire glass and is double, with air spaces between, thus avoiding



LOWER FLOOR



MAIN FLOOR

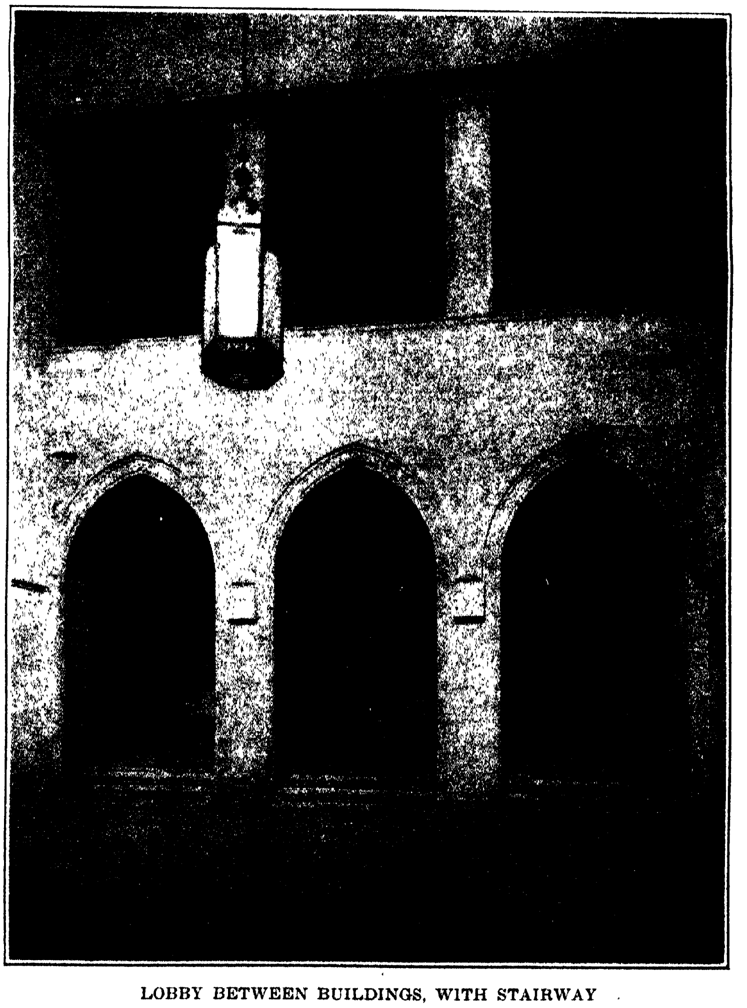
FLOOR PLAN OF THE STERLING CHEMICAL LABORATORY

PRIVATE LABORATORY

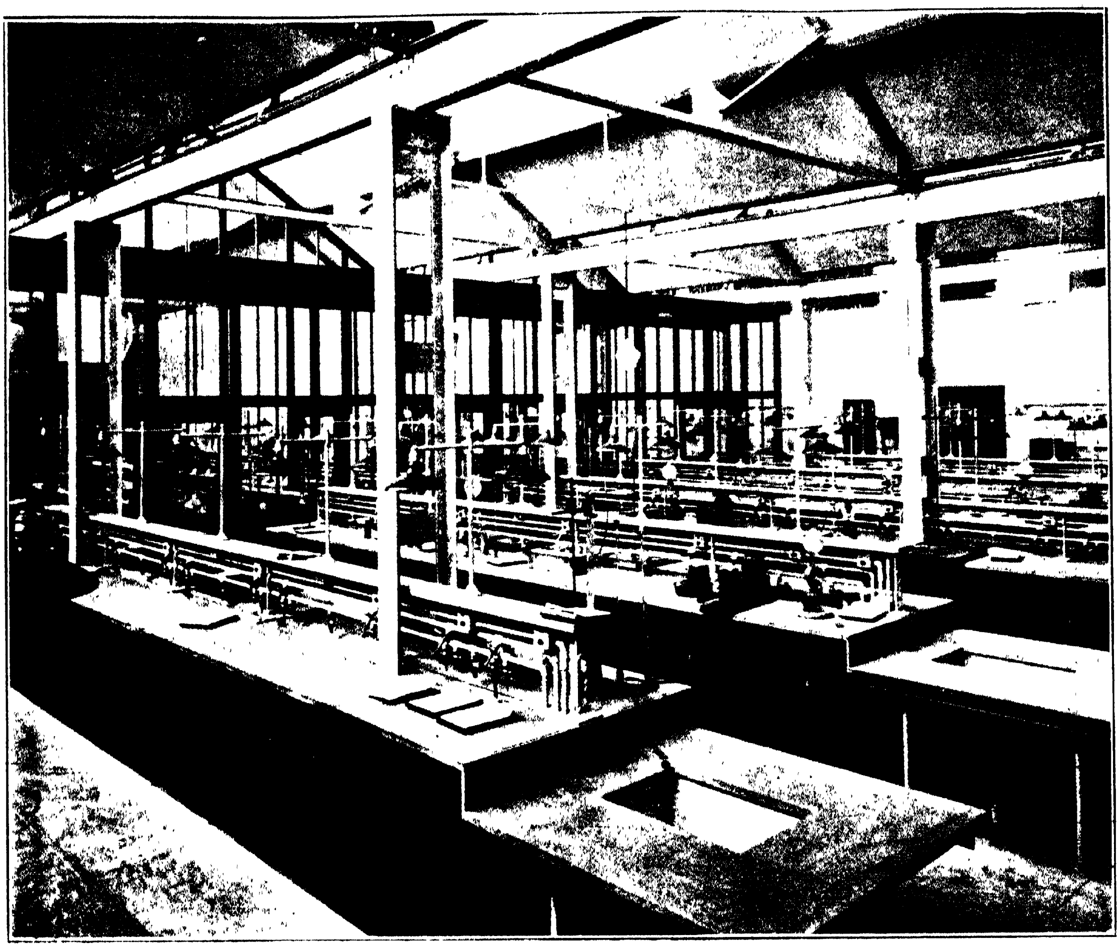
excess heat in summer. It contains the undergraduate teaching laboratories, thus lighted from above, and all partitions may be removed and changed about as needed, without disturbing the building proper. Abundant flexibility is thus assured. Teaching laboratories are restricted to a limited number of students working at one time, thus avoiding the tendency to "study in lockstep," which sometimes occurs if laboratories grow too big. A very clever arrangement in the rooms devoted to quantitative analysis consists in the balance room, which is long and narrow, and extends through the unit as an axis. Swinging doors open into each aisle, which makes the balances readily accessible to the workers. A draft of air blows into this long room and when the doors are opened it blows into the laboratories. This increases the abundant ventilation and avoids a return current with its corrosive effect on the balances. The balance tables cover the entire width of the rooms, which discourages conversation.

The laboratory of elementary chemistry is divided so as to provide places for thirty-two students in each room, and it has a total capacity for eight divisions of students, or 1,280 in all in the suite of five rooms. The qualitative laboratory is in two sections with eighteen and sixty work places respectively. For organic work there are two suites, of which one, of three rooms, is for elementary and the other, of two rooms, for advanced courses. These are also provided with a central balance room and Kjeldahl room. In addition there is a large unit for advanced research in organic chemistry. The physical chemistry department is arranged with balance room similar to that in the quantitative unit, and is provided with thermostat tanks with means for steam and electric heating, cold water circulating coils for cooling, electrical equipment, etc.

In the northeast corner of the plant is a large underground chamber and elsewhere there are special spaces provided for conducting research at constant temperature, at high pressures, for photochemistry, etc. Indeed the scope of major research which may be carried on in this splendid new laboratory is very large and it reflects great credit on the chemical faculty for remarkably shrewd and far-seeing planning by its members. We believe it would be profitable for those chemists who expect to attend the spring meeting at New Haven to bear in mind those lines of research which they would like to pursue, and observe during their visit to the laboratory what provision has been made for meeting such requirements.



LOBBY BETWEEN BUILDINGS, WITH STAIRWAY



PHYSICAL CHEMISTRY LABORATORY, SHOWING BALANCE ROOM BETWEEN SECTIONS

ments. The physical equipment of the laboratory has been selected with great care. In order to eliminate losses from deterioration a drainage system has been installed consisting entirely of chemical earthenware. The lines of this system are straight, without traps or vents. Where the system discharges into the sewer are two large catchbasins. The sinks are also of chemical earthenware, and each is sealed by means of a bell trap which prevents the escape of fumes into the work rooms.

The plumbing fixtures are of brass with dull nickel finish. Standard hose-connection tapers have been used for those which are provided with rubber-tube connections. Hot-water is secured by means of a steam-water mixer, which will provide water at any desired temperature.

Work benches and tables are of Alberene stone, supported by the same cast-iron frames which carry the sinks and plumbing. These frames are attached to the floor by pins which are threaded through washers and permit the benches and tables to be made exactly level. Wooden cabinets are raised from the floor several inches by cement pads.

In constructing the building, red brick and brown sandstone have been used for external walls. Interior walls are of red or buff pressed brick. Floors of the main laboratories in the saw-toothed roof section are concrete. All corridors have tiled floors. The roofs are of glass and "Pyrobar." Care has been taken throughout to protect the structural materials from the action of chemicals.

The general harmony of the planning and of the layout impresses one with the notion that the Yale faculty of chemistry pulls together and is developing an *esprit de corps* which prevents any working at cross-purposes. One gathers the conviction that chemistry is bound to grow at New Haven as one of the great, learned professions, and that this will include industrial research of the highest order.

Impossibility of Accurately Controlling Sulphur Production

Although sulphur deposits have been worked in many parts of the United States, practically the entire output is now obtained from the deep-lying sulphur deposits of Louisiana and Texas. When the wells in this region are once heated, it is not economical to allow them to cool until they have been exhausted. For this reason and because of the desirability of maintaining stocks above ground, more sulphur is often mined during a year than is marketed. A diligent search for new uses for sulphur has ensued and efforts to expand old uses have been made. The further use of sulphur as a fertilizer has received especial attention and most of the agricultural experiment stations are aiding in this research. Experiments in the use of sulphur as a component of acid-proof cement and acid-proof construction material have also yielded promising results. Sulphur is now one of the few commodities of which the price is lower than before the war.

Winter Meeting of the Mining Engineers

Dr. Rosenhain Delivers the Institute of Metals Lecture — Advanced Physical Metallurgy Almost Excludes Consideration of Manufacturing Problems — President Mathewson Pleads for Greater Sociability and Fewer Formal Technical Sessions

FROM the attendance at the various sessions, the interest manifested in the papers, and the discussions which ensued, the Institute of Metals Division appears to be the most active branch of the American Institute of Mining and Metallurgical Engineers. Possibly not so much information on non-ferrous ore dressing and smelting should be expected in a New York meeting, owing to its geographical situation; but this should be no bar to active work among the iron and steel men. Yet the disparity in interest was obvious to many observers.

Institute of Metals Annual Lecture

Perhaps the Institute of Metals profited from a running start. Certainly the technical feature of the first day, if not of the entire meeting, was the annual lecture of the Institute of Metals, given this year by the eminent English metallurgist Dr. Walter Rosenhain. His discussion on "Solid Solutions" was at once erudite, fluent and interesting, and held the close attention not only of the physical metallurgists present but also of many hundreds of listeners who were relative strangers to the subject under study and even of the instruments by which the structure of metals can be studied. Space limitations preclude more than mention of the event at this time—a full digest of the lecture will be presented in these columns next week. At this point, however, it may not be amiss to compliment the Institute of Metals Division, and especially its indefatigable secretary, W. M. Corse, for their enterprise. Announcement that Dr. Zay Jeffries will be the third lecturer insures that the high quality set by Bancroft and Rosenhain will be maintained one year hence.

Social Activities

E. P. Mathewson, the incoming president, stressed the importance of social activities to the success of the Institute in his address at the banquet. His words were homely, but were expressed in a straightforward manner which everyone who knows him would expect. Recalling that the bond of union cementing the A.I.M.E. was of course the technical interests of the members, this will fail if it does not satisfy the social aspirations of the technical men. Dry-as-dust papers must be replaced by those which will elicit animated discussion; these discussions must in some way be carried to the outlying members, either by frequent regional meetings or even by wireless. In other words, the technical interests of the members should be nothing more than an excuse for them to meet, to merge their personalities and become more human.

Award of the James Douglas medal was made to Frederick Laist, manager of the Anaconda Works, for his achievements in the metallurgy of copper and electrolytic zinc. In a brief speech of acceptance he said the achievements, such as they were, were the result of wholehearted co-operation of hundreds of assistants, and he wanted his hearers to know that, and he wanted his assistants to know it, as well.

The usual round of luncheons and theater parties, a dance and a smoker were well attended. On Washington's Birthday a special train took the members to Ansonia, Conn., where they inspected the extensive mills of the American Brass Co. Can it be that this red-letter day ushers in the open door in the brass industry?

Diffusion in Solid Solutions

Dr. Rosenhain, in his lecture, showed how the properties of solid solutions can be explained by considering their atomic arrangement. It was therefore fitting that at a later session Dr. Edgar C. Bain should describe how the X-ray can be used for crystal analysis, and present the information thus found for cored crystals, intermetallic compounds and solid solutions. His two contributions have already been printed in full in *Chem. & Met.* (Jan. 3 and 10, 1923).

In the discussion, Jerome Alexander raised two questions: Whether there was a possibility of a molecular aggregation in solid solutions (such as, for instance, in ice, which is thought to be H_4O_2), and second, whether a spheroidal or colloidal state intervenes between a true solid solution and a two-phase mixture of observable units. Dr. A. St. John reported that he has been able to prepare materials in extremely fine particles. It is well known that a crystal size which may with difficulty be resolved under the microscope produces an X-ray diffraction pattern which contains well-defined narrow bands or lines. As the size of particle decreases, the bands widen, but still have a well-defined maximum. Subdividing the particles still further—to less than colloidal size and approaching particles estimated to contain no more than 125 atoms, the pattern is still observed. Each line has spread out into an extremely broad band—a beam which theoretically should be concentrated at a deflection of 24 deg. occupies the space from 15 to 32 deg., but there is still an observable concentration of intensity at 24 deg. Further subdivision of the particles would mask the true effects still further, but the speaker felt that if he could manufacture a material of cubic crystals containing only 8 atoms it would produce a very cloudy film still having the slightest maximums.

Such markings would be observed superimposed on the pattern of the solid solution if the "stranger" atoms occupied definite positions in the lattice, even though this regularity was interrupted at random every few atoms distance.[1] So far the most minute search had failed to show any such effects in solid solutions; therefore the speaker was forced to the conclusion that the regularity of distribution of stranger atoms in solid solution, though great, was not such that they occupied the northwest corner of alternate cubes, for instance, thus building up an interpenetrating lattice of their own.

In response to the second question—i.e., Does the col-

[1]Dr. Bain has pointed out, however, that if an interpenetrating lattice is displaced regularly, and not at random, a general cancellation of X-rays occurs, and no trace could be found on the film.

loidal state intervene in the decomposition of a solid solution?—Dr. Jeffries expressed the opinion that it necessarily must. Colloidal state is a condition of size; it must intervene between atomic dispersions and microscopic crystals. Annealing of solid solutions at a temperature at which they are stable causes diffusion of stranger atoms. Annealing at unstable temperatures allows precipitation of excess constituent and involves aggregation of stranger atoms; this precipitation starts at random centers, and as the particles grow in size they pass through the colloidal state; but at all times the particle is crystalline, and it grows by adding on one atom at a time. Dr. Rosenhain did not agree entirely with Jeffries' view, even admitting that they were largely speculating about an unknown mechanism. He suggested that when atoms begin to leave solid solution they do not do so easily—conditions must be right. Whether they could aggregate would depend largely upon their own mobility and the expansivity of the lattice in which they were trapped. Consequently precipitation of excess constituent caused a general upset; each tiny crystal of insoluble substance is not well arranged and in turn would be surrounded by masses of mother lattice, badly disturbed or even disintegrated—almost approaching the amorphous condition. If this does not recrystallize quickly, considerable hardening ensues.

Metallography of Aluminum Alloys

E. H. Dix, Jr., of the Army Air Service, presented two papers on the "Preparation of Aluminum Alloys for Metallographic Study" (*Chem. & Met.*, Dec. 20, 1922) and on the "Occurrence of Iron and Silicon in Aluminum." Equilibrium conditions have been worked out in the Eleventh Report of the Alloys Research Committee, but cast alloys or commercial annealings fail to approach this state, and contain some puzzling transition bodies. In very low-silicon ingots (less than 0.10 per cent), iron exists as $FeAl_3$ in very brittle, thin, intersecting plates of blue-gray color (Fig. 1 of the first contribution). With increasing silicon contents—in fact in all commercial ingot—another substance appears, which has been called "X constituent" and is thought to contain iron, silicon and aluminum. It has a habit very similar to $FeAl_3$ and is light gray in color. "X-constituent" and $FeAl_3$ can be differentiated by the fact that the latter retains its color after etching 30 seconds in HNO_3, while the former becomes a watery gray. As silicon goes still higher, all the iron enters the X-constituent, and no $FeAl_3$ is found. "Chinese script" markings shown in Fig. 2 of the first paper etch like this, and are characteristic of aluminum alloys containing equal amounts of iron and silicon. It is often found near the pipe in ingots where needles of $FeAl_3$ verge into it (Fig. 1 herewith) and evidently is the low-melting point constituent in the Al:Fe:Si series. Some unknown constituents occur in cast samples containing more silicon than iron. For instance, Fig. 2 herewith (Al:Fe:Si 97:1:2), contains light gray needles of the X-constituent, rounded purplish particles of silicon, and a rectangular blue-gray constituent whose identity is unknown. Complex needles are often found containing a core of $FeAl_3$, a sheath of X-constituent and an intermediate layer—probably a transition compound which would disappear if properly annealed. These reactions are very slow, however.

Mr. Dix presented some experiments to demonstrate that the X-constituent is certainly not FeSi, but probably contains a relatively small amount of silicon.

"Thermal Properties of Aluminum-Silicon Alloys" were given by Junius D. Edwards.[2] It will be remembered that if an 88.4:11.6 Al:Si alloy be prepared by melting pig metal, it will consist entirely of a eutectic aggregate; but if a trace of alkali metal be added, 15 per cent Si will have to be present before the eutectic is reached. Silicon alloys were shown by Dr. Edwards to have a very low solidification shrinkage, and this accounts for their superior ability to run sound castings, free from pipe. Responding to inquiries about the reason for the bizarre displacement of the equilibrium, Zay Jeffries said that his associates regarded the action of sodium, the modifying agent, as one of obstruction to crystal growth. Sodium is but very slightly soluble in

Fig. 1—Alloy with 0.63 Fe, 0.63 Si; annealed, unetched × 500. Needles of $FeAl_3$ verging into X-constituent with Chinese script habit.

Fig. 2—Alloy with 1.0 Fe, 2.0 Si, annealed, unetched. × 1,000. Needles of X-constituent, rounded particles of silicon, and rectangular mass of unknown intermediate compound

aluminum, even when liquid; therefore the chance of any sodium entering the solid and forming a ternary eutectic was not very great. Probably less than 0.02 per cent sodium remains in the solid alloy. But that small amount which did alloy with the liquid precipitates before the freezing of the aluminum into an infinite number of very fine particles of colloidal size or even less. These really act as an obstruction to the growth of the grains, interfering with the migration of the silicon and aluminum atoms necessary before they can attach themselves to pre-existing nuclei. This sluggish movement of the atoms is also in effect an undercooling of the whole alloy, which in turn is known to promote fine-grained structures, growing from many centers. Other examples of the interference to crystallization offered by foreign particles are well known; notably thoria in tungsten.

[2] *Chem. & Met.*, vol. 28, p. 165 (Jan. 24, 1923); vol. 27, p. 654 (Sept. 27, 1922); vol. 26, p. 750 (April 19, 1922).

SELENIUM AND TELLURIUM

These interesting metals—recovered during the electrolytic refining of copper—were discussed by Victor Lenher, of the University of Wisconsin, after describing their occurrence, chemical relationships, and analytical methods. At the present time about 100,000 lb. of Se is recovered annually—more could be had if it could be sold. It costs about $2 per lb., and is largely used in the manufacture of ruby glass and as a decolorizer of white glass. A small amount of crystalline modification is used in the selenium cell, which has the remarkable property of responding to light waves. Selenium oxychloride is a solvent for a wide range of organic substances.

Tellurium resembles antimony in appearance. But few uses have been found, and its production is nominal, although 150,000 lb. of the element could be recovered annually. Some of the best ceramics are colored by tellurium.

BRITTLE MALLEABLE IRON

It has long been known that perfectly normal malleable iron, having a ductile black fracture, will be converted by hot-dip galvanizing into a brittle material, having a white coarse crystalline fracture and low resistance to shock. Preliminary work by the Eastern Malleable Iron Co. determined that this phenomenon is not due to occlusion of hydrogen during the pickling process. To locate the trouble, a careful research was directed by W. R. Bean, and it was found that high phosphorus and silicon induces these brittle intergranular fractures in malleable iron quenched from 850 to 900 deg. F. Safe analyses are below 0.06 P with 1.50 per cent Si, and 0.22 P with 0.50 per cent Si. In the experiments, a nest of test bars was cast from a crucible furnace; one of these was tested as annealed, and others after galvanizing and after various heat-treatments. Chemical analysis of these melts was systematically varied, and when the results of Humphrey or Alsen notched bar tests were plotted against phosphorus content, it was quickly found that no deterioration occurred in low-phosphorus bars. Galvanizing followed by very slow cooling or quenching in oil at 600 deg. F. caused little deterioration in high P and Si bars; but if these same bars were quenched from the zinc tank in cold water they showed unmistakable damage, almost exactly matched by other bars heated in a muffle and quenched from that temperature. Quenching is therefore the culprit. Control of phosphorus is, however, the easiest way out of the difficulty.

Slow bending (the Humphrey test[*]) is an excellent test for brittleness. Single glow impact (Olsen or Izod test) is supersensitive, while ordinary tension tests are not suitable.

THERMAL CONDUCTIVITY OF ALLOYS

A research into alloys used for gas-engine pistons and bearings was reported by Messrs. Williams and Bihlman, of the General Motors Research Corporation. They describe an apparatus whereby the thermal conductivity of commercial alloys for such purposes may be measured by heating one end of the bar and measuring the calories conducted to a flow colorimeter at the other end. A complete determination requires about 6 hours. The conductivity of No. 12 aluminum alloy (92:8 Al:Cu) is not affected by the method of casting or the amount of return scrap used. Bearing metals are in general good insulators. Copper is quite sensitive to purity and heat-treatment. Results follow (*K* is the calories transmitted per second through a cube, 1 cm. on a side, when opposite faces differ by 1 deg. C.):

Alloy	Temperature, Degrees C.	*K*
Silver	100	0.99[illegible]
No. 1 aluminum, hard drawn (99.5 pure)	79 to 193	0.47
No. 12 alloy (92.8, Al Cu)	85 to 250	0.34
S.A.E. Bearing Alloys		
No 10 (92.5:3 6.0.2:3.7, Sn:Cu Pb Sb)	50 to 100	0.092
No. 11 (86 9 5.2·0.1:7.9, Sn·Cu Pb Sb)	50 to 100	0.062
No. 12 (7 1·64.0 28.8, Cu Pb Sb)	50 to 100	0.076
No. 40 (5.1 84.9·5 0·4.9, Sn Cu Pb Zn)	140 to 325	0.23
No. 62 (10.6 86.6 2 8, Sn·Cu.Zn)	155 to 340	0.142
No 64 (10.8 79 9.6·03, Sn Cu Pb P)	150 to 340	0.109
No. 60 (5 6:85.3 8.3:0.9, Sn·Cu·Pb Zn)	140 to 320	0.177
Aluminum bronze (89.9.9.1 05, Cu Al·Sn)	130 to 350	0.174
Electrolytic copper wire	90 to 210	0 89
Cast electrolytic or lake copper	90 to 225	0.76
Arsenical copper	100 to 230	0.51

BRIGHT ANNEALING COPPER WIRE

In order to bring fine copper wire into proper condition it has been the practice at the Westinghouse Co. to anneal it on spools in an atmosphere of natural gas at 350 deg. C. However, the outer layers were ruined by a thin layer of oxide, formed from small quantities of oxygen in the gas. P. E. Demmler found that the trouble can easily be corrected by previously passing the gas over copper at 600 deg. C., which acts as a catalytic agent in forcing combination of oxygen and hydrocarbons below the ignition temperature. The action consists essentially of oxidation of the copper, followed closely by its reduction by methane, the end products being CO_2 and H_2O.

Other papers on non-ferrous alloys have been printed in *Chem. & Met.*, as follows: "Study of Bearing Metals," by C. H. Bierbaum; "Tests on High-Tin Bearing Metals," by P. W. Priestley; "Determination of Gases in Metals," by H. L. Simons.

Mines Bureau Tests Detonators

A series of tests has been started at the explosives laboratory of the Bureau of Mines at Pittsburgh, Pa., to determine the comparative efficiency of cyanuric triazide as a detonating agent by comparing its minimum detonating charge with pure fulminate on TNT, tetryl, TNA and ammonium picrate. The physiological properties of cyanuric triazide are also being studied. These tests include application to the skin to study irritating properties and tests on animals when taken in food and breathed as vapor.

These tests are part of a general series of tests being conducted at Pittsburgh to fix standards for detonators. Included in the materials tested will be the usual mixtures of mercury fulminate and potassium chlorate, trinitro-resorcin, TNT, tetryl and other compounds used in detonators. An attempt will also be made to determine the relative value of these different substances as material for detonators.

Bureau of Mines Works on Explosives

During the past year methods have been devised at the explosives laboratory of the Bureau of Mines, Pittsburgh, Pa., for determining by tests the relative sensitiveness of explosives to detonation and also their fire-resisting qualities. Further work will be done to develop these tests. When standard tests have been established, a number of different classes and grades of explosives will be tested by these methods. An investigation has also been made of the water-resisting properties of a variety of explosives.

[*] *Chem. & Met.*, vol. 28, p. 1180; vol. 26, p. 941.

Silver Jubilee Meeting, American Ceramic Society

Gathered at the Birthplace of the Society to Celebrate Its First Quarter Century of Constructive Service and to Honor the Founders and Charter Members, Over Five Hundred Ceramic Technologists Divide Their Time Among Technical Discussions, Social Diversions and Plant Visits

EDITORIAL STAFF REPORT

BEFORE the twelfth annual convention of the National Brick Manufacturers' Association, held in Pittsburgh Feb. 16 to 18, 1898, Elmer E. Gorton presented an excellent technical paper on the subject of terra cotta glazes. This constituted a decided innovation in the programs of this association, and while the novel method of presentation aroused temporary interest, it was evident that only a very few of those present could understand or even appreciate technical discussions. Realization of this fact led to a consideration of the possibility of forming a small society of ceramic technologists which should form a section of the N.B.M.A. or be independent, as deemed best. Action was taken on Feb. 18, 1898, in the parlors of the Monongahela House during a meeting attended by Elmer E. Gorton, Samuel Geijsbeck, Edward Orton, Jr., A. V. Bleininger, W. D. Richardson, Ellis Lovejoy, William D. Gates, Carl Giessen and Gustav J. Holl. Mr. Orton was asked to act as provisional secretary and a list of persons who should be invited to join in the formation of the proposed society was agreed upon. As a result, twenty signified their willingness to attend the first meeting, Feb. 6, 1899, and thus became charter members. With the exception of Mr. Holl, those mentioned above were included and in addition the following: Charles F. Binns, Stanley G. Burt, J. Parker B. Fiske, Karl Langenbeck, Ernest Mayer (now deceased), Herman C. Mueller, James Pass (now deceased), H. Ries, Edward C. Stover, Francis W. Walker, Herbert A. Wheeler, W. H. Zimmer.

For the dual purpose of observing the twenty-fifth anniversary of the American Ceramic Society and of honoring these charter members, over five hundred of the present membership of nearly nineteen hundred gathered at the William Penn and Fort Pitt Hotels, Pittsburgh, during the week of Feb. 12. In order to relieve the technical programs of reviews covering the twenty-five years, these were made the theme of the January *Journal of the American Ceramic Society*—a volume of 350 pages to which the reader is referred for progress reports on all phases of ceramic technology, education and research during the past 25 years. During the general session and the social functions, however, opportunity was afforded to make the newer members acquainted with those who conceived and organized the society.

INDUSTRY VIEWED FROM MANY ANGLES AT GENERAL SESSION

Opening the general sessions Monday, Feb. 12, President Frank H. Riddle touched upon many phases of the developments during the past year which indicate that the society is progressing most satisfactorily along the lines of increased service. The year 1922 was in many ways experimental, all activities with the exception of advertising were centralized in Columbus with a full-time general secretary who also served as editor, the journal was enlarged and in addition a bulletin containing items of wide interest but of less permanent value than the technical papers was started, at first separate but later a section of the journal. Although the expense of these extensive improvements was not fully covered by the income, it was felt that conditions were highly satisfactory, for there was a substantial increase in membership and in advertising revenue, the latter in spite of the fact that some of the trade papers in the field showed a decline for the year.

Turning to the future, President Riddle called attention to the possibility of bringing the mechanical equipment more in line with the developments in other industries. The publication of a ceramic handbook was urged both as a tool for workers in the industry and as a means of bringing ceramic engineering more fully to the attention of the technical world. Along educational lines, emphasis was placed on two classes of men needed by the industry: young men receiving instruction in trade schools while serving their apprenticeships, high-grade men for research or eventual plant executives. As long as plant foremen and executives are not interested in ceramic engineering, true progress will be impeded.

Several special reports were adopted in addition to the customary ones which were preprinted and passed without reading. Among the former were: approval of the National Research Council's plan to raise $200,000 over a period of 3 years for the compilation of data on numerical constants; student membership rate of $4.80; granting of charter to Rutgers College Ceramic Club and Student Chapter; budget of $40,000 for 1923, which will require 400 new personal members, 100 corporations and 11 additional pages of advertising.

TALKS BY PROMINENT MEN

Among the prominent speakers at the opening session was W. L. Clause, chairman of the board, Pittsburgh Plate Glass Co., who outlined in a comprehensive way the probable effect upon American industry of certain European and domestic economic problems, such as the inflation of the mark, reparation, the allied debts, the inadequacy of our transportation system and the labor situation. His general conclusion was that it is possible for this country to enjoy a large measure of prosperity regardless of European developments and that the domestic problems are far more important.

B. E. Salisbury, president, Onondaga Pottery Co., emphasized a number of important points in considering research from the point of view of the manufacturing executive. In his estimation a research worker should be a real man first and a scientist second, for without the ability to get along with and really co-operate with plant men, he can never rise above routine.

An earnest appeal for the development of the American decorated chinaware industry along more artistic lines was made by Prof. Charles F. Binns. Mass production of open stock patterns is convenient for manufacturer and consumer, but tends to stereotype methods by stressing quantity rather than quality. At least the decorating department should be supervised by a trained designer. It might also be possible to start a small department for fine ware which would probably not be profitable at first, but which would go far toward the establishment of a reputation similar to that enjoyed by foreign manufacturers.

Speaking from the full experience of a life of service, Edward Orton, Jr., laid down some fundamental characteristics of engineering education. Briefly, he holds that character development should be the aim of education and that engineering training, being founded on scientific truths and quantitative thinking, fits a man not only for his profession but for general service to the community as well. He urged every young engineer to interest himself in some phase of public activity.

Brief talks by Dean M. E. Cooley, University of Michigan, on the work of the Federated American Engineering Societies, by Dr. H. Foster Bain on the ceramic investigations of the Bureau of Mines, by Dr. E. W. Washburn on plans for obtaining ceramic data for the International Critical Tables and by A. L. Scott on the research work of the American Hotels Association completed the regular program.

A. F. GREAVES-WALKER
President American Ceramic Society

An unexpected feature was a talk by Dr. Walter Rosenhain, superintendent, metallurgical department, National Physical Laboratory, Teddington, England, who was in Pittsburgh to deliver a series of lectures at Carnegie Institute of Technology and kindly consented to outline some of the work conducted during and since the war along ceramic lines. A number of interesting developments were brought out such as the preparation of a gastight muffle for use in melting carbon-free ferrous alloys by having a body which would just sinter at the temperature required. A thermocouple protection tube having a high-alumina body has been developed which can be welded in an oxy-acetylene flame when cracks arise. An unusual phenomenon is that this body will crack if heated slowly, but may be plunged quickly into the oxy-acetylene flame without damage.

Charter Members Honored at Social Functions

At the banquet Monday evening following a program which included an address of welcome by Prof. Alexander Silverman, chairman, Pittsburgh District Section, response by President Riddle and brief talks by Dr. Rosenhain, Dean Reavis of the University of Pittsburgh and Karl Langenbeck, the charter members present were formally introduced and in their presence Colonel Orton administered the oath of office to those elected for the year 1923-1924: A. F. Greaves-Walker, president; R. D. Landrum, vice-president; Ross C. Purdy, secretary; Ralph K. Hursh, treasurer; R. R. Danielson, trustee. In concluding the ceremonies, Toastmaster L. E. Barringer presented Colonel Orton with a handsomely bound book containing letters from about fifty former pupils expressing appreciation of what his inspiration and guidance had meant to them.

Tuesday evening a smokerette was held in the ballroom of the William Penn. Dancing followed entertainment, which varied from "community" singing to the reading of a very serious paper on the "Plasticity of Clay" by Dr. B. Rouhland, a German scientist scheduled to appear before the Terra Cotta Division on Wednesday, but granted permission by Dr. Tillotson to speak on this occasion. Serious and forcible objection to some of the professor's statements soon developed and a lively scrap seemed imminent until it was explained that the "professor" was only one of the entertainers.

Throughout the week the products of nearly fifty organizations representing each industrial division were on exhibition at the Fort Pitt Hotel.

Mention should here be made of the several local committees without whose efforts this meeting would not have been possible. These, with their respective chairmen, are as follows: Executive, A. F. Greaves-Walker; transportation, C. C. Phillips; hotels, A. H. Chandler; publicity, A. W. Kimes; service, H. G. Schurecht; smokerette, R. M. Howe; banquet, Alexander Silverman; reception and trips, J. Spotts McDowell; finance, H. L. Dixon; entertainment of ladies, Mrs. A. F. Greaves-Walker.

It has been decided to hold the 1923 summer meeting in connection with a boat trip between Chicago and Detroit. Atlantic City was chosen for the next winter meeting, while a trip to the Pacific coast is contemplated for the summer of 1924.

Plant Visits

Probably no convention held in Pittsburgh has had the opportunity of inspecting more manufacturing establishments. A choice was offered of four trips on Thursday and three on Friday covering a total of twenty-four industrial plants ranging from chinaware, through glass, refractories, insulators and enameled ware, to byproduct coke ovens, zinc works and the largest tube mill in the world. All the trips were well

attended. For the courtesies extended the members express their hearty appreciation to the management of the several plants and to those who looked after the arrangements.

Divisional Meetings

Because of inherent diversities of interest, the society is grouped into industrial divisions. At present there are seven, as follows, the numbers given being the members who registered in the respective divisions for this meeting: Art, 23; Enamel, 65; Glass, 49; Heavy Clay Products, 65; Refractories, 73; Terra Cotta, 26; White Wares, 81. Although each division presented an important technical program on Tuesday and Wednesday at the Fort Pitt Hotel, space limitations preclude a full report of all and emphasis will be placed on refractories, glass and enamel.

Refractories Division

Refractory Raw Materials

In the absence of G. H. Ashley, State Geologist, the flint clay situation in Pennsylvania was discussed by his assistant, Mr. Stone. From all indications there are sufficient quantities of soft clay, flint clay and ganister available to supply the requirements of the refractory manufacturers for many years to come.

R. T. Stull was inclined to disagree with the previous speaker regarding the adequacy of supply of high-grade fireclays. He presented the results of experiments in the preparation of refractories from some of the kaolins and bauxitic clays found along the coastal plains of Georgia. Test lots of these brick have been installed in various types of furnaces and have given uniformly successful service, excelling fireclay and even silica in certain cases.

Properties of Refractories Considered From Many Angles

Progress in the difficult problem of establishing specifications for refractories for coal-fired boiler use was reported by R. F. Geller. Through the co-operation of Stone & Webster, specimens of forty-two different firebrick were obtained from power plants located in various parts of the country. These were subjected to a large number of tests and the results plotted in order to determine those properties which it would seem desirable to specify.

In studying the action of slags upon diaspore, fireclay, silica, magnesite and chrome brick, R. M. Howe, S. M. Phelps and R. F. Ferguson ground the refractories through 80 mesh, added varying amounts of five typical slags (such as blast-furnace, acid open-hearth, basic open-hearth, etc.) and determined the fusion point of the mixtures. When plotted, the results give a comprehensive idea of slag action which agrees with practical observations.

A somewhat similar study involving the effect of alkalis and alkaline earths upon the fusion points of refractory bodies varying in both directions from kaolinite, $Al_2O_3.2SiO_2$, was made by Prof. A. S. Watts. In high-alumina bodies such as $Al_2O_3.1\frac{1}{2}SiO_2$, the alkalis were found to be more active fluxes than the alkaline earths, while with bodies containing more silica than kaolinite the reverse was true.

Professor Watts and R. M. King also reported their work toward the development of a laboratory apparatus for the determination of heat transfer valves which will combine commercial accuracy with ease of manipulation.

Silica Cement

Valuable data on silica cement were given by E. N. McGee. This cement is made by grinding silica bats and adding just enough plastic clay to give workability. In some cases ganister is substituted in part for the bats so that the percentage composition might be: Bats, 50; ganister, 25; plastic clay, 25. The bonding properties are slight even when hot, although a fairly good bond may be obtained by heating and cooling under pressure. Recently it has been found that the addition of molasses to the water will result in a much stronger bond without detriment to the refractoriness. Indeed, a mixture of ground silica or bats and molasses will adhere so firmly to brick that it may be used for patching.

Consumers' Problems

Requirements which would have to be met by the ideal refractory for stokers were treated in some detail by G. I. Bouton. Present operation at 3,000 deg. F. imposes severe temperature conditions in addition to the slagging troubles encountered with many types of coal. The question of refractory requirements for suspended boiler arches was briefly outlined by J. E. Harlow.

Speaking on refractory problems in the oil-refining industry, Alan G. Wikoff stated that the shell type stills used so extensively for handling crude, coking and cracking do not impose very severe conditions on the refractory linings of the settings. With stills of the tube type such as one used for topping and in some cracking processes, requirements become more severe, particularly in the latter case, where firebox temperatures in the neighborhood of 2,600 to 2,800 deg. F. are encountered.

Burning of Refractories

Some of the factors which have apparently operated to prevent the successful application of producer gas in firing clay wares such as refractories which require high temperatures were outlined by W. D. Richardson. In his opinion the continuous regenerative compartment kiln offers great possibilities along this line.

It is not always possible to scrap less efficient kilns in favor of more efficient ones on account of the expense involved. In such cases, however, it is possible to increase the efficiency of the old installation by observing certain precautions and also by exerting a more careful control over labor costs. The effects of putting kiln firemen on a bonus system were set forth by L. C. Hewitt. Standard rates were developed from time studies and the average efficiency (allowing 50 per cent for fatigue) was found to be 67.5 per cent. This was made the base and a bonus was paid above this, 15 per cent for 100 per cent efficiency, 30 per cent for 120 per cent efficiency, etc.

J. H. Krusen's paper on the insulation of periodic kilns was read by E. E. Ayars. An average fuel saving of about 15 per cent is indicated when kilns are insulated with a material such as Sil-O-Cel.

Problems in burning silica brick were considered by Dr. F. A. Harvey, with particular reference to attempts to determine the most efficient heating and cooling schedules for round down-draft periodic kilns. Base

metal couples were used up to 1,800 deg. F., when these were removed and further observations made by an optical pyrometer sighted on a brick set in the center of the kiln. Defining a properly burned silica brick as one having a residual expansion of from 0.4 to 1.4 per cent, many interesting observations were noted. For one thing, the quality of the coal was found to be most important. With 13,500 B.t.u. coal it was found impossible to burn the brick properly, 14,000 B.t.u. coal required 11 days' burn, while 14,500 B.t.u. coal cut the time to 8 or 8½ days. The average time is 10 days to burn, 7 days to cool, but the harder the burn the more careful must be the cooling. Although the maximum rate of heating and cooling has not been determined, the time of soaking or holding at maximum temperature has been pretty well determined. If the maximum temperature is 2,400 deg. F., 72 hours is required, while if 2,600 can be obtained, 24 hours will give a coke-oven burn—that is, 0.4 per cent residual expansion.

Colloquium on Metallurgical Requirements

Wednesday afternoon was devoted to an important colloquium on metallurgical requirements of refractories, led by Dr. D. A. Lyon, Bureau of Mines. Abstracts of the papers presented will be published in a subsequent issue.

Division Officers

For the coming year, the officers of the Refractories Division will be: E. E. Ayars, American Refractories Co., Joliet, Ill., chairman; Dr. F. A. Harvey, United States Refractories Corp., Mount Union, Pa., vice-chairman; R. F. Ferguson, Mellon Institute, secretary.

Photo by Frank Moore Studio, Cleveland

R. D. LANDRUM
Vice-President American Ceramic Society

Glass Division

Aside from the technical papers, some of which are abstracted below, the Glass Division entered into several instructive discussions on such practical subjects as the question of glass tank water coolers and the sulphuring of glasses.

New Data on Physical and Chemical Properties

Resistance of soda-lime glass to water was determined by L. A. Palmer, of the Glass Container Association, by filling bottles with water and immersing them for 6 hours in a solution maintained above the normal boiling point of water. The water inside the bottles was then titrated for alkali as a measure of the action of water upon the glass. It was found that the results fell into three groups, one of which was quite evidently unsuitable for container use.

Under the title "Skiagraphic Study of Fabricated Glass Articles," C. D. Spencer and A. E. Badger reported the results of an investigation in which it was shown that by proper control of the physical structure of the glass at the line of contact it is possible to join successfully g.asses of varying coefficients of expansion. A great deal of the breakage occurring in fabricated articles is due to improper physical structure at the joint.

Petrographic studies of the different forms of silica and of corundum crystals were shown by Herbert E. Insley to be of importance in determining the origin and cause of stones in glass.

Mechanical tests on window and rolled sheet glass by Arthur E. Williams brought out some instructive data on the tensile strength. The product of different factories was found to vary widely, even as high as 50 per cent. Tensile strength of window glass was found to range from 10,000 down to 6,000 lb. per sq.in., thinner pieces testing stronger than thicker ones. Under these tests, non-shatterable glass and wire glass were not found to be any stronger than ordinary glass, while polished plate tested weaker than the drawn.

Further work on tensile strength was reported by Dr. J. T. Littleton, who endeavored to eliminate the surface effects which have influenced previous determinations and found that the strength thus obtained is considerably higher than hitherto recognized.

Rapid routine determinations of refractive index are made possible by a method devised by H. P. Gage and Dr. J. C. Hostetter. Glass in the form of a rod is immersed successively in a series of liquids of known index of refraction until the deflection of an external straight object observed through the rod shifts from left to right or *vice versa.* The true index of the glass then lies between these two values and by adjusting the temperature of the liquid until there is no deflection it is possible to calculate the refractive index quite accurately, provided, of course, that the temperature coefficient for the liquid is known.

Viscosities of soda-lime-silica glasses between 800 and 1,500 deg. C. were determined by Dr. E. W. Washburn and G. R. Shelton in a specially designed torsion type machine calibrated by means of glucose-dextrose mixtures rather than the customary castor oil, because the former are sticky and thus behave more like glass than the latter, which is oily. Calibration curves were found to be not the same for all the different viscosities and it was necessary to correct for this.

Surface tension measurements on these glasses were made by the same authors, using a platinum cylinder attached to a Joly balance, figures in the neighborhood of 200 dyne-cm. being obtained. The surface tension was found to increase with decreasing temperature, but the temperature coefficient is very small.

Gas producers, application of producer gas and the use of recuperators in connection with closed pot furnaces were considered by W. B. Chapman, while A. E. Blake presented additional material on producer gas and gaseous fuels which will form a chapter in Professor Silverman's forthcoming book on the American glass industry.

Two types of furnace for melting glass in the laboratory were discussed by A. E. Badger and S. C. Spencer. One utilized a stranded tungsten wire wound on an alundum core and operated in an atmosphere of purified nitrogen, while the other was of the spiral carbon resistor type.

That it is possible to substitute oil for producer gas in a tank furnace operating in New England was demonstrated by F. S. Thompson. It was found that the tank temperature could be maintained within narrow limits and that the control necessary on a Westlake machine could easily be obtained. In this instance fuel oil at 4½c. per gal. was substituted for coal at $4.50 per ton.

Glass Wool Used for Heat Insulation in Europe

Of the many substitutes developed in the Central Empires under the stress of war-time necessity, one of the few which has survived is glass wool for heat insulation. Arthur D. Saborsky outlined the method of preparation, which consists in winding a number of parallel threads continuously on a revolving drum, and gave some heat transfer values which indicate that the material is more efficient than mineral wool or 85 per cent magnesia. On account of its fibrous nature it can be formed into pads which permit convenient application. It will also stand higher temperatures than some of the other materials.

Recent observations of the European glass industry lead H. W. Hess to the conclusion that there will eventually be little difference between European and American conditions, because of the increasing use of American machinery abroad.

Glass Division officers for the ensuing year were elected as follows: A. R. Payne, chairman; J. H. Forsyth, vice-chairman; A. E. Williams, secretary.

Enamel Division

Preliminary report on warpage of sheet iron and steel in the enameling process was made by R. R. Danielson, who presented his results according to a system which gives a quantitative measure of the warpage, thus doing away with such general descriptive phrases as "slightly warped," "badly warped," etc. Mr. Danielson also reported that the work on cast iron was still in progress, but that it was hoped to complete this during the coming year.

A committee was appointed to survey by questionnaire all types of enamel furnaces. It is expected that this survey will bring together data which will prove valuable and helpful to the entire industry.

With the exception of resistance to acids, very little has been reported on the relation between enamel composition and properties. R. R. Danielson and B. T. Sweely undertook a study of the relation between such properties as expansivity, strength and acid resistance as well as the effect of relative fit of ground and cover coats on resistance to impact and thermal shock. Fourteen ground coats and white cover enamels were applied to about 600 8-in. dinner plates. The enameled ware was tested for resistance to impact, thermal shock and acetic acid. Expansivity and compressive strengths of the enamels were determined before applying to the steel. The conclusions were as follows:

Replacement of B_2O_3 by Na_2O in enamel increases the coefficient of expansion and fishscaling diminishes at the same time.

Compressive strength of ground coats is decreased by replacing B_2O_3 with Na_2O, although the reverse is true in the case of cover enamels.

Impact on parts of ware not free to deflect, such as curved corners at bottom, gives a measure of the strength or toughness of the enamel as applied on the steel. Resistance of enamel on corners to impact is apparently a function of the inherent strength of the enamel rather than of its fit on the ware.

For greatest resistance to thermal shock, ware should be coated with a ground coat having a coefficient of expansion equal to or preferably greater than that of the cover enamel.

Acid resistance, while dependent upon composition, is not affected in the same way for all enamels. For the cover enamels studied, resistance to acids was found to decrease as B_2O_3 was replaced by Na_2O.

Further information on acid resistance was given by E. P. Poste in the fifth part of an extended series of studies on the relative action of acids on enamels.

Tin Oxide Substitutes

Zirconium oxide and sodium antimonate were found by R. R. Danielson and M. K. Frehafer to be apparently the best substitutes for tin oxide, ranking very close to it. Zirconium silicate came next, although here the purity is a very important factor. Opacity does not always increase with an increase in the amount of opacifier used and the proper calcination of the opacifiers is of importance.

Visual estimation is not an accurate method for determining the opacity of enamels, although it may be suitable for classifying enamels for stove work and table tops. For accurate determination of reflecting value, the method of the Colorimetry Section, Bureau of Standards, should be used.

W. F. Wenning also presented some interesting data on the use of zirconia in enamels.

Bentonite, a highly colloidal clay, has a much greater suspending power than ordinary enamel clays, the ratio being about 5 to 1 in favor of bentonite. Its use, as pointed out by M. E. Manson, makes possible a decided reduction in the amount of raw material to be added to the frit. Some possible disadvantages were also considered.

Problems in the design and operation of a sandblasting room were discussed by F. G. Jaeger. Downward draft of 6,000 cu.ft. per minute was found effective in keeping the dust from rising more than 2 ft. above the floor, resulting in improved working conditions. Two men work together, one loading castings on a truck outside the chamber while the other works inside, alternating positions as the ware is changed. They wear heavy rubber gloves and canvas helmets with the seams protected with rubber sheeting. The abrasive—very hard silica sand—is applied by compressed air at 80 lb. gage through best quality rubber-lined hose terminating in chilled cast-iron nozzles with ⅜-in. opening. These nozzles last only about an hour under continuous use. Defective ware may be freed from enamel very economically by placing it behind the new work.

Further operating results on an intermittent gas-

fired enameling furnace previously described were given by H. H. Clark. Previous requirement of 1,800 cu.ft. of 500 B.t.u. gas per hour firing 600 sq.ft. flat ware (690 lb., representing 240 pieces) to a maturing temperature of 1,700 deg. F. has now been reduced to 1,260 cu.ft. With gas at 50c. this means a fuel cost of 63c. per hour, 10c. per 100 sq.ft., or 9c. per 100 lb. After 3 years' operation no repairs have been found necessary.

Several installations of electric enameling furnaces were described and illustrated by E. F. Collins. H. E. Davis presented data on an enamel smelter design which has already been noted in *Chem. & Met.*, Feb. 21, 1923, page 364.

New officers of the Enamel Division are: H. F. Staley, chairman; R. R. Danielson, secretary.

Synthetic Vanillin Manufacture

Interesting Information on Properties and Processes for Preparing This Important Synthetic Organic Chemical

By Burton G. Wood
Consulting Chemist, Pittston, Pa

VANILLIN is one of the most important perfume materials. Chemically it is methoxyprotocatechuic aldehyde, a substance occurring in the form of white needle crystals or plates. The melting point of pure vanillin is 82.5 deg. C. and boiling point is 285 deg. C. It decomposes when boiled at atmospheric pressure, but may be distilled under a vacuum of 0.1 in. Even at this low vacuum, however, there is considerable resin formed, which increases rapidly as the vacuum is lowered.

The crystalline structure of vanillin depends entirely on how the hot aqueous solution is cooled. If the solution is stirred while cooling or while the first crystals are forming, the entire lot can be obtained as plates. If the solution is allowed to stand until the first crystals have formed and then is stirred slowly, the crystals will be mostly needle shaped. At times long fibrous crystals, generally termed "cotton," are formed. This formation is due to concentration and method of cooling and not to the presence of silicates in the water, as has been reported. Needless to say, the crystalline structure has nothing to do with the aromatic properties of vanillin.

From Natural Sources

It has been contended by some, and with just cause, that the aromatic properties of vanillin have been greatly overrated. At a recent meeting of the Flavoring Extract Manufacturers Association several samples of vanilla extract were displayed which contained no vanillin but simply the resins from the vanilla bean. These samples, it was declared, had even a better odor than that of a vanillin solution with which they were compared.

The natural source of vanillin is the vanilla bean, from which it is extracted and sold as vanilla extract. The growing of vanilla beans is a commercial enterprise in some countries, especially in Mexico, in Java, in Madagascar and various other semi-tropical colonies of France and Great Britain and in Brazil. The bean, which is 6 to 8 in. long and 2 to 4 in. thick, is collected in the fall, just before it ripens. The final process consists of sun drying and finally artificially drying the bean until it assumes a dark brown or almost black color. Even the vanilla bean which we associate with pleasantness through its odor induces a skin disease by an oily discharge while curing. Vanilla beans contain from 1.75 to 2.25 per cent vanillin, associated with resins, vanillic acid and sometimes anisyl alcohol and anisic aldehyde.

Manufacture of Synthetic Vanillin

Numerous patents have been granted for the manufacture of synthetic vanillin. Most of these, however, may be said to have only a nuisance value. Many depend upon the oxidation of isoeugenol to vanillin. In general it may be said that even though the hydroxyl group is protected any process in which isoeugenol is the basic material and bichromate, permanganate, etc., are used for its oxidation must necessarily fail unless steps are taken also to protect the aldehyde group as it is formed. Otherwise it will be oxidized direct to the acid.

The electrolytic oxidation of the sodium salt of isoeugenol,[1] using a double cell and a coating of lead peroxide on the anode, has been found to have no practical value, since only a trace of vanillin is formed. The isoeugenol turns into a brown resinous mass. Other difficulties are apparent when it is realized that the electrolysis is carried out in strong alkaline solution with porous diaphragms.

The use of ultra-violet rays would appear to be the simplest method for the preparation of vanillin from isoeugenol. The process consists of passing air through isoeugenol in which is immersed a light emitting ultra-violet rays. The theory of the operation is that the ultra-violet rays convert oxygen in the air to ozone and this in turn is responsible for the oxidation. It will be seen at once that the rate of oxidation depends upon the penetrating power of the ultra-violet rays, and this in turn is dependent upon the clearness of the isoeugenol. The use of distilled isoeugenol, which is much more expensive, is therefore necessary. Even starting with a very light-colored product, the oil darkens in a couple of hours so that the rate of oxidation rapidly decreases. Another difficulty in this process arises from the fact that the air must be circulated through the solution at a rate of about 30,000 cu.ft. per hour, and this causes a considerable loss of isoeugenol by vapor tension. When using 30,000 cu.ft. of air per hour on 800 lb. of isoeugenol the loss amounts to about 80 lb. in 8 hours.

Vanillin can also be made by a number of straight chemical processes, but most of them have not as yet advanced to an economical stage. One process uses protocatechuic aldehyde, but that is most difficult to obtain. Another process uses guaiacol according to Reimer's reaction. Any process using this reaction, chloroform, alkali and a phenol to introduce the aldehyde group is bound to be expensive on account of the low yield of final product. Still another process starts with a diketonic acid. This process need not be discussed excepting to say that this acid is more expensive than the final product.

There are, however, two processes both starting with isoeugenol that deserve more than passing consideration. One depends on the oxygen exchange between isoeugenol and nitrobenzol. The other process depends on the oxidation of isoeugenol to vanillin using ozone and a protecting agent for the vanillin formed. It is the writer's intention to discuss both of these process in subsequent articles on vanillin manufacture.

[1] Deutsches Reich Patent 92,007.

Art and Science of Leather Manufacture—IV

In Addition to Methods Employing Tannin, Hides and Skins May Be Converted Into Leather by Treatment With Smoke and Fat, Alum, Chromium Salts, Iron Salts, Formaldehyde, Oil and Quinone — Water Supply and Waste Disposal Important Factors in Tannery Operation†

BY F. L. SEYMOUR-JONES*

HISTORICALLY smoke and fat tannage was probably the first developed by primitive man. The action of his tent fire smoke and of grease on his skin clothing and hunting trophies must have been discovered at a very early stage in his civilization. Even today among primitive peoples such a tannage is found. The Eskimos work fat and grease into the skin by chewing and masticating it bit by bit, a slow if effective process. Such a leather also is the so-called rawhide, like the South African reims, used for harness and other purposes. The hide is cut into one long strip, and fat is worked in by twisting and untwisting it, keeping it taut by suspension from a branch and attaching a weight. The method is simple and the product has the greatest tensile strength of any leather. In fact, broadly, the more processes a hide undergoes in being turned into leather the less strength it has.

TAWING OR ALUM TANNAGE

Another old method, still largely used today for such purposes as belt laces, aprons, whip lashes, kid gloves, fine shoe leather, etc., is known as tawing. This is in reality an aluminum tannage. In the pure alum tannage the skins are soaked, or drummed in, or sponged with a solution of a basic aluminum salt and common salt. After tannage the skin is dried out, aged, then damped back and staked, either by pulling the skin over a blunt knife edge until soft, or by machine, in which a pair of jaws bearing a blunt knife and a rounded surface or roller grip the skin and pass over it. Such leather is not very resistant to water, though increasingly so on aging. In tawing proper the skins are drummed in a mixture of alum, salt, flour and egg yolk, together with a little olive oil. They are then dried, aged by storing for a month or more to fix the tannage, damped back, softened and staked. They are next washed, re-egged with yolk and salt, and dyed by brushing on. After drying they are perched - i.e., the skin is fixed to a bar and stretched on the flesh side with a moon knife. The flesh is finally fluffed by a rotating emery-covered or carborundum wheel.

Only the gluten, and not the starch, of the flour is taken up by the skin. The proteins of the yolk serve as fillings, but the oil is the most important constituent. The somewhat expensive yolk has been successfully replaced with sulphonated oils, though this is a recent innovation not yet passed into general practice.

Chrome tanning, though known as far back as 1858 to Knapp, the pioneer chemist in leather manufacture, has really developed only during the last 30 years. It has already replaced vegetable tanning in many lines (e.g., glazed kid from goatskins), has established itself in others (e.g., belting leather), and is invading even sole leather manufacture.

CHEMICAL NATURE OF CHROME LIQUORS

Chromium exhibits many valences, but it is only its trivalent salts which tan. If a liquor containing a normal chrome salt alone is used, the acid liberated by hydrolysis of the salt swells the skins unduly, and only the surface is tanned, yielding a cracky leather. Consequently basic salts of chromium are used in tanning. If too basic, tannage is extremely slow and the resulting leather thin and flat. About the best basicity to use is a liquor corresponding to a salt of $Cr(OH)SO_4$ say.

Whether the liquors are solutions of true basic salts or whether they contain hydrous chromic oxide colloidally dispersed in the solution of the normal salt, or whether again they contain chromium in a complex anion, is still somewhat of an open question. Chromic salts in solution exist in two forms, violet and green, the former preponderating in the cold and the latter on heating. The difference is more than one of color, and is explicable on the Werner theory. Thus chromic chloride, $CrCl_3.6H_2O$, ionizes differently according to its color, as shown below:

$$\underset{\text{Violet}}{(Cr.6H_2O).Cl_3} \text{ and } \underset{\text{Green}}{(CrCl_2.4H_2O).Cl.2H_2O}$$

Furthermore, green solutions are highly hydrolyzed and have a hydrogen-ion concentration about ten times that of violet solutions of corresponding strength. Solutions of chromic salts at ordinary temperatures are equilibrium mixtures of these two forms. While the change from violet to green on heating is rapid, the reverse change is slow. There appears to be very little difference in the tanning properties of green and violet solutions, but the swelling effect of the free hydrogen-ion in the green has to be taken into account.

Many tanners prefer to buy their chrome liquors in concentrated form direct from the manufacturer, who frequently obtains it as a dyeworks byproduct. In making it direct, potash alum or chromic sulphate, together with the necessary amount of soda, is often used, but more frequently sodium (or potassium) bichromate is reduced in acid solution. Passing sulphur dioxide through plain bichromate solution provides an excellent liquor. Glucose is frequently used, but care has to be taken in the reduction, as there is a possibility of the formation of hydroxy organic acids, which, with their salts, not only prevent the fixation of chromium by the hide, but can also be used to strip (remove chromium from) chrome leather. Very many other substances have been suggested and are used in reducing—e.g., bisulphites, thiosulphate, sawdust, spent tan, etc.

*Frank L. Seymour-Jones is the son of Alfred Seymour-Jones, of Wrexham, Wales, who for many years has been one of the foremost tanners of Great Britain and one of the leading scientists of the industry. Frank Seymour-Jones was graduated from the University of Leeds, England, with honors in applied chemistry of leather manufacture, being awarded the Le Blanc medal for special distinction. He now holds the Goldschmidt fellowship at Columbia University, where he is continuing fundamental research on tannery processes.

†Article I of this series appeared in *Chem. & Met.*, vol. 27, No. 23, p. 1110, Dec. 6, 1922, Article II in vol. 27, No. 26, p. 1253, Dec. 27, 1922; Article III in vol. 28, No. 5, p. 200, Jan. 31, 1923.

However the chrome liquor be prepared, it will usually contain some neutral salt, either added to it or formed during its preparation or from the salt used in pickling the skins. This materially alters the properties of the liquor. It slows up the tannage, affects the hydrogen-ion concentration and hence the swelling power, and also renders it possible to make the liquor more basic before the chromium begins to precipitate out. Hence in order to evaluate a basic chrome liquor, it is necessary to know its chromium content, basicity (amount of acid combined with one equivalent of chromium), acidity (hydrogen-ion concentration) and its neutral salt content. It is useful to test from time to time the amount of alkali necessary to bring about incipient precipitation. By adding just less than this amount to the liquor, it is possible to continue tanning, and even to finish tanning in liquors almost exhausted of chromium.

The mechanism of neutral salt action, despite much research work, is not yet thoroughly understood. Much light has been thrown upon it, but the very complicated nature of the chemistry of chromium compounds has so far prevented a clear cut solution. Hydration alone can only be a subsidiary cause, since sucrose, in concentrations up to $3M$, does not affect the tanning. Probably some compound formation comes into play.

One-Bath and Two-Bath Processes

The actual operation of one-bath chrome tanning is simple. The goods start off in a weak liquor, which is gradually strengthened as tannage proceeds. Tannage may be in drums or paddles or by suspension, the last being of course much slower, though favored for heavy hides for sole leather. When tanned, the skins are blue throughout, and are washed. One common criterion of tannage is that a piece of skin, placed in boiling water, should not shrink in size; this is known as the boiling test. After washing, the skins are neutralized, to remove nearly all free acid and to fix the chromium on the fiber in a more basic form. Weak alkalis are used for this, so that not only the surface but also the interior of the skin is properly neutralized. Borax and whiting are highly suitable. This is usually carried out in a drum.

After neutralization, light stock is set out on the table with a blunt knife to remove surplus moisture, then fat-liquored by drumming in an oil-water emulsion (usually emulsified with a little soap). Unless sulphonated oils are used, neutralization must be sufficiently thorough to remove excess acid which would otherwise break the emulsion. The fat-liquoring lubricates the fibers, renders the leather supple and pliable and increases its tensile strength. Leather which will crack on bending before fat-liquoring may be bent and stretched at will after, without any cracking of the grain. Dyeing may precede or follow the fat-liquoring.

Heavy stock for belting or sole leather is stuffed in very much the same way as for vegetable leather, except that higher temperatures may be used with safety. As chrome leather is by nature of the tannage "empty," stuffing is usually heavy, not only to add weight but also to render the leather thoroughly waterproof. Hydraulic leather (for pumps, washers, etc.) can be dipped when thoroughly dry into molten waxes and then baked in the oven to distribute and fix the grease.

Apart from the one-bath process, in which the skins are tanned in a basic chrome solution direct. the "two-bath" process is applied to certain classes of goods, particularly glazed kid. In this, reduction of the chromium from hexa- to tri-valent is brought about on the fiber itself. The skins are first treated in a bath of bichromate and hydrochloric acid, then in one of sodium thiosulphate ("hypo") and hydrochloric acid. This converts them into leather. The outstanding difference between the two methods is that in the two-bath process considerable quantities of sulphur are deposited in the skin. The sulphur softens the leather, acts as a filler and combines to some extent with the oils used in fat-liquoring. Straight sulphur tannage is possible, so that there is here probably some tanning action from the sulphur also.

Although the second (acid-hypo) bath to a large extent neutralizes the leather, it is usual to complete neutralization by drumming with borax, etc., prior to fat-liquoring and dyeing.

Finishing Chrome Leather

Finishing is complicated, and varies according to the class of leather desired. After fat-liquoring and dyeing, the skins are sammed (half dried), staked, "grained" (by rolling the skin over itself, to raise the grain pattern) or not, as required, dried out, the grain surface seasoned with an albumen-milk or gum season, and glazed by machine. The glazing machine comprises a glass or agate cylinder on an arm which presses the leather against the bed as the arm moves from the workman, lifting on the return stroke. Frequently artificial grains are embossed on, either with a plate or roller, and extremely clever imitations of the real article are so produced.

Heavy leather chrome tanned receives very little finishing, it being usually sufficient to see that it is of even color and good appearance. Any excess grease is slicked off.

Iron Tannage

Iron tannage has been attempted many times during the last 70 years, and Knapp preferred it to chrome. So far it has met with very little success. Owing to the ease with which ferric iron passes to the ferrous state and *vice versa* the destructive action of the oxygen on the skin is appreciable. Iron-tanned leathers in general are apt to crack on the grain and do not last well. So far the only place where iron tanning has been practiced on a large scale would appear to be Germany. The great shortage of vegetable tanning materials and chromium compounds in the central empires during the war years brought about much p ogress in iron tanning. But even here it was generally carried out as a combination tannage, in conjunction with chrome, formaldehyde or vegetable. The general principles of iron tannage follow those of chrome, with the necessary modifications due to its chemical nature. One difficulty with iron-tanned leather is that if tannin is to be employed as a mordant in dyeing, naturally only blacks can be used.

Many other metallic salts have been suggested for tanning. Most of them tan, but are not likely to be used on a commercial scale. They are principally those of the heavy metals; in particular may be mentioned manganese, cerium and nickel.

Use of Formaldehyde

Formaldehyde is a very efficient tanning agent, and, unlike most tanning materials. is usually used in faintly alkaline solution (around p_H 8). It produces a nice, white leather, but unless all excess aldehyde is removed,

the fiber gradually becomes brittle and tender. Excess alkali will cause the leather to rot on keeping, while excess acidity prevents complete tannage.

Chamois

Wash leather or chamois leather is made almost entirely from the flesh splits (linings) from sheepskins. The lightly drenched skins are kneaded in a fulling mill with sawdust until semi-dry. They are then sprinkled with fish oil, stocked or kneaded again, and the process is continued, with occasional pauses to permit the goods to cool, until the limy smell of the skins is replaced by a more pungent, aldehydic odor, and the skins are thoroughly saturated with oil. They are then boxed up, where, owing to the rapid oxidation of the unsaturated oils, they heat. They are taken out and cooled from time to time, and the process continued until they no longer heat and are yellow throughout, the skins then being thoroughly leathered. Much pungent acrolein vapor is evolved during oxidation. The surplus oil is pressed out from the skins (yielding moellon or degras) and further extracted with alkali, whence it is recovered by neutralization (yielding sod-oil). Degras and sod-oil are used for stuffing other types of leather. Sometimes the goods are hung up in warm stoves during oxidation.

Various kinds of fish oil are used, chiefly cod, together with seal, whale, etc. The skins are subsequently bleached, either by exposing while damp to the sun, or with permanganate or acidified sodium peroxide.

While the acrylic aldehyde formed by dehydration of the glycerin may play some part in giving the skins an aldehyde tannage, all the oils used must contain some free fatty acid. It is possible to tan skins completely with unsaturated fatty acids, containing more than two double bonds and entirely free from glycerin. Consequently a complete explanation of the mechanism of the tannage is still lacking.

Another fat tannage, intermediate between chamoising and rawhide manufacture, is used to produce "Crown" and "Helvetia" leather. In this a paste of soft fats (horse grease, tallow) and flour is worked into the skin. Occasionally oils and fish oils are also used

Quinone Tannage

One tannage, interesting theoretically, was investigated by Meunier. Pelt placed in dilute quinone solution becomes rose-colored, violet, and finally brown, being completely "leathered.' Hydroquinone is present in the final liquor, showing that the pelt had combined not only with quinone but also with oxygen. Tannage in hydroquinone solutions is also possible in presence of air, but is much slower. Similar "oxidation" tannages can be carried out with phenol and phenol derivatives (pyrogallol, gallic acid) in presence of air and preferably in weakly alkaline solution. Further, chlorine, bromine and iodine, especially the bromine, produce very satisfactorily tanned leather. The oxidation theory of tannage is largely based on these facts. Apart from some use of quinone in France, the main practical application lies in the boiling of exhausted tan liquors, whereby part of the non-tans are converted into substances capable of tanning, probably by oxidation.

Some combination tannages, using both mineral and vegetable tannage, are employed for special leathers. "Dongola" leather, a combination of alum tawing and gambier tannage, was originally produced as an imitation glazed kid. Semi-chrome leather is also largely produced. It is a very strong and durable product. Stuffed with 20 to 25 per cent of grease, it is waterproof and was largely used in army boots during the war. It is also eminently suitable for farm boots, where the alkaline liquors of the farm yard render a pure chrome tannage unsuitable. Chroming may precede or follow vegetable tanning, and may be by either the one- or two-bath process. East India kips, roughly vegetable tanned in India, have part of the vegetable tan stripped in alkali, and are then chromed. It is not possible to combine all advantages of two tannages by a combination; thus chrome leather loses much of its stretch by a vegetable retannage.

Patent Leather

Patent leather is now almost entirely chrome tanned, though a little is still manufactured by the vegetable process. The leather is tanned, staked and fat-liquored, then blacked with logwood and iron, dried and staked again. Often the leather is next degreased with benzine or naphtha. Ordinary chrome leather degreased is harsh, but degreased after fat-liquoring it remains supple and soft. After degreasing the leather is stretched out perfectly flat on lath frames. The first varnish coat is then applied by sponge and hand, being very thoroughly worked in over the grain surface. The leather is then dried by exposure to sunlight or ultra-violet light. The enameled surface is smoothed by rubbing over with a flat pumice stone, and a second coat of varnish is applied by brush. This is done in a dust-free room, next to the drying stoves, with the men stripped to the waist. A little water is sprinkled over, and the leather stoved over night. When thoroughly dry a finish is applied, a solution of nitrocellulose in amyl acetate-acetone, together with a pigment; small amounts of castor oil in the finish give durability and aid flexibility. The composition of the varnishes is largely guarded as a trade secret. Boiled linseed oil, tanked to allow the deposition of foots, is the main constituent, though tung oil is also used sometimes. As driers, manganese, lead and zinc salts are used, often the resinates. Prussian blue and lampblack serve as pigments. The oil is boiled to the desired constituency and thinned down with turpentine.

The use of nitrocellulose and collodion finishes has been extended to flesh splits (from ox and cow hides) for upholstery leather. A grain is then embossed on by machine, and a useful product obtained for automobiles, furniture, etc.

Fish Leather

Of recent years some progress has been made in the tanning of fish skins, shark, porpoise, blackfish, etc. In the case of the first the chief difficulty has been the removal of the hard shagreen, but this has now been solved by suitable treatment of the skins in acid solutions. The skins can be limed and bated if desired, and tanned by almost any of the usual processes. The fish leather industry (apart from sealskins) is still in its infancy, but promises to show great developments when the advantages and the limitations of its products are better understood.

Water Supply

In tannery control the importance of the nature of the water supply is very considerable. Apart from considerations of boiler feed water, the hardness adversely affects various processes. Temporary hard

water in washing goods after liming may cause precipitation of calcium carbonate in the grain surface, causing lime blast. In making up deliming liquors with organic acids the neutralization of the hardness by the costly organic acid is expensive. In leaching tanning materials, tannin is precipitated by the calcium bicarbonate. In dyeing, basic dyes are precipitated and dyeing is streaky. Fat liquors containing soap may be curdled by the hardness. Permanent hardness is of less importance, but is equally objectionable with fat liquors. Iron in water is highly objectionable if skins are to be vegetable tanned. Usually pipes in the leach house are made of copper or brass. Organic and much suspended matter usually points to the presence of bacteria, which are objectionable and may cause trouble in bating. Chlorides, found in water from tidal rivers chiefly, are harmful in repressing swelling and producing flat leather.

Byproducts

Byproducts from tanning are of little value. Hide and skin trimmings from the lime yard go for glue and gelatine manufacture. Hair usually finds a market, the white fetching a higher price. Colored hair goes to plasterers, for mixing in with mortar, and iron founders, for cores and loam casting. Spent tanbark is usually burned, after removal of surplus moisture by squeezing; it also occasionally finds a market for covering the earthen pots in the manufacture of white lead by the Dutch process. Scrap leather is of no value for manure, and chrome is reputedly poisonous to plants. It is usually worked up for artificial leather and leather board, or stripped and used for glue stock. Lime sludge from old limes is of some manurial value, owing to its nitrogen content.

The disposal of waste liquors from a tannery is a problem in itself, owing to their usually high bacterial content. Settling tanks and the removal of solid matter are essential. Where such liquors discharge into a stream, cases have arisen where a farmer, down stream, has sued the tanner for damages for the death of cattle from anthrax, reputedly caused by the tannery effluent.

Apart from anthrax, the only unusual sickness likely to arise in a tannery is chrome sores, which come from exposure of the hands to bichromate solutions. Where the men work alternately in the bichromate and the reducing baths, these are not likely to occur, but it is best to avoid contact of the skin with chrome liquors. Lime, and sodium sulphide still more so, in contact with the human skin attack it. Consequently lime yard workers are invariably provided with rubber or other gloves. On the whole tannery workers are an unusually healthy lot and even men working with natural puer seem to suffer no ill effects.

Conclusion

The leather trade offers an entrancing choice of problems to the scientist, bewildering in their number and complexity, but all the more fascinating on that account. The chemist cannot hope to tell the tanner how to make leather until far more is understood of the mechanism of the very diverse and varying processes. He has a useful place in control work today, and those who are capable of applying the results of research, frequently abstruse and of no apparent connection with tanning, will save their firms much time and money, while at the same time maintaining a high quality product.

Coke Shortages in Both France and Germany

Effects of the French and Belgian Occupation of the Ruhr Are Already Being Felt by Chemical and Metallurgical Industries in Both Countries

Developments in the Ruhr district are directly accountable for serious shortages of coke in both French and German steel mills and chemical plants, according to cables received by the Commerce Department from its foreign representatives. Since Jan. 15 practically no coal or coke has entered France from Germany, and the production of the Saar Basin is reported as completely stopped due to a miners' strike effective Feb. 6. The coke shortage is more severely felt than coal; and about thirty-five blast furnaces have shut down in Luxembourg, Lorraine and eastern France since the middle of January. Coke prices have increased by 40 francs per ton, and coal prices are rising. Increased quantities of coal are being imported from England, and orders for coke are being placed in Czechoslovakia. French iron producers cannot depend upon Belgian fuel, as that country now needs its production to supply its own furnaces, and the French iron and steel market is generally slowing down. The metallurgical industries in the Lyon district continue their recovery due to activity in automobiles and electrical constructions for hydraulic development, railway orders and the general pick-up of trade in specialized machines.

Although no figures have been secured on the production of coal in the Ruhr Valley, says Commercial Attaché Herring, Berlin, in a cable to the Department of Commerce, the entire output of coal in Germany during January is estimated about 25 per cent below December. Coke production improved, but was insufficient to fill the needs of industry, while the production of lignite remained unchanged.

Conditions in German Industries

The iron and steel industry complained of a shortage of coke and iron ore during January, while coal supplies were sufficient owing to a cessation of reparation shipments. The machine industries were fully occupied, while locomotive plants reported a growing dullness on account of the marked depreciation; the electrotechnical industry was busy with old orders; the textile industry showed great activity because of large purchases of raw cotton with a favorable exchange during December and subsequently the receipt of numerous foreign orders. Unsatisfactory business was reported by the leather industries, especially in the finished leather goods and stable shoes branches.

Business was brisk in the heavy chemical industry, particularly on account of big export sales; domestic consumers, however, are complaining that low export prices are causing a selling out to foreign buyers. The dye industry is less active and the immediate future is regarded as highly uncertain. The glass industry is normally occupied, but export sales are disappointing; this is partly ascribed to a revival of Czechoslovak competition. Coal supplies for the glass industry are reported especially short. Good exports are reported by the paper industry, but slackened domestic sales; part-time employment has been introduced in some of the mills. The rubber industry is dull and is encountering difficulty in obtaining raw materials as well as coal, necessitating part-time employment.

A Problem in Barrel Storage And How It Is Solved

This Article Will Show How It Can Be Done and Gives a Graphic Comparison Between the Three Most Important Good Methods of Barrel Storage

BY MATTHEW WILLIAM POTTS
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TO ILLUSTRATE the possiblities of economic storage of barrels, let us analyze a warehouse layout. Suppose the engineer has been supplied with the following data and the company desires the best, most efficient and most economical layout for the smallest expenditure of money (they always want that). The data, written as a matter of record and to avoid mistakes and omissions, might be as follows:

1. Maximum storage requirements? 6,000 bbl.
2. Products to be stored?* Chemicals.
3. Like, or assorted products? Approximately 100 different products to be stored. This number includes the different analyses of the same products.
4. What per cent of the products will be in dry form? Approximately 80 per cent.
5. What per cent of the products will be in liquid or paste form? Approximately 20 per cent.
6. What kind and size of barrels will the products be packed in? Standard 50-gal. tight barrels, 26 bilge diameter, 34 in. high, 23 in. chimb diameter.
7. How will the barrels be received? By motor trucks and railroad cars and in from 13- to 40-bbl. lots.
8. How must the materials be taken out of stock? The oldest stock must be shipped first.
9. Must each lot be shipped intact as it was received? No, the barrels will be shipped out in broken lots.
10. Is storage space plentiful or must every cubic foot be utilized? Ground area that can be used is limited, as costs are high.
11. Is there a preference as to the type of building desired? No, the building can be any type, old or new.
12. Is it necessary to take a complete physical inventory? Yes, inventory must be taken every 6 months.
13. How will the goods be shipped? By cars and motor trucks.
14. Will the building be used only as a warehouse or must other facilities be provided? Provide a main office; foremen's or clerks' offices; consolidation shipping space or platform; railroad siding; street entrance and platform for receiving goods from motor trucks.

First, then, a canvass must be made of the vicinity where it is desired to locate the warehouse and the existing buildings studied to see if they can be utilized. Often it is cheaper to move a department into a new building and use the vacated building as a warehouse. To save space we shall eliminate all the preliminary layouts made for this proposition and show only the final layout, together with a detailed discussion on the various methods of storage. Assume that after investigation of a number of buildings we locate the one shown in the drawings, which is of steel and brick construction on a lot 90x170 ft. with a roof height of 26 ft. in the clear. The building proper is approximately 80x150 ft. inside dimensions, giving a total of 12,000 sq.ft. of floor space.

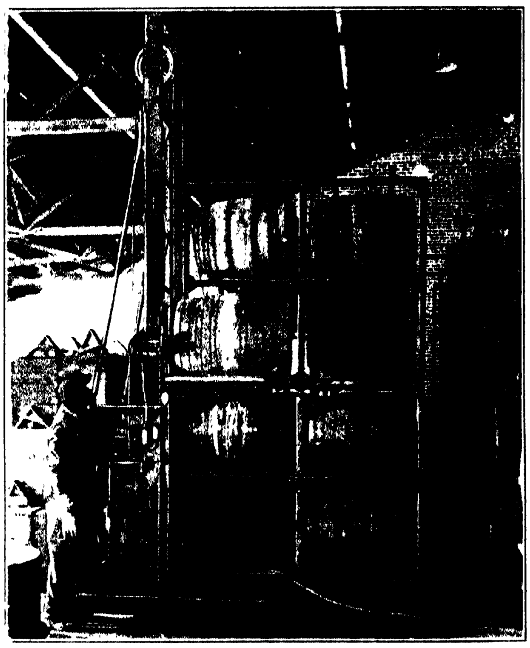

FIG. 15—THE RACK METHOD SHOWING HOW IT IS POSSIBLE TO WASH UNDER THE RACKS

The next thing to consider is the maximum storage requirements of 6,000 barrels. Of these, 4,800 barrels, or 80 per cent, will contain dry products and 1,200 barrels, or 20 per cent of the total, will contain liquids or pastes. The plan view Fig. 16 and the sectional elevation *A-A* of Fig. 17 show the possibilities of storage on the bilge using long dunnage as shown in Fig. 9. (See article by this author in *Chem. & Met.*, Feb. 14, 1923.) We find that using this method we require approximately 650 sq.ft. of floor space to store 72 barrels per tier. This area includes the side aisle necessary to get between the different rows of barrels, but does not include the area required for the main aisle. It will be noted that the side aisles are off center of the bay, which makes the odd-numbered rows contain 5 barrels per tier and the even-numbered rows 4 barrels per tier. With dry products we can tier the barrels 4 high, as shown, making 20 barrels in the odd-numbered rows and 16 barrels in the even-numbered rows, or a total of 288 barrels in 650 sq.ft. of floor area if every barrel space is filled. On the basis of these figures, to store 4,800 barrels of dry products we should require 16.6 such spaces. We still have 1,200 barrels of liquids or pastes which cannot be piled over 2 high. Under these limitations 144 barrels can be placed in 650 sq.ft. of floor area. We therefore must provide 8.3 spaces to our 16.6 spaces, making a total of 24.9 spaces for storage. In addition we must add 10 per cent for empty spaces brought about by the variety of products stored; this addition of 2.4 spaces brings the grand total to 27.3 spaces, each containing 650 sq.ft. and 650 sq.ft. $\times$ 27.3 spaces = 17,745 sq.ft. of floor area for stor-

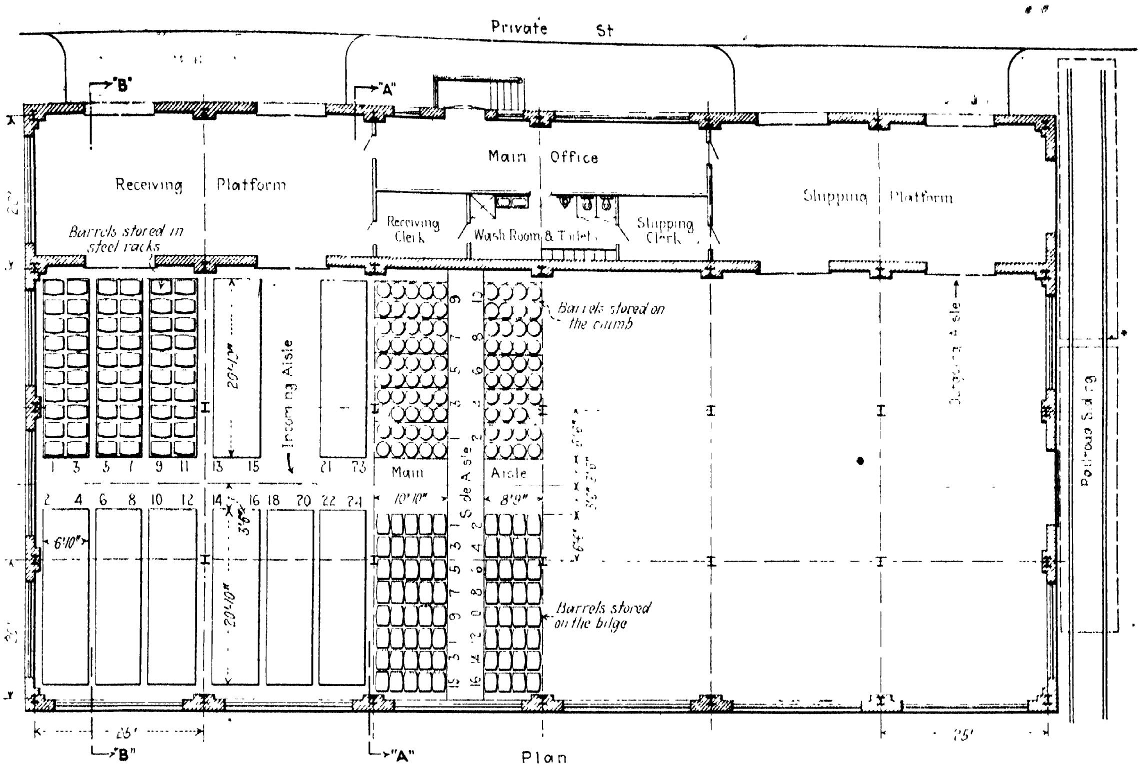

FIG 16—PLAN SHOWING LAYOUT OF BARREL STORAGE

age alone. To this must be added space for main aisles, receiving and shipping platforms, offices, etc.

Chimb Storage With Short Dunnage

In considering the method of storing barrels on the chimb it is recommended that short dunnage be used, instead of long dunnage. It has been found by the writer that by using short dunnage the lumber dunnage bill is reduced to a minimum—in fact, the same lumber has been used for from 1 to 3 years. The use of short dunnage has many advantages. First, it is not so easily broken; second, it can be easily stored in the warehouse when not in use; third, it allows the barrels to be taken down working back from the aisle. What is meant by short dunnage, the size to use and how to use it are shown in Fig. 19.

Referring to plan view Fig. 16 and the sectional elevation *A-A* of Fig. 17, we have a graphic representation of how to store barrels on the chimb. We find that it requires approximately 650 sq.ft. of floor space to store 90 barrels per tier. This floor area includes the same as in the previous method. When using the chimb method of storage we cannot figure a row as one barrel wide, because the barrels are more difficult to place and the man must work on all sides of the barrel until he gets it into position. We therefore plan the rows two barrels wide, the even-numbered rows containing 8 barrels per tier and the odd-numbered rows 10 bar-

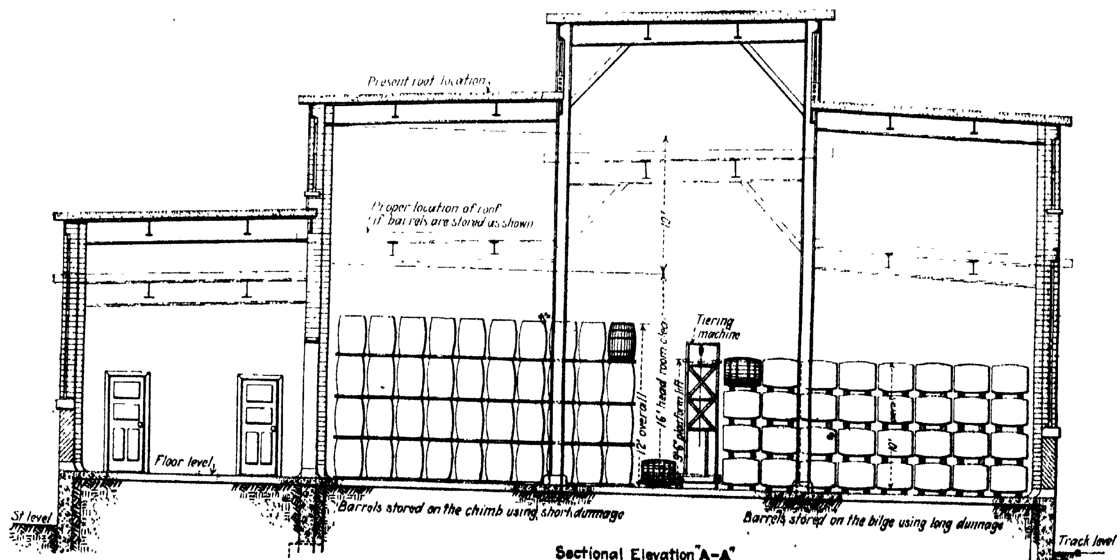

FIG. 17—SECTIONAL ELEVATION AT "A-A" IN FIG. 16

rels per tier. The barrels containing dry products can be tiered 4 high, as shown, so we are able to place 32 barrels in the even-numbered rows and 40 barrels in the odd-numbered rows, or a total of 360 barrels in 650 sq.ft. of floor area if every barrel space is filled. On the basis of these figures, to store 4,800 barrels of dry products we should require 13.3 such spaces. We still have 1,200 barrels of liquids or pastes which must not be piled over 2 high on the bilge. We must therefore provide 8.3 spaces for these liquids or pastes, which when added to our 13.3 spaces for dry products makes a total of 21.6 spaces for storage. In addition we must add 10 per cent for empty spaces brought about by the variety of products stored. This addition of 2.1 spaces brings the grand total 23.7 spaces each containing 650 sq.ft.: 650 sq.ft. × 23.7 spaces = 15,405 sq.ft. of floor area for storage alone. To this must be added space for main aisles, receiving and shipping platforms, offices, etc.

Rack Storage

Most Economical Method for Space Utility

The rack method of barrel storage is shown in plan view, Fig. 16, and section elevation *B-B* of Fig. 18 With the rack system the barrels are all stored on the bilge, and all barrels, whether they contain liquid or dry products, are treated alike, because each barrel is supported by the rack independently, so the height of the pile or the number of tiers is not limited. Approximately 650 sq.ft. of floor area is required to store 60 barrels per tier. This includes space enough between sets of racks so that a man can walk between to inspect the barrels or take inventory. Each row, whether odd or even, contains 10 barrels per tier. The barrels are tiered 10 high, as shown, making a total of 600 barrels in 650 sq.ft. of floor area if every barrel space is filled. On the basis of these figures, to store 6,000 barrels we should require 10 spaces each containing 650 sq.ft. To this we must add 10 per cent for empty spaces brought about by the variety of products stored. This addition of 1 space brings the grand total to 11 spaces: 650 sq.ft. × 11 spaces = 7,150 sq.ft. of floor area for storage alone. To this must be added space for main aisles, receiving and shipping platforms, offices, etc.

The following tabulation compares the three methods:

Method of Storage	Floor Area for Storage Alone, Sq.Ft.
On the bilge with long dunnage...	17,745
On the chimb with short dunnage.	15,405
In steel racks....................	7,150

This shows that for a given area more barrels can be stored per square foot with the rack system than with other methods.

Looking at this problem from another angle, we find that the building we have selected will be large enough to store the following number of barrels under each method:

Method of Storage	Barrels Liquids	Dry	Total
On the bilge with long dunnage...	576	2,304	2,880
On the chimb with short dunnage..	576	2,880	3,456
In steel racks..........	1,200	5,600	6,800

These figures demonstrate that while the building is large enough to take care of our total requirements if we use the rack system, it would be capable of containing only approximately 50 per cent of our needs if either of the other methods were used. The more floor area required for storage the more main aisle, incoming and outgoing aisle space will have to be allowed. The space for receiving and shipping platforms, offices, etc., is the same with either method.

It was stated that the cost of land and rentals was high. This is true in almost every case. If it is necessary to build a new building, the cost is dependent upon the number of floors to be provided and the number of square feet per floor. It is at this point—namely, in the building of new warehouses to provide storage—that it is possible to save considerable money by using the rack system. In the case of old buildings it is sometimes difficult to prove that the rack system will save money, because the limiting head room does not permit the racks to be over 3 tiers high, but even here if the number of barrels handled is large enough, a material saving in the labor cost will be effected by installing racks which may offset the initial cost.

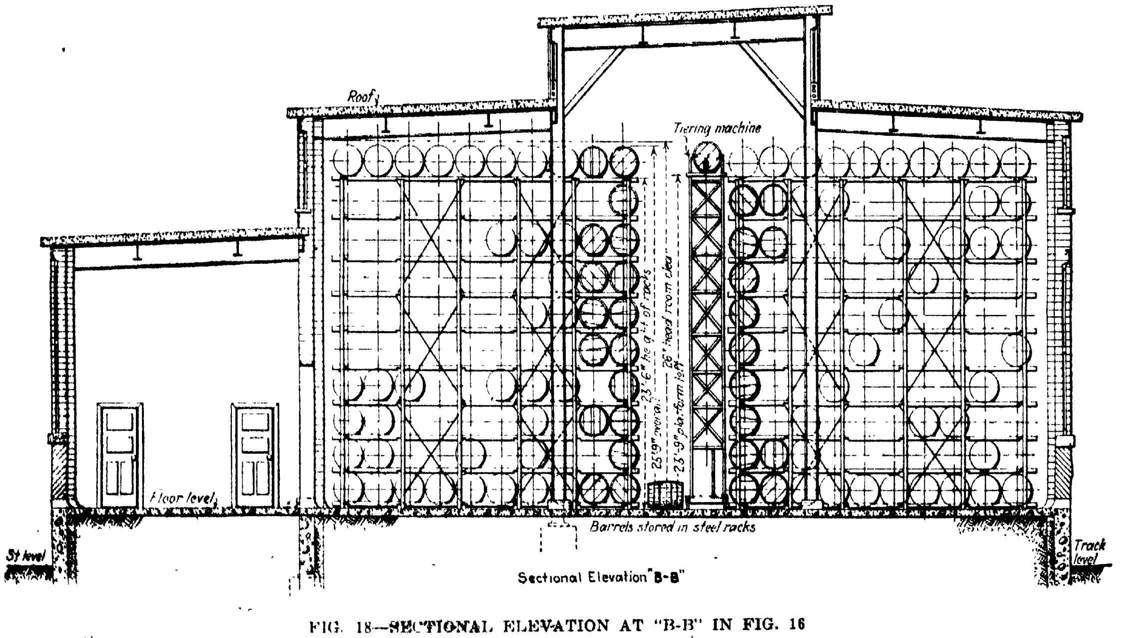

FIG. 18—SECTIONAL ELEVATION AT "B-B" IN FIG. 16

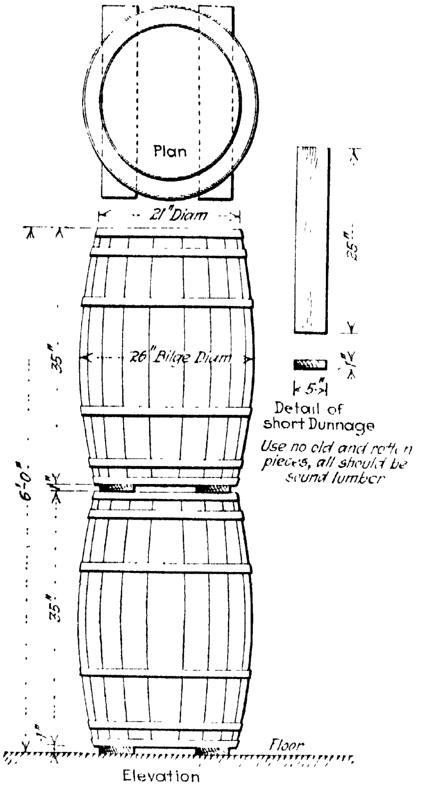

FIG. 19 DIAGRAM SHOWING USE OF SHORT DUNNAGE WHEN STORING BARRELS ON THE CHIMB

We all know that new buildings cost considerable money and this cost is in proportion to the size of the building. The cost of the building site is also dependent upon the size of the building. Taking the problem which we have just analyzed and considering a new building, it will be clearly seen that either bilge or chimb method of storage would require a building twice as large, in ground area, as the one shown, but not so high. The only comparison to make then is: Would it be cheaper to build the larger but lower building? Or would it be cheaper to build the smaller but higher building and equip it with racks? It is a simple engineering problem.

It is of no use to build a high building unless the overhead space can be used. In the storage of barrels, using either the method of piling on the bilge or on the chimb with dunnage, the maximum height of piling recommended is 4 tiers. In order to accommodate this height of pile the building would have to have at least 16 ft. in the clear. With the rack system it is possible to pile the barrels from 10 to 12 tiers high. Selecting the 10 high racks, we should require a building with 26 ft. in the clear. Thus by increasing the side walls and columns 10 ft. and installing racks we are able to reduce the floor area by more than one-half.

A Physical Inventory Must Sometimes Be Made

The complete physical inventory is something that must be considered. The requirements call for a physical inventory every 6 months. To take a physical inventory if barrels are stored on the bilge or chimb with dunnage is impossible without moving each barrel. The complete handling of 6,000 barrels is expensive and difficult; it would also require quite a lengthy shut-down of the plant. With the rack system, if the inventory tags are placed on the heads of the barrels, it is possible for one man to take an inventory of the above stock in 2 days without moving a barrel. In order to facilitate the taking of an inventory the manufacturer of the racks provides brackets on the side of the rack upon which boards are fastened, making a walkway for the man at every second tier.

When installing racks in chemical warehouses there are a few points to remember: First, always install the racks on raised piers as shown in Fig. 15. This makes it easy to wash out beneath the racks in case a barrel or drum should burst and it prevents the acid from attacking the bottom cross members; second, always paint the racks with acidproof paint. They should also be repainted at least once a year.

In conclusion, it might be said that the only satisfactory method of barrel storage is the rack system. This is true up to a certain point and applies chiefly to new warehouses. As previously stated, each installation or problem has to be considered separately. It can be added, however, that every chemical plant in the country can afford to spend a little time and money in looking over its present methods of handling, buying, filling, painting, storing and shipping of barrels. It will be found in many cases that thousands of dollars can be saved without one cent's worth of investment and that thousands more can be saved if a little money is spent in making improvements and installing the latest and most modern equipment.

Some Comparative Statistics on Glass Manufacture in 1919 and 1921

Although it might be regarded as ancient history, nevertheless the comparison between 1919 and 1921 is most enlightening. It should be remembered in studying these figures that 1921 was a year of great depression in the glass industry. It is all the more striking, therefore, that the total quantity of plate glass and of wire glass was greater in 1921 than in 1919. All of the rest of the individual commodities, such as window glass, obscured glass, pressed and blown glass, bottles and jars, showed a diminution in quantity produced of from 10 to 50 per cent.

COMPARATIVE SUMMARY, 1921 AND 1919

	1921	1919	Per Cent of Decrease
Number of establishments	328	371	11 6
Persons engaged	59,705	83,656	28.6
Proprietors and firm members	50	60	
Salaried employees	4,979	6,076	18 1
Wage earners (average number)	54,676	77,520	29 5
Salaries and wage payments	$78,852,000	$100,891,000	20.9
Salaries	12,290,000	13,364,000	8.0
Wages	67,562,000	87,527,000	22 8
Contract work	131,000	241,000	45.6
Cost of materials	86,883,000	90,780,000	4 3
Value of products	212,593,000	261,384,000	18 8
Value added by manufacture	125,710,000	171,104,000	26.5

Lime-Sulphur Concentrate

The U. S. Department of Agriculture Farmers' Bulletin 1285 describes methods and apparatus for the preparation and use of lime-sulphur solutions and the lime-sulphur concentrate, which are so extensively used as an insecticide and fungicide. The circular, which is available on application to the Department of Agriculture, Washington, D. C., describes a wide variety of apparatus for home manufacture of this material. The apparatus ranges in size from a simple 25-gal. kettle to steam plants in which 800 gal. of concentrate can be prepared in a single cooking.

Fundamentals of Rectification

The Conditions for Reversible Rectification

With Certain Assumptions as to the Properties of Mixtures It Is Shown That Low-Temperature Separations Can Be Carried Out in Such a Way That the Minimal Work Necessary Is Equal to the Theoretical Minimal Work by Means of Ideal Semi-Permeable Membranes*

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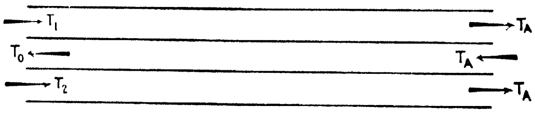
WE SHALL now undertake a general investigation of the conditions existing in an ideal rectification system when all the transformations accomplished therein are thermodynamically reversible.

In any thermodynamic process a necessary and sufficient condition for reversibility is that, during any transformation, equilibrium conditions are maintained throughout—e.g., if a heat transfer occurs, it must be between bodies having only infinitesimal differences of temperature, or if a fluid does work by exerting pressure, that pressure must at any instant be the true equilibrium pressure corresponding to the volume and temperature of the fluid at rest at that instant. Therefore, if we impose the condition that rectification shall be accomplished reversibly, it will be necessary to make the compositions of liquid and vapor in contact at any point in the column to be those compositions for phase equilibrium. That is to say, x and y anywhere in the column at the same level must have the relation for phase equilibrium.

In what follows we shall have occasion to determine not only the conditions existing in the rectification column proper when this relation is maintained but we shall also endeavor to calculate the work necessary to produce these conditions reversibly and to determine the relation between this work and the theoretic minimal work of separating the constituents of a binary mixture by means of the well-known ideal device of semi-permeable pistons. In order to avoid uncertainties connected with the pressure-volume-temperature relations for an imperfect gas, the theoretic minimal work of separation of the constituents of a fluid mixture is generally calculated under conditions such that both the mixture and its separated constituents may be assumed to have the properties of a perfect gas. Since, however, when the separation is accomplished by rectification, the mixture generally enters the column in a condition approaching that of saturated vapor or of liquid, while the separated products generally leave the rectifier in the saturated vapor state, it will be necessary to inquire into the ways and means available for producing these conditions.

Whenever a binary mixture of two constituents whose liquefaction temperature is considerably below atmospheric is separated by liquefaction and rectification, it is the general practice to employ the cold separated products to cool down the incoming mixture entering the column as much as possible in a so-called countercurrent heat interchanger; that is, an apparatus in which the cold outgoing products are in as intimate thermal contact as possible with the incoming unseparated mixture. Considered from the most general point of view, we may say that what an interchanger is designed to accomplish is the taking of heat from an incoming mixture and transfering it as nearly reversibly as possible to the cold outgoing separated products. In general, it is impossible to cause this transfer to take place in the interchanger reversibly, even though we assume perfect insulation from outside heat effects and perfect thermal conductivity between the incoming and outgoing streams, unless certain relations hold between masses and total heats of those streams. This relation we shall proceed to obtain.



In the first place, if we assume that no external heat enters or leaves the interchanger, the "total heat" of all fluids entering the interchanger must equal the total heats of all fluids leaving, since no external work is performed in the apparatus. Second, if we assume that the masses of all fluids entering equals that of fluids leaving, the heat capacity of the entering mixture must be the same as for the outgoing products at the same temperature, since otherwise the temperature of the ingoing fluid could not be equal everywhere to that of the outgoing fluid in thermal contact with it and thus there would rise irreversibility of heat transfer in the interchanger. Even though this last condition is not satisfied, we may still suppose the exchange to be accomplished reversibly without the expenditure of external work, provided that the difference of "total heat" of the ingoing mixture between the initial temperature T_A at which it enters the interchanger and the temperature T_0 at which we wish it to leave the interchanger is equal to the sum of the increases of "total heat" for the separated products between the temperatures T_1 and T_2 at which we wish them to enter the interchanger and the fundamental temperature T_A. The ideal reversible process by which this could be accomplished is as follows:

Let the mass of incoming mixed fluid of temperature T_A entering the system per unit time be m_A and suppose that we wish to lower its temperature to T_0 by transferring the necessary heat to two separated products coming from the rectification apparatus, one of mass m_1 at temperature T_1 and the other of mass M_2 at temperature T_2, the temperature of both these fluids being brought ultimately to the value T_A. Assume that we have a reversible Carnot engine working first between m_A and m_1, transferring heat from the former to the latter until the temperature of m_1 is T_A, and let us calculate the work expended upon this engine.

Let the temperature of m_A at some instant be T, and its specific heat at that temperature be C, and suppose the temperature of m_1 at that instant is τ_1. Let the quantity of heat Cm_AdT be taken from m_A. The

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fraction of this which is transformable to work in a Carnot engine working between T and τ_1 is $\frac{T-\tau_1}{T} Cm_A dT$, and the heat imparted to m_1 will be $\frac{\tau_1}{T} Cm_A dT$. Let this process continue until the fluid m_1 has the temperature T_A, and let T_3 be the final temperature of m_A. The total heat taken from m_1 during this process will be

$$+\int_{A}^{3} Cm_1 dT$$

The total work expended will be

$$-\int_{A}^{3} \frac{T-\tau_1}{T} Cm_1 dT$$

and the total heat imparted to m_1 will be

$$+\int_{A}^{3} \frac{\tau_1}{T} Cm_1 dT$$

Now let the Carnot engine begin to discharge heat into M_2, instead of m_1, the instantaneous temperature thereof bening τ_2. Then by hypothesis, when the final temperature of M_2 is T_1, that of m_1 will be T_0. The heat taken from m_1 during this part of the process will be

$$+\int_{3}^{0} Cm_1 dT$$

The total work expended will be

$$-\int_{3}^{0} \frac{T-\tau_2}{T} Cm_1 dT$$

and the total heat imparted to M_2 will be:

$$\int_{3}^{0} \frac{\tau_2}{T} Cm_1 dT$$

Hence if the total work expended during the whole process is zero, we have:

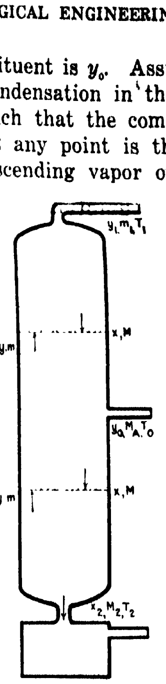
$$-\int_{T_A}^{T_3} \frac{T-\tau_1}{T} Cm_A dT - \int_{3}^{0} \frac{T-\tau_2}{T} Cm_A dT = 0$$

or

$$\int_{A}^{0} Cm_A dT = \int_{A}^{3} \frac{\tau_1}{T} Cm_T dT + \int_{3}^{0} \frac{\tau_2}{T} Cm_A dT$$

That is, the change of total heat of the incoming mixture must be equal to that of the outgoing products, if it be possible to accomplish the exchange reversibly without expenditure of work.

Now assume that we are dealing with a binary mixture which has the property that its difference of total heat between the saturation point and the temperature T_A at which it enters the interchanger is equal to the sum of the differences of the total heats of the separated products each one between saturation and the temperature T_1 at which it leaves the interchanger. For such a mixture, then, we may assume that the work necessary to change the condition of the incoming mixture reversibly from the initial temperature down to the saturation point, by permitting the separated products in the saturated condition to be restored to the initial temperature, is zero, and we may assume that the incoming unseparated fluid enters the rectification column in the saturated condition and each outgoing separated product leaves the rectification column in the saturated condition. Let us suppose that a mass m_A of such a mixture at temperature T_0 enters an intermediate level of a rectification column and that its composition in the more condensible constituent is y_0. Assume that by a system of distributed condensation in the upper half we attain a condition such that the composition x of the descending liquid at any point is that for phase equilibrium with the ascending vapor of composition y at that level. Let the absolute temperature at which the incoming mixture centers, and also the absolute temperature at which the outgoing products leave the interchanger, be T_A.



Let us suppose that the condensation in the upper half of the column is produced by an infinite series of reversible Carnot engines, each one of these engines working between one level in the column and atmospheric temperature. Thus, any Carnot engine working at the level where the composition of liquid is x takes the heat required to condense the mass dM of liquid necessary to be condensed at that level and rejects this heat, together with the heat equivalent of the necessary work, at the temperature T_A. Assume that the vaporization necessary in the lower half of the column is also produced by an infinite series of Carnot engines, each one of these taking in an amount of heat at temperature T_1, such that the heat rejected at a lower level x in the column is such as to produce the amount of evaporation necessary at that level. Suppose that a mass m_1 of composition y_1 of a saturated vapor leaves the top of the rectification column and that a mass M_2 of liquid of composition x_2 is drawn from the bottom of the column. Then the total work necessary to be expended in order to produce the products m_1 and M_2 will be the algebraic sum of the work expended in the whole series of Carnot engines, this series including not only those working as described in the column proper, but those necessary to evaporate the mass M_2 of liquid to saturation.

First consider the level (x, y) in the upper part of the column. Let the mass of liquid descending at this point per unit time be M and its composition x, and the mass of vapor ascending per unit time at the same level be m and its composition y. Then we have the three following equations among x, y, y_1, M, m and m_1:

$$m = M + m_1$$
$$ym = xM + y_1 m_1$$
$$y = F(x)$$

where the function F denotes the relation for constant pressure between the compositions x and y of liquid and vapor in phase equilibrium for the particular mixture treated.

From the first two equations we obtain:

$$M = \frac{y - y_1}{x - y} m_1$$

Considering the column as a whole, we have:

$$m_A = m_1 + M_2$$

and

$$y_0 m_A = y_1 m_1 + x_2 M_2$$

from which

$$m_1 = \frac{x_2 - y_0}{x_2 - y_1} m_A$$

and hence for any M above the level of inlet of m_A we have:

$$M = \frac{y - y_1}{x - y} \frac{x_2 - y_0}{x_2 - y_1} m_A$$

Next consider a level (x, y) in the lower half of the column. Here we have

$$M = M_2 + m$$

$$xM = x_2 M_2 + ym$$

and

$$y = F(x)$$

where F is the same function as before.

From the first two equations we obtain:

$$M = \frac{x_2 - y}{x - y} M_2$$

but from equations for column as a whole

$$M_2 = \frac{y_0 - y_1}{x_2 - y_1} m_A$$

Whence, for any M in the lower part of the column,

$$M = \frac{x_2 - y}{x - y} \frac{y_0 - y_1}{x_2 - y_1} m_A$$

If, for the mixture dealt with, the form of the function F were known, y or x could be eliminated from the two equations we have obtained for M, and thus the value of M obtained as a function of y or x, and by differentiation of this function it would be possible to obtain the derivatives $\frac{dM}{dx}$ or $\frac{dM}{dy}$ in terms of x or y and the constants x_2, y_0, etc.

As an example, consider a mixture for which the latent heat, L, at constant pressure for all compositions follows the proportionality law as indicated by the equation

$$L = L_B x + L_A (1 - x)$$

For such a system, we have shown above that a functional relation between the compositions x and y of liquid and vapor in phase equilibrium which satisfies the conditions is given by

$$\frac{y}{1 - y} = a \frac{x}{1 - x}$$

Eliminating x between this equation and the equation obtained above, giving the value of M in the upper part of the column, we have:

$$M = \frac{(y - y_1)[y + a(1 - y)]}{(1 - a) y (1 - y)} \frac{x_2 - y_0}{x_2 - y_1} m_A$$

By differentiation of this equation, we obtain:

$$\frac{dM}{dy} = \frac{y^2(1 - y_1) + a y_1 (1 - y)^2}{(1 - a) y^2 (1 - y)^2} \frac{x_2 - y_0}{x_2 - y_1} m_A$$

Now, if the quantity dM of liquid be condensed at the level (x, y), the heat necessary to be removed at that point in the column will be:

$$\frac{d(LM)}{dy} dy$$

Let us suppose that the absolute temperature at this level in the column is T. Then the work required to absorb this heat at temperature T by a reversible Carnot engine, and reject it at the initial temperature, will be:

$$\frac{T_A - T}{T} \frac{d(LM)}{dy} dy$$

and the total work necessary to be expended in the upper part of the column will be

$$W_1 = \int_{y_1}^{y_0} \frac{T_A - T}{T} \frac{d(LM)}{dy} dy$$

or

$$W_1 = \int_{y_1}^{y_0} \frac{T_A - T}{T} \left(L \frac{dM}{dy} + M \frac{dL}{dy} \right) dy$$

But if we substitute the value of x from

$$\frac{y}{1 - y} = a \frac{x}{1 - x}$$

in the equation

$$L = L_B x + L_A (1 - x)$$

it becomes

$$L = \frac{L_B y + L_A a (1 - y)}{y + a(1 - y)}$$

and

$$\frac{dL}{dy} = \frac{(L_B - L_A) a}{[y + a(1 - y)]^2}$$

whence

$$\frac{d(LM)}{dy} = L \frac{dm}{dy} + M \frac{dL}{dy} = \frac{x_2 - y_0}{(1 - a)(x_2 - y_1)} \left[\frac{L_B (1 - y_1)}{(1 - y)^2} + \frac{L_A a y_1}{y^2} \right] m_A$$

Substituting this in the expression for W_1, we have:

$$W_1 = m_A \int_{y_1}^{y_0} \frac{T_A - T}{T} \frac{x_2 - y_0}{(1 - a)(x_2 - y_1)} \left[\frac{L_B (1 - y_1)}{(1 - y)^2} + \frac{L_A a y_1}{y^2} \right] dy$$

In the lower half of the column, we have:

$$M = \frac{x_2 - y}{x - y} \frac{y_0 - y_1}{x_2 - y_1} m_A$$

Eliminating x as before, we obtain:

$$M = \frac{(x_2 - y)[y + a(1 - y)]}{(1 - a) y (1 - y)} \frac{y_0 - y_1}{x_2 - y_1} m_A$$

Differentiating this equation, we have:

$$\frac{dM}{dy} = - \frac{y^2 (1 - x_2) + a x_2 (1 - y)^2}{(1 - a) y^2 (1 - y)^2} \frac{y_0 - y_1}{x_2 - y_1} m_A$$

Now, if at the level (x, y) a quantity of liquid $- dM$ be evaporated, the heat required will be $- \frac{d(LM)}{dy} dy$. The work obtained from a Carnot engine working reversibly between the temperature T_A and the temperature T at this point, when said engine rejects the above amount of heat at temperature T, is

$$\frac{T_A - T}{T} \frac{d(LM)}{dy} dy$$

Hence, the total work obtained in the lower part of the column, including that obtained by the evaporation of the liquid M_2, will be

$$W_2 = - \int_0^{y_2} \frac{T_A - T}{T} \frac{d(LM)}{dy} dy + \frac{T_A - T_2}{T_2} [L_B x_2 + L_A (1 - x_2)] M_2$$

where T_2 is the temperature of the liquid M_2

In this case, we have:

$$M = \frac{(x_2 - y)[y + a(1 - y)]}{(1 - a) y (1 - y)} \frac{y_0 - y_1}{x_2 - y_1} m_A$$

$$\frac{dM}{dy} = - \frac{y^2 (1 - x_2) + a x_2 (1 - y)^2}{(1 - a) y^2 (1 - y)^2} \frac{y_0 - y_1}{x_2 - y_1} m_A$$

from which

$$\frac{d(LM)}{dy} = L\frac{dM}{dy} + M\frac{dL}{dy} =$$

$$-\frac{y_0-y_1}{(1-a)(x_2-y_1)}\left[\frac{L_B(1-x_2)}{(1-y)^2}+\frac{L_A a x_2}{y^2}\right] m_A$$

Substituting this value, W_2 becomes:

$$W_2 = m_A\int_{y_0}^{y_2}\frac{T_1-T}{T}\,\frac{y_0-y_1}{(1-a)(x_2-y_1)}\left[\frac{L_B(1-x_2)}{(1-y)^2}+\frac{L_A a x_2}{y^2}\right]dy$$

$$+ m_A\frac{T_A-T_2}{T_2}\,\frac{y_0-y_1}{x_2-y_1}[L_B x_2 + L_A(1-x_2)]$$

Hence, the total work expended in the whole system is

$$W_1 - W_2 = \int_{y_1}^{y_0}\frac{T_1-T}{T}\,\frac{d(LM)}{dy}\,dy + \int_{y_0}^{y_2}\frac{T_1-T}{T}\,\frac{d(LM)}{dy}\,dy - \frac{T_1-T_2}{T_2}[L_B x_2 + L_A(1-x_2)]M_2$$

while the net amount of heat removed from the column is

$$\int_{y_1}^{y_0}\frac{d(LM)}{dy}\,dy + \int_{y_0}^{y_2}\frac{d(LM)}{dy}\,dy - [L_B x_2 + L_A(1-x_2)]M_2$$

Now, since the heat taken from the fluids in the upper part of the column is equal to that added in the lower part, the latter expression must vanish while the expression for total work expended should be equal to the theoretic minimal work of separation, W_m, since all transformations in the system, including those in the interchangers, have been made reversible. Hence we have the two equations:

$$\int_{y_1}^{y_0}\frac{d(LM)}{dy}\,dy + \int_{y_0}^{y_2}\frac{d(LM)}{dy}\,dy - [L_B x_2 + L_A(1-x_2)]M_2 = 0$$

and

$$T_A\left\{\int_{y_1}^{y_0}\frac{d(LM)}{T\,dy}\,dy + \int_{y_0}^{y_2}\frac{d(LM)}{T\,dy}\,dy - \frac{[L_B x_2 + L_A(1-x_2)]M_2}{T_2}\right\} = W_m$$

Substituting the above values of $\frac{d(LM)}{dy}$ and M, these expressions become:

$$\frac{x_2-y_0}{1-a}\left[L_B(1-y_1)\int_{y_1}^{y_0}\frac{dy}{(1-y)^2}+L_A a y_1\int_{y_1}^{y_0}\frac{dy}{y^2}\right]$$

$$-\frac{y_0-y_1}{1-a}\left[L_B(1-x_2)\int_{y_0}^{y_2}\frac{dy}{(1-y)^2}+L_A a x_2\int_{y_0}^{y_2}\frac{dy}{y^2}\right]$$

$$-(y_0-y_1)[L_B x_2 + L_A(1-x_2)] = 0$$

and

$$\frac{x_2-y_0}{1-z}\left[L_B(1-y_1)\int_{y_1}^{y_0}\frac{dy}{(1-y)^2T}+L_A a y_1\int_{y_1}^{y_0}\frac{dy}{y^2T}\right]$$

$$-\frac{y_0-y_1}{1-a}\left[L_B(1-x_2)\int_{y_0}^{y_2}\frac{dy}{(1-y)^2T}+L_A a x_2\int_{y_0}^{y_2}\frac{dy}{y^2T}\right]$$

$$-\frac{(y_0-y_1)[L_B x_2 + L_A(1-x_2)]}{T_2} = K$$

where

$$K = \frac{W_m(x_2-y_1)}{m_A T_A}$$

Integrating the first equation, we obtain:

$$\frac{x_2-y_0}{1-a}\left(\frac{L_B}{1-y_1}+\frac{L_A a}{y_0}\right)$$

$$-\frac{y_2-y_0}{1-a}\left(\frac{L_B}{1-y_0}\,\frac{1-x_2}{1-y_2}+\frac{L_A a x_2}{y_0 y_2}\right)$$

$$-[L_B x_2 + L_A(1-x_2)] = 0$$

But since

$$\frac{y_1}{1-y_1} = a\frac{x_2}{1-x_2},$$

$$\frac{x_2}{y_1} = \frac{a x_2 + 1 - x_2}{a}$$

and

$$\frac{1-x_2}{1-y_1} = a x_2 + 1 - x_2$$

Hence:

$$\frac{x_2-y_0}{1-a}\left(\frac{L_B}{1-y_0}+\frac{L_A a}{y_0}\right)$$

$$-\frac{a x_2 - y_1(a x_2 + 1 - x_2)}{1-a}\left(\frac{L_B}{1-y_0}+\frac{L_A}{y_0}\right)$$

$$-[L_B x_2 + L_A(1-x_2)] = 0,$$

which is identically true—i.e., the method may be employed whatever be the composition, y_0, of the mixture treated or whatever be the compositions y_1 and x_2 of the separated products.

The second equation, giving the work of separation, is:

$$\frac{x_2-y_0}{1-a}\left[L_B(1-y_1)\int_{y_1}^{y_0}\frac{dy}{(1-y)^2T}+L_A a y_1\int_{y_1}^{y_0}\frac{dy}{y^2T}\right]$$

$$-\frac{y_0-y_1}{1-a}\left[L_B(1-x_2)\int_{y_0}^{y_2}\frac{dy}{(1-y)^2T}+L_A a x_2\int_{y_0}^{y_2}\frac{dy}{y^2T}\right]$$

$$-\frac{(y_0-y_1)[L_B x_2 + L_A(1-x_2)]}{T_2} = K$$

In this equation T may be regarded as a function of T_1, T_2, y, a, K, L_A, L_B, which has the property that $T = T_1$ when $y = 0$, and $T = T_2$ when $y = 1$.

This relation may be expressed in the symbolic form

$$\frac{T - T_1}{T_2 - T} = f(y, T_1, T_2, a, K, L_A, L_B)$$

where f is a function such that when $y = 0$ its value is zero, and when $y = 1$ its value is ∞. Assume, for example, that the form of the function is $\frac{by}{1-y}$ where b is a constant whose values depends upon those of T_1, T_2, a, K, L_A, L_B. If this were the relation between y and T, we should have the equation:

$$\frac{T - T_1}{T_2 - T} = \frac{by}{1-y}$$

The value of T from this equation being then substituted in the second integral equation, y would be the only variable therein contained, and said equation would become integrable, the result after integration being an equation to determine the value of the constant b in terms of T_1, T_2, a, K, L_A, L_B. The value of T as determined by the relation assumed between T and y is

$$T = \frac{bT_2 y + T_1(1-y)}{by + 1 - y}$$

If this value be substituted in the integral equation under discussion, it becomes:

$$\frac{x_2-y_0}{1-a}\left\{L_B(1-y_1)\int_{y_1}^{y_0}\frac{(by+1-y)\,dy}{(1-y)^2[bT_2y+T_1(1-y)]}+L_Aay_1\int_{y_1}^{y_0}\frac{(by+1-y)\,dy}{y^2[bT_2y+T_1(1-y)]}\right\}$$
$$-\frac{y_0-y_1}{1-a}\left\{L_B(1-x_2)\int_{y_0}^{y_2}\frac{(by+1-y)\,dy}{(1-y)^2[bT_2y+T_1(1-y)]}+L_Aax_2\int_{y_0}^{y_2}\frac{(by+1-y)\,dy}{y^2[bT_2y+T_1(1-y)]}\right\}$$
$$-\frac{(y_0-y_1)[L_Bx_2+L_A(1-x_2)]}{T_2}=K$$

In the first integral, let:

$$\frac{by+1-y}{(1-y)^2[bT_2y+T(1-y)]}=\frac{A}{(1-y)^2}+\frac{B}{1-y}+\frac{C}{bT_2y+T_1(1-y)}$$

Clearing of fractions and equating like powers of y on both sides of the equation, we obtain the three following equations to determine A, B and C.

$$AT_2+BT_2+C=1$$
$$AbT_2-AT_1+BbT_2-2BT_1-2C=b-1$$
$$-BbT_2+BT_1+C=0$$

from which

$$A=\frac{1}{T_2}$$
$$B=\frac{T_2-T_1}{bT_2^2}$$
$$C=\frac{(T_2-T_1)(bT_2-T_1)}{bT_2^2}$$

Thus the first integral reduces to

$$\frac{L_B(x_2-y_0)(1-y_1)}{1-a}\left[\frac{1}{T_2}\int_{y_1}^{y_0}\frac{dy}{(1-y)^2}+\frac{T_2-T_1}{bT_2^2}\int_{y_1}^{y_0}\frac{dy}{1-y}+\frac{(T_2-T_1)(bT_2-T_1)}{bT_2^2}\int_{y_1}^{y_0}\frac{dy}{bT_2y+T_1(1-y)}\right]$$

Integrating and simplifying, this becomes:

$$\frac{L_B(x_2-y_0)(1-y_1)}{1-a}\left[\frac{y_0-y_1}{T_2(1-y_0)(1-y_1)}+\frac{T_2-T_1}{bT_2^2}\log_e\frac{1-y_1}{1-y_0}+\frac{T_2-T_1}{bT_2^2}\log_e\frac{bT_2y_0+T_1(1-y_0)}{bT_2y_1+T_1(1-y_1)}\right]$$

In like manner the third integral reduces to

$$-\frac{L_B(y_0-y_1)(1-x_2)}{1-a}\left[\frac{y_2-y_0}{T_2(1-y_2)(1-y_0)}+\frac{T_2-T_1}{bT_2^2}\log_e\frac{1-y_0}{1-y_2}+\frac{T_2-T_1}{bT_2^2}\log_e\frac{bT_2y_2+T_1(1-y_2)}{bT_2y_0+T_1(1-y_0)}\right]$$

In the second integral, let

$$\frac{by+1-y}{y^2[byT_2+(1-y)T_1]}=\frac{A}{y^2}+\frac{B}{y}+\frac{C}{byT_2+(1-y)T_1}$$

Clearing of fractions and equating like powers of y as before, we obtain

$$A=\frac{1}{T_1}$$
$$B=-b\frac{T_2-T_1}{T_1^2}$$
$$C=\frac{b(T_2-T_1)(bT_2-T_1)}{T_1^2}$$

Thus, the second integral reduces to:

$$\frac{L_Aay_1(x_2-y_0)}{1-a}\left[\frac{1}{T_1}\int_{y_1}^{y_0}\frac{dy}{y^2}-b\frac{T_2-T_1}{T_1^2}\int_{y_1}^{y_0}\frac{dy}{y}+\frac{b(T_2-T_1)(bT_2-T_1)}{T_1^2}\int_{y_1}^{y_0}\frac{dy}{bT_2y+T_1(1-y)}\right]$$

Integrating and simplifying, this becomes:

$$\frac{L_Aay_1(x_2-y_0)}{1-a}\left[\frac{1}{T_1}\left(\frac{1}{y_1}-\frac{1}{y_0}\right)-b\frac{T_2-T_1}{T_1^2}\log_e\frac{y_0}{y_1}+\frac{b(T_2-T_1)}{T_1^2}\log_e\frac{bT_2y_0+T_1(1-y_0)}{bT_2y_1+T_1(1-y_1)}\right]$$

In like manner the fourth integral reduces to:

$$-\frac{L_Aax_2(y_0-y_1)}{1-a}\left[\frac{1}{T_1}\left(\frac{1}{y_0}-\frac{1}{y_2}\right)-b\frac{T_2-T_1}{T_1^2}\log_e\frac{y_2}{y_0}+\frac{b(T_2-T_1)}{T_1^2}\log_e\frac{bT_2y_2+T_1(1-y_2)}{bT_2y_0+T_1(1-y_0)}\right]$$

Now let us assume that the products m_1 and M_2 are the pure components completely separated; then $x_2=1$, and $y_1=0$. Substituting these values in the above integrated expressions, and remembering that when $x_2=y_2=1$,

$$\frac{1-x_2}{1-y_2}=a,$$

the equation for the separation work becomes:

$$\frac{L_B}{(1-a)T_2}\left[y_0+(1-y_0)\frac{T_2-T_1}{bT_2}\log_e\frac{bT_2y_0+T_1(1-y_0)}{T_1(1-y_0)}\right]$$
$$-\frac{L_By_0(1-x_2)}{1-a}\left[\frac{1}{T_2(1-y_2)}+\frac{T_2-T_1}{bT_2^2}\log_e\frac{1-y_0}{1-y_2}\right]$$
$$+\frac{L_Aay_1(1-y_0)}{1-a}\left[\frac{1}{T_1y_1}-b\frac{T_2-T_1}{T_1^2}\log_e\frac{y_1}{y_0}\right]$$
$$-\frac{L_Aay_0}{(1-a)T_1}\left[\frac{1-y_0}{y_0}+b\frac{T_2-T_1}{T_1}\log_e\frac{bT_2y_0}{bT_2y_0+T_1(1-y_0)}\right]$$
$$-\frac{L_By_0}{T_2}=K$$

Evaluating for the limits as $y_1=0$, $x_2=1$,

$$\frac{L_By_0}{(1-a)T_2}+\frac{L_B(1-y_0)}{1-a}\frac{T_2-T_1}{bT_2^2}\log_e\frac{bT_2y_0+T_1(1-y_0)}{T_1(1-y_0)}-\frac{L_Bay_0}{(1-a)T_2}-\frac{L_Aay_0}{1-a}b\frac{T_2-T_1}{T_1^2}\log_e\frac{bT_2y_0}{bT_2y_0+T_1(1-y_0)}-\frac{L_By_0}{T_2}=K$$

or

$$\frac{L_B(1-y_0)}{bT_2^2}\log_e\frac{bT_2y_0-T_1(1-y_0)}{T_1(1-y_0)}+\frac{L_Aaby_0}{T_1^2}\log_e\frac{bT_2y_0+T_1(1-y_0)}{bT_2y_0}=\frac{(1-a)K}{T_2-T_1}$$

Although we have assumed the functional relation between y and T in the above calculations, the result exhibits the limitations which any functional relation between T and y must possess for a mixture having the properties we have assumed.

Table I shows the values obtained for x, y and T by Baly (*loc. cit.*) for mixtures of oxygen and nitrogen with the corresponding computed values of a and b. The table shows that b is fairly constant for all values of y, while a increases somewhat with increasing values of y.

Taking as an average value, $b=1.58$, we shall calculate a from the equation last written. In this equation:

$$K=\frac{W_m}{T_Am_A}$$

where

$$W_m=PVy_0\log_e\frac{1}{y_0}+(1-y)\log_e\frac{1}{1-y_0}$$

TABLE I

T	y	x	$\frac{y}{1-y}$	$\frac{x}{1-x}$	$\frac{T-T_1}{T_2-T}$	b	
77 54	0	0	0	0	0	0	0
78 0	2 18	8 10	0 02228	0 0881	0 0355	0 2528	1 590
78 5	4.38	15 25	0 04580	0 1800	0 0757	0.2543	1 650
79.0	6 80	21 60	0 0730	0.2755	0 1221	0 2650	1 673
79 5	9 33	27.67	0 1029	0 3824	0 1710	0 2690	1 660
80 0	12 00	33 35	0 1364	0 5005	0 2242	0.2725	1 645
80 5	14 78	38 53	0 1734	0 6270	0 2830	0.2765	1 632
81 0	17 66	43 38	0 2146	0.7660	0 3476	0 2800	1 620
81 5	21.22	47 92	0 2683	0 9205	0 4185	0 2910	1 570
82 0	23 60	52 17	0 3090	1.091	0 4980	0 2830	1.610
82 5	26 73	55 94	0 3646	1 269	0 5862	0 2895	1 634
83 0	29.95	59.55	0 4274	1 471	0 6860	0 2900	1 600
83 5	33 35	62 93	0.5002	1 696	0 7990	0 295	1 596
84 0	36 86	66 20	0.5840	1 957	0 9285	0 298	1 590
84 5	40 45	69.31	0.6795	2 257	1 076	0 300	1 585
85 0	44 25	72 27	0 7940	2 605	1 251	0 3045	1 576
85 5	48 17	75.10	0 9290	3 015	1 457	0 308	1 568
86 0	52 19	77.80	1 090	3 500	1 705	0 3115	1 564
86 5	56 30	80.44	1 288	4.110	2 007	0 313	1 557
87 0	60 53	82 95	1.533	4 863	2 388	0 315	1 557
87 5	64 85	85 31	1 845	5 810	2 874	0 317	1 557
88 0	69 58	87.70	2 275	7 060	3 534	0 322	1 555
88 5	74 37	89 82	2.890	8 825	4 455	0 324	1 540
89 0	79 45	91 98	3.866	11 46	5 845	0 337	1 510
89 5	84 55	94 09	5 470	15 91	8 190	0 344	1 497
90 0	89 80	96 15	8 80	19 82	12 98	0 444	1 476
90 5	95 10	98 16	19 40	53 30	28 17	0 364	1 450
90 96	100 00	100 00					

Now assume as a particular case $y_0 = \frac{1}{2}$, then the work equation becomes:

$$\frac{L_B}{bT_2^2}\log_e\frac{bT_2+T_1}{T_1}-\frac{L_Aab}{T_1^2}$$

$$\log_e\frac{bT_2+T_1}{bT_2}=\frac{2(1-a)PV\log 2}{(T_2-T_1)m_AT_A}$$

Taking $V = 1$ c.c., and assuming that

$$L_A = 47.85$$
$$L_B = 51.2$$
$$P = 1 \text{ atmosphere}$$
$$T_A = 273.13$$

then $m_AT_A = 0.00134 \times 273.13 = 0.366$, and

$$\frac{2PV\log_e 2}{(T_2-T_1)m_AT_A}=\frac{2\times 76\times 13.59\times 981\times 0.6931}{13.42\times 0.00134\times 273.13\times 4.184\times 10^7}=0.00682$$

Substituting these values and solving for a, we obtain:

$$a = 0.222$$

Bearing in mind the several assumptions which we have made in regard to the properties of the mixture considered in the above theory which are not exactly true for oxygen and nitrogen, and considering also the probable inaccuracies, particularly of temperature measurement in Baly's experimental work, the above result may be regarded as very satisfactory.

Employing this value of a, and taking $y = 20.8$, we find for the composition x of the liquid having phase equilibrium with air,

$$x = 0.542$$

This result thus seems to support the probability, already suspected as a result of experimental work performed under the direction of Dr. Harvey N. Davis at Harvard University, that Baly's values of co-existing phase compositions are somewhat too close together.

SUMMARY

The purpose in undertaking the foregoing calculation was, first of all, to determine whether processes of low-temperature separations of mixed gases involving liquefaction and rectification may ideally be carried out in a reversible manner—i.e., in such a way that the minimal expenditure of work necessary to accomplish the result by such methods is equal to the theoretical minimal work of separation by means of the ideal device of semi-permeable pistons. While the calculation as actually performed is based upon one or two simplifying assumptions in regard to the properties of the mixture treated, the result is such as to show clearly that rectification can actually be accomplished in a manner approaching thermodynamic reversibility and indicates the main features that must characterize such a process under these conditions, even though the mixture treated does not possess the simple properties assumed for the one studied above.

The value of considerations of reversibility in any process wherein economy of energy expenditure is desirable can scarcely be overestimated. In the development or improvement of any process, the engineer should constantly bear in mind that perfect efficiency is attained when and only when the various transformations, compressions, expansions, heat transfers or what not are perfectly reversible. When these conditions are not met to the highest possible degree, we may be certain that we have attained the highest possible thermodynamic efficiency. We must remember, however, that in order for rectification to be accomplished, irreversible conditions between the liquid and vapor in contact at all levels in the rectifier is necessary to a degree and that the more nearly we approach reversibility in this respect the slower will be the rectification. A similar statement, of course, may be made in regard to all thermodynamic transformations—these transformations are possible only by reason of the existence of irreversible conditions of one kind or another. This being the case, true economy in any process should be sought by endeavoring so to adjust the various irreversibilities therein in such a manner that the sum total of the available energy dissipated by reason of these irreversibilities is a minimum, these adjustments being carried to the point where further economy of available energy would be neutralized by increased cost of equipment and of operation of the apparatus necessary to accomplish that economy.

British Gas Statistics

The *Gas Journal* (London) summarizes the latest statistics regarding the British gas industry in its issue of Jan. 31, 1923. The totals given in this summary are for Great Britain—England, Scotland, and Wales. The bulk of the sales are coal gas or water gas, but the small amount of "Other Gas" included relates to plants making semi-water gas, carburetted hydrogen, producer gas, peat gas, gasoline gas or acetylene gas used in city distribution systems. The quantities of coal gas recorded include some coke-oven gas produced for distribution either alone or mixed with other kinds of gas.

	1921	1920
No. of companies	797	758
Materials Used:		
Coal carbonized (tons)	15,775,696	17,566,316
Coke for water gas	1,254,122	....
Oil (gal.)	51,731,492	....
Gas Made:		
Coal gas (M.cu ft.)	194,518,147	214,703,118
Water gas (M.cu ft.)	49,894,716	36,932,530
Other gas (M.cu.ft.)	4,606,869	5,342,096
Total	249,019,732	256,977,744
Coke and Byproducts Made:		
Coke and breeze (tons)	10,404,702	....
Tar (gal.)	160,376,472	....
Ammonium sulphate (tons)	115,979	....
No. of Customers:		
Prepayment	4,071,220	4,030,647
Ordinary	3,488,090	3,417,685
Length of mains (miles)	39,547½	38,847

Synopsis of Recent Chemical & Metallurgical Literature

Utilizing Rubber Latex in Paper Making

The use of rubber latex for manufacturing purposes is rapidly gaining recognition. The practical effect of its application in industry will result in the further co-ordination of the rubber and other industries, according to a writer in the *India Rubber World* for February. The first successful application of rubber latex relates to the improvement of paper as regards strength. Two methods have been followed in utilizing rubber latex for paper making—viz., the beater method and a new method known as top sizing. The former method, patented by Frederick Kaye, is fairly well known. It consists of adding the rubber latex, well diluted, to the beater pulp. The amount of latex varies with the quality of the fiber. Experiments with partly beaten fiber made into hand sheets with and without latex indicate that the bursting strain and folding number of the latex paper were much above those of paper made under exactly similar conditions without latex.

Unfortunately, however, American paper manufacturers have not met with great sucess in the use of latex with the beater method. The element of uncertainty in this difficult method has led to the discovery of a simpler and surer process. This is known as the "top sizing method," and consists of top sizing with latex, containing a minimum of 30 per cent pure rubber. After the paper has been immersed in a top sizing mixture of latex and casein, it is run between rolls to squeeze out the excess liquid and to insure an even distribution on the surface. The paper is then dried on moderately heated rolls. The latex-casein mixture consists of 75 per cent latex and 25 per cent water-soluble casein, calculated on a basis of dry rubber and casein, diluted with equal volumes of water. After dipping and drying, or partial drying, the paper may be subjected to a dilute formaldehyde bath, which tends to increase the water resistance. The top sizing process is also applicable in making paper for wrapping, insulating, oil- and water-resistant purposes. Experiments have already been made with kraft paper and the favorable results indicate quite clearly the value to the industry of such a process.

Rotary Kiln Lime Burning

EDITOR'S NOTE:—This is an abstract of an informal talk before the National Lime Association in June, 1922. Rotary kiln operation in the lime industry is likely to be a significant factor in the future and the author's wide experience gives to these remarks a considerable prestige. It is published in the *Proceedings* of the National Lime Association.

From the cement manufacturer many data have been obtained on physical problems such as structural strength of kilns, dry burning, feeding devices, etc., but many new problems were encountered. Progress has been slow because there is only one unit with which to experiment and deviations from practice which gives fairly good results are consequently conservative.

Fuel

Kilns may be fired with either producer gas or pulverized coal and although the author's experience has been only with producer gas, he believes pulverized coal will work excellently and intends to install a unit. Mechanical gas producers give a much more even gas and have made possible an increase in production from 90 tons per day to 110 tons per day with a lime-coal ratio of over 3. (This is on a 6½ ft. inside diameter by 150 ft. long kiln.)

Size of Stone

Material is sized through a 1½-in. screen and retained on a ⅝-in. mesh. Experience seems to indicate that the kilns like small stone, but there is a practical limit to the sizing. Considerable difference of opinion exists as to whether the fines or coarse particles are more difficult to burn. The author's experience indicates that operating conditions will determine this. The fines will ride in the center of the kiln if it is overloaded, whereas in a thinner load with rapid passage of material the larger pieces are apt to have an unburned core. The latter case is more frequently met in practice.

Kiln Loading and Speed

A definite ratio between kiln loading and speed should be maintained. The depth of the load should be kept constant and the rate of burning controlled by variation in kiln speed. An increase in heat is apt to be dangerous because of the danger of fluxing and sticking of the charge especially with dolomitic lime. An additional control is exercised by changing the angularity of the wheels under the cool end, which controls the travel in the kiln. The author believes that ½ in. per foot is the best inclination, though he uses ¾ in. Greater speed can be obtained at a smaller angle. Heat recovery is out of the question on a single unit. With two units the investment might pay.

Dusting in the limekiln is very difficult to control and very essential to control, for dusting effectively damps the burning flame. The control must be exercised at the discharge end, for at the charging end the rock is non-pulverent.

In order to recover some heat from the lime it is usually run through a rotary cooler. The best design of this apparatus is in inserting quadrant partition plates. This divides the charge into four units and cuts down the dusting. Z-bars are worse than useless, as they pick up the lime and drop it through the air. This makes dusting a great nuisance.

The rotary kiln has very high capacity and an interchange of ideas will doubtless lead to a great improvement in efficiency of operation.

Important Articles in Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem. & Met.* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. Those that are of unusual interest will be published later in abstract in this department, but since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage. The magazines reviewed have all been received within a fortnight of our publication date.

GAS COMPOSITION BY CALCULATION. M. L. Abbott. *Gas Age-Record*, Feb 3, 1923, pp 141-143.

GAS-FIRED STEAM BOILER CALCULATIONS. J. P. Leinroth. *Gas Age-Record*, Feb 10, 1923, pp 169-172.

EUROPEAN DISTILLATION OF COAL TAR. R. Furness. *Gas Age-Record*, Feb 10, 1923, pp 175-177.

BYPRODUCT OVEN HEAT BALANCE. D. S. Chamberlain and E. W. McGovern. *Gas Age-Record*, Feb. 17, 1923, pp. 199-202.

REMOVAL OF NAPHTHALENE FROM GAS. W. H. Fulweiler. Paper read at annual meeting of New England Association of Gas Engineers. Feb 14 and 15, 1923, at Boston, Mass.

BARYTES: OCCURRENCE, MINING AND USES. R. B. Ladoo. *Eng. and Mining Jour.-Press*, Feb. 17, 1923, pp 319-320.

DISTILLATION OF OIL SHALES IN SPAIN. E. A. Ritter. *Eng. and Mining Jour.-Press*, Feb 17, 1923, p 326.

THE GROWING CHEMICAL INDUSTRY OF PALESTINE. R. P. Spielmann. *Chem. Age* (London), Feb. 3, 1923, pp. 114-116.

PROPERTIES OF WOOD IN PAPER MAKING. B. Johnsen and H. N. Lee. *Paper*, Jan. 31, 1923, pp 11-14.

PAPER SIZING AND COLLOIDS. Rudolph Lorenz. *Wochenblatt für Papierfabrikation*, vol. 53, p 4512 (1922).

SUPERPHOSPHATE HANDLING EQUIPMENT. Kai Warming. *Chim. et Ind.*, January, 1923, pp. 43-44.

PRODUCTION OF AMMONIUM SULPHATE IN GAS PLANTS. A. Grebel. *Chim. et Ind.*, January, 1923, pp. 26-42.

CHEMICAL ACHIEVEMENTS OF PASTEUR. G. Bertrand. *Chim. et Ind.*, January, 1923, pp. 1-161.

AN ATTEMPT TO CHEAPEN THE PRODUCTION OF ZIRCONIUM DIOXIDE. J. W. Bain and George E. Gollop. *Canadian Chem. & Met.*, February, 1923, pp 35-8.

THE BUSINESS OF BUYING LABORATORY EQUIPMENT. James H. Wilson. *Canadian Chem. & Met.*, February, 1923, pp. 39-40.

Recent Chemical & Metallurgical Patents

Determination of Naphthalene in Gas—W. H. Fulweiler has assigned to the U.G.I. Contracting Co. his patent for quantitative determination of naphthalene in illuminating gas. In the practice of the invention the naphthalene content of the gas is converted into naphthalene picrate by passing a known quantity of gas through a standard solution of picric acid, thereby increasing the electric resistance of the solution. The value of the electric resistances of the treated and of the standard solutions are then compared, thereby estimating quantitatively the naphthalene content of the gas. (1,443,330. Jan. 23, 1923.)

Artificial Fuel—Christian I. Gillstrap has devised the process of forming an artificial fuel of ground lignitic material, ground clay, ground commercial coke and a tar binder which is processed by coking the mixture at 500 to 1,000 deg. C. His patent also covers the product which is defined as "an artificial fuel consisting of a mixture of 2,000 parts of crushed lignitic material, 20 parts of coal tar, 100 parts of ground clay, and 40 parts of ground commercial coke mixed together and heated to effect coking." (1,443,359. Jan. 30, 1923.)

Process of Making Coke Briquets—W. E. Davies, of London, England, is granted a patent on a special process of coke-briquet making which is intended to meet the difficulty which he describes as "the tendency for the briquet to suffer disruption so that no practical coke is produced." He describes the process as follows: "A process of making coke in briquetted form which consists in first mixing the coal or reinforcing its pre-existent natural binding material with up to 10 per cent of its weight of a resinous binder, then compressing the coal to form briquets which are perforated, bored or the like to increase their surface, and then carbonizing or partly gasifying the briquets under a pressure maintained below that of the atmosphere, substantially as described." (1,443,618. Jan. 30, 1923.)

Crusher—Milton F. Williams has patented and assigned to the Williams Patent Crusher & Pulverizer Co. a new form of crusher. There are two new and interesting features to this crusher, which follows in general the familiar rotary hammermill type. The first is a breaker plate which may be adjusted toward or away from the hammer circle to suit the degree of fineness of the material being crushed. The second is an adjustable bottom to the crusher feed-hopper, by means of which the rate of feeding can be varied at will, or changed to suit the angle of repose of various substances which might be crushed. (1,439,781. Dec. 26, 1922.)

Nickel Alloy—This invention comprises the addition to the customary Monel metal alloy of an excess of aluminum over that usually employed, so that the total amount of aluminum shall constitute from 8 to 10 per cent of the total contents of the alloy.

It is claimed that with this amount of aluminum the metal becomes so hard that it cannot be cut with a hacksaw or filed, and if an attempt to file it is made, it turns the teeth of the file. On the other hand, the metal, while so hard, is tough and extremely resistant to shock, which makes it of value in construction. It also retains the ability of standard Monel metal to resist corrosion. Tests have shown that an addition of aluminum in percentages in excess of 17 per cent produces a brittle alloy. (1,439,865. Leon Cammen, assignor to the International Nickel Co. Dec. 26, 1922.)

Method of Producing Fine Powders—W. K. Lewis, of Newton, Mass., has assigned to the Goodyear Tire & Rubber Co. a patent for production of fine powders. In the case of zinc oxide, for example, if zinc vapors are led into diffusion or oxidizing chamber directly from retorts and burned with air, one would imagine that a very fine degree of subdivision would be obtained. As the particles agglomerate to large degree, this is not the case. The author prevents this agglomeration by adding a diluting gas, in this case carbon dioxide. The particles thus do not have an opportunity to form aggregates at the high temperature of crystallization. (1,442,285. Jan. 16, 1923.)

American Patents Issued Feb. 13, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,444,773—Soap Flaker and Distributor. Walter C Bellows, Montreal, Que., Canada, assignor to Arthur Finestone, Montreal.

1,444,802—Chemical Compound Isopropylallylbarbituric Acid. Ernst Preiswerk, Basel, Switzerland, assignor to the Hoffmann-La Roche Chemical Works, New York.

1,444,833—Apparatus for Obtaining Potash From Distillery Waste by Burning the Same. Carl Haner, Jr, Baltimore, Md., assignor to U. S Industrial Alcohol Co.

1,444,844—Making Emulsions. Karl P. McElroy, Washington, D. C., assignor to Robeson Process Co., New York.

1,444,865—Process for Treating Rubber and Products Obtained Thereby. Charles E. Bradley, Montclair, and Sidney M. Caldwell, Leonia, N J., assignors to the Naugatuck Chemical Co., Connecticut.

1,444,887—Method of Producing Pure Iron by Electrolysis. August Schwiete, assignor to the firm Chemische Fabrik Griesheim-Elektron, Frankfort-on-the-Main, Germany.

1,444,891—Method for Making Acid-Proof Alloys. Richard Walter, Dusseldorf, Germany.

1,444,956—Method of Sizing Paper. Judson A De Cew, New York, N. Y, assignor to Process Engineers, Inc.

1,444,989—Process of Obtaining Sodium Dekaborate from Boronatrocalcite. Wilhelm Voss, assignor to Schott & Gen, Jena, Germany.

1,444,997—Apparatus for the Electrical Separation of Suspended Material From Gases. Evald Anderson, Berkeley, Calif., assignor to International Precipitation Co., Los Angeles, Calif.

1,445,004—Method of and Apparatus for Solidifying Materials. Edwin Cowles, Auburndale, Mass., assignor to the Electric Smelting & Aluminum Co., Inc., Lockport, N. Y.

1,445,082—Method of Manufacturing Anhydrous Metallic Chlorides. Bernard Howard Jacobson, Charleston, W. Va., assignor to E. C. Klipstein & Sons Co., New York.

1,445,162—Apparatus for Converting Formates Into Oxalates. Herman W. Paulus, Richmond Hill, N Y., assignor to Royal Baking Powder Co.

1,445,167—Process for the Manufacture of Phosphate Manures. Hermann Plauson, Hamburg, Germany.

1,445,168—Process for the Manufacturing of Vinyl Halides. Hermann Plauson, Hamburg, Germany.

1,445,303—Method of and Means for Producing Pure Liquid Hydrocyanic Acid. William G Dingle, Los Angeles, Calif.

1,445,329—Method of Effecting Solution of Substances and Removing Coatings From Bodies. Victor Lenher, Madison, Wis.

1,445,331—Compound of Mon-Azo Dyestuffs and Lakes Derivable Therefrom. Arthur Linz, New York, N. Y., assignor to the Chemical Foundation, Inc.

1,445,366—Method of Producing Zinc Oxide. Earl P. Stevenson, Cambridge, Mass., assignor to Arthur D. Little, Inc., Cambridge, Mass.

1,445,378—Ammonia Dynamite. Clifford A. Woodbury, Media, Pa., assignor to E. I. du Pont de Nemours & Co., Wilmington, Del.

1,445,382—Manufacture of Acetose. Joe Olgierd Zdanowich, London, England.

1,445,387—Coated Paper and Substance for Coating the Same. Henry N. Case, Oak Park, Ill, assignor to Sears, Roebuck & Co, Chicago.

1,455,438—Apparatus for Treating Hydrocarbons. Stephen Louis Gartlan, Toronto, Ont., Canada, assignor of fifty-five one-hundredths to Albert Edward Gooderham, Toronto.

1,445,495—Process for Rendering Chlorides of Ketones Soluble by Means of Alkalis. Antoine Regnouf De Vains, Miribel, Ain, France.

1,445,544—Process for the Manufacture of Crotonic Acid From Crotonaldehyde. Theodor Odinga, Basel, Switzerland, assignor to Elektrizitätswerk, Lonza, Gampel, Switzerland.

1,445,603—Treatment of Sulphite Cellulose Liquors. Jacob S Robeson, Pennington, N. J., assignor to J. S Robeson, Inc., Wilmington, Del.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Proposed Dye Tariff Rules

Tentative Draft for Import Regulations for Dyes Issued as Basis for Criticism—Treasury Department Desires All Suggestions for Changes Prior to March 1

IN accordance with paragraphs 27 and 28 of the new tariff act, the Treasury Department has issued a preliminary draft of regulations for the entry and appraisement of dyes and coal-tar products. This is to serve as a basis for criticism by importers, manufacturers and others interested; and suggestions for changes to be embodied in the final draft will be received up to March 1.

The tentative draft follows:

Taking Samples Prior to Entry. An importer may be permitted under proper supervision to take samples prior to entry of articles dutiable under paragraphs 27 and 28, and appraising officers may take samples of such articles when deemed necessary.

Information Required Prior to Entry or Appraisement. An importer shall furnish to the appraising officer prior to entry or prior to appraisement such information as such officer may request

Determination of Similar Competitive Articles. A domestic article shall be considered a similar competitive article as compared with an imported article if, in the use or uses which constitute a major portion of the quantity of the imported article consumed in the United States, said domestic article accomplishes results substantially equal to those accomplished by the imported article when used in substantially the same manner.

A domestic article, which is not freely offered for sale but the predominant use of which is for the manufacture of another similar competitive domestic article, shall be considered a similar competitive article as compared with an imported article which is or may be used for the same purpose as the domestic article.

Lists of Competitive and Non-Competitive Articles. The United States appraisor of merchandise at New York shall issue at once a list of articles which he deems competitive and non-competitive, respectively, and shall from time to time add articles thereto or remove articles therefrom, as investigation and experience shall justify. Such lists shall be advisory only. The appraiser shall furnish copies of such list and amendments thereof to the Customs Information Exchange for circularization to other appraising officers and shall furnish copies thereof to the public upon request. Appraising officers shall not furnish any information regarding the American selling price or the United States value of any article named in such lists, but may upon request furnish importers with the names and addresses of all the known domestic manufacturers of or dealers in any such articles.

Entry of Articles on the Competitive or the Non-Competitive List. In entering articles named on such lists importers must state the value thereof, bearing in mind the provision in section 489 of the tariff act of 1922 that "Duties shall not, however, be assessed upon an amount less than the entered value" with the exception specified in the rest of this section of the act.

Entry of Articles on Neither the Competitive Nor the Non-Competitive List. When an article offered for entry is not named on either the competitive or the non-competitive list, the appraiser shall proceed immediately to determine to which list the article belongs, pending which determination the importer may withhold formal entry. The appraiser shall inform the importer of his determination of the question, but shall not furnish the importer with any advice regarding the value of the merchandise, though the appraiser may upon request furnish the importer with the names and addresses of all the known domestic manufacturers of or dealers in any such articles.

Difference in Strength of Imported and Domestic Articles. When an imported article is of substantially different strength from a domestic product which is deemed a similar competitive article, the value of the imported article shall be adjusted in relation to the selling price of the domestic product in accordance with the proportion which the strength of the imported articles bear to that of the domestic.

Similar Competitive Domestic Articles Which Are Not Freely Offered for Sale in the United States in the Same Condition as the Foreign Article When Imported. When a similar competitive article manufactured or produced in the United States is not freely offered for sale in the United States in the same condition as the foreign article when imported, the ad valorem rate on the latter shall, nevertheless, be based on the American selling price of the former, but such selling price shall be the price that the manufacturer, producer or owner would have received in a *bona fide* sale, or was willing to receive for such merchandise when sold in the usual course of trade and in the usual wholesale quantities, at the time of exportation of the imported article. In ascertaining the price that the manufacturer, producer or owner would have received, the appraiser shall use all reasonable ways and means in his power, which, in the opinion of the department, may properly include consideration of the cost of production, the relation of the article to any completed article of which it forms a part, or the selling price of similar articles, according to the circumstances of the particular case.

Sand-Lime Brick Association Holds Annual Meeting

The Sand-Lime Brick Association held its nineteenth annual convention at Grand Rapids, Mich., on Feb. 8 and 9, 1923. The meeting was very well attended, and the general tone was extremely optimistic. Almost every member reported difficulty in making enough brick to meet the demand a situation very unusual for this time of year. They are facing the opening of the spring building season with no stock on hand.

The program contained many interesting papers, dealing with technical problems, equipment, labor and transportation. Among the papers were some of particular interest; as Robert Marshall on "Influence of Lime in Cement Mortar," I. G. Toepfer on "Use of a Rod Grinding and Mixing Mill," "High Labor Turnover," by J. M. Zander, and "Common Labor Shortage," by W. H. Crume. An inspection was made of the plant of the Grande Brick Co.

The officers elected for the coming year were: President, J. Morley Zander, Saginaw, Mich.; vice-president, H. W. Terry, Toronto, Canada; secretary, J. S. Palmer, Sebewaing, Mich.; treasurer, Allen G. Walton, Hummelstown, Pa.; executive committee: Frank Waterman, Toronto, Canada; Irvin G. Toepfer, Milwaukee, Wis.; H. S. North, New Brunswick, N. J.; W. H. Crume, Dayton, Ohio; W. J. Carmichael, Willoughby, Ohio.

Ascertainment of American Selling Price When the Domestic Similar Competitive Article Is Offered for Sale Under Conditions Indicating an Intent to Restrain Foreign Trade. When the appraising officer shall be satisfied, after due investigation, that a similar competitive article is manufactured by only one manufacturer in the United States, or that there is a combination of manufacturers or dealers by reason of which such article is offered for sale at an arbitratry and unreasonable price which does not secure *bona fide* sales and operates to prevent importations of the imported article, such officer shall ascertain the price that the manufacturer, producer or owner would have received, within the meaning of section 402(f) of the tariff act of 1922 in *bona fide* sales, attention being invited to regulation 8 herein. All such cases shall be reported to the department with a view to their being referred to the Federal Trade Commission.

Where There Are Two or More Corresponding Domestic Products. Where there are two or more corresponding domestic products, the American selling price of the domestic product which compared with the foreign product accomplishes results more nearly equal shall be taken as the basis for assessment of the ad valorem rate; provided, however, that due allowance in price shall be made for any difference in concentration or strength between the domestic and the foreign product.

Articles Which Are Not Coal-Tar Products. The words "similar competitive articles" in paragraphs 27 and 28 shall not be construed as relating exclusively to coal-tar products. An imported coal-tar product may be compared with a domestic non-coal-tar product, or an imported non-coal-tar product dutiable under paragraphs 27 and 28 with a domestic coal-tar product, for the purpose of determining whether they are similar competitive articles. The rule provided in paragraphs 27 and 28 for the determination of similar competitive articles and the regulations herein provided thereunder, shall be applied in such cases.

Ascertainment of United States Value. The following instructions for the ascertainment of United States value are reproduced from Treasury Decision No. 39297 of Oct. 31, 1922:

Tests. Tests which are necessary in the appraisement of imported articles shall be made under conditions approximating as closely as practicable the conditions under which the articles will be actually used in trade or manufacture.

Trade Papers as Sources of Information. Appraising officers may consult the trade papers, but the weight to be given to the quotations and other information therein is for the determination of the officers themselves.

Information Required at Ports Other Than New York. Appraising officers at ports other than New York when in doubt on any question arising under paragraphs 27 and 28 shall take the question up direct with the appraiser at New York, who shall give his advice as promptly as possible. If the inquiring appraiser shall be dissatisfied with the advice of the appraiser at New York, or the latter shall be in doubt on the inquiry, the question shall be submitted to the department for an expression of its views.

Nation Will Fight Weevil

National Campaign Formed to Carry On Fight—Calcium Arsenate the Crux of the Battle

As A result of the meeting held in Atlanta, Ga., on Feb. 20-21, by interested parties, a campaign was incorporated under the laws of Tennessee to carry on a 5-year war of extermination against the boll weevil. Dr. Miller Reese Hutchison of New York is the president and managing director.

Under the plan of organization adopted, Dr. Hutchison will be the active head of the corporation, with full executive power, and will appoint a board of directors consisting of one man from each state in the cotton belt and prominent men in the cotton industry in the North and South. The directors of the cotton states will, in turn, appoint committees of five, of which they will be chairmen, to carry on the work in their respective states.

All phases of the work were considered by the various speakers at the meeting. Among others, D. B. Bradner, chief chemist of the United States Chemical Warfare Service, explained the experiments being conducted by the government in the use of poisonous gases to combat the evil. He said so far the tests had been very good.

Another feature of the meeting was the discussion of the threatened shortage of calcium arsenate, by Howard Armbruster, New York, Bradley Stoughton, New York, and Guy E. Currier.

Armbruster's Speech

Mr. Armbruster said in part:

Consideration of this subject to be comprehensive and of real value must include the demand [for calcium arsenate]. Seriously we must admit that until this question of the demand for calcium arsenate is more definitely indicated than at present there can be no true solution of the calcium arsenate problem which will put an ample supply of poison in every county in the South at exactly the moment the cotton crop needs it.

Demand does not and cannot change the industrial classification of a byproduct. This byproduct supply of arsenic being limited and increase or decrease in its production being controlled by factors having absolutely nothing to do with the demand, it is evident that it must be supplemented by direct production. And this means development of new processes and establishment of new plants with consequent investment of capital. All this cannot come in a day or a month or a year, even though the need be as great as it is at present.

So with the increasing of existing plants producing calcium arsenate from commercial byproduct arsenic and the building of new ones utilizing the same methods has come the establishment of new plants to produce commercial white arsenic direct from ore, new methods of producing calcium arsenate from white arsenic and of producing calcium arsenate direct from ore

Arsenic the raw material is largely a byproduct and has a historical record as to selling price more erratic than that of any recognized basic raw material for the chemical industries. The price chart on arsenic the world over for the last 20 years looks like a cross-section of the mountains of Switzerland. Even now with this tremendous demand springing up almost over night arsenic has not yet touched the high point of a few years ago Gentlemen, you might just as well accept the situation on a cold-blooded basis You cannot have a steady supply of any product of mine, factory or even of agriculture where the initiative of human agency is required unless the economic stimulus of steady demand is also existent It simply won't happen and a seasonal and fluctuating requirement for an indefinite quantity can't qualify as a steady demand Take the arsenic industry as it has existed in this country can you blame the smelters for regarding this small feature of their total production with indifference? They don't want to produce it they have to—it is in the ores they mine and smelt and they cannot help themselves. Formerly they let it go up their smelter stacks as not worth saving; but legislation compelled them to control these fumes, as the crude arsenic dust was naturally objected to by their neighbors So they began recovering it in the crude state and then refined it to make it marketable I venture to say that if this legislation of various Western states had not forced the control of arsenical smelter fumes in the past the arsenical insecticide industry would never have made the strides it has in recent years—entirely independent of and preceding the present boll weevil situation

I am going to close with an appeal for constructive co-operation between consumer and producer of boll weevil poisons I put the consumer first because his demand must come first and he must appreciate just that fact if he wants producers to function efficiently or at all

If this national boll weevil campaign can assist toward that, and I believe that it can, I am sure it will do one most constructive piece of work that needs doing very much indeed. After all that kind of thing is just what this campaign is for as I see it, to co-ordinate all agencies to the end that this pest be controlled and destroyed.

Engineering Foundation Elects Officers

The annual meeting of the Engineering Foundation's board of directors was held on Feb. 23, and immediately following the results of elections for officers was announced.

Charles F. Rand, treasurer of the A.I.M.E., was re-elected chairman. Edward Dean Adams of New York, Fellow of the American Society of Civil Engineers and member of the American Institute of Electrical Engineers, was elected first vice-chairman. Frank B. Jewett, president of the American Institute of Electrical Engineers, second vice-chairman; Joseph Struthers, treasurer, and Henry A. Lardner, assistant treasurer.

The new board of directors will be made up as follows: Alfred D. Flinn, Dr. W. F. M. Goss, Colonel A. S. Dwight, George H. Pegram, Bancroft Gherardi, S. H. Woodard, Prof. A. L. Walker, J. H. Barr, H. H. Porter, Dr. D. S. Jacobus, Prof. H. M. Boylston, E. W. Rice, Jr., E. A. Sperry and J. V. Davies.

Raw Material Survey Planned by Hoover

Production of Rubber, Sisal, Nitrates and Quinine Is Sought for U. S. Controlled Territory

RECOMMENDATIONS for an exhaustive investigation into the possibility of developing new sources of crude rubber in order that American consumers may avoid a shortage of supply and high prices as a result of the policy of restricted production and penalizing export taxation adopted by the British colonial governments were submitted to the House Appropriations Committee recently by Mr. Hoover and Assistant Secretary of Commerce Huston. Later the scope of this prospective investigation was broadened to include numerous other raw materials used by American manufacturers, the production of which is controlled by foreign countries.

For this reason the committee has been asked to make the appropriation of $500,000 required for a survey of crude rubber sources available for investigation into other import commodities where there is a growing tendency for restrictions and price control. Mr. Hoover believes that the government should ascertain possible sources of supply of crude materials in order to assure American industry free and unrestricted access to needed supplies. In addition to the rubber situation he intends to seek escape from foreign manipulation of the supply of nitrates, sisal for farm binder twine, quinine and other raw materials.

$100,000 for Experimental Work

Of the $500,000 suggested for the investigation it is planned that $100,000 would be available for experimental work on rubber. It is proposed that the rubber investigation should cover the economic problems of production in Latin America and the Philippines together, with probabilities of extended production in other quarters. Study would be made of such questions as comparative costs, available land, rubber supplies, laws, taxation and transportation facilities. Surveys of sources for other essential raw materials would be carried on along the lines of the program outlined for the rubber investigation.

In connection with this matter of rubber production it is of interest to note a memorandum recently handed to Secretary of War Weeks by the chief of the Bureau of Insular Affairs. This memorandum states that of all our insular possessions, the Philippines alone are suitable for development as a source of crude rubber. The Canal Zone is also available for this purpose—as the Republic of Panama already successfully produces the product.

Rubber in the Philippines

The memorandum continues:

"That rubber would grow in the Philippine Islands has been known and wild rubber has been collected and sold by the Moros and pagan people of Mindanao and the Sulu Archipelago for many years. Since the American occupation, most careful studies have been made of the possibilities of rubber production in the Philippine Islands. Reports bearing on this have been printed and circulated. Production has been experimental under the Philippine Department of Agriculture and it has been undertaken in a commercial way by private parties and there is at present produced on rubber plantations in the Philippine Islands about 202,000 lb. a year, which is increasing as new trees come into production.

"It may be stated that people in the United States seriously interested in the production of rubber are well advised of the possibilities of rubber production in the Philippine Islands. This matter has been laid before them in every possible way for a number of years. In the year 1917 Mr. Pearson, editor of the *India Rubber World*, made a trip to the Philippine Islands for the purpose of investigating the rubber situation there. His report, which ran through several numbers of the *India Rubber World*, was most favorable to the profitable production of rubber in the Philippines. There are available in the bureau estimates covering every feature of the planting and production of rubber in the Philippine Islands, some of which are taken from the actual plantation results."

The situation with the other raw materials mentioned above and with others not mentioned is not so urgent as that at present obtaining in the rubber market. The possibility, however, of such a situation developing in them is latent, and it is for this reason that the Department of Commerce wishes to make the broad general survey now planned. The department feels that there is a surprising number of different combinations which hold the American market at their mercy in point of prices and quantity of supply.

Status of Other Raw Materials

Sisal, for the manufacture of binder twine, for example, is produced almost entirely in the Province of Yucatan, Mexico, and the prices for this harvest necessity have been as thorns in the flesh of the Middle Western farmer for years. Quinine, originally produced in Peru, is now cultivated in the Far East and bought by this country through Great Britain or the Netherlands under very much the same conditions that the American rubber supply is obtained.

Raw nitrate production in Chile is almost wholly under British or Chilean capital, and it is the intention of the department to open up avenues for the entry of American capital into the business of furnishing the home maker with this and other necessary commodities unhampered by the commercial policies of other nations.

Activities of the C.W.S.

Secretary Weeks in Speech to Agricultural Editors Lauds Pest Destruction

Peace activities of the Chemical Warfare Service and what they mean to the farmer were pointed out by the Secretary of War on Feb. 26 during the course of an address before the American Agricultural Editors' Association. Among other things, Mr. Weeks said:

One cannot pass by the matter of pest destruction without consideration of the work of the Chemical Warfare Service. As you know, while we deprecate the use of gases in war, we have determined that we must be prepared to defend ourselves against any possible use of poison gases by unscrupulous outlaw countries. In studying this problem to assure the effectiveness of our gas masks and other defensive appliances we must investigate the effects of all poisonous compounds. It is the policy of the War Department to conduct our investigations so that the data which we discover can be given every possible peace-time use in addition to serving the defensive purpose. The Chemical Warfare Service has accordingly been able to make valuable contributions to the medical science, to the dye industry, and finally, to the work of pest extermination. The Public Health Service is already using with great effect the compounds recommended by the Chemical Warfare Service for the fumigation of ships and public warehouses. The Agricultural Department is becoming very much interested in their recommendations for the destruction of the boll weevil, the corn borer, the potato hopper and lesser pests. In the Philippines the chlorine compounds of the Chemical Warfare Service, and their flame throwers, are being experimented with for the destruction of the locusts which periodically invade sections of the islands, and appear to promise great success in eliminating this great scourge. I need not dilate on the importance of finding a way to eliminate the boll weevil and the corn borer, since you gentlemen know better than I that these pests are spreading with a rapidity that actually threatens human life in all countries. I understand that in one section of Ohio the extreme method of the embargo is being considered as a necessary safeguard for agricultural prosperity. The corn borer, like the potato hopper, lives, as you know, in the inner parts of the plant so that it is difficult to reach with sprays which must be eaten by the creature to cause its death. The various gases which are studied by the Chemical Warfare Service are likely to prove effective, however, for the reason that they penetrate so readily and need only contact with the skin of the insect to cause death. They are effective, moreover, against eggs as well as adults. I feel confident that the hearty co-operation of the Chemical Warfare Service with the Agriculture Department will in time produce results of gratifying value to the farmer.

Chemical Plants in the Occupied Territory

A second installment of the comprehensive list of important chemical manufacturers in the Ruhr Valley and adjacent districts in the occupied German territory has just been issued by the Commercial Intelligence Division of the Bureau of Foreign and Domestic Commerce, Washington, D. C. The names and addresses of additional plants at Düsseldorf, Duisburg, Essen, Gelsenkirchen, Höchst-on-the-Main, Kehl, Krefeld, Leverkusen, Linden, Ludwigshafen and Mainz are included on this list, which covers 500 establishments. The form of presentation is the same as that in the first installment which was given in detail on pages 341 and 342 of last week's *Chem & Met.*

Proposed Regulations to Prevent Dust in the Sugar Industry

National Fire Protection Committee Makes Report to Be Acted Upon at the Annual Meeting in May

THE sub-committee report on "Proposed Regulations for the Installation and Use of Grinding and Pulverizing Systems for Sugar" has been approved by the main committee on dust explosion hazards of the National Fire Protection Association. This code is to be recommended for tentative adoption at the annual meeting of the association in May. In the meantime, however, there will be a meeting of the committee at the Hotel Statler, Buffalo, March 5 and 6, to consider further suggestions.

Anyone interested in these regulations and desiring to suggest additions or changes should communicate at once with David J. Price, chairman, U. S. Bureau of Chemistry, Washington, D. C.; or Mr. Price may be addressed in care of the Hotel Statler, Buffalo, on March 5 and 6. The regulations proposed are as follows:

These regulations are issued to eliminate or reduce the hazards inherent in the manufacture of pulverized sugar, particularly the avoidance of its ignition and the propagation of a resulting fire. It is essential that there shall be no escape of dust into the atmosphere of the room, a condition favorable to a dust explosion.

For this reason it is important that the apparatus be provided with effective appliances to prevent and confine the ignition; proper venting of the apparatus and ventilation of the pulverizing department are important.

The term "pulverizing department," as used in these regulations, comprises the portion of the plant in which the pulverizing processes are carried on. The equipment may consist of the mills or pulverizers, scalpers, bolters, or screens, dust collectors and conveying apparatus.

Location. The processes of pulverizing sugar should preferably be carried on in a detached building used for no other purpose and located at a safe distance from other property, or if close by, have exposing walls blank and parapeted; such structure, except the exposing walls, to be of light incombustible materials.

If the processes, owing to the nature of the business, must be carried on in the main plant, the portion of the plant devoted to them shall be segregated and be located, if possible, in the upper stories under the roof.

Construction. When the processes are carried on within the main building or buildings of the plant, the walls, partitions, floors and ceilings of such section of the plant shall be not less than 4-in. reinforced concrete or the equivalent in strength and fire resistance.

A portion of the exterior walls and roof (considered in lieu of an exterior wall) equal to not less than 10 per cent of the combined area of the inclosing walls shall be of light incombustible material, preferably thin glass; provided that when in a building with other processes not more than 40 per cent of any exterior wall shall be of such material. Window ledges, girders, beams and other projections shall have the tops beveled or other provision be made to minimize the deposit of dust thereon.

Communications. Wherever possible access to the pulverizing department shall be from the outside; this can be accomplished by means of balconies. Where this is not practicable and direct communications are required, these should be protected by standard self-closing, hinged Class B fire doors, swinging outward from the rooms in which the processes are conducted, unless safe egress is provided to the outer air, in which case standard automatic sliding doors may be used to protect the openings.

Where power is transmitted to apparatus within the rooms from any driving mechanism or unit outside of same, the transmission medium—belt or chain—shall be incased both inside and outside of the pulverizing department in dust-tight inclosure, constructed of substantial non-combustible material. Where power is transmitted by means of shafts, the same shall pass through close-fitting shaft hole in wall or partition.

All pipe openings through walls or partition shall be tight.

No conveyors' spouts or chutes shall pass through any of the inner or separating walls of the portions of the plant containing the pulverizing department.

Spouts through the floors within the pulverizing department and from the lower floor to the packing or storage section must be of substantial metal construction, and tight.

Power. If electric motors are used these should preferably be located outside of the pulverizing department and the power transmitted as noted under communications. If inside of this department, they must be in accordance with the standards of the National Electrical Code for dusty locations.

All controlling and circuit breaking devices, if within the pulverizing department, must be of the inclosed approved safety type, cabinets or inclosure must be dust-tight and kept locked when apparatus is in operation. See Electrical Code.

Lighting. Electric incandescent lights only shall be permitted in the pulverizing department. Lamps shall be inclosed in dustproof globes provided with approved wire guards, in accordance with the National Electrical Code.

Switches and cut-outs shall be approved and dust-tight. These should preferably be located outside of the rooms containing the pulverizing department.

Wiring. All wiring shall be in conduits, in accordance with the National Electrical Code.

Preventive Measures.

a. All apparatus must be properly and securely installed to insure constant true alignment and avoid hot bearings or friction. It should be equipped with such devices as will prevent ignition or confine the results of ignition, and devices which will minimize the amount of dust in the atmosphere. The apparatus should be installed and arranged in unit systems so that pulverizers will deliver to but one set of scalpers and bolters; interconnections between sets of apparatus should not be permitted.

b. All mills or pulverizing apparatus together with their pulleys, shafting and belts shall be electrically grounded in an effective manner.

c. All sugar delivered to the mills or pulverizers shall be through ¼-in. wire mesh screens and over magnetic separators. If sugar is dumped into delivery hoppers from a floor above the mills, these hoppers should have a curbing at least 7 in. above the floors and be provided with screens of ¼-in. mesh.

d. Delivery spouts or receiving hoppers immediately above the mills which require openings for inspection of the sugar shall be provided with wire mesh screens of not more than four meshes to the inch.

e. The mills shall either discharge the pulverized product directly through spouts or scroll conveyors into the screens, bins or bulk containers, or the product shall be discharged from the mills by air currents set up by the centrifugal force of the blades or beaters and an inclosed fan, or the pulverized sugar shall be removed by means of an exhaust fan

f. Mills delivering directly through spouts should be provided with devices in or underneath the discharges which retard the flow of sugar in such a manner as to keep a small space immediately underneath or near the discharge filled up with pulverized sugar, thus smothering any spark that may originate in the mill This can be effected either by means of a revolving choke valve, or if sugar is delivered directly into the scroll, by the omission of a small portion of the blade and substituting therefor pins.

g. Blowers or exhaust fans shall be installed on proper foundations and secured in a substantial manner and shall not be used for any other purpose.

Where practicable the exhaust fan should be located beyond the collector. When located between the collector and the pulverizing apparatus or any portion of same from which the dust is to be removed, the blades should be of composition bronze, or the casing consist of or be lined with similar material. Ample clearance shall be provided between the blades and the casing. See Blower Rules of the National Board of Fire Underwriters

The fan bearings must not extend into the casings, and if possible be self-oiling.

h. Screens (scalpers, bolters, etc.) shall have their reels or sieves in dust-proof inclosures. When connected to dust collectors, the flues shall be of metal, and the collectors shall be properly vented to the outside of the building.

i. Dust collectors shall be vented to the outside of the building. Where cloth or stockinet tubular dust collectors are used, these must be in tight metal inclosures, with tight-fitting doors and be vented to the outside of the building. If practicable, dust collectors should be located outside of the building.

j. Vents must be of ample size. These are especially required at certain types of mills, screens, dust collectors and elevator heads. The vent flues must be substantially constructed of metal and be carried out of doors as directly as possible, avoiding especially short turns—never through an adjoining building or room—and be properly proportioned.

Vent outlets should be provided with cowls or hoods, and where the non-escape of dust is essential, with counter-balanced relief valves or covers provided with a soft felt gasket, at least ⅜ inch thick

k. Open flames of any kind, or any operations or repairs resulting in sparks or utilizing heat, should not be permitted in the pulverizing department while in operation or when the air is charged with floating particles of dust.

Housekeeping. Good housekeeping is one of the most important factors; apparatus which will not leak and permit the escape of dust or sifting out of the sugar is essential. Accumulations of escaping sugar or sugar dust must not be tolerated in the building. It is recommended that the interior of the pulverizing department be painted a color which is in contrast with that of the dust.

Fire Protection. The building or rooms in which the processes of pulverizing are carried on should be protected by a system of approved automatic sprinklers, and approved first-aid fire appliances, together with small hose.

A.I.C.E. to Meet at Wilmington

The American Institute of Chemical Engineers plans to hold the summer meeting at Wilmington, Del., June 20 to 23. A program of papers is being prepared on the general topic of Adsorption Agents, including Activated Carbons, Bone Char, Silica Gel, etc. Members are asked to contribute papers along this line. In accordance with a rule adopted at the Richmond meeting copy of papers to be delivered must be sent to the Secretary 60 days before the meeting—i.e., not later than April 21, 1923.

U.S. Chamber of Commerce Aids Distribution

The Elimination of Excess Varieties Urged as a Help Toward Efficiency

The domestic distribution department of the Chamber of Commerce of the United States has launched a movement among the distributors of the country looking to the elimination of excess varieties in all lines of merchandise. In this connection, the department has just issued an illustrated pamphlet in which great stress is placed upon the savings and increased profits which can be effected by an active study of simplification.

It is stated in the pamphlet that "today, through useless competition, variety has been piled upon variety, visiting upon distribution much expense and confusion of effort."

To substantiate this contention, the pamphlet cites the following appropriate example: "In a certain industry there had been futile attempts for several years to reduce the number of forms such as order blanks, receipts, shipping manifests, etc., to some sort of uniformity and consistency of practice. Hundreds of varieties were in use but not more than six or eight were needed. The problem was precisely the same in every establishment so far as their relations with customers were concerned. Yet although there was a strong demand within the association for a reduction in the number of these forms, some trifling but unconquerable reasons existed to explain their inability to proceed. Upon appealing to this department, a method was devised which involved a conference between the representatives of this department, of the industry and of the Department of Commerce, as a consequence of which a committee was appointed which after a few months' study has reduced the several hundred forms to a maximum of eight and which presently will offer its report for adoption by the associated industry as a whole."

Too Many Styles in Dress

In dealing with styles, the department points out that "even the most casual investigation of this subject leads into the ungoverned whirl of a vicious circle. At least a beginning might be made in those trades where fashion is an important element, by a study of certain general types. It might be discovered that shoes will lend themselves to some reduction; and even women's hats might yield certain results if a study were made of the frames upon which are fastened the fluffs of fur, flowers, feathers, fruits and farm products. Men's clothing presents many difficulties, but reasonable modifications in the violent fluctuations in the height of the waist line, in the size of the trousers, in the inclination of the pockets or in the number of buttons on a sack coat may be found practicable. Indeed, a study is being made now of the many varieties of blue serge in order to abandon those which serve no purpose of style or of utility. Briefly, in order to accomplish a multitude of reductions in the number of varieties it is necessary merely to arouse a sympathetic state of mind among manufacturers and distributors."

"A period has arrived in distribution," the pamphlet concludes, "when the demand is insistent that distributors shall manifest an active interest in the betterment and progress of that branch of business through which they serve the public, and our duty as the domestic distribution department of the Chamber of Commerce of the United States places us squarely before you as an agency to co-operate with you to the extreme limit of our capacity."

Number of High-Analysis Fertilizers Reduced

Conference of Agronomists Agrees to Reduction From 200 to 32 in Eighteen States of Middle West

As the result of the third group conference for the purpose, held at Baltimore recently by agronomists representing the Middle Atlantic States, agreements are in existence for the recommended use of high-anlaysis commercial fertilizers in eighteen states of the Middle West, the North and the East whereby the number of grades which are to be pushed for sale among the farmers have been reduced from more than 200 to 32.

Officials of the Soil Improvement Committee of the National Fertilizer Association, which was represented at each of these conferences, characterize the program now undertaken as far in advance of any previous plan and believe that the groundwork has been laid for great improvement and economy in fertilizer practice. Just what it will mean in lower plant-food costs to the farmers depends upon the farmers themselves, for while the agricultural colleges and the fertilizer salesmen will recommend and push the particular high analyses selected for each group of states, other grades will be delivered if the purchasers demand them.

A high-analysis fertilizer has been defined as one which contains 14 per cent or more of plant food elements, this line of demarkation having been recommended by the Soil Improvement Committee in 1918 and agreed to as feasible and satisfactory by the agronomists and manufacturers.

Specific Reductions Made

Participating in the Baltimore conference, held Feb. 8 and 9, were agronomists representing New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia and West Virginia and thirty of the manufacturers marketing fertilizer in these states. Nineteen analyses were agreed upon, fifteen for general purposes and four for special needs in limited areas. In Maryland alone last year, 192 different analyses were registered, twenty-six of them representing 81 per cent of the total tonnage and the remainder being divided in small lots among 166 analyses. High-analysis fertilizers agreed upon for the Middle Atlantic States are: For general use, 0-12-6, 2-12-2, 2-10-6, 2-12-4, 3-8-3, 3-8-8, 3-10-6, 4-8-4, 4-8-6, 4-12-0, 4-12-4, 5-8-5, 5-10-5, 6-8-4, 7-6-5; for special use, 0-10-10, 0-10-4, 4-8-10, 10-5-0.

At a conference in October, fifteen high analyses were agreed upon for Ohio, Indiana, Michigan, Wisconsin and Missouri, being: For mineral soils, 0-12-6, 0-14-4, 2-12-2, 2-12-4, 2-12-6, 2-16-2, 3-12-4, 3-8-6, 4-8-6, 4-12-0, 2-14-2; for organic soils, 0-8-24, 0-10-10, 0-12-12, 2-8-16.

New England agronomists and manufacturers at a conference in Boston in January agreed upon nine high analyses for use in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut. These are: 0-12-6, 2-12-4, 3-10-4, 3-10-6, 4-8-4, 4-8-6, 5-4-5, 5-8-7, 8-6-6.

Equipment Men to Exhibit at New Haven

Due to the frequent requests of several firms, the executive committee of the New Haven-Connecticut Valley Sections in charge of the coming meeting of the American Chemical Society at New Haven has decided to make available space for exhibits of an educational and professional nature. These will consist largely of laboratory apparatus and new equipment of interest to chemists. The building used for this purpose will be the old Sheffield Chemical Laboratory, which is now vacant. Apparatus dealers and publishers of scientific books may arrange for space by addressing Prof. T. B. Johnson, Room 157, Sterling Chemical Laboratory, New Haven, Conn. There will be a nominal fee charged to cover the use of the building and service.

American Institute of Chemistry Council Meets

The Council of the American Institute of Chemistry at its meeting on Feb. 19 appointed a committee consisting of Dr. Frederick Crane, Miss C. M. Hoke and Lloyd Lamborn to prepare a four-page folder setting forth the purposes and plans of the Institute, and to provide for its presentation to the chemists of the United States. It also directed incorporation under the non-profit-sharing corporation law of the State of New York.

Plans are being arranged for the formation of skeletonized committees to deal with questions of ethics, professional classification and certification, and employment conditions. These problems are fundamental ones to the organization and after study and co-operative consideration an attempt will be made to solve them. The Council invites correspondence on these topics as well as on the general plans of the Institute.

Papers and Speeches for Spring A.C.S. Meeting

More Detailed Information on Topics of Meeting Now Made Available by the Society

Progress in all branches of industrial and theoretical chemistry will be reviewed in detail at the sixty-fifth general meeting of the American Chemical Society at New Haven, Conn., April 2 to 7.

One of the most important features of the week will be a symposium on "Motor Fuels," held jointly by the Division of Petroleum Chemistry and the Section of Gas and Fuel Chemistry. The results of various investigations as to the worth and quantity obtainable of alcohol blends, new methods of producing gasoline from petroleum and natural gas, work in blends of benzol and kerosene, and other blends will be reported. Papers will be presented also covering the most recent discoveries in regard to anti-knock compounds, more efficient carburetion and other subjects which have a direct bearing on the problem of keeping the supply of motor fuels of all kinds equal to the demand.

History of Coal-Tar Dyes

Another important discussion will be that of the Division of Dye Chemistry, which has arranged for a symposium on "The Coal-Tar Dye Industry in the United States Prior to 1914."

The most recent facts and theories concerning nutrition will be brought out in the meeting of the Division of Biological Chemistry, which will hold a symposium on that subject. Noted authorities on matters of nutrition will present papers, and recent work in the attempt to isolate and get a better understanding of vitamines will be reviewed.

Because of the wide concern over the cotton boll weevil and other destroyers of crops, agricultural chemists have been busy with experimentation and research related to these problems in the last few months. Their progress will be reported in a symposium on "Insecticides and Fungicides," at the meeting of the Division of Agricultural and Food Chemistry.

Chemical problems involved in the production of artificial silk, paper, guncotton, smokeless powder, celluloid and pyroxylin lacquers will be discussed in various papers to be presented before the Division of Cellulose Chemistry. This division will deal particularly with recent achievements in the artificial silk industry at a symposium on "Oxycellulose, Cellulose Hydrate and Hydrocellulose.'"

The Division of Rubber Chemistry will honor the memory of Charles Goodyear, who, by his pioneer work on the vulcanization of rubber, made possible the rubber industry today.

Weeks and Garvan to Speak

Among the men of prominence who have accepted invitations to speak at the general sessions of the society are Secretary of War John W. Weeks and Francis P. Garvan, president of the Chemical Foundation.

The dedication of the Sterling Chemistry Laboratory of Yale University will be held on Wednesday, April 4, at which members of the chemical society will be guests of Yale.

Chemists of international note who will be present and take part in the dedication exercises and also in the chemical society meetings will be Prof. W. Lash Miller, of Canada; Prof. G. Urbain, of France; Prof. F. G. Donnan and Principal J. C. Irvine, of England; Prof. G. Bruni, of Italy; Prof. A. F. Holloman, of the Netherlands; Prof. The Svedberg of Scandinavia, and Professors M. Gomberg, G. N. Lewis and A. A. Noyes, among others, will represent the United States.

It is expected that 3,000 chemists will attend the general meeting.

French-Badische Convention Is Ratified

France to Produce Ammonium Sulphate and Ammonia Nitrates Under German Supervision

The bill to ratify the convention between the French Government and the Badische Anilin und Soda Fabrik was ratified by the French Chamber of Deputies on Feb. 8 by 555 votes to 5. France needs 110,000 tons of nitrogen annually for agricultural manures. In addition, in war time France would need about 100,000 tons of nitrogen for explosives. At present France produces about 19,000 tons and imports about 34,000 tons annually. Germany produces over half a million tons, and under Art. 297 of the Versailles treaty is entitled to retain this amount. France obtained possession of the formula of the Haber process during the war, but all the efforts of the French chemists to utilize the formula for the manufacture of nitrogenous products failed. It was in order to obtain the secret of the practical manipulation of the formula that the French Government signed on Nov. 11, 1919, the convention with the Badische Anilin und Soda Fabrik.

The main lines of the convention are as follows: The Badische Fabrik shall supply to France full details of the method of manufacture of the above-mentioned nitrogenous products as employed in the company's factories at Oppau and Merseburg. The Badische Fabrik is to supply complete plans for the construction of a factory in France capable of producing 100 tons of nitrogen daily and to send experts to superintend the construction and working of the factory. Until the factory attains a certain stipulated productivity the Badische Fabrik is to give free access to French official experts to study the methods at the Badische company's factories. Lastly, the Badische Fabrik renounces for the period of the convention all right of manufacture and sale of these products in France, the French colonies and protectorates. In return France pays the Badische Anilin und Soda Fabrik five million francs as "architect's fee" payable in two installments, of which the first was paid on April 4, 1920, and the second will be payable when the French factory produces a minimum of 20 tons of nitrogen per day consecutively in a fortnight.

France also pays the Badische company a sliding scale percentage on the factory's production of nitrogen estimated according to the average c.i.f. price of Chilean nitrates at French ports, with a minimum of half a million francs yearly. It is estimated that the percentage will be equivalent to 2 per cent of the sales.

The convention is to continue for a period of 15 years from the date when the factory produces 30 kg. of nitrogen daily. On the expiration of the convention, France retains all the rights of patents and good will acquired thereunder. The bill proposes that a limited liability company should be formed with a capital of 50,000,000 francs, of which three-fifths of the shares are to be subscribed by the state and the remainder in fixed proportions by the agricultural associations, chambers of commerce, workers' co-operatives and the general public. This company would lease from the state a portion of the Toulouse powder factory, which is to be converted into a nitrates factory.

The bill aroused considerable opposition, especially from the interests behind the factories employing the process invented by the Frenchman Claude. The critics assert that the bill unfairly favors German against French invention, to which the advocates of the bill reply that there is room for both.

Dinners at New Haven A.C.S. Meeting

Thursday, April 5, 6:30 to 8:30 p.m., will be reserved for fraternity and college reunion dinners, and it is expected that this will be found to be one of the most enjoyable features socially of the New Haven meeting of the American Chemical Society. The University Dining Hall, which has a seating capacity of over 1,500, is available for this service. Arrangements for these college reunion dinners and reservations should be made as early as possible by communication with Dr. Arthur H. Smith, 94 Woodlawn St., Hamden, Conn.

New Jersey Chemists Meet

The New Jersey Chemical Society met at Stetters in Newark, N. J., on the evening of Feb. 12. After dinner and a short social meeting, a technical program was given. Dr. Colin G. Fink, of the division of electrochemistry, Columbia University, spoke on "Modern Methods in Metallurgical Research," confining most of his attention to problems of corrosion of non-ferrous alloys. Following Dr. Fink, Charles P. Titus, president of the New York Microscopical Society, spoke on the "Microscopical Investigation of Cigarettes." The meeting was attended and enjoyed by a large gathering of New Jersey chemists and metallurgists.

Safety Code for Walkways Urged

A conference attended by sixty-three representatives of trade associations, technical societies, safety organizations and government departments, held in the Engineering Societies Building in New York, Feb. 14, declared by unanimous vote "that it is desirable to have a nationally uniform safety code on walkway surfaces" and that the development of this code should be carried out under the procedure of the American Engineering Standards Committee.

The conference voted to include in the code the following places: elevator floors, elevator landings, corridor floors, ramps, runway floors, stair treads and landings, fire escape treads and landings, floors around machinery and at door thresholds, and sidewalk hazards such as coal hole covers and sidewalk doors. This new code will apply to apartment houses, factories and other working places, office buildings, hospitals, hotels and restaurants, railway cars, railway stations and train platforms, schools and theaters.

The conference voted that the performance characteristics which should be considered in walkway surfaces are: resistance to slipping, durability, freedom from the tripping hazard, and flammability. General and maintenance requirements will also be included in the code.

Following the conference, the manufacturers' representatives met and appointed a committee, under the chairmanship of H. W. Mowery, to arrange for representation, in the continuing work, of manufacturers of the various classes of floors and floor coverings, in view of the fact that several of these classes of materials are not covered in any trade association.

The next step in the development of this code will be the appointment of sponsors by the American Engineering Standards Committee and the organization of a sectional committee which will draft the code. This sectional committee will be composed of official representatives of all organizations concerned with the subject of safe walk way surfaces, either as producers, consumers, casualty underwriters or governmental officials representing the general public.

Auto Manufacturers Enter Glass Business

Two items in the past week's dispatches illustrate the increasing tendency on the part of great manufacturers to control the sources of supply of the different elements entering into their products.

According to the first item, Henry Ford definitely enters the industrial field in the Pittsburgh district with the acquisition of the Allegheny Plate Glass Co. at Glassmere. The Ford interests take possession of the plant immediately and will use it to produce plate glass exclusively for automobiles.

The Allegheny plant, which covers 40 acres of ground, is one of the largest and most completely equipped in the world. Its annual output is between 6,000,000 and 7,000,000 sq.ft. of plate glass.

The second item reports that W. C. Durant has acquired control of the American Plate Glass Co., located at Kane, Pa., by purchasing the entire stock of the company. The plant has a capacity of between 5,000,000 and 6,000,000, sq.ft. of plate glass a year, which is sufficient to meet all requirements of the Durant enterprises for some time to come. Mr. Durant stated that the purchase was made in order to avoid any possibility of being handicapped through a shortage of plate glass.

The American Plate Glass purchase will be independently financed, it was announced, and 249,000 partners in Durant enterprises will be given an opportunity to invest in it and to participate in the profits to be derived from existing and future business.

Personal

Dr. THOMAS F. BAKER, who has been acting president of the Carnegie Institute of Technology, Pittsburgh, since the resignation of Dr. Arthur A. Hamerschlag last July, has been elected president.

R. C. BURTON, of Zanesville, Ohio, has been elected president of the National Brick Manufacturers' Association.

Dr. H. C. COOPER has removed from New York to Chicago, to become director of the scientific department of Bauer & Black, manufacturers of surgical dressings, etc. Dr. Cooper was for a number of years professor of chemistry in Syracuse University. In 1918-1920 he had charge of physical chemistry and electrochemistry at the College of the City of New York, since which time he has been manager of the electrochemical plant of the Acids Manufacturing Corporation. He was recently chosen chairman of the New York Section of the American Electrochemical Society.

D. P. GAILLARD, who was commanding officer of the Old Hickory Ordnance Reserve Depot, Jacksonville, Tenn., is now assistant to the director of the Fixed Nitrogen Research Laboratory of the Department of Agriculture, Washington, D. C.

W. A. GRAY, JR., who was superintendent of the Romage process, Bransdall Refining Co., is now a member of the staff of the general engineering department of the Standard Oil Co. (N. J.), at Elizabeth, N. J.

J. H. HALL, assistant professor of chemistry, Illinois State Normal University, Normal, Ill., has resigned to accept a position as research chemist with the California Fruit Exchange. He will begin his new duties about March 8, and will be located in the Exchange laboratory near Los Angeles.

CARLTON C. JEWETT, of Buffalo, N. Y., has been appointed treasurer of the Dunlop Tire & Rubber Co., with the local plant.

P. M. MCHUGH, of the Dorr Co., who recently returned from an extended trip to Hawaii, sailed for Cuba on Feb. 21. He will return in 3 or 4 weeks.

RANDOLPH MILLER, formerly assistant secretary of the Kokomo Rubber Co., Kokomo, Ind., has been elected treasurer and director, succeeding D. L. Spraker, resigned.

Dr. HOBART ROGERS of the School of Medicine, Indiana University, gave an interesting address before the members of the Butler College Chemical Society, Indianapolis, Ind., Feb. 16, on the subject of "Physiological Chemistry."

LLOYD L. ROOT, of Grass Valley, Calif., for several years superintendent of the Mexican Candelaria Mines Co., has been appointed state mineralogist to succeed Fletcher Hamilton.

Dr. WALTER RUNGE, consulting engineer, of New York City, sailed for England on Feb. 17 on professional business. He will return some time in April.

ACHESON SMITH, past president of the American Electrochemical Society, is in Europe and expects to return early in March.

FRANCIS M. TURNER, JR., is giving a course of six lectures on Chemical Plant Equipment at the University of Toronto, Feb. 26 to March 3.

Obituary

CYRUS BORGNER, founder and president of the Borgner Fire Brick Manufacturing Co., Philadelphia, Pa., and prominent in civic affairs, died Feb. 13, at his residence, 6041 Drexel Road, Overbrook, aged 73 years. He was for a number of years treasurer and president of the Franklin Institute of Philadelphia, and at the time of his death was vice-president of the local Manufacturers' Club. He was a director of the Philadelphia Bourse and vice-president of the Philadelphia Chamber of Commerce. He is survived by his wife, one son and two daughters.

WILLIAM PENN WORTH of Coatesville, Pa., pioneer iron and steel manufacturer, president of the Worth Steel Co., Claymont, Del., died at his apartments, St. James Hotel, Philadelphia, Feb. 14, of heart disease, aged 67 years. At the time of his death he was president of the Coatesville National Bank. He is survived by his wife, three sons and two daughters.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

How the Business Cycle Works

Basic Causes of Periodic Ebb and Flow of Commercial Activity Are Clearly Explained in Analysis of Retailer-Wholesaler Relations

IN A FORUM meeting of the New York Credit Men's Association on Feb. 20, Prof. Willford I. King, of the National Bureau of Economic Research, presented an unusually clear explanation of how the business cycle operates. By developing his subject in such a way as to show how different commercial developments affect the retailer and wholesaler, he was able to give concrete expression to the basic economic conditions on which the cyclic theory rests. His address goes a long way toward answering the objections commonly held that "the idea of a business cycle is too indefinite to be of any practical value" and that "business conditions are constantly affected by an infinite variety of unpredictable forces of various strengths."

Extracts from Professor King's address will be found in the following paragraphs:

Economists have noted the apparent existence of three important cycles, with wave lengths of about 20, 7 and 3½ years. Apparently, the last mentioned is the most clearly defined, its waves being higher than those in either of the others. However, it is unusual for severe depressions to occur oftener than once in 7 years, and the fact has been often noted that for a long period—namely, in 1837, 1857, 1877 and 1897, deep depressions occurred at 20-year intervals.

During these depressions the retailers cannot indefinitely continue to reduce their stocks. Their shelves become so nearly empty that buying cannot longer be avoided. As their purchases rise to equal the current requirements of their customers, the resulting demands on the wholesalers cause a rise in wholesale prices. As wholesale prices climb, retailers realize that prices have been low, and begin to purchase more heavily. This makes wholesale prices rise more sharply. The retailers become more and more alarmed at the rise in wholesale prices and buy faster than ever. Stocks accumulate at a constantly accelerated speed. The rise in wholesale prices goes on with added momentum.

Manufacturer Feels Demand

Wholesalers pass the demand along to the manufacturers An increasing demand at rising prices sets idle factories in motion. As demand increases, increasing factory production is followed by higher prices for factory products. Manufacturers' profits increase. As factory owners see sales and prices both rising and profits growing, they infer that sales and prices will keep on rising and profits will keep on growing. They therefore hasten to hire more labor, to contract for more raw material before prices go up, and to borrow more money to finance their enlarged operations. They thus expand their business because they believe that in the near future they will be able to market a still larger supply of their product at prices higher than ever. The increase in their activities naturally causes an increase in the price of the raw materials they are purchasing, and a rise in the price of labor.

As the cycle moves upward the retailer must buy upon a rapidly rising market, but the physical volume of his sales gradually tends to diminish, while his stock constantly increases. At first this situation causes no alarm, but for some reason or other he finally wakes up to the fact that he has on hand a very large inventory, bought at extremely high prices, and that his sales are not at all satisfactory. This discovery marks the climax of the boom. Soon the retailer becomes panicky. He stops buying; on the way up he has been ordering more goods than he needs because he has expected to get only partial delivery on his orders. Now he finds that he is threatened with a flood of high priced goods which he cannot sell. He, therefore, not only stops buying, but tries to cancel the orders which he has already placed with the wholesaler. The wholesaler does likewise with the manufacturer. Suddenly the manufacturer finds that instead of being unable to produce goods fast enough to meet the demands of his customers, he is getting few orders, and cannot make deliveries on the old ones.

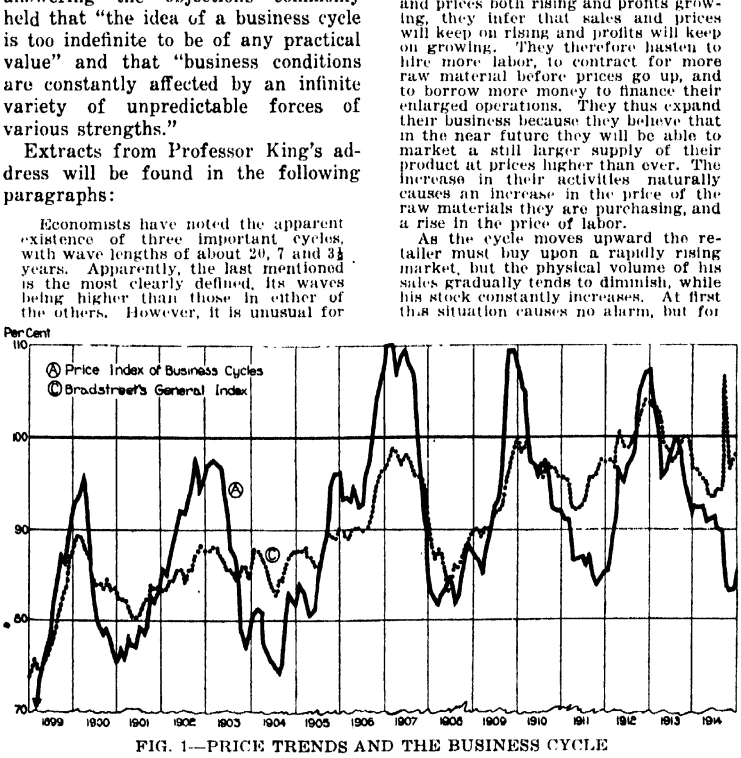


FIG. 1—PRICE TRENDS AND THE BUSINESS CYCLE
The Harvard Economic Service's price index of business cycles is compared with Bradstreet's price index.

"Chem. & Met." Weighted Index of Chemical Prices

Base 100 for 1913-14

This week	176.38
Last week	175.31
February, 1922	148.00
February, 1921	166 00
February, 1920	252.00
April, 1918 (high)	286.00
April, 1921 (low)	140.00

The continued strength in the cottonseed oil market, together with the manufacturer's advance in the price of copper sulphate, is responsible for the gain shown in this week's index number

The Lag Between Wholesale and Retail Prices

With the stoppage of purchases by the retailer, optimism suddenly turns to pessimism Wholesale prices being based upon anticipations, break violently. Retailers, however, follow the practice of selling goods at a certain margin above costs, therefore, although they have stopped buying, they at first cut prices but slightly. Some of them, however, are forced to reduce prices in order to collect money to satisfy their creditors, and these may make rather sharp price reductions. In general, however, retail prices fall rather slowly. A paradoxical situation thus arises. Although the first break in the boom occurred when the retailers stopped buying, nevertheless, retail prices remain rather stable, while the first really sharp price decline occurs at the factory, retail prices "tagging along" after factory prices at a distinctly later date. Apparently, though of course not really, the effect has preceded the cause.

When the manufacturers find new orders distinctly cut down and many of the old orders canceled, their natural tendency is to reduce output accordingly. They discharge employees and otherwise reduce expenses. This does not help them much, for they have borrowed money they expected to repay from the proceeds of larger sales at higher prices. With lower prices and reduced sales, some are unable to meet their loans. If creditors decide to "carry" them, the credits become "frozen." If creditors demand immediate settlement, the manufacturer in many cases will be forced into bankruptcy.

Eventually a stage is reached in which the retailers again find their large stocks running out and they are compelled once more to buy to meet the demands. Buying by retailers stimulates the wholesale business, which, in turn, places orders with the manufacturers. This starts the wave of optimism all along the line. Once again pr'ces begin to rise. The cycle is complete and business is again ready to start out of the trough up over a new wave.

The cyclic character in the trend of wholesale and retail prices is shown in Fig. 1, in which the price index of business cycles of the Harvard Economic Service is contrasted with Bradstreet's index over a rather extended period.

Copper Sulphate Advance Features New York Market

Imported Caustic Potash, Permanganate of Potash and Bleaching Powder Also Somewhat Higher—Market Generally Steady

NEW YORK, Feb. 26, 1923.

BUSINESS in the chemical market during the past week was somewhat quiet, but the general tone was of a comparatively steady character. Buyers have shown a disposition to operate on a conservative basis, due to the unsettled situation abroad and the uncertainty of spring business. The single feature of the week's activities, as far as prices are concerned, was the advance by domestic makers of copper sulphate. The continuous rise in the price of copper metal, together with the added buying interest among consumers, was the direct cause of the new advance. Imported goods have been advanced by leading dealers. Resale formaldehyde was quoted at much lower levels among several weak holders. Producers, however, continue to quote the market firm at former levels. The export situation in the alkali market showed considerable improvement, with several large tonnage inquiries noted from European centers. Barium chloride, prussiate of potash and oxalic acid were rather unsteady at slightly lower quotations. Caustic potash, permanganate of potash and bleaching powder showed continued activity and prices were notably higher during the latter part of the week.

High Spots of the Market

Arsenic—Resale material was fractionally lower at 15½@15¾c. per lb. Although business is somewhat dull, spot goods remain quite scarce and the general tone of the market is firm. Shipments were quoted at 15¼c. per lb.

Barium Chloride—Spot material was quoted down to $87 per ton by leading importers. Shipments from abroad were noted at $85 per ton. The general condition presents a rather unsteady situation.

Bleaching Powder—Large producers report a well-sold market at the works and quote $2.20 per 100 lb. for any prompt shipments. The resale market is very strong, with quotations heard around $2.50 per 100 lb., for large drums.

Caustic Potash—Imported material was much firmer during the interval and the lowest figure heard was around 7⅝c. per lb. The general range was 7⅝@7¾c. per lb. for 88-92 per cent. Cabled demand from abroad was responsible for the new advance.

Caustic Soda—The export market presented a stronger tone and several inquiries were received from leading European countries. Prices held around $3.45@$3.50 per 100 lb. f.a.s. Domestic inquiry continued very strong at $3.75@$4 per 100 lb., ex-store. Contracts remained quotably unchanged at the works.

Chlorate of Potash—Imported goods were quoted somewhat lower at 7c. per lb. for powdered and crystal. Several large tonnages were reported on dock from Germany during the past week. Producers were firm at 8½@9c. per lb.

Copper Sulphate—Producers advanced quotations to $6.50 per 100 lb. for 99 per cent large crystals and $6.40 for smaller crystals. The rise in the metal market and the strong consuming demand were responsible for the new level. Imported material was also advanced to $5.75 per 100 lb. on spot.

Epsom Salt—Domestic U.S.P. material was quoted at $2.50 per 100 lb., with technical at $1.75@$2 per 100 lb. Imported U.S.P. held around $2 per 100 lb. and technical at $1.10@$1.20. Demand was merely of a routine nature.

Formaldehyde—The market presented an unsteady tone with several second hands quoting as low as 15c. per lb. on spot. Producers were firm at 16c. per lb. in carload lots and 16½c. for lesser quantities.

Oxalic Acid—Producers quote the market at 12½c. per lb. f.o.b. works. Imported goods on spot held around 12¾@13c. per lb. Shipments were quoted at 12½c. per lb. duty paid. The demand was rather quiet.

Prussiate of Potash—The market appeared slightly lower, due to the lack of consuming interest. The yellow salt was quoted at 37½c. per lb., with a probable concession on actual business. Red prussiate was down to 80c. per lb.

Active Buying of Vegetable Oils

Linseed Oil—Leading crushers announced another sharp advance in prices to become effective Feb. 26. Late figures for nearby shipments ranged around 98c. per gal., carload basis in barrels. April shipment was quoted at 97c. per gal., with May at 94@95c. per gal. Foreign oil held quite firm, with March-April shipment from England at 94c. per gal., duty paid.

Castor Oil—Several odd lots of No. 3 grade sold as low as 12½c. per lb., but producers reported a strong market at 12¾c. The general inquiry showed material improvement, due to the stronger market for castor beans. The U.S.P. material was quoted firm at 13¼c. per lb., in barrels.

Coconut Oil—Prices were quoted along steady lines, although actual business was very quiet. Spot Ceylon type oil closed at 8½c. per lb., sellers' tanks. Cochin oil was quoted at 9¾c. per lb., prompt shipment, in barrels.

Corn Oil—The market appeared quite strong with a few odd lots quoted at 10⅛c. per lb., f.o.b. point of production. The general range was around 10⅛@10¼c. per lb. Spot in barrels was quoted around 11¼c. per lb.

Good Alkali Business in the St. Louis Market

Satisfactory Volume Reported Although Prices Are Somewhat Unsteady—Imported Chemicals Affected

ST. LOUIS, MO., Feb. 22, 1923.

Trading in industrial chemicals in this market has been very encouraging and there is a pronounced tendency toward higher levels. This is particularly true of the imported chemicals, which are affected by the European situation, and some rather heavy buying is being done in this line. The shortage of box-cars, interruptions and delays in transportation have caused serious shortages of stocks in many directions, and have also resulted in a firmer tone in the market.

Alkali Market Is Good

The market on alkalis is good. Prices are somewhat unsteady, but quite a volume of business is being transacted and usually at a fair price. Occasionally there are inside quotations, but as a rule quotations are as per schedule. *Caustic soda*, solid, is being quoted at $3.75 in 5-drum lots and $3.90 in single drums. *Flake* caustic in 5-drum lots can be had at $4.25 and $4.40 in single drums. *Soda ash* in ton lots in bags is being quoted at $1.95 per 100 lb. and in less than ton lots at $2.10 per 100 lb. The usual differential of 15c. for barrels over bags still holds. *Bicarbonate of soda* is moving in good volume and prices are quite firm. Barrels are generally being quoted at $2.40 and kegs at $2.60 per 100 lb. *Sal soda* is firmer than usual and quality material is quoted at $2 per 100 lb. in barrels, $2.25 per 100 lb. in kegs. Some low-grade materials are being offered at lower prices, but are not affecting the market generally.

Other Price Changes

Heavy *mineral acids* are in much better demand and the increased volume is very marked. *Citric acid* is not doing much, but developments are in order for the next few weeks. *Oxalic acid* is not moving so well and prices remain the same. Producers of *phosphoric acid* advanced their prices last week, but trading has not been so good. The season for this article is approaching, however, and a material increase should be expected. The movement of *tartaric acid* is fair, but should show more life very soon. The *white arsenic* situation is still very tight and supplies are very difficult to obtain. *Glycerine* is again very firm and without exception is being quoted at 18½c. in drums. Contract business is being done on the same basis and future predictions are for firmness. There has been no change in the price of *copperas* and supplies are easier, but little surplus has been accumulated. The demand for *cream of tartar* is increasing, but no large quantities are involved. *Potassium cyanide, granular*, is moving briskly. The market for *permanganate of potash* is extremely strong with a

heavy demand, but supplies are limited. *Sulphur* is holding its own in price and is increasing in volume. Quite a volume has been unloaded in this market recently. Refined flowers in 10-bbl. lots are quoted at \$3.85 per 100 lb., single barrels at \$4, light flour refined, in 10-bbl. lots at \$3.30, single barrels at \$3.40 per 100 lb. Roll brimstone is at \$3 per 100 lb., and crude sulphur in bags at \$1.90 in ton lots, \$2 per 100 lb. in less. *Zinc dust* has advanced ½c. since our last report and is now quoted at 10½c. in carload lots f.o.b. St. Louis, with a good volume of business transacted at this figure. The *zinc sulphate* market is very lively, and in one direction it is reported that the demand has been unusually heavy during the last 2 weeks. The market is firm with no change in price—3¼c. in carload lots f.o.b. St. Louis. *Zinc spelter* is very active and in good demand for domestic consumption as well as for export. Since the first of the year the market has advanced about \$15 per ton and today is quoted at \$7.40@\$7.50 per 100 lb., f.o.b. St. Louis.

Vegetable Oils in Better Demand

Linseed oil has firmed up quite lively and the market is now completely in the hands of the producers. Five-bbl. lots are quoted at \$1 for the raw and \$1.02 for the boiled oil, while 1- to 4-bbl. lots are quoted at \$1.11 and \$1.13 respectively per gallon. *Castor oil* is very firm at 14½c. per lb. in drums, and the present condition of the seed market would seem to indicate a still higher market. *Turpentine* is holding very well and is quoted today at \$1.54 per gal. in 5-bbl. lots and \$1.59 per gal. in single barrels.

Steel Market Shows Signs of Excitement

The Cause, However, May Be Found in the Widespread Tendency to Speculate

PITTSBURGH, Feb. 23, 1923.

The finished steel market presents a still more excited condition. Many jobbers and manufacturing consumers are seeking to place additional orders or contracts, and seem rather indifferent as to prices that may be charged. This is a familiar phenomenon in steel market movements and mills interpret it as indicating that there is a widespread tendency to speculate, by overrating prospective requirements and by endeavoring to anticipate price advances. Accordingly, a great deal of the offered business is being refused, or is being filed for entry later at prices that may then be ruling. The actual turnover in the market, in sales and purchases, is lighter than in January, and is made up largely of orders against actual construction projects.

The superficial appearance of the steel market, with a large volume of inquiry, with mills refusing to entertain much of the inquiry and with prices advancing, would suggest that steel is scarce and that there is not going to be enough to meet all requirements in the next few months. If such a condition develops, it will be unprecedented and not far removed from a miracle. For 5 months shipments of steel from mills have been very heavy, and they are at a greater rate still at the present time, with very favorable prospects for mill operation in March. On account of the time of year, consumption of steel in many quarters has been restricted.

In industrial activity there is always a limiting factor. Sometimes it is the amount of "confidence," sometimes the supply of money or capital. Sometimes, possibly, it may be the supply of steel, which was restricted in the latter part of 1919 by the steel strike, followed by the bituminous coal strike. In the next few months industrial activity will be limited only by two influences—supply of transportation and supply of labor. Transportation limitation is merely a possibility, not a probability. Labor limitation is a certainty. In the past few months there have been restrictions in outdoor work and the steel mills have had a fairly good labor supply, resulting in heavy production and deliveries. The steel has not all been consumed, some of it being accumulated against spring requirements. Steel production has acquired a margin of safety over steel consumption. Much of the willingness of steel buyers to take deliveries so freely of late and at the present time is due in part at least to the fact that on the whole the deliveries are at prices much below those now ruling, being against old orders or contracts. There is much more chance, for the next few months, of steel consumption being restricted by labor supply than of steel supplies falling short of actual consuming capacity.

Prices Advance

The minimum market price on bars, shapes and plates has advanced in the week from 2.20c. to 2.25c. The 2.25c. price seems to have been an objective of some conservative sellers and the chances seem to be that the general basis of the market will not advance farther, higher prices, if obtained, being on early deliveries and thus representing a delivery premium rather than a general advance. Possibly the same observation may be made of finished steel prices in general.

The advancing tendency in the independent market for sheets, the Steel Corporation having been sold out through June and therefore not being a factor, has crystallized on definite prices at which a number of independents have opened order books for shipment after April 1. These prices now represent the sheet market, and are as follows: Blue annealed, 2.75c., base, on 12 gage and heavier and 2.90c., base, on 13 gage and lighter; black sheets, 3.60c.; galvanized sheets, 4.75c.; automobile sheets, 5.25c. Splitting the blue annealed list is an innovation, making the advance over old prices \$5@\$8 a ton according to gage. Black sheets advance \$5 a ton and galvanized sheets \$8, the spread being increased on account of the high price of zinc, while difficulty in securing labor for galvanizing departments is also a factor. The price of independent producers of automobile sheets had been 5c., so that there is an advance of \$5 a ton in the independent market, but the Steel Corporation had not advanced above its old price of 4.70c., at which it is sold practically through June.

By a weighted average, finished steel prices are now 60 per cent above their 1913 average, or at 160 using 1913 as 100. The Bureau of Labor's index number of commodities at wholesale, on this basis, has been at 156 for the past three monthly announcements. Last week Secretary Mellon was reported as expressing the opinion that the general advance in commodity prices, with the exception of steel, had probably ended. The present outlook is that steel may not advance farther, except for the development of delivery premiums, involving only small tonnages. As a matter of fact, the great bulk of the present mill deliveries is at much below current market prices.

Coke and Pig Iron

The Connellsville coke market has developed a new line. The common belief had been that the declining tendency marked since the first of the year would continue until the market should reach a level commensurate with old prices with allowance for higher wages now paid. Demand for domestic consumption was expected to disappear this month, causing a decline of its own. Furnaces having contracts for the current quarter intended to defer as long as possible negotiating contracts for second quarter.

The coke market has turned, losing its prospect of further decline and becoming strong. The chief factor apparent is that two steel companies in Youngstown, Republic Iron & Steel Co. and Youngstown Sheet & Tube Co., have bought Connellsville coke to July 1, paying \$7 for most of the tonnage and \$6.75 for a smaller part. The particular point is that these companies have by-product coking capacity sufficient to cover normal requirements of their blast furnaces, but under forced operation they require a little outside coke. The tonnage bought by the two companies is 29,000 tons a month. Two or three months ago these steel interests were willing if not anxious to sell basic pig iron, thus competing with merchant furnaces. Now they buy coke in the market patronized by merchant furnaces and thus become their competitors in the purchase of raw materials. There is an interesting reversal of the force applied upon the merchant pig iron market. The merchant furnaces now see that coke will cost them more for second quarter than was expected. The pig-iron market has already strengthened materially, basic and foundry being quotable \$1 a ton higher than a week ago. The market now stands at \$28 for bessemer, \$27 for basic and \$28 for foundry, at valley furnaces, with \$1.77 freight to Pittsburgh. It may easily advance a couple of dollars a ton within a month.

Current Prices in the New York Market

FOR CHEMICALS, OILS AND ALLIED PRODUCTS

Although these prices are for the spot market in New York City, a special effort has been made to report the American manufacturer's quotations whenever available. In many instances these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported and resale stocks are reported when of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb	$0 36 – $0 38
Acetone, drums	lb	21 – 21½
Acid, acetic, 28%, bbl	100 lb	3 15 – 3 40
Acetic, 56%, bbl	100 lb	6 25 – 6 50
Glacial, 99½%, carboys	100 lb	12 00 – 12 50
Boric, crystals, bbl	lb.	11½ – 11¾
Boric, powder, bbl	lb.	11 – 11½
Citric, kegs	lb	49 – 50
Formic, 85%	lb.	.15 – 17
Gallic, tech	lb.	45 – 50
Hydrochloric, 18° tanks, 100 lb		90 – 1 00
Hydrofluoric, 52%, carboys	lb.	.12 – 12½
Lactic, 44%, tech, light, bbl.	lb	11 – 11½
22% tech., light, bbl	lb	05 – 05½
Muriatic, 20°, tanks, 100 lb.		1 00 – 1 10
Nitric, 36°, carboys	lb	.04½ – 05
Nitric, 42°, carboys	lb.	06 – 06½
Oleum, 20%, tanks	ton	17.00 – 18 00
Oxalic, crystals, bbl.	lb.	.12½ – 13
Phosphoric, 50% carboys	lb	08 – 09
Pyrogallic, resublimed	lb	1 50 – 1 60
Sulphuric, 60°, tanks	ton	9 00 – 10 00
Sulphuric, 60°, drums	ton	12 00 – 14 00
Sulphuric, 66°, tanks	ton	14 50 – 15 00
Sulphuric, 66° drums	ton	19 00 – 20 00
Tannic, U.S.P., bbl.	lb.	65 – 70
Tannic, tech, bbl	lb.	.40 – 45
Tartaric, imp. crys, bbl	lb	30½ – 31
Tartaric, imp, powd, bbl.	lb.	31 – 32
Tartaric, domestic, bbl	lb	– 32
Tungstic, per lb of WO_3	lb	1 00 – 1 20
Alcohol, butyl, drums	gal	.18 – 23
Alcohol ethyl (Cologne spirit), bbl	gal	4.75 – 4 95
Alcohol, methyl (see Methanol)		
Alcohol, denatured, 188 proof No. 1	gal.	.38 – 40
Alum, ammonia, lump, bbl	lb.	.03½ – 03¾
Potash, lump, bbl	lb	.03 – 03½
Chrome, lump, potash, bbl.	lb.	.05 – 05½
Aluminum sulphate, com, bags	100 lb.	1.50 – 1 65
Iron free bags	lb.	.02¼ – .02½
Aqua ammonia, 26°, drums	lb.	.06½ – 07½
Ammonia, anhydrous, cyl	lb.	.30 – 30½
Ammonium carbonate, powd casks, imported	lb.	.09½ – 10
Ammonium carbonate, powd domestic, bbl	lb.	.13 – .14
Ammonium nitrate, tech, casks	lb.	10 – 11
Amyl acetate tech., drums	gal	2 80 – 3 05
Arsenic, white, powd, bbl	lb	15½ – 16
Arsenic, red, powd, kegs	lb.	.13 – 13½
Barium carbonate, bbl	ton	70 00 – 75 00
Barium chloride, bbl.	ton	87 00 – 95 00
Barium dioxide, drums	lb.	.18 – 18½
Barium nitrate, casks		08½ – 08¾
Barium sulphate, bbl...	lb.	04 – 04½
Blanc fixe, dry, bbl	lb	.04 – 04½
Blanc fixe, pulp, bbl	ton	45 00 – 55 00
Bleaching powder, f.o.b. wks., drums	100 lb	2 20 – 2 50
Resale drums	100 lb	2 50 – 2 75
Borax, bbl.	lb.	05½ – 05¾
Bromine, cases	lb.	25 – 27
Calcium acetate, bags	100 lb.	3 50 – 3 60
Calcium carbide, drums	lb.	04½ – 04¾
Calcium chloride, fused, drums	ton	22 00 – 23 00
Gran drums	lb.	.01½ – 01¾
Calcium phosphate, mono, bbl.	lb	06½ – 07
Camphor, cases	lb.	.91 – 93
Carbon bisulphide, drums	lb.	.07 – 07½
Carbon tetrachloride, drums	lb.	.09½ – .10
Chalk, precip domestic, light, bbl	lb.	.04½ – 04¾
Domestic, heavy, bbl	lb.	.03½ – 03¾
Imported, light, bbl	lb.	.04½ – 05
Chlorine, liquid, cylinders	lb.	06 – 06½
Chloroform, tech, drums	lb.	35 – 38
Cobalt oxide, bbl	lb.	2 10 – 2 25
Copperas, bulk, f.o.b. wks.	ton	16 50 – 20 00
Copper carbonate, bbl	lb	.19 – 20
Copper cyanide, drums	lb	.47 – 50
Copper sulphate, crys., bbl	100 lb.	6.40 – 6 50
Cream of tartar, bbl	lb.	.24 – 25
Dextrine, corn, bags	100 lb.	3.25 – 3 50
Epsom salt, dom., tech, bbl.	100 lb.	2.00 – 2.25
Epsom salt, imp, tech, bags	100 lb.	1.10 – 1.25
Epsom salt, U.S.P., dom., bbl.	100 lb.	2.50 – 2.75
Ether, U.S.P., drums	lb.	.13 – .15
Ethyl acetate, com., 85%, drums	gal.	.80 – .85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 – 1.00
Formaldehyde, 40%, bbl	lb	$0 15 – $0 16½
Fullers earth, f.o.b. mines	net ton	16 00 – 17 00
Fullers earth – imp., powd	net ton	30 00 – 32 00
Fusel oil, ref, drums	gal	3 55 – 4 05
Fusel oil, crude, drums	gal	2 30 – 2 40
Glaubers salt, wks, bags	100 lb	1 20 – 1 40
Glaubers salt, imp, bags	100 lb	1 00 – 1 25
Glycerine, c.p., drums extra	lb	18½ – 19
Glycerine, dynamite, drums	lb.	17 – 17½
Iodine, resublimed	lb	4 40 – 4 50
Iron oxide, red, casks	lb.	.12 – .18
Lead:		
White, basic cabonate, dry, casks	lb.	.09½ – 10
White, in oil, kegs.	lb.	12 – 13½
Red, dry casks	lb	11¼ – 11¾
Red, in oil, kegs	lb	13 – 14½
Lead acetate, white crys., bbl.	lb	13 – 13½
Lead arsenate, powd, bbl	lb	23 – 24
Lime Hydrated, bbl	per ton	16 80 – 17 00
Lime, Lump, bbl	280 lb	3 63 – 3 65
Litharge, comm, casks	lb	.10½ – 10¾
Lithophone, bbl	lb	06½ – 07
Magnesium carb., tech, bags	lb	08 – 08½
Methanol, 95%, bbl	gal	1 23 – 1 25
Methanol, 97%, bbl	gal	1 25 – 1 27
Nickel salt, double, bbl	lb	10 – 10½
Nickel salts, single, bbl	lb	11 – 11½
Phosgene		69 – .75
Phosphorus, red, cases	lb.	.35 – .40
Phosphorus, yellow, cases	lb.	.30 – 35
Potassium bichromate, casks	lb.	.09¾ – 10
Potassium bromide, gran, bbl	lb.	.16 – 23
Potassium carbonate, 80-85%, calcined, casks	lb.	.05¾ – 06
Potassium chlorate, powd	lb	07 – 08
Potassium cyanide, drums	lb.	.45 – .50
Potassium hydroxide (caustic potash) drums	100 lb	7 35 – 7 50
Potassium iodide, cases	lb	3 50 – 3 60
Potassium nitrate, bbl	lb	.06½ – .07
Potassium permanganate, drums	lb.	.19½ – .20
Potassium prussiate, red, casks	lb.	.80 – .85
Potassium prussiate, yellow, casks	lb.	37½ – 38
Salammoniac, white, gran, casks, imported	lb.	06½ – .06¾
Salammoniac, white, gran, bbl, domestic	lb.	.08 – .08½
Gray, gran, casks	lb.	08½ – .08¾
Salsoda, bbl	100 lb.	1.20 – 1 40
Salt cake (bulk)	ton	26 00 – 28.00
Soda ash, light, 58% flat, bags, contract	100 lb.	1.60 – 1.67
Soda ash, light, basis, 48%, bags, contract, f.o.b. wks	100 lb.	1.20 – 1.30
Soda ash, light, 58%, flat, bags, resale	100 lb.	1 75 – 1.80
Soda ash, dense, bags, contract, basis 48%	100 lb.	1.17½ – 1.20
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90
Soda, caustic, 76%, solid, drums, f.a.s	100 lb.	3.45 – 3 70
Soda, caustic, 76%, solid, drums, contract	100 lb.	3 35 – 3 40
Soda, caustic, basis 60%, wks, contract	100 lb.	2.50 – 2.60
Soda, caustic, ground and flake, contracts	100 lb.	3.80 – 3.90
Soda, caustic, ground and flake, resale	100 lb.	4.00 – 4 15
Sodium acetate, works, bags	lb.	06 – .06½
Sodium bicarbonate, bbl	100 lb.	2.00 – 2 50
Sodium bichromate, casks	lb	07¾ – .08
Sodium bisulphate (niter cake)	ton	6.00 – 7.00
Sodium bisulphite, powd., U.S.P., bbl	lb.	.04½ – .04¾
Sodium chlorate, kegs	lb.	06½ – 07
Sodium chloride	long ton	12 00 – 13 00
Sodium cyanide, cases	lb.	.20 – .23
Sodium fluoride, bbl.	lb.	.09 – .10
Sodium hyposulphite, bbl.	lb.	03 – 03½
Sodium nitrite, casks	lb.	08½ – .09
Sodium peroxide, powd, cases	lb.	.28 – .30
Sodium phosphate, dibasic, bbl.	lb.	.03¾ – .04
Sodium prussiate, yel. drums	lb.	.19 – .20
Sodium silicate (40°, drums)	100 lb.	.80 – 1.15
Sodium silicate (60°, drums)	100 lb.	2.00 – 2.25
Sodium sulphide, fused, 60-62% drums	lb.	.04 – .04½
Sodium sulphite, crys., bbl.	lb.	.03½ – .03¾
Strontium nitrate, powd., bbl.	lb.	.09½ – .10½
Sulphur chloride, yel drums.	lb.	.04½ – .05
Sulphur, crude	ton	18.00 – 20.00
Sulphur dioxide, liquid, cyl.	lb.	.08 – .08½
Sulphur, flour, bbl.	100 lb.	2.35 – 3.15
Sulphur, roll, bbl.	100 lb.	$2 00 – $2 50
Talc—imported, bags	ton	30 00 – 40 00
Talc—domestic powd, bags.	ton	18 00 – 25 00
Tin bichloride, bbl	lb.	11 – 11½
Tin oxide, bbl	lb.	.47 – 48
Zinc carbonate, bags	lb.	14 – .14½
Zinc chloride, gran, bbl	lb.	06 – 07
Zinc cyanide, drums	lb.	.37 – 38
Zinc oxide, XX, bbl	lb.	07½ – 08
Zinc sulphate, bbl.	100 lb.	2 75 – 3 00

Coal-Tar Products

Alpha-naphthol, crude, bbl	lb.	$0 80 – $0.85
Alpha-naphthol, ref, bbl	lb.	1 05 – 1.10
Alpha-naphthylamine, bbl	lb.	.27 – .30
Aniline oil, drums	lb.	.16½ – .17
Aniline salts, bbl	lb.	.24 – .25
Anthracene, 80%, drums	lb.	.75 – 1.00
Anthracene, 80%, imp, drums, duty paid	lb.	.65 – .70
Anthraquinone, 25%, paste, drums	lb.	.70 – .75
Benzaldehyde U.S.P., carboys	lb.	1.40 – 1.45
Benzene, pure, water-white, tanks and drums	gal.	30 – .35
Benzene, 90%, tanks & drums	gal.	.26 – .32
Benzene, 90%, drums, resale	gal.	.32 – .34
Benzidine base, bbl	lb.	.85 – .90
Benzidine sulphate, bbl	lb.	.75 – .80
Benzoic acid, U.S.P., kegs	lb	.72 – .75
Benzoate of soda, U.S.P., bbl.	lb.	.57 – .65
Benzyl chloride, 95-97%, ref., drums	lb.	.25 – .27
Benzyl chloride, tech, drums	lb.	.20 – .23
Beta-naphthol, subl, bbl	lb.	.55 – .60
Beta-naphthol, tech, bbl	lb.	.24 – .25
Beta-naphthylamine, tech	lb.	1.00 – 1.25
Carbazol, bbl	lb.	.75 – .90
Cresol, U.S.P., drums.	lb.	.25 – .29
Ortho-cresol, drums	lb.	.24 – .26
Cresylic acid, 97%, resale, drums	gal.	1.50 – 1 75
95-97%, drums, resale	gal.	1.50 – 1.75
Dichlorbenzene, drums	lb.	.07 – .09
Diethylaniline, drums	lb.	.50 – .60
Dimethylaniline, drums	lb.	.41 – .42
Dinitrobenzene, bbl	lb.	.20 – .22
Dinitroclorbenzene, bbl.	lb.	.22 – .23
Dinitronaphthalene, bbl.	lb.	.30 – .32
Dinitrophenol, bbl	lb.	.35 – .40
Dinitrotoluene, bbl	lb.	.22 – .24
Dip oil, 25%, drums	gal.	.25 – .30
Diphenylamine, bbl.	lb.	.53 – .55
H-acid, bbl.	lb.	.80 – .85
Meta-phenylenediamine, bbl.	lb.	.95 – 1.00
Michlers ketone, bbl	lb.	3.00 – 3.50
Monochlorbenzene, drums	lb.	.08 – .10
Monoethylaniline, drums	lb.	.95 – 1.10
Naphthalene, crushed, bbl.	lb.	.05½ – .06
Naphthalene, flake, bbl.	lb.	.06 – .06½
Naphthalene, balls, bbl.	lb.	.07 – .07½
Naphthionate of soda, bbl.	lb.	.58 – .65
Naphthionic acid, crude, bbl.	lb.	.60 – .65
Nitrobenzene, drums	lb.	.10 – .12
Nitro-naphthalene, bbl.	lb.	.30 – .35
Nitro-toluene, drums.	lb.	.15 – .17
N-W acid, bbl	lb.	1.15 – 1.20
Ortho-amidophenol, kegs	lb.	2.30 – 2.35
Ortho-dichlorbenzene, drums	lb.	.17 – .20
Ortho-nitrophenol, bbl.	lb.	.90 – .92
Ortho-nitrotoluene, drums	lb.	.10 – .12
Ortho-toluidine, bbl.	lb.	.13 – .15
Para-amidophenol, base, kegs	lb.	1.15 – 1.20
Para-amidophenol, HCl, kegs	lb.	1.20 – 1.25
Para-dichlorbenzene, bbl.	lb.	.17 – .20
Paranitraniline, bbl	lb.	.74 – .75
Para-nitrotoluene, bbl.	lb.	.55 – .65
Para-phenylenediamine, bbl.	lb.	1.50 – 1.55
Para-toluidine, bbl	lb.	.85 – .90
Phthalic anhydride, bbl.	lb.	.35 – .38
Phenol, U.S.P., drums	lb.	.34 – .35
Picric acid, bbl	lb.	.20 – .22
Pyridine, dom, drums	gal.	nominal
Pyridine, imp, drums	gal.	2 30 – 2.50
Resorcinol, tech., kegs	lb.	1.50 – 1.55
Resorcinol, pure, kegs	lb.	2.00 – 2.10
R-salt, bbl.	lb.	.55 – .60
Salicylic acid, tech, bbl.	lb.	.40 – .42
Salicylic acid, U.S.P., bbl.	lb.	.45 – .47
Solvent naphtha, water-white, drums	gal.	.37 – .40
Crude, drums	gal.	.22 – .24
Sulphanilic acid, crude, bbl.	lb.	.18 – .20
Thiocarbanilide, kegs	lb.	.35 – .38
Toluidine, kegs	lb.	1.20 – 1.30
Toluidine, mixed, kegs	lb.	.30 – .35
Toluene, tank cars	gal.	.35 – .37
Toluene, drums	gal.	.40 – .43
Xylidines drums	lb.	.40 – .45
Xylene, pure, drums	gal.	.45 – .50
Xylene, com., drums	gal.	.40 – .42
Xylene, com., ta...	gal.	.30 – ....

Naval Stores

Rosin B-D, bbl.	280 lb.	$6 00 –	
Rosin E-I, bbl.	280 lb.	6 10 –	$6 25
Rosin K-N, bbl.	280 lb.	6 40 –	6 80
Rosin W.G.-W.W., bbl.	280 lb.	7 25 –	7 95
Wood rosin, bbl	280 lb.	6 25 –	
Turpentine, spirits of, bbl	gal.	1 51 –	1 52
Wood, steam dist., bbl.	gal.	1 35 –	
Wood, dest. dist., bbl.	gal.	1 25 –	
Pine tar pitch, bbl.	200 lb.	–	6 00
Tar, kiln burned, bbl.	500 lb.	–	12 00
Retort tar, bbl.	500 lb.	–	11 00
Rosin oil, first run, bbl.	gal.	.43	
Rosin oil, second run, bbl.	gal.	.47 –	...
Rosin oil, third run, bbl.	gal.	.53 –	
Pine oil, steam dist	gal.	–	90
Pine oil, pure, dest. dist.	gal.	–	85
Pine tar oil, ref.	gal.	–	.46
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla	gal.	–	35
Pine tar oil, double ref, bbl.	gal.	–	75
Pine tar, ref., thin, bbl	gal.	–	25
Pinewood creosote, ref, bbl.	gal.	–	52

Vegetable Oils

Castor oil, No 3, bbl	lb	$ 12¾ –	$ 13
Castor oil, AA, bbl	lb	.13¼ –	13½
Chinawood oil, bbl.	lb.	.18½ –	18¾
Coconut oil, Ceylon, bbl.	lb	09½ –	9¾
Coconut oil, Cochin, bbl.	lb.	09¾	10
Corn oil, crude, bbl	lb	.11¼ –	.11½
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	10 –	10
Summer yellow, bbl.	lb.	.12 –	12¼
Winter yellow, bbl	lb	13	13¼
Linseed oil, raw, car lots, bbl.	gal	98 –	99
Raw, tank cars (dom.)	gal.	94 –	95
Boiled, 5-bbl lots (dom)	gal	1 02	1 04
Olive oil, denatured, bbl.	gal	1 10 –	1 15
Palm, Lagos, casks	lb	08 –	08¼
Palm kernel, bbl	lb	.08¾ –	09
Peanut oil, crude, tanks (mill)	lb.	.13½ –	.13¾
Peanut oil, refined, bbl	lb.	16 –	16½
Rapeseed oil, refined, bbl	gal	.85 –	86
Rapeseed oil, blown, bbl	gal	90 –	91
Soya bean (Manchurian), bbl	lb	.12 –	
Tank, f.o.b. Pacific coast	lb	.10⅛	

Fish Oils

Menhaden, light pressed, bbl.	gal	$0.60 –	
White bleached, bbl	gal	64 –	65
Blown, bbl	gal.	68 –	69
Whale No 1 crude, tanks, coast	lb	06 –	06½

Dye & Tanning Materials

Divi-divi, bags	ton	$38 00	$39 00
Fustic, sticks	ton	30 00	35 00
Fustic, chips, bags	lb	04 –	05
Logwood, sticks	ton	28 00 –	30 00
Logwood, chips, bags	lb.	02½ –	03½
Sumac, leaves, Sicily, bags	ton	65 00 –	
Sumac, ground, bags.	ton	55 00 –	60 00
Sumac, domestic, bags	ton	35 00 –	
Tapioca flour, bags.	lb	03¾	05

EXTRACTS

Archil, conc, bbl	lb	$0 17	$0 18
Chestnut, 25% tannin, tanks	lb	02 –	03
Divi-divi, 25% tannin, bbl	lb	04 –	05
Fustic, crystals, bbl	lb	20 –	22
Fustic, liquid, 42°, bbl	lb	08 –	09
Gambier, liq, 25% tannin, bbl.	lb.	08 –	09
Hematine crys, bbl	lb.	14	18
Hemlock, 25% tannin, bbl	lb	04 –	05
Hypernic, solid, drums	lb	.24 –	26
Hypernic, liquid, 51°, bbl.	lb	14 –	17
Logwood, crys., bbl	lb	19 –	20
Logwood, liq, 51°, bbl	lb	09 –	10
Quebracho, solid, 65% tannin, bbl.	lb.	.04½ –	05
Sumac, dom., 51°, bbl.	lb.	.06½ –	07

Waxes

Bayberry, bbl.	lb.	$0 28 –	$0 30
Beeswax, refined, dark, bags	lb.	30 –	32
Beeswax, refined, light, bags.	lb	34 –	35
Beeswax, pure white, cases.	lb	40 –	41
Candelilla, bags	lb	33 –	34
Carnauba, No. 1, bags	lb	.38 –	40
No. 2, North Country, bags	lb	.24 –	24½
No. 3, North Country, bags	lb.	17½ –	18½
Japan, cases	lb.	15 –	15½
Montan, crude, bags.	lb	.03½ –	.04
Paraffine, crude, match, 105-110 m p.	lb.	.04 –	04½
Crude, scale 124-126 m.p., bags	lb.	.02½ –	.02¾
Ref., 118-120 m.p, bags	lb.	.03⅛ –	.03½
Ref., 125 m p, bags	lb.	.03½ –	.03¾
Ref. 128-130 m.p., bags	lb.	.04 –	.04¼
Ref., 133-135 m.p., bags.	lb.	.04½ –	.04¾
Ref., 135-137 m.p., bags	lb.	05 –	05½
Stearic acid, sgle pressed, bags	lb	.10 –	10½
Double pressed, bags	lb.	.10½ –	.10¾
Triple pressed, bags	lb	.11 –	11½

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb.	$3 20 –	$3 25
F.a.s double bags	100 lb.	3 85 –	3 95
Blood, dried, bulk	unit	4.60 –	
Bone, raw, 3 and 50, ground	ton	30.00 –	35 00
Fish scrap, dom., dried, wks.	unit	5 00 –	5.10
Nitrate of soda, bags	100 lb.	2.60 –	2.65
Tankage, high grade, f.o.b. Chicago	unit	4.70 –	4 80

Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$3.50 –	$4 00
Tennessee, 78-80%	ton	7 00 –	8 00
Potassium muriate, 80%, bags	ton	35 00 –	36 00
Potassium sulphate, bags	unit	1 00 –	

Crude Rubber

Para—Upriver fine	lb	$0 33 –	$0.33½
Upriver coarse	lb	27½ –	.28
Upriver caucho ball	lb	29½ –	30
Plantation—First latex crepe	lb	35½ –	35¾
Ribbed smoked sheets	lb	.35½ –	.35¾
Brown crepe, thin, clean	lb	31 –	32
Amber crepe No 1	lb	31 –	32

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh. ton	$450 00 –	$550 00
Asbestos, shingle, f.o.b., Quebec	sh ton	60 00 –	80 00
Asbestos, cement, f.o.b., Quebec	sh ton	15 00 –	17 00
Barytes, grd, white, f.o.b mills, bbl	net ton	16 00 –	20 00
Barytes, grd., off-color, f.o.b. mills bulk	net ton	13 00 –	21 00
Barytes, floated, f.o.b St Louis, bbl	net ton	24 00 –	28 00
Barytes, crude f.o.b mines, bulk	net ton	8 50 –	9 00
Casein, bbl, tech	lb	11 –	12
China clay (kaolin) crude, f.o.b Ga	net ton	7 00 –	9 00
Washed, f.o.b Ga	net ton	8 00 –	9 00
Powd, f.o.b Ga	net ton	13 00 –	20 00
Crude f.o.b Va	net ton	8 00 –	12 00
Ground, f.o.b Va	net ton	13 00 –	20 00
Imp, lump, bulk	net ton	15 00 –	20 00
Imp, powd	net ton	45 00 –	50 00
Feldspar, No. 1 pottery	long ton	6 00 –	7 00
No. 2 pottery	long ton	5 00 –	5 50
No 1 soap	long ton	7 00 –	7 50
No. 1 Canadian, f.o.b mill	long ton	25 00 –	27 00
Graphite, Ceylon, lump, first quality, bbl	lb	06 –	.06½
Ceylon, chip, bbl	lb	05 –	05½
High grade amorphous crude	ton	35 00 –	50 00
Gum arabic, amber, sorts, bags	lb	15 –	16
Gum tragacanth, sorts, bags	lb	50 –	60
No 1, bags	lb	1 75 –	1 80
Kieselguhr, f.o.b. Cal	ton	40 00 –	42 00
F.o.b N Y	ton	50 00 –	55 00
Magnesite, crude, f.o.b Cal	ton	14 00 –	15 00
Pumice stone, imp, casks	lb	03 –	.05½
Dom, lump, bbl	lb	05 –	05½
Dom, ground, bbl	lb.	06 –	07
Shellac, orange fine, bags	lb	82 –	83
Orange superfine, bags	lb.	84 –	.85
A C garnet, bags	lb	79 –	80
T N, bags	lb	80 –	81
Silica, glass sand, f.o.b Ind	ton	2 00 –	2 50
Silica, sand blast, f.o.b Ind	ton	2 50	5 00
Silica, amorphous, 250-mesh, f.o.b Ill	ton	17 00 –	17 50
Silica, bldg sand, f.o.b Pa.	ton	2 00 –	2 75
Soapstone, coarse, f.o.b. Vt, bags	ton	7 00 –	8 00
Talc, 200 mesh, f.o.b, Vt, bags	ton	6 50 –	9 00
Talc, 200 mesh, f.o.b. Ga., bags	ton	7 00 –	9 00
Talc, 200 mesh, f.o.b Los Angeles, bags	ton	16 00 –	20.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	ton	$45–50
Chrome brick, f.o.b Eastern shipping points	ton	50–52
Chrome cement, 40-50% Cr_2O_3	ton	23–27
40-45% Cr_2O_3, sacks, f.o.b Eastern shipping points.	ton	23 00
Fireclay brick, 1st quality, 9-in shapes, f.o.b Ky wks.	1,000	40–46
2nd quality, 9-in. shapes, f.o.b. wks.	1,000	36–41
Magnesite brick, 9-in. straight (f.o.b. wks)	ton	65 68
9-in arches, wedges and keys	ton	80–85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9-in. sizes, f.o.b Birmingham district	1,000	48–50
F.o.b. Mt Union, Pa	1,000	42–44
Silicon carbide refract. brick, 9-in.	1,000	1,100 00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N.Y.	ton	$200 00 –	$225 00
Ferrochromium, per lb. of Cr, 6-8% C	lb	.11½	.11½
4-6% C.	lb.	.12 –	.13
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid.	gr. ton	105.00 –	107 50
Spiegeleisen, 19-21% Mn	gr. ton	35 00 –	37.00
Ferromolybdenum, 50-60% Mo, per lb Mo.	lb.	1.90 –	2 15
Ferrosilicon, 10-15%	gr. ton	38.00 –	40.00
50%	gr. ton	80.00 –	85.00
75%	gr. ton	150.00 –	160.00
Ferrotungsten, 70-80%, per lb of W.	lb.	$0.90 –	$0.95
Ferro-uranium, 35-50% of U per lb of U	lb.	6.00 –	....
Ferrovanadium, 30-40%, per lb of V	lb	3.50 –	4.00

Ores and Semi-finished Products

Bauxite, dom crushed, dried, f.o.b shipping points	ton	$6 50 –	$8.75
Chrome ore, Calif concentrates, 50%, min Cr_2O_3	ton	22 00 –	23.00
C.i.f. Atlantic seaboard	ton	18 50 –	19.00
Coke, fdry, f.o.b ovens	ton	7 75 –	8 25
Coke, furnace, f.o.b ovens	ton	6 75 –	7.00
Fluorspar, gravel, f.o.b. mines, New Mexico	ton	17.50 –	....
Fluorspar, No 2 Lump—Ky & Ill mines	ton	25.00 –	....
Ilmenite, 52% TiO_2	lb.	.01½ –	.01¾
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.33 –	.....
Manganese ore, chemical (MnO_2)	ton	75.00 –	80.00
Molybdenite, 85% MoS_2, per lb MoS_2, N Y	lb.	.65 –	.70
Monazite, per unit of ThO_2, c.i.f., Atl seaport	lb.	.06 –	08
Pyrites, Span, fines, c.i.f Atl seaport	unit	.11½ –	.12
Pyrites, Span, furnace size, c.i.f Atl seaport	unit	.11½ –	.12
Pyrites, dom. fines, f.o.b mines, Ga	unit	.12	
Rutile, 95% TiO_2	lb	.12 –	....
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.50 –	8.75
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	8.00 –	8 25
Uranium ore (carnotite) per lb of U_3O_8	lb	3.50 –	3.75
Uranium oxide, 96% per lb U_3O_8	lb	2.25 –	2.50
Vanadium pentoxide, 99%	lb.	12 00 –	14 00
Vanadium ore, per lb V_2O_5	lb.	1.00 –	....
Zircon, washed, iron free, f.o.b Pablo, Fla	lb.	04½ –	.13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	16 00@16.125
Aluminum, 98 to 99%	24 00
Antimony, wholesale, Chinese and Japanese	7.15 7.50
Nickel, virgin metal	25 00–27.00
Nickel, ingot and shot	29 00
Monel metal, shot and blocks	32.00
Monel metal, ingots	38 00
Monel metal, sheet bars	45.00
Tin, 5-ton lots, Straits	43 125
Lead, New York, spot	8 00
Lead, E St Louis, spot	8 00–8.15
Zinc, spot, New York	7 55–7.60
Zinc, spot, E. St Louis	7.20–7.30

OTHER METALS

Silver (commercial)	oz.	$0 64⅛
Cadmium	lb	1 15
Bismuth (500 lb lots)	lb.	2 55
Cobalt	lb	3 00@3.25
Magnesium, ingots, 99%	lb	1 00@1 05
Platinum	oz	110 00@114 00
Iridium	oz.	260 00@275.00
Palladium	oz.	79.00
Mercury	75 lb.	70.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.75
Copper bottoms	30.75
Copper rods	20 50
High brass wire	19.50
High brass rods	17.00
Low brass wire	21.10
Low brass rods	22 00
Brazed brass tubing	24.25
Brazed bronze tubing	29.00
Seamless copper tubing	25.25
Seamless high brass tubing	23.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound.

Copper, heavy and crucible	11 30@11.50
Copper, heavy and wire	11 25@11.50
Copper, light and bottoms	9.25@ 9.50
Lead, heavy	5.75@ 6.00
Lead, tea	3.50@ 3.75
Brass, heavy	6.25@ 6.40
Brass, light	5.35@ 5.75
No. 1 yellow brass turnings	6.30@ 6.50
Zinc	3.50@ 4.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named.

	New York	Chicago
Structural shapes	$3.29	$3.14
Soft steel bars	3.19	3.04
Soft steel bar shapes	3.19	3.04
Soft steel bands	3.29	3.19
Plates, ¼ to 1 in. thick	3.29	3.14

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

GADSDEN—The Alabama Co., Union Trust Bldg., Baltimore, Md., E. N. Rich, president, has acquired a tract of property totaling about 100 acres on the Shinbone Ridge, near Gadsden, comprising extensive iron ore properties, and plans for large development work. A plant will be installed at an early date.

Arizona

MIAMI—The Inspiration Copper Co. will commence immediately the construction of an addition to its mill. A contract for the steel frame work has been awarded.

California

LOS ANGELES—The California Paint Remover Co., 712 Crocker St., is planning for the erection of a new 1-story plant on 11th St., to be 115x160 ft., estimated to cost close to $30,000, with equipment.

LODI—The American-Mexican Ramie Co. has tentative plans under consideration for the erection of a new local plant for fiber refining for commercial service. G. W. Schlichten is president.

LOS ANGELES—The Mexican Petroleum Co., 120 Broadway, New York, N. Y., has acquired property at Los Angeles Harbor, and plans for the construction of a new oil refinery. It will consist of a number of buildings and is estimated to cost in excess of $6,000,000, with machinery. E. L. Doheny, Los Angeles, is president.

HUNTINGTON BEACH—The Pacific Gasoline Co., Los Angeles, is planning for the construction of a large gasoline absorption plant on local site recently acquired. The plant will be operated for gasoline production in co-operation with the Amalgamated Oil Co., and is estimated to cost more than $100,000. W. J. Bower is president and general manager. E. T. Hitchcock will be in charge of construction.

OAKLAND—The Western Rock Products Co., Balboa Bldg., San Francisco, has acquired property at the foot of 85th Ave., Oakland, as a site for the erection of a new plant for the manufacture of pigments and other paint ingredients. Plans will be drawn at once.

LOS ANGELES—The Pacific Coast Borax Co., Kohl Bldg., San Francisco, is taking bids on a general contract for the erection of the first unit of its proposed new refining plant at Los Angeles Harbor, estimated to cost approximately $500,000. The installation will include a power plant and machine shop. Albert C. Martin, Higgins Bldg., Los Angeles, is architect.

Connecticut

SOUTHBURY—Fire, Feb. 15, destroyed a portion of the local paper-manufacturing plant of the Diamond Match Co., 111 Broadway, New York, N. Y., with loss estimated at $100,000, including equipment. It is planned to rebuild.

HARTFORD—The Hartford City Gas Light Co., 565 Main St., will commence immediately the erection of a reinforced concrete addition to its artificial gas plant, estimated to cost approximately $35,000. Buck & Sheldon, 60 Prospect St., Hartford, are engineers.

Florida

SARASOTA—J. D. Hazen is planning for the erection of a new 1-story foundry in connection with a new marine repair plant to be constructed in the Hog Creek Basin section.

EUSTIS—The A. J. Wolz Sons Co., operating a local brick-manufacturing plant, will make a number of additions and improvements, including the installation of additional machinery.

MIAMI—The Sun Oil Co. will install a new storage and distributing plant on site at Alton Rd. and Third St., estimated to cost approximately $50,000.

Georgia

HELEN—The Smethport Extract Co., Damascus, Va., has purchased property near Helen heretofore held by the Morse Brothers Lumber Co., and plans for the early erection of a new plant for the production of tannic acid for leather tanning and other service. It will cost about $25,000.

Illinois

ROCK ISLAND—The Servus Rubber Co., 101 Central Park Bldg., has tentative plans under consideration for the erection of an addition to its plant for considerable increase in capacity. It is expected to build five new factory units. J. J. Adams is president.

CHICAGO—The Hoffman Brothers Tanning Co., 1701 Grand Ave., has taken bids and will soon award a general contract for the erection of a 2-story and basement addition, 25x100 ft., at Grand and Kilpatrick Aves. August C. Wilmanns, 38 South Dearborn St., is architect. C. D. Hoffman is president.

Indiana

EVANSVILLE—The Best Brick Co. is planning for extensions in its plant for increased output. Machinery to cost about $12,000 will be installed.

SHELBYVILLE—The Kennedy Car Liner & Bag Co. has awarded a contract to the H. K. Ferguson Co., Cleveland, O., for the erection of a new plant, 250x100 ft., for the manufacture of paper products, to replace a portion of its works recently destroyed by fire. The structure is estimated to cost about $100,000, including equipment. Fred W. Kennedy is president.

Kansas

PERU—The Mid-Continent Clay Co. is arranging for the discontinuance of face-brick manufacture, and will devote its entire plant to the production of burned clay roofing tile and tile slabs. Necessary facilities will be installed for the change.

Kentucky

ASHLAND—The American Rolling Mill Co. is arranging for the immediate rebuilding of its chemical laboratory at the local works, destroyed by fire, Feb. 12. Headquarters of the company are at Middletown, Ohio.

Louisiana

ELIZABETH—The Calcasieu Mfg. Co. has construction under way on a new local paper mill and plans to install machinery at an early date. The plant will be ready for service in the spring. It is estimated to cost in excess of $75,000.

Maryland

BALTIMORE—The Piccadilly Ink Co., recently incorporated with a capital of $100,000, to manufacture writing and other inks, has acquired the 3-story building, 25x30 ft., at 872 Linden Ave., for a new plant and will take immediate possession. A large portion of the structure will be given over to analytical laboratories, and equipment will be installed at once. R. F. Humphries, Jr., is president, and E. H. Wight, director.

BALTIMORE—The Board of Awards office of the City Register, City Hall, will receive bids until March 7 for additions to the Monte-Bello filtering plant at the municipal waterworks, as per plans and specifications at the office of William A. Megraw, Room 204, City Hall, Baltimore, water engineer.

Michigan

ST. JOSEPH—Frank S. Bicking, West Chester, Pa., formerly an official of the S. Austin Bicking Paper Co., East Downingtown, Pa., has acquired the plant and property of the Mullen Brothers Paper Co., St. Joseph, at a sale in bankruptcy, for a consideration said to be in excess of $93,000. The new owner is said to be planning for the organization of a new company to take over and operate the plant. A number of improvements will be made.

Minnesota

ST. PAUL—The Waldorf Paper Products Co., Hampden and Wabash Aves., is completing plans and will take bids early in March, for the erection of a new plant at Hampden and Myrtle Aves., to be 5-story, 83x250 ft., estimated to cost approximately $250,000, including machinery. H. A. Sullwold, 611 Endicott Bldg., St. Paul, is architect.

Missouri

ASH GROVE—The Ash Grove Lime & Portland Cement Co. is planning for improvements at its plant, including the erection of a new power house, estimated to cost about $75,000.

Massachusetts

PEABODY—The Griess-Pfleger Tanning Co., 810 Sycamore St., Cincinnati, O., has acquired the local tanning plant of J. T. O'Shea. The structure was recently completed and has never been occupied. The new owner plans for the immediate installation of machinery and will operate as a branch tannery for the production of finished calfskin. It is purposed to develop an output of 250 doz. calfskins daily.

Nebraska

OMAHA—Armour & Co., Union Stock Yards, Chicago, Ill., are considering plans for the rebuilding of the portion of their packing plant at South Omaha, destroyed by fire, Feb. 15, with loss reported in excess of $1,500,000, including lard refineries and other structures.

New Jersey

NEWARK—The Anglo-American Varnish Co., 53 Johnston Ave., has filed plans for the erection of an addition to its plant to cost about $22,000. Fred A. Phelps, Union Bldg., is architect.

BAYONNE—The Ingram Richardson Mfg. Co., Beaver Falls, Pa., manufacturer of porcelain enameled iron signs, etc., has awarded a contract to James Mitchell, Inc., 999 Bergen Ave., Jersey City, N. J., for the erection of its proposed new local plant, to be 1-story, reinforced-concrete, 181x321 ft. Work will be placed under way at once. The A. M. Allen Co., 7016 Euclid Ave., Cleveland, O., is architect and engineer.

TRENTON—The General Chinaware Corp., 15 Broad St., New York, N. Y., recently organized to manufacture sanitary earthenware products, has acquired the former local plant of the New Jersey Chinaware Co., and will conduct operations at this location. Extensive production is planned; improvements will be made in the plant.

KEARNY—Swift & Co., Harrison Turnpike, are planning for the rebuilding of the laboratory at their local meat-packing plant, destroyed by fire, Feb. 8, with loss reported at $8,000. Headquarters of the company are at the Union Stock Yards, Chicago, Ill.

New York

BUFFALO—The Mineral Potash Corp., care of J. P. Andrews & Co., 514 Brisbane Bldg., is planning for the installation of a commercial feldspar plant, including grinding, crushing and pulverizing machinery, tramway, air compressors and auxiliary equipment. To provide for the installation, the company is disposing of a stock issue of $300,000, the entire proceeds to be used for this purpose.

BROOKLYN—Gerstendorfer Brothers, 231 East 42nd St., manufacturers of bronze powders, etc., have awarded a contract to the John W. Ferguson Co., United Bank Bldg., Paterson, N. J., for the erection of their proposed new plant at Clinton and Lorraine Sts., Brooklyn, to be 1-story, 25x200 ft., with three 1-story structures adjoining, 40x41 ft., 40x45 ft. and 30x500 ft. The last noted will be equipped for the manufacture of varnishes. The new plant is estimated to cost $385,000, including machinery. Russell G. Cory, 30 Church St., New York, is architect and engineer. Edward Eckart heads the company.

Ohio

PORT CLINTON—The American Gypsum Co. is considering plans for the erection of a new mill at its local plant, estimated to cost approximately $100,000, including machinery. F. J. Griswold is in charge.

PORTSMOUTH—Plans are nearing completion for the construction of a new 1-story foundry, 100x300 ft., at the plant of the

Ohio Stove Co., estimated to cost $75,000, to be used for the production of iron castings. The Austin Co., Euclid Ave, Cleveland, is engineer and contractor.

ASHTABULA—The Ashtabula Gas Co., in conjunction with the local city council and the Northeastern Oil & Gas Co, has preliminary plans in progress for the construction of a new artificial gas plant for local and neighboring service, estimated to cost close to $1,000,000. F W. Stone, manager, is in charge

Oklahoma

COLGATE—The Western Carbon Co is selecting a site in Coal County for the construction of a new plant for the production of carbon black, estimated to cost about $350,000, with machinery. Roy C. Morrison is local representative

OKLAHOMA CITY—The Noble Oil & Gas Co has acquired a local oil-refining plant and plans for extensions and improvements, including the installation of additional equipment

Oregon

HUNTINGTON—The Sun Portland Cement Co has work in progress on the first unit of its proposed new local cement mill, estimated to cost in excess of $100,000, and plans to place the plant in service at the earliest date It is proposed to build two other plant units in the near future Headquarters of the company are at Portland, Ore

Pennsylvania

LEHIGHTON—The Aluminum Pigment & Products Co will commence immediately the construction of a new 1-story plant

PHILADELPHIA—The Bisbee Linseed Co, Drexel Bldg, has filed plans for the construction of a new 1-story building at Delaware Ave and Bigler St, to cost about $15,000

QUAKERTOWN The Krupp Foundry Co, Inc, Lansdale, Pa., manufacturer of cast-iron pipe, has acquired a local site for the erection of a new 1-story foundry, 125x200 ft, to be operated as a branch plant Bids for construction will be taken at once

BOWMANSVILLE—The Prince Metallic Paint Co will make enlargements in its plant for considerable increase in production Additional machinery will be installed

YORK—William H Grothe, Boundary Ave, operating a brick-manufacturing plant, will remodel and improve the works Additional machinery will be installed to double, approximately, the present output

WILKES-BARRE—Abraham Gast has acquired the local plant of the Wyoming Tire & Rubber Co at a receiver's sale. The new owner is said to be planning for the organization of a company to operate the factory

Tennessee

NASHVILLE The Hermitage Portland Cement Co, Chattanooga, has perfected plans for the immediate erection of its proposed new plant on site near Nashville, to have an initial daily output of 2,000 bbl It will consist of a number of buildings and is estimated to cost more than $500 000, with machinery John C. Vance is president

CHATTANOOGA—The Chattanooga Stamping & Enameling Co. has commenced the installation of new electric furnaces and other equipment at its plant to cost about $30,000 The capacity will be increased approximately one-third.

MEMPHIS—Fire, Feb. 7, destroyed the building occupied by the Myers Paper Co, with loss estimated at close to $100,000 It is planned to rebuild.

PURYEAR—The Dixie Brick & Tile Co will commence immediately the construction of additions to its plant, including the installation of clay-grinding, brick-manufacturing and other machinery It is purposed to advance the capacity from 30,000 to 40,000 face-brick per day Walter H. Jackson, Calconda, Ill, is engineer in charge of construction. O A Harker, Jr., is president.

Texas

EL PASO—The Rio Grande Oil Co is planning for the construction of additions to its local oil refinery and the branch refining plant at Phoenix, Ariz; the work will include the installation of considerable new machinery. It is also expected to build a new refinery on site to be selected at Los Angeles, Calif The company has recently increased its capital from $750,000 to $1,500 000 for proposed expansion.

DALLAS—The Wax Wrap Paper Co., recently organized, has acquired a local building for the establishment of a plant for the manufacture of waxed papers. It is expected to develop an output of 10,000 lb. per day Machinery will be installed at an early date. J L Parchman is secretary.

Utah

EUREKA The Eureka Smelting & Mining Co. has plans under way for the construction of a new smelting plant at its properties, estimated to cost in excess of $400,000 The company has recently acquired the plant and properties of the Eureka-Croesus Mining Co. Frank L Torres is president.

Virginia

RICHMOND—The Wortendyke Mfg Co, East 13th St, is having preliminary plans prepared for the erection of a new plant for the manufacture of paper products, to be located in the South Richmond district. It will be 3-story, and is estimated to cost $200,000 Joseph H Wallace & Co, 5 Beekman St, New York, is engineer.

West Virginia

LUMBERPORT—The Radio Glass Co, recently organized as a subsidiary of the Mound City Glass Co, will soon commence the construction of a new plant on site adjoining the works of the parent organization The initial works will be equipped for light cutting, needle etching, plate etching and kindred service and is estimated to cost in excess of $10,000. E P. Boggess, president of the Mound City company, heads the new organization.

CHARLESTON—The Libbey-Owens Sheet Glass Co, Nicholas Bldg, Toledo, O, is taking bids for the erection of the proposed 2-story addition to its local plant, 45x200 ft., estimated to cost $300,000, including equipment The Devore Co, Nicholas Bldg, is engineer D D Libbey is president

Wisconsin

WAUKESHA—The Harvey Paper Co, 543 West Main St, plans to have work under way on a new local mill at an early date It will cost about $10,000 H C Harvey is president

Capital Increases, etc.

THE PORTSMOUTH COTTON OIL & REFINING CO, Portsmouth, Va, has filed notice of increase in capital from $1,750,000 to $2,000,000, for proposed expansion John Aspergren is president

THE NEW YORK GUMMED PAPER CO, 25 Dey St, New York, N Y, has arranged for an increase in capital from $5,000 to $75 000.

THE MCWANE CAST IRON PIPE CO, Birmingham Ala, has filed notice of increase in capital from $100,000 to $200,000, the proceeds to be used in part for the erection of a new plant, now in progress, and for general expansion.

THE CONTINENTAL SUGAR CO, Nasby Bldg., Toledo, O, is disposing of a bond issue of $1,700,000, a portion of the proceeds to be used for general financing and operations. C. G. Edgar is president.

THE E T MANKIN CO, INC., Richmond. Va manufacturer of clay products, has filed notice of increase in capital from $20,000 to $150,000 for general expansion, at the same time changing its name from Burroughs & Mankin, Inc.

THE AMERICAN CONCRETE PRODUCTS CO., INC, 30 North La Salle St, Chicago, Ill., has filed notice of increase in capital from $25,000 to $50,000

THE SINCLAIR CRUDE PRODUCING CO, Tulsa, Okla, affiliated with the Sinclair Refining Co, 45 Nassau St., New York, N Y, is disposing of a bond issue of $20 000,000, a portion of the proceeds to be used for extensions in oil plants and system. H L Phillips is president.

Walter C Ellis has been appointed receiver for the UNITED STATES WAXED & COATED PAPER CO, 511 Mulberry St, Newark, N. J

THE CICERO-CHICAGO CORRUGATING CO, Cicero, Ill, has filed notice of increase in capital from $100,000 to $200,000

Officials of the Air Reduction Co, 342 Madison Ave., New York, N. Y, manufacturer of commercial oxygen, acetylene, etc, and the Braun Corp, New High St., Los Angeles, Calif., manufacturer of chemical apparatus, have organized a new company to be known as the CALIFORNIA CYANIDE CO., to manufacture sodium cyanide and other chemical products. It is purposed to build a local plant. F. W. Braun has been elected president.

Industrial Developments

GLASS—The Marienville Glass Bottle Co. has commenced operations at its new plant at Marienville Pa, and will develop capacity production with a full working force. The plant represents an investment of about $75 000, and replaces a works recently destroyed by fire

Window glass-manufacturing plants in western Pennsylvania are running at full capacity and will maintain this basis of output for an indefinite period. Record shipments are being made.

The Ruth-Hastings Glass Co, Conshohocken, Pa., specializing in the manufacture of glass tubing, has resumed operations at its local plant after a shutdown for many months It is expected to advance production at an early date, giving employment to an increased working force

Negotiations are said to be under way for the purchase of the plant of the American Plate Glass Co James City, near Kane, Pa., by New York interests, for a consideration of close to $5,000,000 The plant will be developed to maximum capacity by the new owners

CERAMIC—The Central Refractories Co., New Lexington, O, has completed improvements and the installation of additional equipment at its local plant, and purposes to operate at on a capacity basis, giving employment to a full working force. Improvements will also be made at the Orviston, O plant, and maximum output developed at this works

The National Fire Proofing Co., Pittsburgh, Pa, is operating its East Palestine, O, plant at full capacity, and is said to have orders on hand to insure continuance on this basis for an indefinite period. The branch plants at Keasbey and Natco, N. J., are also running full, and it is expected to make extensions in these two plants at an early date for greater output

The Provo Brick & Tile Co, Provo, Utah, is running under a maximum working schedule, giving employment to a normal working force, and will continue on this basis indefinitely The company has plans under consideration for enlargements in the plant, doubling the present rated capacity.

The Edwards Brick Co, Columbia, Mo., manufacturer of brick and tile, is running full, with regular working force, and will continue on this basis for an indefinite period The company has recently installed a quantity of new machinery for greater capacity

The B Mifflin Hood Brick Co, Atlanta, Ga is operating at capacity at its plant at Walden's Ridge, Tenn, for the manufacture of floor and roofing tile A new building is being constructed at the plant for increased production, and will be placed in service at an early date

LEATHER—The Central Leather Co., New York, N Y., has advanced production at its tanneries to about 60 per cent of capacity, as compared with an operating basis of 40 per cent a short time ago It is expected to make a further increase at an early date

The Carr Leather Co, Peabody, Mass., is running at close to normal capacity, devoting practically the entire output to suede leathers A normal working force is being employed

A number of glazed kid plants at Wilmington, Del are curtailing operations and are letting employees go temporarily. The change is said to be due to the lack of export business

The Richard Young Co., Wilmington, Del., is maintaining full operations at its local tannery, specializing in the production of kangaroo and other leathers.

RUBBER—The Howe Rubber Co., New Brunswick, N J, manufacturer of inner tubes for automobile tires, is running at full capacity, giving employment to a regular working force.

The Goodyear Tire & Rubber Co., Akron, O, is running at maximum output on a basis of 1,000,000 tires every 45 days. Plans are under way to enter on a spring production schedule of 40,000 tires a day, a capacity never before attained at the mills.

The Dunlop Tire & Rubber Co., River Rd., Buffalo, N. Y., scheduled to open its local plant on May 1, will devote initial production to heavy pneumatic tires, solid rubber tires and cord tires. A large working force will be employed

The Lee Tire & Rubber Co., Conshohocken, Pa., is maintaining full production at its local mill, giving employment to a normal working quota. Orders on hand are

said to insure this basis of operation for some time to come.

The Firestone Tire & Rubber Co., Akron, O., is arranging to advance production at its plant to a basis of 80,000 tires a day, a record figure in the history of the company

IRON AND STEEL -The Republic Iron & Steel Co., Youngstown O, has blown in its Youngstown-Hanna blast furnace The stack has been idle since November 1920

The Replogle Steel Co., Wharton, N. J, is making ready to blow in the second blast furnace at its local mills. The unit has a rated capacity of 600 tons per day The active furnace, with like capacity, is running full.

The Emporium blast furnace, Emporium Pa., is said to be planning to blow in the stack at an early date The plant has been idle for some time past.

The Woodward Iron Co., Woodward, Ala, is completing repairs and improvements at its second Vanderbilt blast furnace, and plans to blow in the stack at an early date, placing all five furnaces on the producing list.

The Brier Hill Steel Co., Youngstown, O., has work under way on the relining of its Tod blast furnace and plans to blow in the stack as soon as it is ready.

The Youngstown Sheet & Tube Co, Youngstown, O., is increasing production in its open-hearth department, and will run at capacity for an indefinite period

The United States Steel Corp, New York N. Y., is operating its plants in different parts of the country on an average basis of 91 per cent of maximum output, establishing a new high record at a number of the mills

The Valley Mould & Iron Co, Sharpsville, Pa, is operating at all but one of its blast furnaces, giving employment to a large working force.

MISCELLANEOUS The New Jersey Zinc Co., Palmerton, Pa, is increasing production at its plant and adding to the working force A wage advance of 10 per cent in the form of a quarterly bonus to all employees has been made.

The Noble Oil & Gas Co., Burkburnett, Tex. is operating its local gasoline refinery at capacity, developing an output in excess of 1,000,000 gal per month The plant will be continued on this basis for an indefinite period.

Pratt & Lambert Inc, Tonawanda St, Buffalo, N. Y., is maintaining full capacity operations at its local varnish-manufacturing plant, giving employment to a full working force Tentative plans are under consideration for the erection of additions

The International Ultramarine Works, Rossville, S. I., New York, is maintaining regular production at its local plant, with normal working force

The River Raisin Paper Co., Monroe, Mich, is running at capacity, giving employment to a regular working force

New Companies

THE HICKORY BALL CLAY CO., Mayfield, Ky., has been incorporated with a capital of $50,000, to operate a clay mining and refining plant for commercial production The incorporators are G. W. Ligon, A C. Plumlee and W A Ligon, all of Mayfield

THE CELLU-WASTER CO, 78 Paris St, Newark, N. J, has been incorporated with a capital of $50,000, to manufacture celluloid and reclaimed celluloid products composition specialties, etc. The incorporators are Patrick W. Smith, B. Waterbrook and Dean Lawrence

THE ALBERT DAVID CHEMICAL CO, New York, N. Y., care of the United States Corporation Co., 65 Cedar St, representative, has been incorporated under Delaware laws with capital of $300,000, to manufacture chemicals and chemical byproducts.

THE KERR PORTLAND CEMENT CO, Wheeling, W. Va., care of the Capital Trust Co. of Delaware, Dover, Del, representative, has been incorporated under Delaware laws with capital of $3,500,000, to manufacture portland cement The incorporators are S. B Wilson, Wheeling; Alvin M. Keys and J. W. Ferguson, both of Burgettstown, Pa.

THE ALOKA CHEMICAL CO., 5618 Harper St., Chicago, Ill., has been incorporated with a capital of $12,000, to manufacture chemical specialties. The incorporators are Mark L. Day, George L. Williamson and S E. Lambert.

THE INDIANA SANITARY POTTERY CO., Hammond, Ind., has been incorporated with a capital of $100,000, to manufacture sanitary ware The incorporators are Frank S Crumley, Abraham and Jacob C. Newar, and Peter W. Meyn, all of Hammond.

THE CUSTELOID CO., New York, N. Y., care of Samuel Rubin, 120 Broadway, New York, representative, has been incorporated with a capital of $10 000, to manufacture celluloid products The incorporators are J Lefkowitz and D J Cohen

THE DOBBINS-DWYER MFG CORP, New York, N Y, care of R L Armstrong, 50 Church St, New York, representative, has been incorporated with a capital of $200,000, to manufacture chemicals and chemical byproducts The incorporators are C Sullivan and R M Dobbins

THE HILLSBOROGH PETROLEUM & GAS CO, Tampa, Fla, has been incorporated with a capital of $250,000, to manufacture petroleum products S. W Mahaffey is president and general manager, and M L Vincent, secretary and treasurer, both of Tampa

THE DALEY PAPER CO, Bangor, Me. has been incorporated with a capital of $10,000, to manufacture paper products The incorporators are E Desmont Daley and James J. Sullivan, both of Bangor

THE KETTLE CREEK REFINING CO, care of the Corporation Trust Co. of America, du Pont Bldg, Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $600,000, to manufacture refined oil products

OTTO GOETZ, INC, Brooklyn, N. Y, care of C Eichler, 481 Knickerbocker Ave, Brooklyn, representative, has been incorporated with a capital of $200,000 to manufacture glassware and glass products The incorporators are P, J and Otto Goetz.

THE SWITCH PLATE CORP, Norfolk, Va., has been incorporated with a capital of $100,000, to manufacture glass products S W Harris is president, and H R. Walker, secretary, both of Norfolk.

THE HENRY COUNTY OIL CO, Crystal Lake, Ill, has been incorporated with a capital of $25,000, to manufacture petroleum products The incorporators are Edward E. and George E. Grant, and Alfred O Erickson, 511 City Hall, Crystal Lake The last noted represents the company

THE MOUNTAIN STATE GLASS CO, Mannington, W. Va, has been incorporated with a capital of $100,000, to manufacture glass products The incorporators are H D Atha, C L. Prichard and R F Alder, all of Mannington.

THE MONTAGUE CASTINGS CO, Montague, Mich, has been incorporated with a capital of $20,000, to manufacture iron and other metal castings. The incorporators are John O Reed, Whitehall, Mich; Fred J Howden, Muskegon, Mich.; and Charles W. O'Brien, Montague.

THE MILL PRINTING INK CO, Brooklyn, N Y care of Watson, Kristeller & Swift, 68 William St., New York, representative, has been incorporated with a capital of $60,000, to manufacture printing and other inks The incorporators are H D Watson, J C. Williams and F. W. Kristeller.

THE NORTHEASTERN OIL CO, Boston, Mass, has been incorporated with a capital of $100,000, to manufacture oil products. G A Bergfors is president, and William J. Bursaw, Beverly, Mass., treasurer.

THE HEMOLENE CHEMICAL CO, St. Louis, Mo, has been incorporated with a capital of $100,000, to manufacture chemicals and chemical byproducts. The incorporators are G L. Kitchen and L. J McKim, both of St. Louis.

THE ALHAMBRA BRICK & TILE CO, Sturgis, Mich, care of Edmund S Hellings, Equitable Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $1,150,000, to manufacture brick, tile and other burned clay products The incorporators are Fred P. Leaming, Sturgis; Harry H. Culver, Chicago, Ill.; and Charles Peters, St. Louis, Mo

THE FIBEROID BUTTON & FINISHING CO, INC., Waterbury, Conn., has been incorporated with a capital of $25,000, to manufacture fiber washers, insulating washers and other fiber products. The incorporators are W. D. Munson, Middlebury, Conn.; B. D. Cashman and E. V. Ball, 25 State St., Waterbury. The last noted represents the company.

THE DANVILLE OIL SYNDICATE, INC., 1106 First National Bank Bldg, Danville, Ill., has been incorporated with a capital of $150,000, to manufacture petroleum products. The incorporators are Howard A. Swallow, Robert R. Bookwalter and Samuel E. Phillips.

THE E-X CHEMICAL PRODUCTS CORP., 101 New Jersey Railroad Ave., Newark, N. J., has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are P. M. Beach, R. E. Fried and John J. Sloat.

THE DANFORTH-ABBOTT CO., New York, N. Y., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated with a capital of $500,000, under Delaware laws, to manufacture polishes and kindred products. The incorporators are John L. Farrell, Theodore L. Harrison and William F. McDermott, all of New York.

THE NEW HAVEN GRAY IRON WORKS, INC., New Haven, Mich, has been incorporated with a capital of $15,000, to manufacture gray iron and other metal castings. The incorporators are Jay Baldwin, Louis C. Harris and A. J. Bennett, all of New Haven.

THE DIRTENEMK CHEMICAL CO., INC., 118 West Patrick St, Frederick, Md., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts The incorporators are M. Roy Sharrer and Clarence M. Albaugh.

THE UNITED STATES & CANADA PETROLEUM CO, care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del, has been incorporated under Delaware laws with capital of $40,000,000, to manufacture petroleum products.

THE ENTERPRISE GALVANIZING CO., Philadelphia, Pa., is being organized under state laws to manufacture galvanized metal products Application for a state charter will be made on Feb. 27. The company is represented by Clinton O Mayer, 1218 Chestnut St, Philadelphia

Coming Meetings and Events

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual convention in Norfolk, Va., May 7 to 9.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York.

AMERICAN FOUNDRYMEN'S ASSOCIATION will hold a meeting in Cleveland, O., April 28 to May 4.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its summer meeting June 20-23 at Wilmington, Del.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W. Va., June 7, 8 and 9.

AMERICAN OIL CHEMISTS' SOCIETY will hold its annual meeting at the Eastman Hotel, Hot Springs, Ark., April 30 and May 1

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923

IRON AND STEEL INSTITUTE (London) will hold its annual meeting May 10 and 11 at the House of the Institution of Civil Engineers, London, S W. 1.

NATIONAL FOREIGN TRADE COUNCIL has postponed its annual conference from April 25, 26 and 27, to May 2, 3 and 4. It will be held in New Orleans, La.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J, the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

A PAPER INDUSTRIES EXPOSITION will be held in Grand Central Palace, New York City, during the week of April 9, 1923, by the International Exposition Co.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chémical Society, joint meeting. May 4—American Chemical Society, regular meeting May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY and IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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The Evil of the Tax-Free Security

EXPERIENCE of the past few years has made it very clear that the tax-exempt security and the progressive income tax cannot live in peace together. The tax-free bond tends to destroy the graduated feature of the income tax. That the tax rate shall increase with the increase in the size of the individual's income is a principle which has been firmly established in the code of equity of every civilized people, and the man who predicts that the people in this country will tamely submit to the nullification of progressive income taxes is a very blind prophet indeed. To be sure, most students of the problem agree that the federal income tax scale has been pushed to a height which is difficult to justify and that it should be modified as soon as the fiscal exigencies of the Treasury will permit. But income taxation, graduated to very substantial levels, is here to stay, and the warping, distorting effects of the tax-exempt security would probably survive even the most radical revision of the income tax that lies within the realm of possibility.

The opportunity—or rather the compulsion, for it is an opportunity which the rich man must be economically insane to ignore—to invest in tax-exempt bonds has brought about a revolution in the normal investment habits of large owners of capital. Persons who normally could place their funds in public utility or industrial bonds now must ignore such offerings unless, indeed, the utilities or industries chance to be publicly owned. The result has been unfair to private industries in a double sense. Not only are they shut out from their customary market for money but at the same time competing public undertakings are given a subsidy in the form of abnormally cheap money.

The extent to which this country has indulged in tax-exempt securities was recently brought out before the Ways and Means Committee in a striking manner. It was testified that there are between 10 and 15 billions of state and municipal tax-free bonds in existence and a further 3 billions of United States bonds are totally exempt. In addition there are outstanding about 18 billions of United States bonds containing certain exempt privileges for the next 3 years, so that it may be safely said that the total of tax-exempt securities lies between 20 and 30 billions of dollars. Just what proportion of this amount has been spent on developments other than the agencies of production and distribution is not known and is difficult to estimate. But it is evident that with such temptations for public extravagance, our efforts to achieve economy in public affairs are very seriously threatened.

Whatever his views may be regarding the severity of the surtaxes in the present federal income tax, the business man will be wise to regard as a separate issue any proposals for their reduction. The only surtaxes nullified by the tax-exempt securities are those applying to investment or "unearned income." Moreover the nullification of these rates is at the cost of a derangement of the investment market, in misdirected economic effort and, consequently, in waste. The only feasible road back to normalcy is to be rid of the tax-exempt bond.

The Artistic Temperament In the Practice of Chemistry

SOMETIMES the talk over a club table is worth repeating. Five or six men were at luncheon to the accompaniment of speculative discourse. "I hardly think," said one of the number, referring to a leading chemical technologist, "that he succeeded because of any mathematical bent of his mind. The man is primarily an artist and has the real artistic temperament. I don't mean the hysterical emotion of an opera singer; I mean the sense of rightness. He hates waste rather because it indicates the wrong way to produce than because it is economically wrong. His sense of form and color is such that he would have succeeded as a painter, a sculptor or an architect, if the curiosity that makes chemists had not gained possession of him. He abhors a mess of any kind. An inadequate yield produces waste, and waste again is usually a mess, which is contrary to his artistic sense."

This called to mind another eminent chemist whose contributions to pure science are known the world over. He has mathematics available and uses it as a tool, as a short-cut to reach his conclusions, but he does not worship mathematics as his less gifted brethren do. This man, in addition to his major work, practices one of the fine arts as an avocation.

One of the party suggested that all good chemists are born, not made, but he could not get a discussion of his postulate, because it led into the tiresome old dispute as to heredity or environment being of leading weight in influencing a man's career.

Agreement was reached, however, that curiosity, the untiring curiosity of a child, the drive to find out, is a leading requirement of anyone who would devote his life to the application of chemistry. Most of those present insisted that an active and projective imagination is of equal importance. Now this is the equipment of the true artist: the keen imagination that sees things as he is convinced they should be. A defective reaction offends him. His curiosity eggs him on to study it, but his artistic temperament will not let him rest until he has discovered the reaction of his ideal, the way to do the thing as it should be done.

At the conclusion of the discourse the impression prevailed that any chemical engineer who reaches the

heights must be an artist in his work. He may be a master at manipulation, an extraordinary craftsman, but if he lacks the needful imagination, the art of seeing things as they should be, before they are made, he cannot reach the front rank. Chemistry and the fine arts are closely related.

Is Public Education Worth What It Costs?

OFFHAND the average American will answer this question with a strong affirmative, but probably he will reckon without a knowledge of all the facts. The expenditure for education in the United States has been mounting upward by leaps and bounds, as is clearly set forth in the 1922 annual report of the Carnegie Foundation for the Advancement of Teaching. The president of the Foundation, Dr. HENRY C. PRITCHETT, is plainly concerned over the trend in public education; and the astounding figures that he presents make us pause and wonder whether we are on the right track.

The expenditure for primary and secondary schools in the United States—i.e., for grade and high schools, as we call them—has risen from $140,000,000 in 1890 to over $1,000,000,000 in 1920. The enrollment in public or grade schools has risen during the same period from 13,000,000 to 22,000,000—an increase of 70 per cent—while the enrollment in public high schools jumped from 200,000 to over 2,000,000, or an increase of more than 1,000 per cent. The increase in college attendance has been likewise a striking feature, although figures are not given. It appears, however, that while attendance at grade schools has kept pace with the increase in population, that of high schools and colleges has advanced at a rate of growth several times the rate of increase in population. In 10 years the cost of education per capita has increased from $34 in New York State in 1910 to $106.97 in 1920. This is only an example.

It is pleasing to think that so much is done for education in this country and that there is such a widespread interest in the subject. But, as Dr. PRITCHETT says, "it is possible to dissipate enormous sums of money in the name of education which serve neither to equip children with a body of knowledge nor to train their minds, nor to instruct them as to their duties and rights under the government through which the education is furnished." His protest is that with such increasing costs we may soon reach a burden that is too heavy for the respective communities to bear. "In no country in the world," he says, "does so large a proportion of the energy of the teaching profession devote itself to the tedious task of lifting ill-prepared children and youths through courses of study from which they gain little or no good."

Our interest is in technically trained men and in skilled workmen who know how to use their hands and are willing to use their heads. We do not want them to learn to loaf on their jobs at school. We want our technical men not only to have thorough training in physics, chemistry and engineering, but in addition to this we want them to have the consciousness that they are professional men with professional obligations in the community.

We think the signs of the times point to a simpler and less expensive government with compulsory grammar school education. Secondary and higher education should be for those who want it and are competent to achieve it. Others gain no profit from secondary and higher education, although the expense of trying unsuccessfully to train them is indeed becoming a tax that may grow too heavy to meet.

The attitude on the part of business toward education in the United States is disclosed in a recent referendum conducted by the Chamber of Commerce of the United States on the question of a federal Department of Education with a Secretary in the President's Cabinet, and the principle of federal aid to education in the states on the basis of an equal share of the expense. It is significant that the referendum disclosed a strong opposition against both proposals. A third one relating to the enlargement of the present federal Bureau of Education brought out a strong negative vote but not sufficient to commit the Chamber against the proposal. Evidently business in the United States, as represented by the constituent bodies of the National Chamber, has sensed something of the conditions brought out in Dr. PRITCHETT'S report, and feels that we may well pause and take stock of our efforts at education before we go further.

What Causes Variations in Lime?

ELSEWHERE in this issue we publish a note by OLIVER BOWLES of the Bureau of Mines which is suggestive and stimulating. It seems that not so very long ago a woman, Miss SQUIRE, president of the Allwood Lime Co., completed a series of test burnings on different kinds of limestone which led to the isolation of one in particular. This stone on burning yielded a special lime that sold for as high as $200 a ton—a good wholesome dollars-and-cents reason for wondering just what it is about a limestone that affects the lime produced from it.

Of course one very obvious variation is impurity, but apparently that is not the only factor nor yet the significant one. In a given limestone bed there are many strata and the different layers yield widely variant limes. Why? Is the variation a regular and progressive function of the depth? Not at all. It is true that in general the older strata will be denser, and this, of course, will have its effect. But from a geological point of view the various conditions prevailing at the time of sedimentation, such as the density of the medium, the origin of the calcareous material, the time required, etc., all affect the variety of limestone deposited. These conditions may have changed frequently in the deposition of any given bed, so that the strata vary irregularly and may change every few inches.

There is a large school that still adheres to the idea that differences in lime are due to differences in method of burning. This undoubtedly has a distinct effect, but indications have almost reached the point of conclusive proof in showing that it is not the whole story. A careful systematic study of the fundamental properties of burned limes, together with historical data as to their origin, will probably be necessary before a comprehensive answer can be given. Of course these historical data must be specific enough to distinguish between the different limestones in the same quarry. The problem seems to offer not only a wonderful opportunity for constructive research but a fertile field for play of imagination as well. And the solution may conceivably revolutionize some phases of a tremendous industry.

The Vertical Trust In American Industry

THE tendency toward the adoption of the vertical trust by American industry becomes more evident with each passing month. Recent news items from the glass-manufacturing district near Pittsburgh report the purchase by the Ford Motor Co. of the Allegheny Plate Glass Co., with a yearly production of 7,000,000 sq.ft., and the purchase by W. C. DURANT, of Durant Motors, Inc., of the American Plate Glass Co., with 6,000,000 sq.ft. annual production. These are only the latest of a long series of similar items, typified by the Ford control of mines, railroads, blast furnaces, coke ovens, artificial leather factories and, in fact, of almost all the various agencies that go to make the complete motor car or enter into its production in any way.

While the automotive industry provides, perhaps, the most conspicuous examples of this "vertical" type of organization, the tendency is fully as marked in industries which are more strictly chemical and metallurgical. For examples, we might point out the Newport Chemical Works, organized, as its slogan reads, "From coal to dyestuff"; or the Aluminum Company of America, which controls its product from mine to consumer. Numerous other examples of more or less well-developed vertical trust will come quickly to every mind. The tendency is already well founded and is evidently rapidly increasing.

Now, therefore, while this growth is still in its infancy it will be profitable to study it somewhat and ask ourselves what it holds in store for chemical and related industry. Consolidation into larger units seems to be the necessity of the day. Obviously, to change from our customary method of "horizontal" mergers to the "vertical" method will have some effect. It will be well for industry to consider what this will be while the movement is still young, so that the necessary steps can be taken to meet the new kind of competition that will result.

Atomic Speculation

A MASS of evidence—much of it derived quite recently from X-ray studies—indicates that solid solutions are dispersions of atoms (not molecules) in the solvent, and these "stranger atoms" replace their hosts at or very close to the exact position in the normal space lattice of the solvent metal. This replacement or substitution, atom for atom, is accompanied by distortion of the space lattice, more or less extensive, and a correspondingly greater amount of internal energy in the crystal.

DR. WALTER ROSENHAIN, in his recent lecture before the Institute of Metals (presented in digest elsewhere in this issue), develops beautifully several logical deductions from the above discoveries. Undoubtedly none of his hearers but admired the way he argued his conclusions, showing how they corresponded with known metallurgical facts. He was thus enabled to group many of the metals into classes showing combinations of properties, in striking agreement, yet so far having escaped notice.

In the face of this achievement, it is easy to let criticism sleep. Yet we think it will not be captious to point out that it is possible our eminent guest has at one place drawn out the theory a little too fine. To explain the phenomenon of the mushy stage, he notes that the solvent atoms immediately surrounding the stranger will melt with it first because of their distorted positions, to be followed at higher temperatures by the next layers, less and less disturbed from their normal lattice and containing less and less potential energy.

If one agrees that the stranger atoms locate the points where fusion begins, it is hard to see why the distorted lattice should remain disturbed after the cause of the disturbance has been removed, especially since at temperatures near melting the atomic mobility is large and the rigidity of the lattice is low.

Apparently it is necessary to avoid getting too close to the infinitesimal limit—there must be a sort of mass action—else it would be easy arithmetic to figure each atom of solute to influence just a few solvent atoms, in this region the concentration being high enough to melt. This reduces us to the rather absurd position that all the solvent atoms must enter the liquid state as soon as the first one melts.

A more attractive explanation is contained in a recent communication from FRANCIS B. FOLEY. Consider a cooling solution, like carbon steel. When the temperature reaches 1,530 deg. C., the melting point of iron, there is a definite tendency for cubic crystals of pure iron to form. Doubtless such aggregation of iron atoms does take place, but the alloying tendency of carbon is also present, and atoms of carbon assume some position on these elementary crystals, distorting their structure so that everything immediately disrupts and re-enters the liquid state. The liquidus is reached when the atomic attraction of the iron lattice is just sufficient to overcome the kinetic disturbances of high temperature and the distortions caused by diffusion of the correct amount of carbon into the crystal.

On this supposition, at any temperature in the mushy stage there is an interchange of both solvent and solute atoms between the solid and liquid phase, and melting occurs by the entrance of an excessive amount of stranger atoms into a lattice already strained near the breaking point by harboring many guests.

Another point where we would make a suggestion: Dr. ROSENHAIN supposes that diffusion occurs by a stranger atom moving in a short line, pushing ahead a long line of atoms and dragging behind a tail long enough to reach from the grain boundary. This involves what appears to be very large forces. Is it not more reasonable to suppose that only a small group of atoms rotate?

Assume, for instance, that the stranger occupied the face center on a cubic system. The four corresponding atoms of the lattice unit might interchange places in cyclic manner, the action being repeated with new partners as often as necessary for the stranger to find its last resting place. This involves breaking bonds on four atoms only instead of many thousands. The objection that the atoms are keyed against rotation would hold with equal force against movement by translation—if the corner atoms key the face-centered atoms against rotation, the face-centered atoms also key the corner atoms against translation. The most attractive thing about diffusion by rotation of a unit lattice or a part of it is this: The action is extremely local, and occurs within a region where the lattice is already distended by the mere presence of the solute atom.

Readers' Views and Comments

Accelerated Reactions in Pulsating Gaseous Currents

To the Editor of Chemical & Metallurgical Engineering

SIR:—The article in your issue of Dec. 27 entitled "Accelerated Reactions in Pulsating Gaseous Currents," by J. Deschamps and J. F. Shadgen, and the comments by various correspondents which have appeared in several issues since then have interested me greatly. My interest is largely due to the fact that I have had a practical application of the principles advocated by Deschamps and Shadgen under observation for several years and I should like to call attention to one phase of the subject which I believe has not been brought out by any of your correspondents.

We have here a Gayley dry air blast plant for drying the air supplied to the blast furnaces by refrigeration. In this system air is forced into a chamber by a fan and passed over a nest of pipe coils cooled by means of the circulating refrigerated brine. On these coils the moisture condenses. The air is then led by means of a duct to the suction side of the blowing engines. In one case these engines are of the reciprocating type and the varying demands they make on the air supply as the different engines get into step and fall out of step cause rather strong pulsations of air pressure in the refrigerating chamber. These fluctuations of pressure are of the order of 2 or 3 oz. per square inch and have a frequency of about thirty to sixty per minute.

When I came here several years ago I was struck by the fact that the moisture content of the air leaving the refrigerator was always appreciably below that corresponding to the temperature of saturation. The most satisfactory explanation for this result that I can give is as follows: On entering the refrigerator one immediately notices the fluctuations in air pressure by the somewhat unpleasant sensation on one's ear drums. Then he will notice what seems to be a flickering of the lights in unison with the pulsations of air pressure. Upon closer examination it will be observed that at each rarefaction a fog forms, causing a halo around each light which disappears at each compression. The air has evidently been cooled so that the water vapor is near its point of saturation and since in every pulsation the part of the cycle representing an expansion is accompanied by a drop in temperature some of the vapor condenses to form a fog. Now if in that part of the cycle representing a compression the accompanying rise in temperature causes a complete re-evaporation of this fog, then these pulsations will cause neither a loss, except through friction, nor a gain, except inasmuch as they improve the circulation of the air among the coils as argued by Messrs. Deschamps and Shadgen. But as long ago as 1870 Sir W. Thompson demonstrated that a small drop will evaporate in air containing so much moisture that condensation would take place on a flat surface. (See Chapter XX, Capillarity, in "Theory of Heat," by Clerk Maxwell.) Consequently if any of these small drops in the fog formed during a rarefaction come in contact with any surface, they will immediately flatten out and will not re-evaporate in the compression half of the cycle. The effect of this will be to maintain the absolute humidity below that corresponding to the saturation humidity at the average pressure and temperature of the air. The amount of this condensation is dependent on the amplitude and frequency of the pulsations of pressure. In fact, it would be quite possible to extract a large part of the moisture of the air with only cold water in the pipes by increasing the variations in pressure.

The point I am trying to bring out is that if a certain reaction is influenced by the pressure, then in a varying pressure a lowering of the pressure will not always undo the effect brought about by the raising of the pressure or *vice versa*. In some cases this can be made to be of advantage.

A. E. MUELLER.

Maysville, Wis.

They All Aspire

To the Editor of Chemical & Metallurgical Engineering

SIR:—Apropos your editorial in the issue of *Chem. & Met.* dated Feb. 21, relative to the popularity of the term "engineer," the following was clipped from a recent issue of the New York *Tribune*:

Everybody's One of 'Em

No longer little Micky Hare,
  Whose ways are wild and meek,
Will keep my clothing in repair
  For 50 cents a week.
He now demands a larger sum,
  Which I esteem too dear,
For lately Michael has become
  A Pressing Engineer

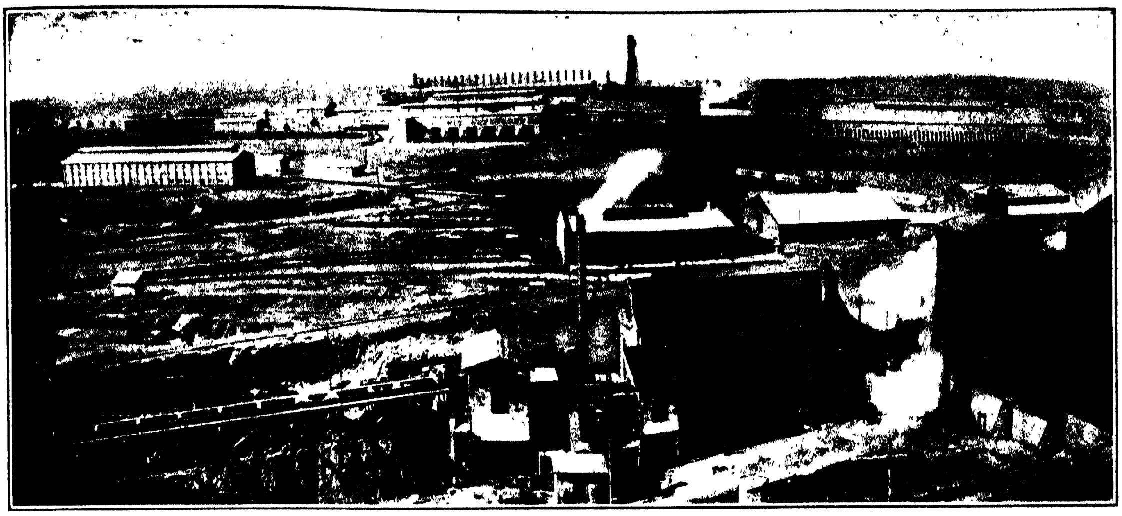
The days when Tonto Dorio
  Would clip and trim my lawn
And make my kitchen garden grow
  For ten a month are gone
He now is making wads of pelt,
  Takes contracts by the year,
And on his billheads styles himself
  A Mowing Engineer.

The lads from Greece who cleaned my shoes
  Once in a cheaper time
Now with a haughty scowl refuse
  My little proffered dime.
One sees them by appointment now,
  They're risen, it appears,
And have become, so they avow,
  Shoe Surface Engineers.

Old 'Rastus Johnson comes no more
  To take the cans away,
Or knocks upon the kitchen door
  To seek his weekly pay.
He's found a means of getting his—
  The dusky profiteer—
His card informs me that he is
  A Garbage Engineer.

It would seem that in the profession of chemistry one also finds those who, though not doing work which can be classed as that of a chemical engineer, have taken over the name at least. I have in mind one man who holds a high position in a large concern. This man is in reality a chemical engineer and performs such work. So disgusted has he become, however, at the tendency of all professions to adopt the term engineer, and in particular the tendency of all chemists to describe themselves as "chemical engineers," that he refuses to allow himself to be so designated, preferring to be known as an "industrial chemist."

New York City. PAUL D. V. MANNING.



PANORAMA OF PLANTS 2 AND 1 OF THE ATLAS PORTLAND CEMENT CO., NORTHAMPTON, PA.

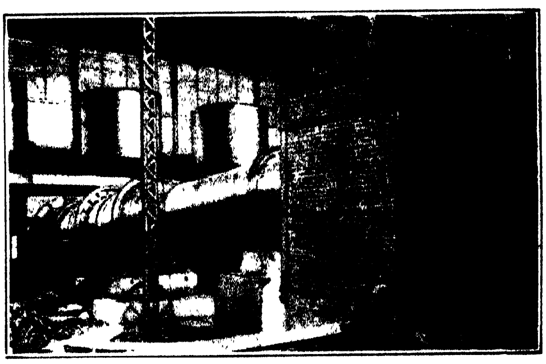
A Pioneer Passes

An Appreciation of the Work of the Late Harry J. Seaman, of the Atlas Portland Cement Co.

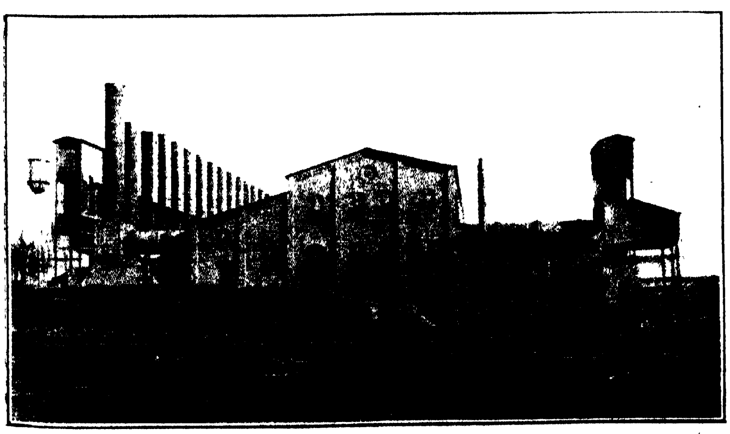
H. J. SEAMAN

IT IS perhaps almost a truism among those who are familiar with technical progress to say that it is seldom dramatic. Certainly as an industry or a process develops, the steps by which it progresses are so gradual, so almost imperceptible, that at times and for long periods it may seem to stand still. Yet if, for some reason, there is occasion to review a long period, the elements of the dramatic appear. Progress has been stupendous and amazing, the imperceptible steps have slowly but surely achieved a revolution. So when the announcement of the death of Harry J. Seaman appeared in the daily press, a host of friends paused in retrospect and realized, many with surprise, that a great leader and pioneer had died. An unfailing courtesy which had endeared him to his colleagues and subordinates, and a most retiring modesty, had militated against a popular appreciation of his excellent work.

He was graduated in chemistry from Lafayette in 1879, and with 13 years of experience in metallurgical work he came in 1892 to be superintendent of the Atlas Portland Cement Co., which was then being organized. During his first years in the cement industry many costly experiments were being made in an attempt to use oil for firing the kilns, and Mr. Seaman, with an associate, an English engineer named Hurry, began a series of experiments on the use of pulverized coal in cement burning. There was something approaching the dramatic in the application of these experimental runs to plant work. A large plant was constructed, using pulverized coal as a fuel, but the plant was also equipped with oil-burning appliances as a precautionary measure and to some extent to throw competitors off the trail. The operation of this plant was carried on for 2 years before many of the competitors realized the secret of its success. A whole industry then followed his lead. In the accompanying photograph of the Northampton plant, it is interesting to note that the brick building in the foreground is the original coal-pulverizing building



EARLY 60-FT. KILN



224-FT. KILN, CAPABLE OF TURNING OUT 1,800 BBL. CEMENT PER DAY

erected in 1894 for the new Atlas cement company plant. The kilns in this plant were relatively small, 6½ ft. in diameter by 60 ft. long. In the background of the same photograph is plant No. 4, erected in 1904, with kilns still 6½ ft. in diameter but 135 ft. long. There followed, step by step, the construction of larger and larger kilns. In 1906 a unit 8 ft. 5 in. in diameter by 135 ft. long; in 1909, 10 ft. in diameter by 224 ft. long, and finally, in 1910, four kilns were constructed 12 ft. in diameter by 233 ft. long. During the 22 years in which Mr. Seaman was at the helm of the Atlas, the company grew from a small industrial plant of seven kilns to the huge organization operating 103 kilns with a combined output of 50,000 bbl. a day. This in 1914 made it the largest cement plant in the world. A severe illness then robbed Mr. Seaman of his energy and for 2 years he had virtually retired from active work. But during the war he was instrumental in the installation of potash-recovery systems to remove the potash from the cement kiln dust and he combined this process with waste-heat boiler installation and a complete elimination of flue dust from the kilns. The combination of these installations was unique and again represented pioneer work.

It is appropriate that we should pause for a momentary appraisal and appreciation. Mr. Seaman gave a high type of service to his company, to the industry and to the public. In its detail of progress, it was seldom dramatic, but as a whole it presents a picture which will serve as an inspiration for many years.

Present Situation in the German Glass Industry

In a recent trade dispatch from Berlin concerning the German glass industry, it is reported that in the table glass branch of the industry deliveries of raw materials have been difficult to obtain. Demand in the home market has decreased, but this decline is thought to be temporary and all the plants are very busy at present with orders on hand. Encouraging reports of the improvement in trade come from the East, Italy, Rumania and German Austria.

The hollow glass industry has experienced considerable difficulty in procuring raw material. In spite of the consequent increase in price of raw material, the finished article has not advanced unreasonably. The recent fall in the value of the mark has revived foreign trade in some measure, but the small orders received will not be sufficient to keep the various plants in operation for any length of time. A further decrease in coal supplies will render it necessary to close many plants entirely.

Specifications for Chemical Lime

The rapid increase in the use of commercial lime as a chemical in recent years has been recognized in technical circles throughout the country. There is no more striking evidence of this than the action of the American Society for Testing Materials in establishing standards for lime for chemical uses. The first of these chemical lime specifications appears in the 1922 Tentative Standards of the A.S.T.M. covering the use of lime in the varnish, paper, textile and silica brick Industry.

Work upon specifications for lime for all its other many chemical uses is now actively in progress by the A.S.T.M. committee C-7 on lime through its sub-committee on chemical lime under the chairmanship of Dr. M. E. Holmes. Other technical societies are co-operating in this work and it is expected that in due time standards of quality for lime will be set up covering all its important chemical uses. This should lead to greater efficiency in lime production and greater economy and quality in the use of lime.

Record Production in 1922 of Fuel Briquets

According to the United States Geological Survey, a record production for fuel briquets was established during 1922, when the total output amounted to 619,425 net tons. In 1920, 398,949 tons were produced.

FUEL BRIQUETS PRODUCED IN THE UNITED STATES IN 1917-1922

Year	Net Tons	Value	Year	Net Tons	Value
1917	406,856	$2,233,888	1920	567,192	$4,623,831
1918	477,235	3,212,793	1921	398,949	3,632,301
1919	295,734	2,301,054	1922	619,425	5,444,926

The deficit in domestic anthracite in the region supplied by the upper Lake docks resulted in a greatly increased production in the Central States. Other districts have also reported an encouraging increase. The same type of binder has been generally used and a similar raw fuel constituent employed in the various plants.

RAW FUELS USED IN MAKING BRIQUETS IN THE UNITED STATES 1919-1922, IN NET TONS

Fuel	1919	1920	1921	1922
Anthracite culm and fine sizes and semi-anthracite	118,595	356,877	190,964	254,563
Semi-bituminous and bituminous slack and coke	*97,387	*125,506	121,925	235,542
Lignite, sub-bituminous coal, and oil gas residue	80,383	89,656	†85,352	†123,339
	296,365	572,039	398,241	613,444

* Includes no coke † Includes no brown lignite

Of the fourteen plants that operated, six used anthracite culm or fines, two semi-anthracite, one a mixture of anthracite fines and bituminous slack, one semi-bituminous slack, one a mixture of bituminous slack and sub-bituminous coal, two carbon residue from the manufacture of oil gas, and one bituminous coal, first subjected to low-temperature carbonization. The total quantity of raw fuel used was 609,186 net tons, of which 42 per cent was anthracite or semi-anthracite, 39 per cent semi-bituminous slack, bituminous slack and coke, and 19 per cent sub-bituminous coal and oil-gas residue.

First Glass Factory in Lithuania Completed

In a recent trade report from Berlin it is stated that the construction of the first glass factory in Lithuania has just been completed at Petrasuoni. The factory is equipped in accordance with the most modern technical requirements and stands in the center of four villages, opposite a high road, not far from the railway, on the Niemen, 5 km. from Kovno. Bottles will be the main product and modern machinery has been installed. Extensive peat fields have been rented 3 km. from the factory and special machinery has been installed for digging peat.

Production of Alcohol in Poland

Of the 2,000 agricultural distilleries existing before the war, 1,420 are at present in operation within the territory of the Polish Republic. The estimated production of the agricultural and industrial distilleries during the present campaign is 1,200,000 hl. of alcohol of 100 deg. The home consumption is placed at 600,000 hl., leaving the same quantity for export.

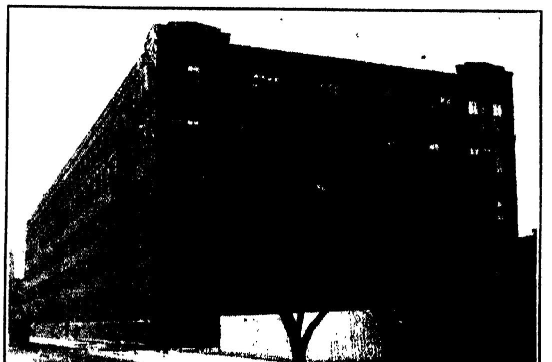
Wall Paper Manufacture In a Model Mill*

Hanging Paper Made on Fourdrinier Machines Is Coated With a Clay Slip, Giving a Surface Upon Which the Design Is Printed With Lake Colors Suspended in an Adhesive Medium

MURAL decoration is a subject which in all probability dates back to the crude effects obtained by primitive man when he varied the monotony of bare walls of his cave by draping them with skins of animals. Later, with the development of textile arts, woven materials were largely used, and from the eleventh to the middle of the eighteenth century the tapestry industry flourished. Cloth painted in imitation of tapestry subsequently became popular and it is but a short step from this to the use of paper as a base. Printing ink and ordinary hand presses were used at first, followed by the process of printing from hand blocks, which is still in use for particularly artistic effects.

About 1839 Potter and Ross, in England, began investigations which resulted in the adaptation of calico-printing machinery to the printing of wall paper. It is to this development that the modern machine-printed wall paper industry owes its origin.

This is a very interesting branch of the paper industry and yet very little technical information is available regarding it. Accordingly the following outline of processes employed by a mill which has many unusual features may be of interest. The mill, which is that of Sears, Roebuck & Co., Chicago, occupies a 5-story building provided with a thirteen-car siding from the tracks of the Baltimore & Ohio Chicago Terminal Railroad. As the mill has a capacity of 30,000,000 rolls of wall paper per year, the need for adequate transportation facilities is evident.


EXTERIOR VIEW OF A MODEL MILL

In the trade, it is customary to refer to paper base upon which the design is printed as hanging paper, while the finished wall paper is termed paper hangings. Several paper mills make hanging paper, which is then sold to other firms more properly referred to as wall paper printers than as wall paper manufacturers. The latter term implies plants in which the whole series of operations is carried out. The Sears, Roebuck & Co., mill is of this type, being a self-contained unit. The paper is made, the colors are prepared and the printing is done all within the establishment.

Waste paper of various kinds—catalog trimmings, office waste, records, overissue newspapers, etc.—is reduced to pulp together with a certain amount of groundwood and sulphite, coloring matter and sizing. The groundwood and sulphite are received in the form of laps, bales or rolls. The pulping operation is begun in pulpers and beaters of the usual type, the mill being equipped with two 2,100-lb. Niagara and one 1,750-lb. Allen beaters. The beater furnish varies according to the type of hanging being made, since it would not be possible to obtain some of the lighter colored effects on stock which might be perfectly satisfactory for a dark shade.

When the stock in the beaters or pulpers has been properly disintegrated it is discharged to concrete stuff chests, which serve to store the pulp until it is fed to the Jordan engines, which complete the pulping operation by separating the cluster of fiber still more. The pulp then passes to a set of stuff chests, which keep it in suspension so as to insure a uniform feed to the paper machine.

For forming the paper, a 132-in. Fourdrinier machine is provided. When running on hangings the full width of the machine is not used, but it is adjusted to give a trimmed sheet 117 in. wide, since this will just make six rolls wall paper width, 19½ in. The main portions of the machine are driven by a steam engine, although some of the accessories are motor operated. The speed is 500 to 550 ft. per minute.

Just before entering the flow box on the machine the pulp passes through two rotary screens to remove any coarse fibers which might be present. It then flows at uniform consistency and at a carefully regulated rate onto the endless 65-mesh Fourdrinier wire. The first part of the machine is given a shaking motion at right angles to the direction of flow so that as the water drains through the screen by gravity and the fibers begin to form a sheet they will not point in the same direction but will interweave to produce a strong well-formed sheet. Removal of water is accelerated near the end of the screen by oscillating suction boxes placed under the screen. In these a vacuum equivalent to several inches of water is maintained by motor-driven Nash Hytor pumps. While the paper is in a fluid condition it is kept from flowing off the sides of the screen by two endless deckle-straps of vulcanized rubber about 2½ in. square in cross-section. These are so mounted that they travel with the screen, and the width of the sheet may be varied by adjusting the distance between them.

After passing the suction boxes, the sheet is passed over a suction couch roll. This roll, together with the breast roll at the head of the machine, forms the support upon which the Fourdrinier wire is stretched. This suction couch roll removes enough of the remaining

*This article is based upon an address delivered before the Chicago Chemists' Club by Herbert A. Hauptli, superintendent of Wall Paper Mills, Sears, Roebuck & Co.

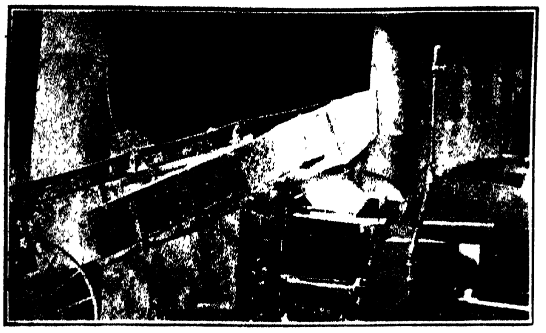


FIG 1—BEATER FOR PREPARING CLAY SLIP

water so that the sheet is sufficiently strong to make the jump to the first press unsupported.

Felt belts carry the sheet during the rest of its journey through a series of press rolls and to the drying cylinders. The drying cylinders are covered with a glass hood which acts as a receiver for all the water vapor as it evaporates from the paper. This vapor is then removed by a powerful fan.

Reels take care of the finished paper as it comes from the machine after passing through a stack of calenders. From the reels it passes through slitters and is rewound on a rewinder as six rolls each 19½ in. wide. These form the wall paper base or hanging. About 45 tons of paper is produced per day.

An unusual feature of the mill is the continued re-use of white water—that is, the water which drains through the Fourdrinier screen carrying with it an appreciable amount of the finer fibers. This is pumped back to storage chests and is ready for use in the beaters and thus circulates continuously through the process. It is of course necessary to add sufficient fresh water to make up for that lost by evaporation in the driers. This amounts to about 75 tons per day. Such re-use of white water is made possible by the fact that no injurious chemicals are used in treating the pulp and consequently there is nothing to accumulate in the water and cause trouble.

China clay forms the base for the coating materials and the colors which are used in printing the designs on the paper. Clay is unloaded from cars on the siding directly to a storage room by means of portable belt conveyors. Another unusual feature is that in one end of the room is a regular Niagara beater in which the clay slip is formed. A charge of clay is transferred from the storage piles to the beater, the required amount of water and glue is added and a uniform slip is rapidly produced. Fig. 1 shows the conveyor in position for charging the beater, with clay storage piles in the background. This beater has replaced a whole battery of agitator tanks and is doing the work more rapidly, more satisfactorily and with less labor and attention. It will handle 5 tons of clay per hour.

For the production of the various colors, portions of aluminum hydrate base are treated in mixing tanks, Fig. 2, with suitable amounts of coal-tar dyes to produce the desired lake or shade. The lake is then filtered through a continuous filter, Fig. 3, and the pulp color is mixed in a kneading and mixing machine with the adhesive vehicle which will hold the color on the paper. Glue, various gums and starch preparations are used in making these pastes. As the pulp colors must often remain in contact with the moist pastes for some time, care must be exercised in choosing dyes and pigments which will not be affected under these conditions. Direct and acid dyes are largely used, although for certain colors inorganic pigments are employed. Some of the special inks do not contain any pulp colors, being composed of paste and such materials as bronze powders or finely ground mica. About 3½ tons of pulp color is produced per day in this department.

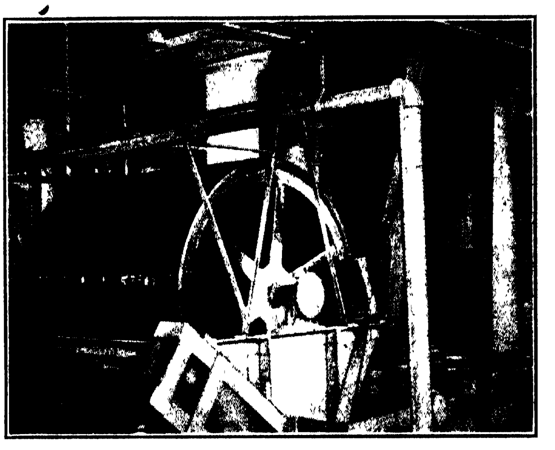


FIG. 3—CONTINUOUS FILTER FOR PULP COLORS

Since the hanging paper does not have the color or texture necessary for the background of the printed design, a coating operation precedes the printing process proper. Coating machines apply a plain ground color to the entire surface of the paper. In some cases the color is simply china clay, or the clay may be made still whiter by precipitating barium sulphate upon it, while in other cases tinted clays are used. These operations are carried out in the tanks shown in Fig. 4. From these the clay is pumped to agitator tanks, which keep the coating in suspension until it is used on the

FIG. 2—COLORED LAKES FORMED IN THESE MIXING TANKS

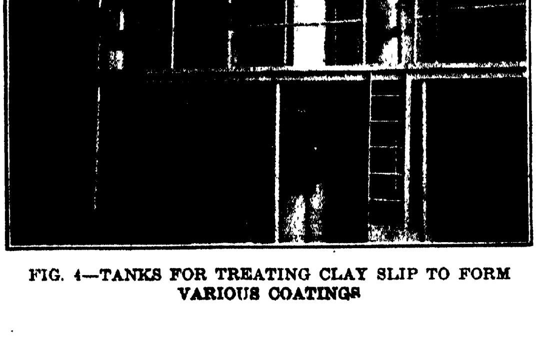


FIG. 4—TANKS FOR TREATING CLAY SLIP TO FORM VARIOUS COATINGS

coating machines. In the latter the paper runs under a roller fed with coating material by an endless belt which dips in a trough containing the clay slip. Brushes working at right angles to the line of motion of the paper distribute the coating evenly. After drying, the paper is ready for the design. The festoon driers used are similar to those which will be described in connection with the printed paper.

In general appearance, the printing machines resemble those used in textile mills. There is a great difference, however, in the printing rolls. For wall paper, these consist of maple rolls with the designs outlined in strips of sheet brass. From the original design prepared by the artist, a series of transfer patterns is made—one for each color. These are then transferred to the wooden rolls and skilled workmen proceed to cut lengths of sheet brass strips, bend them to conform with the curves of the design and then hammer them firmly into the surface of the roll. The brass strips extend about ⅜ in. beyond the surface of the roll. Where solid masses of color are required, the spaces between the strips are filled in with specially prepared felt. When the design has been completed, the surface formed by the projecting strips is ground in a lathe until uniform so that it will print evenly.

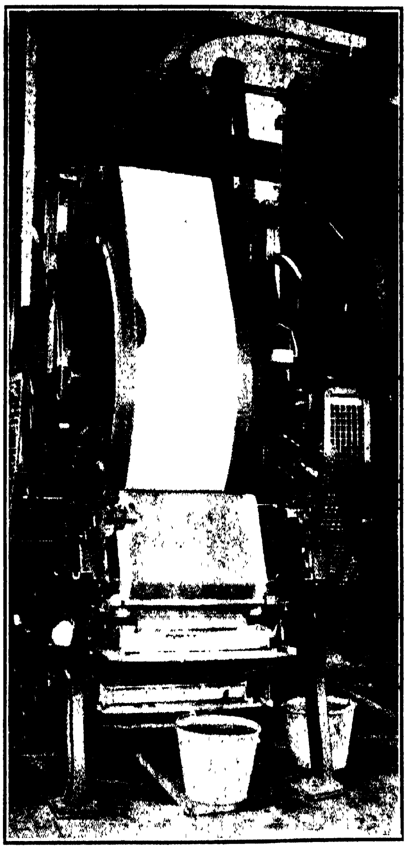


FIG. 5—PRINTING MACHINE

As may be well imagined from the brief outline just given, this work requires skill and unlimited patience. Imperfections in spacing are readily apparent in the finished print, so that the labor involved in the production of, say, a dotted honeycomb design is quite obvious.

All of the rolls required for a given design are mounted on the printing machine. At this mill there are two sets of machines, one for eight-color work, the other for twelve. Each printing roll is supplied with the appropriate color by means of a short felt band which picks up color from another roll revolving in a shallow reservoir or trough containing color. Above this roll is a blade which scrapes excess color from the felt so that just the right amount of color will be transferred to the printing roll. The paper is supported on a rubber blanket during printing in order to insure clear, perfect impressions. These details are evident in Fig. 5, and also in Fig. 6, which shows a battery of printing machines in operation.

FIG. 6—BATTERY OF PRINTING MACHINES IN OPERATION

Paper is fed to the machines from a reel just in front of which is a short belt conveyor. Several yards of paper are carried on this in the form of loose folds, giving sufficient leeway to permit change of rolls without stopping the machine. Passing through the printer, each printing roll contributes its particular color. As the paper emerges bearing the complete design, it is picked up by a series of moving spaced bars and carried in short festoons underneath a duct from which warm dry air issues. With this arrangement the annoyance of spots due to condensation in the hood is entirely eliminated. Fig. 7 is a view along one set of driers, although the individual festoons are not apparent, as they were in motion while the picture was being taken. The lower drier carries paper from the coating machine, while the printed paper is handled on the upper one.

After traveling about 85 ft. the wall paper is thoroughly dry and with some patterns this completes the manufacturing process. In others, however, subdued effects are produced by overprinting the whole design with a sort of screen, usually in white. This is done on a supplementary printing machine followed by another festoon drier. Embossed effects may also be obtained by running the paper through an embossing machine having properly surfaced rollers.

FIG. 7—VIEW ALONG FESTOON DRIERS

Special papers include the oatmeals and varnished tile. The surface of the former consists of colored or tinted stock containing comparatively fine particles of sawdust. In the latter, the design is printed from engraved rollers and the entire surface is coated with a transparent spirit varnish.

Ingenious automatic machines reel up the paper in measured 16-yard lengths, at the same time perforating the selvage edge so that it can be removed easily after the paste has been applied. This feature is fully protected by United States patent and is used only on Sears, Roebuck paper. These double rolls, as 16-yard rolls are known in the trade, are wrapped up in a very neat manner and placed in stock or shipped to the stores at Chicago, Philadelphia, Dallas and Seattle. For delivery, the rolls are packed in paper cartons. As noted previously, the mill has a capacity of about 30,000,000 rolls of wall paper per year.

In spite of the large amount of glue used, the characteristic odor so common in many mills is entirely absent. This is only one indication of the careful chemical control which is maintained by the laboratory to make certain that the proper care is exercised in the handling and treatment of all materials. Similar attention to a multitude of other details has resulted in spotless cleanliness throughout the mill. The paper machine is painted white and no rubbish is allowed to accumulate anywhere. An efficient ventilating system insures comfortable working conditions at all times. Indeed, at every point indications of efficient and understanding management are in evidence.

Bureau of Mines Works on Explosives

Much experimental work on explosives is at present under way at the experimental station of the Bureau of Mines, at Pittsburgh, Pa. One of the most important researches is for the determination of fundamental data on the solubility, hygroscopicity, melting point and decomposition temperatures of compounds used in explosives. This information leads to the development of methods of purification and separation of materials and thereby makes the handling of explosives less hazardous. The solubility of TNT in eleven solvents has been determined and the data are ready for publication.

Small-scale tests of ammonium nitrate are being made to determine its explosibility by means of boosters only. The tests will be made at normal temperature with the ammonium nitrate at normal density and with such a degree of confinement as is found suitable from preliminary tests. The compression of small lead blocks will be used as the criterion of explosibility. The use of the following explosives as boosters is contemplated: Picric acid, tetryl, TNT, TNA, amatol 80/20, high-grade ammonium dynamite, blasting gelatine and 40 per cent ammonia dynamite. This work is being done in co-operation with the National Research Council, which will direct further work on the problem.

One of the important problems in metal mining, tunneling or quarrying is the most economical method of bringing down the ore or rock. The two factors having great influence in determining this are drilling and blasting costs. In considering the efficiency of the explosive used, the diameter of cartridge has always been supposed to play an important part. However, the attention of the Bureau of Mines has been called to the lack of definite data on the effect of cartridge diameter on the strength and sensitiveness of high explosives. This information is especially valuable to the user of explosives, as it assists him to determine what diameter of borehole is most economical. Accordingly the bureau, in co-operation with the Institute of Makers of Explosives, has conducted a series of tests to show the effect of cartridge diameter on the strength and sensitiveness of certain high explosives. The results of these tests are given in Serial 2436, by Spencer P. Howell, explosives engineer, and J. E. Crawshaw, explosives testing engineer, which may be obtained from the Bureau of Mines, Washington, D. C.

Information regarding additions, removals and changes in the permissible list of explosives from March 15 to Dec. 31, 1922, is given in Serial 2430, by S. P. Howell, explosives engineer, which has just been issued by the Bureau of Mines. The list supplements that contained in Technical Paper 307, issued in March, 1922.

Increase in Newsprint Production in Canada

In a study made by the Canadian Pacific Railway, figures have been compiled which permit a comparison of the newsprint situation in Canada in 1922 with previous years. During the first 10 months of last year production reached 896,840 tons, an increase of 237,249 tons over the same period for 1921. As the American market depends upon Canada for approximately one-third its annual consumption, the bulk of the dominion's output comes to the United States. More than 900,000 tons was exported last year, but it has been estimated that Canada and the United States will together use 13 per cent more newsprint this year than in 1920.

Increased advertising on this continent will also result in a greater consumption of newsprint and if the demand from Oriental and European markets continues, the coming year will in all probability show the largest newsprint production in the history of the industry in Canada. A comparison of figures for a 10-year period indicates the extraordinary development of the Canadian newsprint mills. The total output in 1913 amounted to 350,000 tons. In 1921 it had advanced to 805,114 tons, an increase of 130 per cent. During the 10-year period, 1912-22, it has been estimated, there was an increase of 300 per cent in the production of newsprint.

Sugar Refining in Bulgaria

Bulgaria has five large, well-equipped beet-sugar factories with a potential producing capacity of 50,000 metric tons of refined sugar annually, according to a recent report to the Commerce Department. National pre-war sugar consumption in Bulgaria, which ranged around 35,000 tons annually, has now declined to about 25,000 tons. Thousands of refugees have migrated into the country from Macedonia and east Thrace and the population has increased by about 500,000 over pre-war figures despite a loss of 8.5 per cent in territory. Were the factories operating at full capacity, the country would already be on an exporting basis. The director of a large sugar factory located at Sofia stated that his plant will not run at more than 20 per cent capacity this season. The beets cannot be obtained; farmers are holding out for higher prices for the raw beets and display a tendency to turn from beet raising to the culture of more remunerative crops such as tobacco. Sugar producers are of the opinion that Bulgarian domestic production during the present campaign will amount to about 15,000 tons of refined sugar; thus a surplus of 10,000 tons remains to be purchased abroad.

Stafford Wood-Carbonization Process

An Apparently Successful Attempt to Use Wood Scrap From Lumber Mills Outlined—All of the Valuable Byproduct Recovered

AFTER hundreds of unsuccessful attempts have been made to utilize small waste wood in the carbonization and wood-distillation industries, Prof. O. F. Stafford, a University of Oregon man, has perfected a process that is commercially successful. A superior grade of charcoal as well as the usual wood-distillation products can be obtained from mill waste under his process. So it is reported by *Science Service*.

Professor Stafford first demonstrated his process scientifically on the University of Oregon campus. He and the firm of engineers behind him have now succeeded, after several years' work, in demonstrating it as a practical commercial process. Two wood-distillation plants on the Atlantic coast, one of them controlled by a big corporation, placed every resource at Professor Stafford's disposal, and the success of the process was completely demonstrated.

By the new process a fine grade of charcoal can be obtained as well as the usual byproducts of carbonization, acetic acid, acetone and methanol, basic in the manufacture of such articles as dyes, paints, varnishes, celluloid, smokeless powder and artificial leather.

Economical Advantage of the Process

Cord and slab wood have been the accepted material used in making charcoal and its byproducts. As small waste wood is materially cheaper than either slab or cord wood, the desirability of utilizing it in carbonization operations has long been recognized. Eight hundred applications have been made at various times at the Patent Office by those who thought they had hit upon a process of carbonizating small waste wood on a commercial scale. The failure of these efforts, until the Stafford process was proved successful, has been due, in general, to heavy costs of installing and maintaining the complicated mechanical appliances required.

In 1920, after experimental demonstrations at Cambridge, Mass., work was continued in a plant of 200 cords daily capacity at Kingsport, Tenn., which had originally been erected by the National Research Council during the war for chemical experimentation.

The commonly accepted practice of carbonization is to place cord or slab wood in large oven retorts made of steel plate. Fires in the furnaces beneath are started. Vapor outlets from the oven are provided, these outlets leading to condensers for the recovery of the liquid products of the distillation. The charcoal is withdrawn after the wood has been carbonized.

The Stafford Carbonizing Chamber

The retort used in the Stafford method is a cylinder, 32 ft. high and 9 ft. in diameter. The cylinder is set vertically and the appliances are such that the wood to be carbonized is fed continuously into the top, while charcoal is withdrawn continuously from the bottom. A remarkable feature of the process is that no heat is applied to the cylinder after the process once is started, the carbonization of the wood being spontaneous under the conditions which the invention maintains.

In previous processes the principal difficulty encountered in the use of small waste wood has been that of transmitting heat to the interior of a mass of finely divided woody material in the retort. Such a mass is a poor conductor of heat. Only the portions of it in contact with the hot walls of the retort can in any reasonable time reach a carbonizing temperature. The numerous attempts to handle such material have had to do principally with overcoming this difficulty.

Formerly the wood used in carbonization work has always contained moisture. But Professor Stafford experimented with perfectly dry wood. He found that when the dry wood is heated under his process to the temperature at which the charring begins the carbonization went along to completion without further application of heat from outside sources. In other words, the process is exothermic.

Cost of Installation and Upkeep Low

The cost of installing a plant under the new plan is considerably less than that of building an oven retort plant of equivalent capacity. It has other advantages, among which are low depreciation and low labor and fuel costs as compared with other systems.

It has not yet been demonstrated whether the charcoal made under the Stafford process can be used in the iron industry. The charcoal produced from small waste wood would have to be briquetted for direct use in a blast surface.

In the working out of the Stafford process in the Pacific Northwest, Douglas fir would be the most available species of wood. It occupies an intermediate position between the hardwoods and the soft or resinous wood, such as the Southern long leaf pine. Hardwoods give a high yield of wood alcohol and acetic acid, while the Southern pine gives low yields of alcohol and acid but a high yield of turpentine oils and resins.

Magnesia as Polishing Agent

In a paper entitled "Polishing Aluminum and its Alloys for Metallographic Study," by E. H. Dix, Jr., appearing in *Chem. & Met.* for Dec. 20, 1922 (p. 1217) and presented before the February meeting of the Institute of Metals division of the A.I.M.E., it was recommended that magnesia be used as the final polishing medium. Dr. Walter Rosenhain, who originated its use, says that it is necessary for the magnesia to be kept clean and perfectly dry. It is best to try some "heavy magnesia" from several makers, rather than buying through a broker, and then place repeat orders direct with the source of a sample which will satisfactorily polish copper, gold or any soft metal. It is possible for the individual to calcine the carbonate, but not necessary to go to this trouble. Likewise, it is impossible to levigate the product after its formation.

Polishing disks must be kept vigorously clean. Each day they must be scrubbed with a hand brush and a copious amount of freshly distilled water, continuing the process for some time after the cloth appears quite clean. If the disk is not used constantly, it should be flooded with distilled water daily, and kept constantly wet.

The great advantage of magnesia as a final polisher is that a trace of it does not produce complicating reactions in the etching medium. The disadvantage is the ease with which it transforms into gritty particles of carbonate.

Second Institute of Metals Lecture

A Digest of Walter Rosenhain's Address Upon Atomic Arrangement in Solid Solutions, and How This Will Affect Such Phenomena as Melting Range, Hardness, Diffusion and Intermetallic Compounds

HAVING been asked to give an address on some theoretical aspect of metallurgy, Dr. Rosenhain chose to propose a new theory on the nature of solid solutions. Even though there is no quantitative proof of each step of its development, there is a body of experimental evidence in support of the main theory, and logical conclusions drawn from it are in striking accord with well-known facts. While solid solutions are by no means confined to alloys, they have been studied most extensively by metallurgists; consequently it appeared best to confine attention to intermetallic solid solutions.

Solidification of Solid Solutions

The term "solid solution" is paradoxical to the uninitiated, involving a contradiction of terms. What it connotes is approximately "a crystalline body formed either from a liquid solution or from an intimate mixture of solids, or from both, which retains in the solid state an admixture of the two substances (solvent and solute) as intimate as that which exists in a liquid solution." Equilibrium diagrams of many binary alloy systems show areas where solid solutions are stable—theoretically it seems that complete insolubility is impossible. From typical diagrams, the lecturer reviewed the well-known facts shown on Fig. 1 that a liquid of composition x (e.g., 75 per cent A, 25 per cent B), upon cooling will commence solidifying when the temperature reaches c, but the solid separating is of a composition shown by d on the solidus curve. As the solid is rich in B, it impoverishes the liquid in that element, thus requiring a further cooling before more of it will freeze. If cooling be at a very slow rate, the demands of equilibrium will be met, and the solidified portion also gives up part of its excess of B to its surroundings as it cools. Thus at any temperature during the mushy range the composition of the liquid is represented by a point e on curve L and that of the solid by the corresponding point f on curve S. Finally the last trace of liquid (rich in A) solidifies, and its excess of A will diffuse into the solid, which finally cools as a homogeneous solution of composition g (75 per cent A, 25 per cent B). The same mechanism is followed during solidification of alloys of the type shown in Fig. 2, having only a limited mutual solubility in the solid.

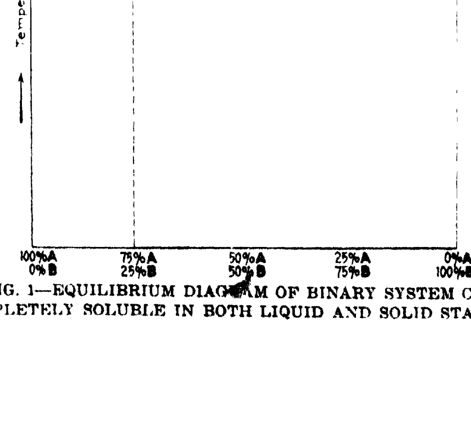


FIG. 1—EQUILIBRIUM DIAGRAM OF BINARY SYSTEM COMPLETELY SOLUBLE IN BOTH LIQUID AND SOLID STATE

Consideration of Fig. 2 indicates that the temperature of melting falls with increasing concentration of solute in the solid solution—that is to say, less energy needs be imparted to a solid alloy to disrupt the atoms sufficiently to transform them into the liquid state. If it be granted that this family of alloys requires a fixed total of energy to induce the mobility of the liquid state, it follows that a store of energy must be held in the crystals of solid solution—that is, the material is "self-strained" with potentially disruptive energy. The limit of solubility in the solid would therefore be determined by the maximum amount of such energy which could be stored in the internal structure of the crystal. The latter conclusion is also reached by elementary thermodynamical considerations even though it is demanded by this theory that a solid solution must occur because it constitutes an atomic arrangement which contains the least amount of stored energy. Solid solutions will continue to form with increasing amounts of solute, until a composition is reached where the energy content of the more highly saturated solid solution would be greater than that inherent to a duplex structure. This implies that increasing concentration of the solid solution brings with it an increasing storage of internal energy until the limit is reached.

Energy Stored in Strained Crystals

How can this energy be stored within the crystals? Here is where the X-ray diffraction patterns give the greatest help.

Readers of *Chem. & Met.* will remember the recent articles by Bain[1] and Jeffries and Archer[2] on this method of investigation. For the sake of continuity it need only be said that if a beam of monochromatic X-Rays be projected through an aggregate of fine crystals, it will be diffracted in a definite series of directions. The diffracted rays, falling on a photographic film, will develop a series of lines or bands whose mutual spacing will depend upon the geometry of the internal structure of the crystal and the distances of the atoms, each to each.

[1] "Studies of Crystal Structure With X-Rays," vol. 25, p. 657 (Oct. 5, 1921).

[2] "Crystalline Structure of Metals," vol. 24, p. 771 (May 4, 1921).

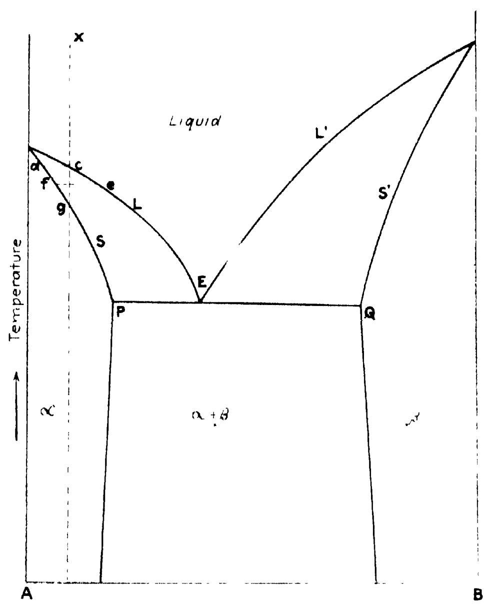


FIG. 2—EQUILIBRIUM DIAGRAM OF BINARY SYSTEM PARTIALLY SOLUBLE IN SOLID

Such studies have revealed the fact that most metals crystallize in relatively simple cubic lattices of varying dimensions. More complex lattices are possessed by brittle metals like zinc, bismuth and antimony, by the compound Fe_3C (cementite), and are to be anticipated in intermetallic compounds.

Essential Structure of Metallic Crystal

We must think, then, of a metallic crystal as built of atoms fixed upon an imaginary framework. The atoms move about their equilibrium position by thermal agitation, but the average distance atom to atom is definitely governed by the forces exerted by its surroundings and which hold it to its mean position in the space lattice. Heating the metal increases the thermal agitation and expands the lattice; when this expansion is carried beyond a certain limiting amount it seems to break the interatomic linkage, and the crystal melts. If the lattice is extended by mechanical means, the new phase formed is Beilby's amorphous metal.

It should furthermore be remembered that it is probable that the atom is a complex structure in itself consisting of a nucleus and an outer system of electrons. It occupies and dominates completely the space determined by the radius to the outer electron shell; and the dimensions of the space lattice are such that the atom volumes so defined almost or quite touch one another. (That is to say, there is no insterstitial space comparable in dimensions with the space occupied by any single atom.) Still the outer electrons or their orbits must be deflected not only by mutual interactions with their neighbors, but also by the application of external stress. Whatever, therefore, tends to change the space lattice also distorts the atoms or at least deranges their outer electrons.

Pure metals, we are assured, possess lattices of great regularity, but solid solutions must be more complex, since they contain many "stranger" atoms (solvent) among those of the host (solute). It is known that such solutions are still crystalline; for instance, alpha brass readily forms twins.[2] X-ray analysis of a solid solution shows also a well-defined space lattice, ordinarily differing only slightly in dimensions from that of the solvent metal.[3]

Do the stranger atoms replace their hosts in their regular positions, or do they find their way into voids? The latter possibility is unlikely, except in very special cases, because there is small room left in a close-packed lattice, and insertion of a stranger atom would distort the lattice beyond the limits of endurance, and second it would demand that solubility be inversely proportional to atomic volumes—a condition which experiment shows does not exist. The alternative supposition—which might be called a "substitution" theory—has been verified by X-ray work in Dr. Rosenhain's laboratory by Messrs. Owen and Preston [and in this country by Dr. Bain]. It also leads to a general view of the atomic structure of solids which explains a wide range of known facts, and should ultimately lead to quantitative verification and even predictions.

Stranger Atoms Substituted for Hosts

Substitution of a stranger atom for an atom of solvent in the space lattice must profoundly affect the entire lattice in that vicinity. Fig. 3 shows the simplest case of the arrangement of atoms along any principal plane in a cubic lattice. Now, replace the center atom with another, Fig. 4. Suppose further that the natural space lattice of the latter, when pure, is larger in

[3] "Nature of Solid Solutions," by Edgar C. Bain, *Chem. & Met.*, vol. 28, p. 21 (Jan. 3, 1923). "Cored Crystals and Metallic Compounds," by Edgar C. Bain, *Chem. & Met.*, vol. 28, p. 63 (Jan. 10, 1923).

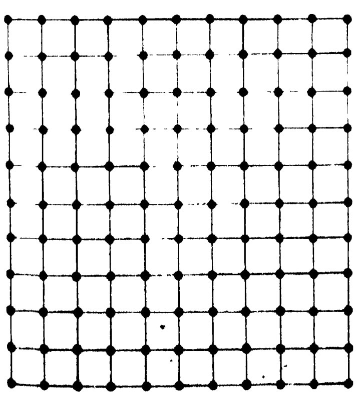


Fig. 3—Spacing of atoms on principal plane of cubic lattice

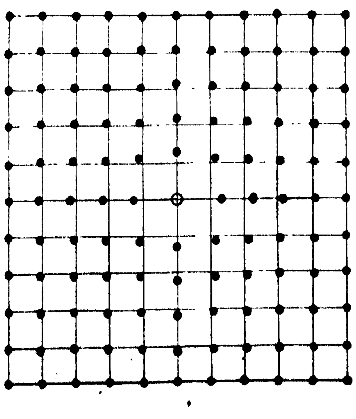


Fig. 4—Distortion in ductile lattice due to large stranger atom

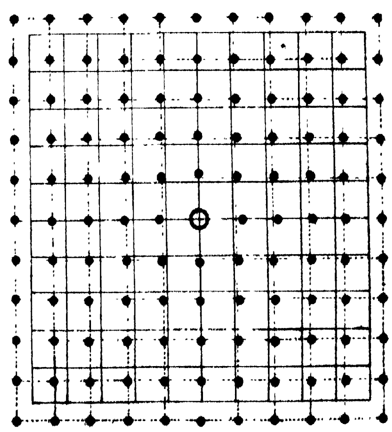


Fig. 5—Distortion in stiff lattice due to large stranger atom

dimension. This would probably mean that the forces between solute atom and the surroundings would be less than those between solvent atoms themselves, and several layers of the latter would shift outward an ever-decreasing amount to balance this lessened attraction. It is apparent that a considerable amount of material is affected. For instance, assume a cube corner to be the center of a disturbance reaching five atoms deep; then a concentration of only one atom in 8,000 would be sufficient to affect the entire mass, bringing about not only a series of local intense distortions but also a slight general expansion of the entire lattice. The relative amount of local and general distortion evidently depends upon the character of the solvent metal itself—a "stiff" lattice might act about as shown in Fig. 5. The first case might be likened to some peas scattered about between the layers of a pile of rubber sheets; the second, to pebbles between tin plates.

It might be argued that the same effect would be

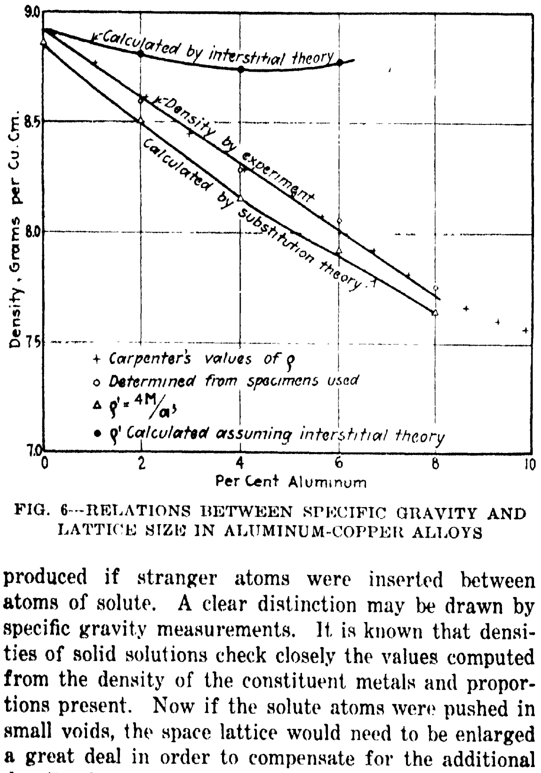


FIG. 6—RELATIONS BETWEEN SPECIFIC GRAVITY AND LATTICE SIZE IN ALUMINUM-COPPER ALLOYS

produced if stranger atoms were inserted between atoms of solute. A clear distinction may be drawn by specific gravity measurements. It is known that densities of solid solutions check closely the values computed from the density of the constituent metals and proportions present. Now if the solute atoms were pushed in small voids, the space lattice would need to be enlarged a great deal in order to compensate for the additional density due to the interpolated solute atoms. If the substitution theory is correct, however, the average dimension of the space lattice would remain practically unchanged. At Dr. Rosenhain's suggestion, Messrs. Owen and Preston studied the copper-aluminum system from this standpoint (Fig. 6) and found the space lattice to correspond very closely to that required by the substitution theory,[4] and widely at variance to that required by assuming the insertion of atoms.

Limit of Solubility

Many interesting inferences can now be drawn, bearing in mind this picture of the atomic arrangement.

First, as to the limit of solid solubility. Evidently, "similar" atoms will enter into each other's space lattice with the minimum of distortion, and the mutual solubility will be large before unstable conditions are reached. The difficulty is to establish a criterion of "similarity." Crystal form and atomic dimensions are naturally of great importance—a metal crystallizing in the cubic and another in the hexagonal system would not be expected to form a continuous series of solid solutions. On the other hand, copper and nickel both form face-centered cubic arrangements with dimensions 3.60 and 3.54 Angstrom units respectively. It is not surprising to find them build an equilibrium diagram like Fig. 1.

Hardening Effect

Second, hardness or the resistance to plastic deformation will be largely affected by the lattice distortion in solid solutions.[5] When a metallic crystal is loaded, it first deforms in an elastic manner until its limit is reached, after which slip occurs and layers of the crystal slide over one another. Such sliding will be easiest in a perfectly regular lattice; the layers of atoms lying on the two sides of such a slip plane may be regarded as two smooth surfaces sliding over each other. Any distortion of the lattice will act as a roughening of this surface, will interfere with slip, and thus harden the metal.[6]

Here are two measurable properties—viz., limit of solid solubility and hardening—which appear to depend upon disturbance of the lattice. Theoretically, the greater the range of solid solutions formed the less should be the hardening effect of the added metal per atom added. What are the actual relationships observed?

To quote only the well-known solutions of copper, the specific hardening effect ranks in the following manner, from least to greatest: Ni, Mn, Zn, Al, Sn. The limit of solid solubility for the respective alloys is 100 per cent, 100, 36, 14, 6.7.

Mechanism of Melting Over a Range

Other even more typical properties of solid solutions may be explained from the standpoint of a distorted space lattice—namely, the occurrences during solidification (or their reverse during melting) summarized in Figs. 1 or 2.

First, consider a crystal of pure metal as it is heated. Increasing thermal agitation of the atoms merely expands the lattice. Thus, Westgren has measured the lattices of iron at various temperatures, and finds they agree with values calculated from the thermal expansion of a bar. As already argued, this expansion cannot exceed a certain value without the appearance of a new phase (an allotropic transformation occurs or the metal melts); and the important point is that all parts of the lattice reach this breakdown at the same temperature. Pure metal melts at one uniform temperature. (It is also significant that refractory metals have, in general, low coefficients of expansion.)

However, a solid solution such as α of Fig. 2 contains many regions where the lattice is locally distended. On heating such a crystal, the locally deformed regions around stranger atoms will reach the limit of lattice-extension first, and melting will begin there and at a temperature at which the bulk of the lattice is still stable. We have partial melting and a liquid appears whose content of solute is higher than the average of the whole crystal. As the temperature rises, further

[4] Bain in this country has verified this fact for several other series of solid solutions. See footnote 8.

[5] "Hardness of Solid Solutions," by W. Rosenhain; *Proc. Royal Soc. London*, A, vol. 99, p. 192; *Chem. & Met.*, vol. 25, p. 243 (Aug. 10, 1921).

[6] "Slip Interference Theory of Hardening," by Zay Jeffries and R. S. Archer, *Chem. & Met.*, vol. 24, p. 1057 (June 15, 1921).

regions of less distorted lattice will melt, diluting the liquid solution, and finally the mushy range is passed and the whole crystal has melted. This will occur at less than the temperature required by pure solvent because the entire lattice is deformed and reaches its limiting extension after a smaller amount of thermal expansion.

On the basis of the substitution theory, the solidus (line S of Figs. 1 and 2), or beginning of melting, depends upon the maximum local extension in the lattice caused by stranger atoms, while the liquidus (line L), or end of melting, depends essentially upon the general extension of the lattice. If local distortion is large and general extension small, the solidus should have a steeper slope than the liquidus, and will be steeper the lower the solid solubility of the stranger atoms. This is generally confirmed. Long ranges of solid solutions give narrow mushy ranges; low solubilities are associated with nearly vertical solidus lines. It may also be inferred that slight local distortions but the general extensions of Fig. 5 are more likely to occur in the rigid lattices of harder and stronger metals of high melting points. This connects strength, hardness, high melting point and ability to form long ranges of solid solutions (e.g., Fe, Ni, Co, Cr, Cu, Ag, Au). On the other hand, soft, low melting metals (Pb, Sn, Cd,) approach the wholly eutectiferous type of diagrams.

While the above argument has been based on expansions of the lattice by stranger atoms, it may be applied *mutatis mutandis* if the solvent lattice is compressed. Then the melting point of the alloy should be higher than that of pure metal (Fig. 1). For instance, alloying nickel (2.50 A.u.) to copper (2.54 A.u.) will compress the lattice of the latter and raise the melting point. The equilibrium diagram shows that even near the copper end of the series the portions first to solidify have a higher nickel content than the liquid from which they form. The silver-palladium system is another striking confirmation of the above facts.

Diffusion

Although the equilibrium diagrams (Figs. 1 and 2) show that the solidified alloys x should have a homogeneous structure, it always occurs that equalization between the first solidified parts and the last remaining mother liquor is never attained during cooling. A cast alloy always shows "cored" crystals. This apparent duplex structure may be obliterated, however, and replaced by the uniform appearance characteristic of pure metal by a suitable annealing far below the melting point.

Bearing in mind that this is done without anything like recrystallization of the alloy,[1] we may ask, By what mechanism does this redistribution of solute atoms occur? Since a space lattice is approximately filled by its constituent atoms, can it open up to allow passage for migrating atoms?

Dr. Rosenhain thinks this may be explained by the phenomenon of intercrystalline slip. As temperature rises, the force necessary to produce slip decreases rapidly. Furthermore, it requires less force to slip a single crystal than an aggregate, where each is supported on all sides by its neighbors. He believes, therefore, that intense local forces set up in the immediate neighborhood of stranger atoms will cause slight slips, probably of only a few atom-diameters distance, rather than the 2,000 or more caused by plastic deformation, and probably only a row or single line of atoms move, rather than a whole layer. If the distribution of the stranger atoms is not uniform, there will be a tendency to slip in a direction leading toward the region of low concentration. Slips of one step at a time, taking place at intervals in the various principal planes of the lattice, will be sufficient to account completely for diffusion—it is obviously possible by a suitable number of successive slips of this nature to carry a solute atom from any one position in the lattice to any other.

Under these conditions, what happens to the atom at the end of the row when slip occurs? It probably passes into the more or less non-crystalline or amorphous layer present at the boundary, while at the other end of the row room is made for the entry of an atom passing into the lattice from the intercrystalline layer. Other considerations lead us to suppose that an interchange of matter constantly occurs at high temperatures between crystals and their boundary layers.

Dr. Rosenhain observed that to test these assumptions about diffusion will be difficult. It would be expected that the atoms which distort the lattice most would cause the most of this extremely local slipping and diffuse fastest. However, we have no experimental data on rates of diffusion. In a qualitative way, however, the extremely sluggish diffusion in copper-nickel alloys has been noted, and in this we have seen that the lattice distortion is very slight. Carbon also diffuses in gamma-iron very rapidly, although its solubility is relatively low. On the other hand, phosphorus diffuses very slowly in iron, its solubility is low, and it has a pronounced hardening effect—i.e., distorts the lattice materially.

Intermetallic Compounds

It is only a step from solid solutions to intermetallic compounds. If the latter be defined as homogeneous crystalline alloys between two metals in such a ratio as to conform to the law of multiple proportions, it would be impossible to distinguish them from solid solutions. Intermetallic compounds, however, have definite characteristics, and are located on the equilibrium diagrams in special ways. Likewise, a definite X-ray spectrum has been found for the compound $CuAl_2$—it is very complex and quite different from either pure copper or aluminum. Doubtless in it, like in some salts which have been studied, the copper and aluminum each builds up its own special lattice, and the two interpenetrate in some way which results in low symmetry.

Since the "substitution" theory of the constitution of solid solutions calls for but a single lattice—that of the solvent metal—here at once is the distinguishing criterion between solutions and compounds. The complex lattice of intermetallic compounds reflects their most striking property—their hardness and brittleness—and explains it in no way in which a consideration of the properties of their ductile constituents would suggest.

Can such complex lattices as intermetallic compounds go into solid solution as such—i.e., in molecular association? It seems obvious that it is impossible. A molecule of $CuAl_2$ is altogether too large to find room upon the space lattice of aluminum. Furthermore, if it could, it would then exhibit its typical X-ray spectrum; and this has not been discovered even in a 96:4 Al:Cu alloy. It follows that the compound does not exist until

[1]Small boundary changes occur during first cooling of the alloy, and mark out areas ordinarily independent of the dendritic structure.

it comes into existence as a separate crystalline phase—it must dissociate to go into solution.

On the other hand, it appears possible for an intermetallic compound *AB* to dissolve metal *A*, by replacing certain of the atoms *B* on its lattice by new *A* atoms, or *vice versa*. Undoubtedly in such cases interatomic bonds play a great part, and it would not be well to speculate until more facts are at hand.

Hardening Theory

There remains one most important consideration—the variation of solid solubility with temperature. That such changes are of the greatest importance to the hardening phenomena has only been recently recognized.

Dr. Rosenhain thinks that the thermal expansion of the two metals concerned should be decisive. Assume a solvent *A* containing a solute *B*, a smaller atom but having a greater rate of expansion than *A*. Then the two should become increasingly similar and more soluble with increasing temperature. However, other factors undoubtedly have influence. It does not seem wholly justifiable to suppose that the thermal expansion of isolated atoms of *B* would be the same as a crystal of *B*. Again, increasing temperature probably changes the atom in other ways than in merely increasing its lattice spacing. Its interatomic bonds, its mobility, its volume may be appreciably changed. Certainly such changes occur in some metals abruptly and profoundly at allotropic transformations. A change in "stiffness" of the solvent lattice with changing temperature is also a factor, since it affects the energy content of the solid solution for a given concentration of solute. It is apparent, therefore, that here again is a matter which must be investigated from many angles before it can be reduced to a quantitative equation.

In conclusion, the lecturer pointed out that a study of atomic lattices and their distortions by stranger atoms would be the first step toward a quantitative metallurgy—where the hardness, limit of solid solubility, rate of diffusion, melting range and brittleness could be computed. In this way, the X-ray may draw a key map to what is now an unchartable wilderness of facts.

Wood Distillation Products in 1921 and 1922

In *Chem. & Met.* for Dec. 27, 1922, there was published a preliminary report of the Bureau of Census on the production of wood distillation products in 1921. In checking over these figures, the Secretary of the National Wood Chemical Association of Bradford, Pa., discovered that the Census Bureau had made an error in reporting the crude methanol production, which according to the estimate of the association was at least 3,000,000 gal. higher than it should be and entirely out of line with the production of acetate of lime. The other figures appear to have been reported more accurately.

The attention of the Census Bureau was called to this apparent discrepancy and that department immediately reviewed the report of the manufacturers of wood-distillation production and the detailed statistics of production for 1921. The revised figures are given in the following table for those products which were incorrectly reported in the previous article.

The Census Bureau's report points out that the output of acetate of lime was relatively small due to the fact that, as some of the manufacturers explained, there was no market for this product and it was found to be much cheaper to use the crude liquor rather than manufacture it in acetate of lime.

	1921	1919	1914
Products, total value	$9,258,500	*$32,625 300	*$10,529,800
Methanol:			
Crude, gal.	3,964,400	9,104,000	9 602,400
For sale—			
Gallons	3,289,300	6,980,700	7,197,000
Value	$1,110,600	$5,593,500	$1,605,900
Made and consumed, gal	675,100	2,123,300	2,405,400
Refined, gallons	2,831,700	7,391,000	6,465,000
For sale—			
Gallons	2,715,300	6,984,700	6,235,100
Value	$1,924,400	$8,381,900	$2,709,400
Made and consumed, gal	116,400	406,300	229,900
Acetate of lime, lb.	61,316,300	168,956,000	166,085,000
For sale—			
Pounds	55,448,900	153,910,000	163,522,000
Value	$737,000	$2,682,200	$2,138,900
Made and consumed, lb.	5,867,400	15,046,000	2,563,000

* Includes byproducts from other industries to the amount of $79,991

1922 Output Doubles

According to a more recent report of the Bureau of the Census, the production of acetate of lime and methanol almost doubled in 1922 as compared with 1921. The total output of firms which produced over 97 per cent of the total acetate of lime in 1921 amounted to 119,911,000 lb., while the methanol production was reported to be 6,687,845 gal. in 1922. The following table shows the monthly production figures as reported by firms with a daily capacity of 4,500 cords (or pro-rated to that capacity in months where some reports were lacking). These were taken from the "Survey of Current Business," published by the Department of Commerce:

	Production	
Months, 1922—	Acetate of Lime, Lb.	Methanol, Gal
January	8,330,000	468,818
February	7,993,000	457,656
March	9,660,000	534,812
April	7,390,000	416,112
May	7,064,000	404,847
June	7,495,000	441,149
July	8,718,000	475,376
August	9,253,000	508,644
September	9,537,000	537,803
October	12,217,000	664,933
November	15,440,000	853,687
December	16,814,000	942,008
Total	119,911,000	6,687,845

Trend of World Production and Consumption of Sugar

Cuba's ability in 1922 to distribute both a record crop and a record carryover can be attributed mainly to a record consumption in the United States and to a European crop that fell far short of the consumption needs of that continent. Cuba exported more than 4,000,000 tons to the United States, approximately 850,000 tons of which (in terms of raw sugar) went to Europe after refining. Altogether, Europe was supplied with 1,700,000 tons toward her deficit of 2,300,000 tons, most of the remainder coming from Java. Approximately 3,000,000 tons of Cuban sugar remained in this country and, combined with the production of the United States and its possessions, supplied the record American consumption of nearly 5,500,000 tons (raw sugar).

Another 4,000,000-ton crop from Cuba is predicted for 1923. Encouraging reports also come from Java and a greatly increased production in Europe is expected. It is estimated, however, that various decreases elsewhere, in the United States in particular, will result in a crop only 125,000 tons greater than last year, which must supply the world consumption of sugar, calculated as 350,000 tons more than in 1922 and 725,000 tons larger than the total production.

An Untrodden Field in Lime Research

An Introduction to the Work Which Must Be Done on the Relation of Lime to Its Limestone Source

BY OLIVER BOWLES
Mineral Technologist, U. S. Bureau of Mines

WIDE research has been conducted in factory and laboratory to determine the physical and chemical properties of lime in their relation to utilization for various purposes. It is now generally recognized that limes differ greatly in their physical properties and chemical activities, such as plasticity, rate of slaking, or rate of settling as milk of lime; but it is not so generally known that these variations often bear no relation to the chemical composition of the original limestone. Limestones of identical composition may, under the same burning conditions, give limes that vary greatly in character. A definite relationship undoubtedly exists between the character of the lime and the physical properties of the parent limestone, but little serious effort has yet been made to correlate them.

THE PIONEER WOMAN

In attributing honor where honor is due it is a noteworthy fact that to a woman must be given credit for the only important practical work that has yet been accomplished in this line of investigation. Miss Mary E. Squire, president of the Allwood Lime Co., Manitowoc, Wis., spent 4 years of investigational work, and finally identified and isolated a particular limestone bed from which is manufactured a lime that commands a price as high as $200 a ton, because it fulfills the most stringent requirements of lime for processes of extreme refinement. Possibly other work of a like nature has been done, but if so it has received little publicity.

The importance of the problem has been brought to the attention of the Bureau of Mines from two other sources, one a lime producer and one a consumer. A prominent lime manufacturer is sufficiently aroused to the significance of the relation between finished lime and the physical properties of limestone that he has expressed a willingness to engage the services of a geological chemist to make a detailed microscopic study of the various formations in his quarry, together with a study of the limes produced. A specialist employed by one of the largest consumers of lime in the United States has written to the Bureau of Mines requesting information on this same subject. Such faint glimmerings betoken the approaching dawn of an active inquiry.

What are the controlling factors—the nature of the original organisms that provided the shells from which the stone was formed; the origin, whether chemically precipitated or fragmental; the degree of cementation or recrystallization; the grain size, grain shape or some other characteristic?

The problem undoubtedly has a direct bearing on quarry processes and on lime utilization, fields in which the Bureau of Mines is enlarging its activities; but so much remains to be done that pioneer work of varying character could be profitably undertaken by several agencies. The field is open; who will supplement our present meager information?

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Refined Tar for Coating Cast-Iron Pipe and Fittings*

Discussion of Properties of Tar and Methods of Application to Obtain Satisfactory Coatings of Foundry Products

BY S. R. CHURCH
Technical Adviser, The Barrett Co., New York City

TEN years ago I first gave some attention to the question whether or not there ought to be a specification for a refined tar product for coating cast-iron pipe and fittings. I found that at practically all the foundries crude coal tar was being used. The method of coating varied somewhat, but was usually developed by experience and not marked by close control. I came to the conclusion that the coating could probably be improved by: (1) Closer temerature control of both castings and bath; (2) adoption of some method for testing the consistency of the coating from time to time and keeping it uniform; (3) specifications for the coating that would insure reasonably uniform consistency and freedom from excess water. It did not seem to me at that time that the last-named requirement was of greater importance than the two others.

The tars first used for coating pipe were horizontal gas-works coal tars. In the early days of gas making fireclay retorts were used and the first important change in the character of coal tar occurred when fireclay was replaced by silica retorts. With the latter, higher heats were employed and tar was produced of very high viscosity and high free carbon content.

WATER-GAS TARS LESS DESIRABLE

The newer types of tar—coke-oven, vertical-retort and water-gas—are thinner and of lower free carbon content than the horizontal gas-works tars. Undoubtedly the best coating is not obtained when very thin tar is used. Crude water-gas tar or crude vertical-retort tar makes a very poor coating, lacking body. To obtain a coating having the consistency and covering power of a medium gas-works coal tar, most of the tars now available must be modified by distillation, or reduced to the proper consistency. Either coal-tar or water-gas tar may be reduced to any desired consistency, but it is doubtful whether water-gas tar should be used for pipe coating, as its resistance to chemical attack and its life under conditions of service have not been well established.

What happens when a hot casting is dipped in tar? The object of the process is to obtain a thin but complete coating that will dry in a short time, adhere strongly to the pipe, be resistant to abrasion and finally protect the metal from corrosion. If crude tar is used, the heat is sufficient to drive off enough of the more volatile oils so that the remaining film or coating is pitch. If pitch is used to start with, either higher temperatures must be employed or a thicker coating will result. I do not believe there is any merit in a thicker coating *per se*; on the other hand, a very thin tar may produce a coating so thin as to be non-protective and unduly brittle. I am inclined to the opinion that what is needed is a refined—distilled—tar with reasonable limits as to viscosity and free carbon. The viscosity limits should be specified at an elevated temperature, say 100 deg. C., approaching that of the bath.

*Extracts from a paper read before the New England Water Works Association.

Evaporation by Compression

Description of the Process Now in Operation in Several Important Industrial Plants in Europe, Where It Has Proved a Valuable Factor in Heat Economy—Also a Close Study of the Heat Consumption Usually Calculated in the Sugar Industry

BY PROF. DR. WILHELM GENSECKE

By the courtesy of Dr. Frank Mueller, who was associated with Dr. Gensecke in the operation of the experimental plant described.

A GREAT DEAL has recently been written concerning the possibilities of applying steam compression in evaporation, so the principles of the process are undoubtedly known in technical circles. It is important to note that the purpose and function of the compressor are not to generate the heat required for the evaporation, but to raise a sufficient quantity of heat to a higher temperature level; therefore, it is aptly called the "heat pump."

The operation of multiple-effect evaporators is an example, familiar to everyone, of how a quantity of heat introduced into the process can be re-utilized.

A comparison of the thermal economy of multiple-effect evaporation and evaporation by compression must be based on the assumption that the energy necessary for the evaporation by compression has to be generated by steam power, every horsepower involving a definite steam consumption depending on the thermal efficiency of the power plant. On this basis the multiple arrangement is theoretically the better one. The exchange of a certain amount of heat in a surface apparatus presupposes (given a known coefficient of heat and a known heating surface) a certain drop of temperature, which theoretically is the same, regardless of the evaporation process used. Assuming the selected apparatus to be "heat tight," and ignoring any losses by radiation; assuming further that the required heat transfer demands a temperature drop of, say, 10 deg. C., it is not difficult to calculate what amount of evaporation 1 kg. of steam can produce. Only the total temperature drop available for the process need be known. This temperature drop is determined on the one hand by the temperature of the saturated steam of the boiler, and on the other hand by the temperature of condensation, which in its turn is determined by the cooling water of the condenser connected with the last evaporator. If the boiler pressure is 16 atmospheres absolute and the temperature of the saturated steam at that pressure is 200 deg. C., the vacuum of the condenser 92.5 per cent and the temperature of condensation at this vacuum 40 deg. C., the whole available temperature drop is 160 deg. C. and a sixteen-fold evaporation is obtained with 10 deg. C. temperature drop in each evaporator; that is to say, 16 kg. of water can be evaporated in the evaporation plant by means of 1 kg. steam. The plant works with a sixteen-fold effect, and consequently has sixteen evaporator stages.

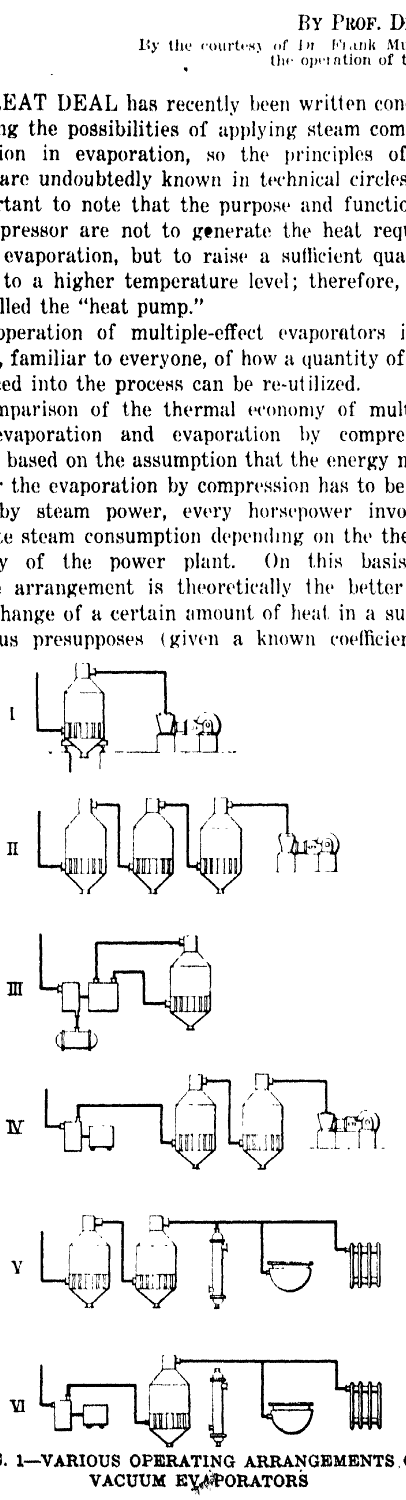


FIG. 1—VARIOUS OPERATING ARRANGEMENTS OF VACUUM EVAPORATORS

The relation thus obtained is a good approximation. In a more accurate examination of this relationship, one must take into account the dependence of the heat content on the temperature.

OPERATION OF COMPRESSION PLANT

How does a compression evaporation plant function under the same conditions? The heating surfaces of all sixteen stages function at the same temperature. They may be imagined as being united in one large heating body. The temperature drop of 10 deg. C. is created by the heat pump, and the amount of energy required is then the same as that required for the running of the compressor. If the compressor and also the driving engine could be run without any losses, 1 kg. of steam in the driving engine would transmit 1 kg. of steam to the compressor, provided a temperature drop of 10 deg. C. (the same as is available for the compressor) were available for the steam of the driving engine. Actually, however, the same drop is available for the driving engine as that which is available for the multiple-effect evaporator—viz., 160 deg. C. Consequently, the result would be the same as with the multiple-effect evaporator—that is, a sixteen-fold evaporation. This relation also is an approximation, as the energy produced by the adiabatic expansion over a certain temperature drop is not exactly equal to the energy requirement of adiabatic compression at the same temperature drop.

As is well known, saturated steam becomes wet when

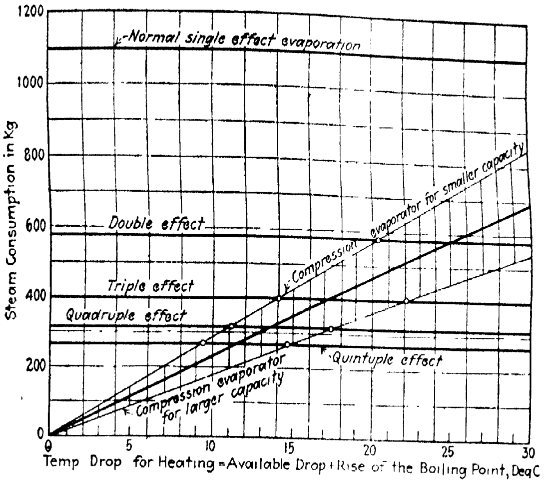


FIG. 2—THERMAL EFFICIENCY OF VARIOUS VACUUM EVAPORATORS

expanded, and superheated when compressed. Consequently, the energy gained during expansion is somewhat less than the energy required for compression, assuming the steam to be saturated at the beginning in both cases.

These are conditions which would govern systems operating without loss. Under actual conditions, it must be remembered that compressors suitable for evaporation operate with an efficiency of 65 per cent, and the same is the case with the driving engine. By multiplying the efficiencies, a resulting efficiency of 0.42 is obtained—that is to say, the compression evaporation plant allows an efficiency of 42 per cent of that of a multiple-effect evaporator. The objection could be raised that in the case of compression evaporation, the heat value of the compressor losses becomes available for the evaporation process. This, however, is inconsiderable in practice, as this work loss of the machine is covered by a thermal efficiency which in most cases is less than 20 per cent.

As far as is known, multiple-effect evaporators with sixteen stages have never been constructed. However, seven or eight stages are sufficient to equalize compression evaporation with multiple-effect evaporators as far as thermal efficiency is concerned. At the same time it must be remembered that evaporation is assumed to be accomplished by a temperature drop of 10 deg. C., and this brings us into fields of operation which seem perfectly feasible. It may be mentioned at this point that evaporators of six stages have often been constructed for the sugar industry.

The number of stages in multiple-effect evaporation is limited by practical considerations. The first stages would have to be operated under heavy pressure. This would make the plant much more expensive and more difficult to operate. In practice, therefore, the number of stages seldom exceeds three.

The considerations mentioned above hold true only for an evaporation process which is independent of other operations.

Usual Operating Arrangements

If one should limit oneself to the above considerations alone, he would arrive at an unfair conclusion, because in modern heat practice a new basis for calculation is created by the coupling of thermal processes. Such a coupling is usually made possible in one of the following ways:

a. Combination of energy-producing system and evaporation process. The back pressure of the engine is used for heating the evaporation plant.

b. Combination of evaporation process and heating process. The vapors of the last evaporating unit are used for boiling and heating purposes, etc.

c. Simultaneous application of methods *a* and *b*. The boiler steam flows successively through the engine, the evaporator, and heating and boiling plant.

The possibilities of these methods of operation are shown in Fig. 1. Plans I to III refer to independent evaporation processes; plan I shows the normal single-effect evaporator; II is an example of a multiple-effect evaporator; III is a compression evaporator with a steam-driven compressor. Plan IV shows a scheme for the utilization of exhaust steam from the engine for evaporation purposes. Plan V shows the utilization of the vapors for heating purposes. Plan VI illustrates the most perfect case of the utilization of heat, thermal coupling of engine, evaporator and heating plant.

In comparing independent evaporation processes, Fig. 2 may be referred to, the calculations from which it is obtained being based on average operating conditions. The high steam consumption of the single- and multiple-effect systems is noticeable. If a comparison is to be made with the compression evaporator, it must be borne in mind that the quantity of steam needed for the compression evaporator is very nearly proportional to the temperature drop that the compressor has to overcome. The manner of calculating the quantity of steam necessary is shown in Table I. The figures in the table obtain for a temperature rise in the compressor of 19.6 deg. C. The steam consumption varies within rather wide limits according to the efficiency of compressor and driving turbine.

Table I shows that the drop in temperature is of decisive importance when judging the economy of the heating process. This varies within very wide limits in the event that increased concentration causes a considerable rise in the boiling point. This point will be considered later.

TABLE I—CONSUMPTION OF ENERGY AND STEAM FOR COMPRESSION EVAPORATOR*

	Larger Plant	Smallet Plan
Efficiency of steam turbine, per cent	0 65	0 45
Efficiency of compressor, per cent	0 65	0 60
Drop of heat turbine, cal per kg.	202	202
Steam consumption for 1 hp of the turbine working without loss, kg per hr	3 13	3 13
Actual consumption for 1 hp per hr, kg per hr	4 82	6.95
Heat rising for $\frac{P_2}{P_1} = 2\ 0$,‡ cal per kg	30 5	30 5
Actual heat consumption for the transmission of 1 kg steam, cal per kg	47 0	50 8
Steam transmission per 1 hp-hr, kg	13 5	12 5
Steam consumption in transmitting 1,000 kg of steam, kg	356	555

* Steam enters at 300 deg. C. and 12 atmospheres absolute and exhausts at 0 08 atmosphere.

‡ Assuming $p = 1\ 0$ atmosphere absolute, $t = 19\ 6$ deg C

TABLE II EVAPORATION WHEN UTILIZING EXHAUST HEAT

	Single Effect	Double Effect	Triple Effect
Required evaporation, kg	1,000	1,000	1,000
Required quantity of heating steam, kg.	1,100	575	400
Live steam consumption for back pressure engine, kg	1,100	575	400
Live steam pressure, atmospheres	12 0	12 0	12 0
Live steam temperature, deg. C.	300	200	300
Back pressure, atmospheres	1 2	1 2	1 2
Adiabatic temperature drop, cal per kg	110	110	110
Turbine efficiency, per cent	0 65	0 65	0.65
Steam consumption for 1 hp, kg. per hr.	8 85	8 85	8 85
Capacity with 1,100 kg live steam, hp.	125	65	45 2
Specific steam consumption of the condensation turbine, kg. per hr.	**4 82**	**4 82**	**4 82**
Hourly consumption for total capacity, kg per hr.	**605**	**313**	**218**
Consequently, live steam consumption for the evaporation plant, kg. per hr.	**495**	**262**	**182**
Equivalent quantity of low-pressure steam, kg. per hr.	**565**	**300**	**206**

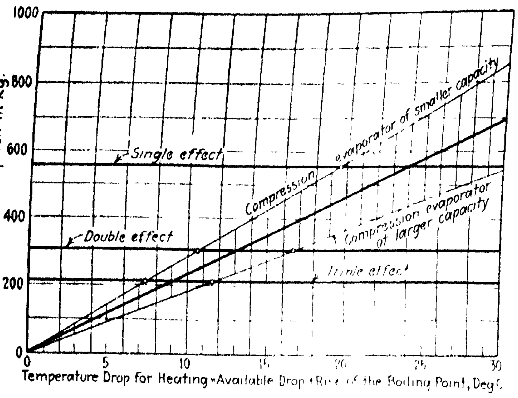


FIG. 3—COMPARISON OF VACUUM AND COMPRESSION EVAPORATORS

If it is possible to operate with a small drop in temperature, evaporation by compression may be far superior in heat efficiency to the five-stage multiple-effect evaporator; on the other hand, a rise of 20 to 30 deg. C. in the boiling point puts the efficiency on a parity with that obtained by double-effect evaporation.

As mentioned above, the evaporator plant is often heated with the exhaust steam of the engine. Thus, a new basis on which to consider the heat economy is created, and the following question is thereby raised: How can the steam consumption for the generation of energy and the heat required for the evaporation be separated in this case? This can be ascertained by subtracting from the total steam consumption of the combined plant that amount of steam consumption corresponding to the capacity of the condensing turbine. The remainder represents the steam consumption of the evaporator. An example is shown in Table II. It must be remembered in this case that the heat content of superheated live steam is not identical with that of saturated steam of low pressure. If, in spite of this, the two quantities that constitute the total required steam are equalized, the heat equivalent of the generated energy as well as the loss of heat due to radiation are fully covered. The conclusion to be derived from this example is that for the given steam conditions the heat required for the evaporation is reduced to one-half of that required with a system operating independently, provided the number of stages are the same. Fig. 3 shows the application of this deduction as a basis of comparison with compression evaporation. If, for instance, a temperature drop of 24 deg. C. is necessary, the compression evaporator equals the single-effect evaporator in efficiency, and furthermore it can be seen that even under more favorable conditions—i.e., the necessary temperature drop—favorable efficiency of compression evaporation can be maintained by arranging two or three evaporators in a series.

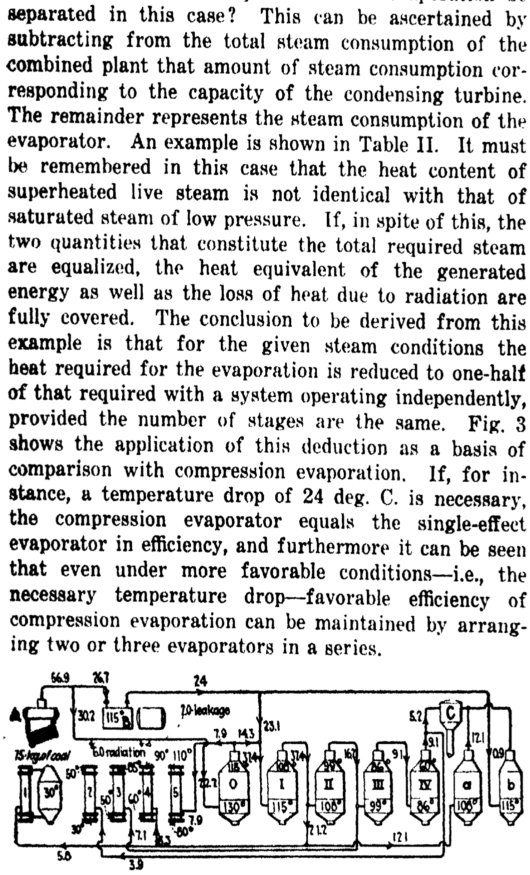


FIG 4—HEAT DISTRIBUTION IN PLANT FOR EVAPORATION OF BEET SUGAR SOLUTION

A—Boiler. B—Engine. 1—Calorizators for diffusion. C—Condenser. 2-5—Heaters for thin liquor. I-IV—Evaporators. a, b—Secondary evaporators. O—Preliminary evaporator.

Considering now the conditions of evaporation where the exhaust steam of the evaporator is used for heating purposes, one must start from the viewpoint that the steam necessary for heating purposes is independent of the construction of the evaporation and power plants. If all the vapors of the evaporators can be used, an improvement of economy is inconceivable. No saving of heat can be obtained by compression evaporation. As an example of an installation where, by a double-thermal coupling, a perfect heat economy is attained, the manufacture of raw sugar may be mentioned, and it may be of interest to analyze such an installation in respect to heat economy, using as a basis figures obtained in practical operation.

Heat Economy in the Sugar Industry

We may assume that the principles of the manufacture of raw sugar are known and therefore need mention only those points which are of importance to heat economy.

The total heat consumption is divided into three separate parts. The first part is required for the production of the thin sugar liquor as well as for the preparation of the same for evaporation. The second part is necessary for the evaporation of the thin liquor, in which operation large quantities of water must be evaporated and in which large quantities of heat are consequently necessary. The last part is essential to generate the mechanical energy in the engines necessary for the manufacturing process.

For the production and preparation of the thin liquor, the beet shavings must first be leached. The juice must then be heated and brought to the saturation point, and finally to the boiling point, the same temperature that prevails in the evaporator. It is customary in the sugar industry to express the necessary quantity of heat in terms of the kilograms of steam necessary for 100 kg. of beets. The figures given in Table III have been established by practical experience, and show the heat consumption for the entire operation.

TABLE III—STEAM CONSUMPTION FOR THE TOTAL PRE-HEATING FIGURED ON 100 KG. BEETS

	Kg.
Leaching of the beets	5.6
Pre-heating of the raw beet juice	11.0
Saturation of the thin liquor and heating up to boiling point	11.2

The evaporation process is divided into two stages: A primary evaporation whereby the greatest part of the water in the thin liquor is removed in multiple-effect evaporators, and a secondary step which is effected with a greater temperature drop in a single-effect evaporator under vacuum. The quantity of water that must be evaporated in this case is not very large. However, the quantity of steam necessary for its evaporation is considerable because, for practical reasons, single-effect evaporators must be chosen.

The steam consumption for the generation of mechanical energy can be calculated if the quantity of energy necessary is known. The latter is given as between 1.2 and 1.5 hp. per hour for 100 kg. of beet shavings. The generation of energy was formerly decentralized to quite an extent. Nowadays a fairly effective centralization is sought for and obtained by using electrical transfer of energy. To make a comparative analysis, losses by radiation and leakage must be considered.

The various heat-absorbing plants are coupled to-

TABLE IV—SUGAR FACTORY AT OFFSTEIN

Daily quantity of beets worked, kg	1,500,000
Hourly quantity of beets worked, kg	62,400
Steam consumption	
Live steam addition, kg. per hr	12,000
Exhaust steam of the engine, kg. per hr	12,000
Exhaust steam of the turbine, kg per hr	11,000
Total, kg per hr	35,000
Steam consumption for total of 100 kg beets, kg	56.1
Hereof: (a) For diffusion, kg	5.8
(b) For pre-heating, kg.	22.0
(c) For boiling, kg	11.9
Total $a + b + c$, kg	39.7

Conditions for operating machines	Steam Pressure Above Atmospheric Pressure Entrance	Exhaust
Piston engines	6.0	1.0
Steam turbine	12.0	1.0

gether thermally in a practical way. The mechanical energy is thereby generated throughout in engines using back pressure, and the total exhaust steam is introduced into the evaporators. By this method the heat consumption necessary for the generation of energy is reduced to a very small quantity. This quantity represents the heat equivalent of the energy generated, so that, not taking into consideration the radiation losses of the engines and the leakage losses, the generation of energy is produced with an efficiency of 100 per cent.

By coupling the evaporator and the diffusion and warming plants, an additional advantage is obtained—viz., that for the primary heating plant only that heat quantity need be considered which is lost in the condenser of the last evaporator. The heat distribution in a modern plant can be seen from Fig. 4, which shows that of the 56.9 kg. of steam which is necessary for 100 kg. of beet shavings, only 2.7 kg. is absorbed for the generation of energy and only 5.2 kg. for the primary evaporator, in which the greatest exchange of heat takes place. Of the remainder, 13 kg. is used for the secondary evaporator and 28 kg. is necessary for diffusion and heating purposes. Radiation and leakage losses require 8 kg. of steam. These figures were established in the operation of an Austrian sugar factory. Corresponding figures of a German factory, which are shown in Table IV, confirm the reliability and correctness of these figures.

Considerations Affecting Steam Consumption

When endeavoring to ascertain whether and to what extent a reduction of the steam consumption is possible and practicable, the following considerations must be a guide. The heat requirement for diffusion and preliminary heating, neglecting the theoretical possibility of utilizing the hot distillate from the evaporator, must be considered as unavoidable, as well as the heat necessary for covering the losses caused by radiation and leakage. If for technical reasons boiling under vacuum in a single effect system is resorted to, it is necessary to generate this additional heat quantity in the boiler, as the heat of the vapors is consumed in the condenser. It is true, however, that the heat necessary for preheater No. 2 could be covered by its heat of evaporation, so that the quantity of steam could be reduced from 13 to 13 — 3.9 = 9.1 kg. Correspondingly, the exhaust heat of the vapors would naturally be increased from 5.2 to 5.2 + 3.9 = 9.1 kg.

The lower level of the obtainable steam consumption, taking into account the above assumptions, would be attained when this loss of the exhaust heat of 9.1 kg. is eliminated. The steam consumption for 100 kg. of beets would be 47.8 kg. The elimination of the heat loss of the condenser can be effected by two methods:

a. Increase in the number of the preliminary boilers arranged in series. In practice, never more than two preliminary boilers have been used.

b. Reduction of the steam consumption for the generation of mechanical energy, which should be tried by centralization and application of higher pressures and temperatures, whereby a larger amount of steam is made available for the preliminary boilers.

By the total elimination of the condenser losses of the evaporation plant, which is a practical possibility, the most favorable operation is obtained. A proposal to operate the evaporation plant with vapor compression would be of no advantage when the generation of mechanical energy is brought about by means of steam power. In case electrical energy can be generated by means of water power, a reduction of the operating costs would be possible only when the price of heat from electrical energy is less than that of coal, multiplied by the efficiency of the boiler. However, there is probably no locality where this is the case, even with very favorable rates for electricity. Even if such were possible, the advantages would be only slight.

Drying Beet Shavings

If, therefore, it is desired to give further consideration to the utilization of vapor compression, the possibility of covering the unavoidable heat consumption of diffusion, preheating and boiling by heat sources which are independent of the manufacture of sugar must be investigated. Such a possibility arises if a plant for the drying of the shavings is run in conjunction with the sugar factory. As such a drying plant is to be found in most modern factories, its possibilities are worthy of consideration.

The value of the dried shavings is so great that devices for the drying of the shavings taken from the diffusion batteries have been quite generally installed, although the heat necessary for the drying is considerable, as the following figures show.

Seven kilograms of dried shavings is obtained from 100 kg. of beets. The solid and water contents are as follows: Dried shavings, 85 per cent of solids, 15 per cent of water; pressed wet shavings, 12 per cent of solids, 88 per cent of water. The quantity of water to be evaporated from 7 kg. of shavings can be calculated as follows: 7.0 kg. dried shavings contains 5.94 kg. solids and 1.06 kg. water; 51.75 kg. wet shavings contains 5.94 kg. solids and 43.5 kg. water. The production of 7 kg. of dried shavings requires accordingly the evaporation of 43.5 — 1.1 = 42.4 kg. of water.

The shavings are dried by means of a direct utilization of combustion gases, obtained by burning coal on a specially constructed grate. On the basis of tests which have been obtained in practice, we can figure on a coal consumption of 0.6 kg. coal for 1 kg. of dried shavings, so that for 7 kg. of dried shavings, corresponding to a quantity of 100 kg. of beets, a coal consumption of 4.2 kg. is necessary. Comparing this coal consumption with that necessary for the total manufacture of raw sugar, which, according to the normal conditions shown in Table IV is 7.5 kg., it follows that the consumption necessary for drying is 5.6 per cent of the total.

The 42-kg. steam obtained by the drying of the shavings has the abnormally high evaporation figure of 10, which can be accounted for by the fact that the loss of

TABLE V—DETERMINATION OF DEW POINT

Theoretical air consumption for the combustion of 1 kg. of coal					9.7 kg. air
Combustion water + water content of the air per 1 kg. of coal					0.5 kg. H_2O
Evaporation of water per 1 kg. of coal = 42 4÷4 2					10.0 kg. H_2O
Total quantity of steam per 1 kg. of coal, 10 + 0.5					10.5 kg. H_2O
Air surplus	1.0	1.2	1.4	1.6	1.8
Air consumption per 1 kg. coal	9.7	11.7	13.6	15.5	17.5
Weight of combustion gases	10.7	12.7	14.6	16.5	18.5
Weight of steam			10.5		
Steam constant of 1 kg. gas	0.98	0.84	0.72	0.635	0.57
Dew-point, deg. C	86	85	83	82	80.5

the exhaust heat is very small, on account of the low exhaust temperature— about 100 deg. C.— of the mixture of the vapors and the combustion gases.

The heat of condensation of the 42 kg. of steam present in the exhaust gases is more than sufficient to supply the heat necessary for the diffusion, preheating of the juice, etc., if the two following assumptions are considered:

a. That the temperature at which the heat can be made available is high enough.

b. That the required percentage of steam can be separated from the mixture of steam and gas.

The dew-point of the mixture of steam and gas is important for the consideration of these two points, as is shown in Table V. The table shows that in practice a dew-point of 83 to 85 must be figured, which means that at this temperature the condensation of steam begins. The percentage of steam condensing is greater the lower the point at which the mixture of steam and gas is cooled. Further calculations show that the heat of about 70 per cent of the steam content can be obtained by condensing the same, if the temperature is lowered 15 deg. below the dew-point— that is, down to about 70 deg. C. This temperature, however, is sufficient for only a small part of the heat consumption of the sugar factory, and it is therefore necessary to raise the temperature by means of a heat pump.

Effect of Drying on Heat Economy

The following considerations show how the heat economy is influenced by the utilization of the exhaust heat from the drying of the shavings and also by the necessary rise in temperature difference.

It is assumed that the mechanical energy necessary for raising the temperature must be generated by means of steam power. A study of Fig. 5 shows that of the 42 kg. of steam contained in the exhaust gases, about 16 kg. can be used in the sugar factory, which must be made available by cooling the mixture of steam and gas to from 75 to 77 deg. C. This corresponds to

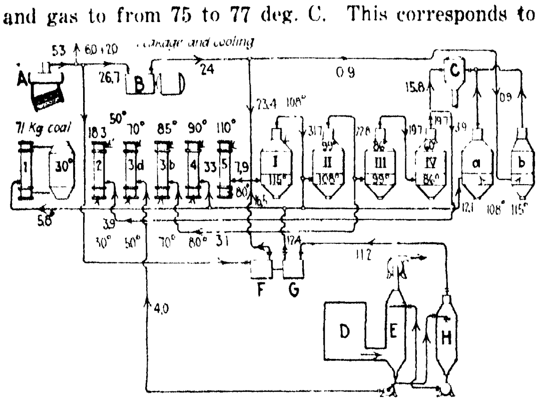


FIG. 5—HEAT DISTRIBUTION IN PLANT INCLUDING DRYING OF SHAVINGS

A—Boiler. *B*—Power engine. *C*—Condenser. 1—Calorizator for diffusion. 2-5—Pre-heaters for the juice. I-IV—Evaporators *a*, *b*—Secondary evaporators. *D*—Drier for shavings. *E*—Heat exchanger. *F*—Driving turbine for heat pump. *G*—Heat pump. *H*—Heat transformer.

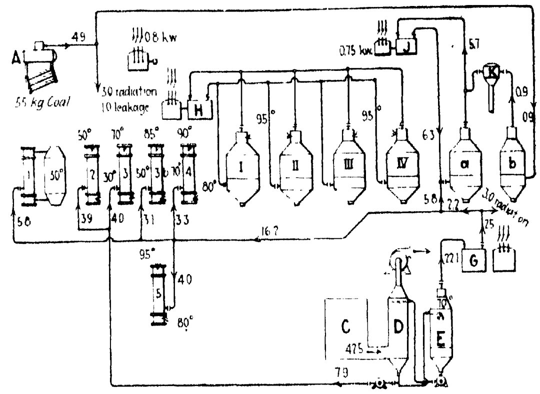


FIG. 6—HEAT DISTRIBUTION IN SYSTEM USING VAPOR COMPRESSOR ON PRIMARY AND SECONDARY EVAPORATION SYSTEMS

A—Boiler. *B*—Condenser. *C*—Shavings drier. *D*—Heat exchanger. *E*—Heat transformer. *F*—Vapor compressor for secondary evaporator. *G*—Heat pump. *H*—Vapor compressor. 1—Calorizator for diffusion. 2-5—Heaters for thin liquor. *a*, *b*—Secondary evaporators.

Total consumption of electric energy—66 kw.

a steam pressure of only 0.4 atmosphere absolute, which must be raised to a pressure of 1.6 atmospheres absolute if the heating temperature is to be 108 deg. —that is, as high as the temperature of the vapors otherwise used for heating purposes. For this purpose, the driving turbine must produce an energy of 81.5 cal. for 1 kg. of generated steam, at a compressor efficiency of 65 per cent. If the turbine is driven with live steam (of 13 atmospheres absolute and 300 deg. C.) and gives up its exhaust steam to the exhaust steam distributor at a back pressure of 1.75 atmospheres absolute, corresponding to a saturation temperature of 115 deg. C., then at 55 per cent efficiency 55.2 cal. per kg. of live steam is transformed into mechanical energy, and accordingly 0.677 kg. of vapor can be generated by means of 1 kg. of steam.

The operating conditions of the vapor compressor are shown in Fig. 5. It may be seen that a small part of the exhaust heat of the drying plant corresponding to 4 kg. of steam can be made available without a preliminary rise of temperature.

The final result of a program carried out according to Fig. 5 is a steam consumption of 53 kg. of steam per 100 kg. of beets. In contrast to the plan of Fig. 4, this means a saving of steam of 3.9 kg.—that is, 7 per cent. This saving seems to be very small, but is explained by the fact that in order to obtain the highest possible capacity of the driving engine of the heat pump, no attention has been paid to the installation of the preliminary boiler of Fig. 4. When it is considered that even without the use of the exhaust heat of the drying plant a lower level of steam consumption—viz., 48—can be reached by increasing the number of the preliminary boilers arranged in series, the conclusion may be justified that, basing the operation on steam economy alone, the use of the exhaust heat from the drying of the shavings produces no economical result.

More favorable results are obtained by providing the primary and secondary evaporation systems with a vapor compressor. In this case a much larger part of the exhaust heat of the drying plant can be used and the boiler would have to generate only a part of the steam necessary for covering the losses. Such a working plan is shown in Fig. 6, according to which 49 kg. of steam besides 6.6 kw.-hr. per 100 kg. of beets is necessary. If the electrical energy must be generated

by means of steam power in a condensing turbine, the entire steam consumption amounts to 49 kg., which is as great as when no vapor compression is used.

However, with hydro-electric energy, conditions may be entirely different, and the relation between energy and coal consumption, which is based upon the efficiency of the power engine, is eliminated. In that case it is possible to reduce the operating costs by one-half or more of the costs required with steam operation exclusively.

Fields of Application of Evaporation by Compression

Summing up the conclusions derived from a consideration of the points outlined above, the prospects for a successful application of evaporation by compression do not appear especially favorable, if judged only from the viewpoint of heat economy. In practice, however, conditions are frequently not such as to make the evaporation a secondary operation utilizing exhaust steam. Often the problem arises how to operate the evaporation process independent of other operations in a most economical way. However, despite the fact that from a thermal standpoint nothing would hinder the multiple-effect evaporator from being operated in a manner as economically favorable as the compression evaporator, practical objections often arise against such an installation.

One principal objection to multiple-effect installations is the fact that the temperatures in the various stages are different. This results in objectionably high pressures in the first stages under certain conditions. Often multiple-effect evaporation cannot be used in any event, this being the case if, in consideration of the properties of the final product and of the physical and chemical conditions of the liquid to be evaporated, a certain evaporation temperature has to be chosen, which temperature can be raised only within small limits. In such cases the compression system has in many instances great advantage from the standpoint of heat

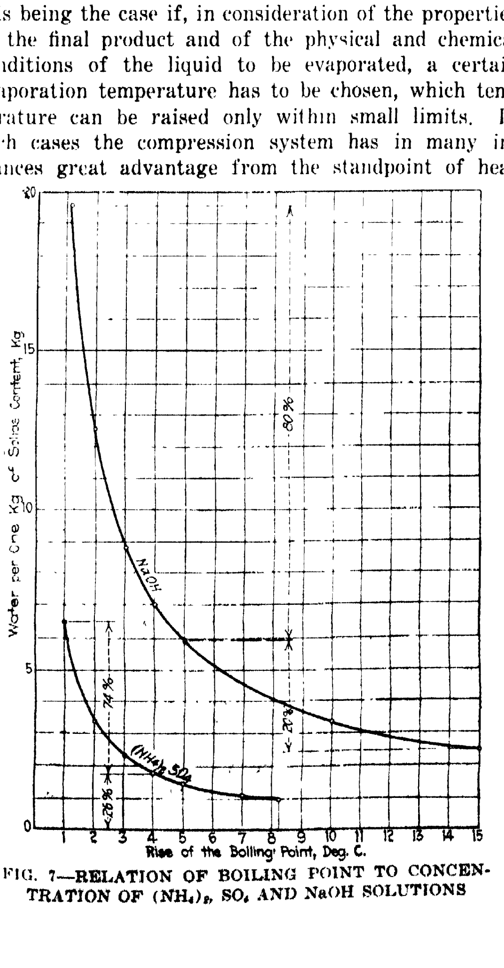


FIG. 7—RELATION OF BOILING POINT TO CONCENTRATION OF $(NH_4)_2SO_4$ AND NaOH SOLUTIONS

economy. As an example, the evaporation of milk, fruit juices and tanning materials may be chosen. In inorganic chemistry, there are also many such examples.

The economy of compression evaporation can be questioned if we have to deal with a considerable rise of the boiling point. But even in such cases, larger installations can be favorably operated if we take into consideration that the rise in the boiling point is a function of the concentration. In order to explain this relation, let us turn to Fig. 7. A distinction must be made between the two principal cases. In the first, only the concentration must be raised by evaporating without a separation of the dissolved substance; in the other, the problem is to separate the dissolved substance in a solid form. In the latter case the boiling point

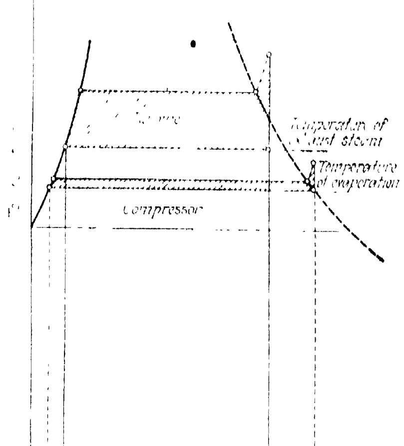


FIG. 8—ENTROPY DIAGRAM

rises to a maximum, at which point the separation of the salt begins and then remains constant. The curves, which represent the dependence of boiling point on concentration, always have a certain resemblance in character, and there are universal laws which determine this function. The figure shows the boiling conditions of caustic soda and ammonium sulphate solutions. The first case involves a concentration of the solution and the second a separation of salt. The curve shows that the rise in the boiling point, corresponding to the concentration at the start, is usually low, and that a considerable percentage of water can be evaporated with only a small rise in the boiling point of 4 or 5 deg. The practical conclusion that must be drawn from this is that the evaporation process should be done in two separate stages: A preliminary concentration in which the greater part of the water is evaporated in the compression evaporator under a slight rise of the boiling point, and a secondary evaporation with a greater temperature drop in a single- or multiple-effect evaporator heated in the usual manner.

The conditions are especially favorable for the compression evaporator, when evaporation must be done at low temperatures and when, at the same time, steam must be supplied to a heating plant. It is not possible to use the exhaust heat of the evaporator directly, because the temperature would be too low. On the other hand, in the case of compression evaporation, the exhaust steam of the driving turbine can be fully utilized at any desirable pressure—that is, at any desirable temperature. A plan of operation is shown

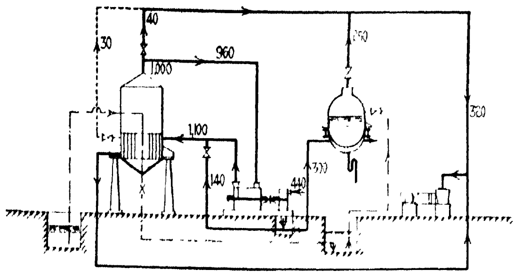


FIG 9—SYSTEM UTILIZING EXHAUST STEAM FROM TURBINE

in Fig. 8, where, in the temperature entropy diagram, the operation of the compression and the driving engine is shown, and where the temperatures and relation of heat economy can also be seen.

An example of this basic arrangement which has been put into successful operation in practice is shown in Fig. 9.

Evaporating Fruit Juice

A fruit juice of a very important foodstuff industry must be concentrated to a sixth part of its original weight. The final product is of such a thick consistency as to make it impossible to evaporate the last portion of water in a tube evaporator. For this purpose a steam-jacketed bowl heated with a sufficiently great drop in temperature seems to be better adapted. The evaporation temperature must be about 60 deg. C.

The evaporation is done as follows: The preliminary concentration of 1:3 is done in the compression evaporator, then the final concentration of 1:2 in a bowl. Eighty per cent of the water is evaporated in the compression evaporator; 20 per cent in the secondary evaporator. Both evaporators are operated under the same vacuum. The exhaust steam of the driving turbine of the compressor is exhausted at a pressure of 5 or 10 lb. gage and to a large extent serves to heat the secondary evaporator. The remainder serves to cover the loss by radiation.

The installation shown in Fig. 9 evaporates altogether 1,000 + 250 = 1,250 kg. of water per hour. Formerly, when using a single-effect evaporator, 1,500 kg. of steam per hour was necessary. The new operation reduces the consumption to 440 kg. per hour, which means a saving of 70 per cent of the former steam consumption. Fig. 10 is a photograph of an installation which operates according to the plan shown in Fig. 9, but which has a much larger evaporation capacity. Fig. 11 shows an installation in Switzerland for the vacuum evaporation of milk. This plant is electrically operated, on account of the comparatively high cost of coal. Table VI shows results of operations over long periods. The specific figures on the evaporation capacities are therefore correct for normal operations.

TABLE VI—RESULTS OF A MILK EVAPORATION PLANT

Concentration	1:5
Height of the barometer, mm	735
Vacuum evaporator, mm	585
Vacuum heating chamber, mm	545
Estimated temperature of vapors, deg. C	60.3
Measured temperature of vapors, deg. C	59
Temperature of heating steam, estimated, deg. C	65.3
Temperature of heating steam, measured, deg. C	65
Duration of the evaporation	6 hr., 25 min
Average evaporation per hr., kg	1,680
Voltage	245
Intensity of current, amp	92
Energy consumption, kw	31.4
Water evaporation for 1 kw.-hr., kg	53.5
Water evaporation for 1 hp.-hr., kg	45.0

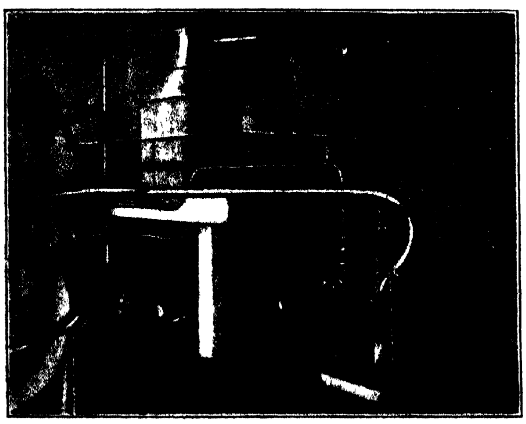


FIG 10—INSTALLATION OPERATING ON ARRANGEMENT SHOWN IN FIG. 9

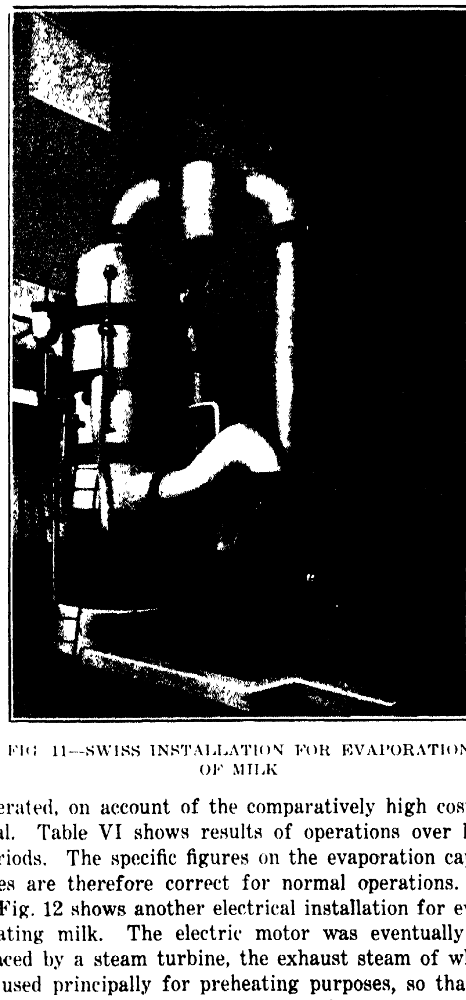


FIG 11—SWISS INSTALLATION FOR EVAPORATION OF MILK

Fig. 12 shows another electrical installation for evaporating milk. The electric motor was eventually replaced by a steam turbine, the exhaust steam of which is used principally for preheating purposes, so that in this case the operation by means of steam proved to be much superior to the electrically operated plant.

Résumé

The field of operation for the compression evaporator is limited. Compression evaporation may possess very considerable advantages if operated in its proper field. Examples on conditions which justify its use are:

Where the evaporation has to be done at a certain temperature because of the properties of the liquid, which means that it has to be done in a single-effect evaporator.

Where the direct use of the vapors of the evaporator is not possible on account of special conditions mentioned above—the temperature is too low, or because

the vapors carry over volatile acids and therefore it would not be possible to use them.

The characteristic of the compression evaporator which should be emphasized in connection with the use of exhaust steam is *that the temperature at which the exhaust steam is used can be made entirely independent of the temperature of evaporation in the evaporator.*

Economy of the Compression

The capacity of the evaporator in respect to the evaporation of water depends primarily upon the extent of heating surface, the viscosity of the liquid to be evaporated, and the construction of the evaporator, especially with regard to good circulation.

On the other hand, in the case of vapor compression, the efficiencies of the compressors must be considered, and this, as previously mentioned, has a great bearing on the heat economy. Three special types of compressors have to be considered.

a. Piston compressor (including rotary blowers).

b. Turbo-compressors with steam-driven turbine (the electrical drive not to be considered).

c. Injector-compressors.

As a rule, the turbo-compressor is considered the most advantageous for the compression of vapors. This view is true in many cases, but not in all. The turbo-compressor allows a slight rise of temperature with good efficiencies of 60 to 65 per cent. As the rise in heat is effected by arranging separate stages in series, the efficiency can be kept at the same level independent of conditions of compression. There is no limit to the increase of the transmitted vapors as far as practical considerations go, especially when considering the possibility of arranging several units in parallel. On the other hand, the capacity of the compressor is limited. In case of small quantities of vapors, the turbo-compressor can either not be operated at all, or only at a high cost and low efficiency.

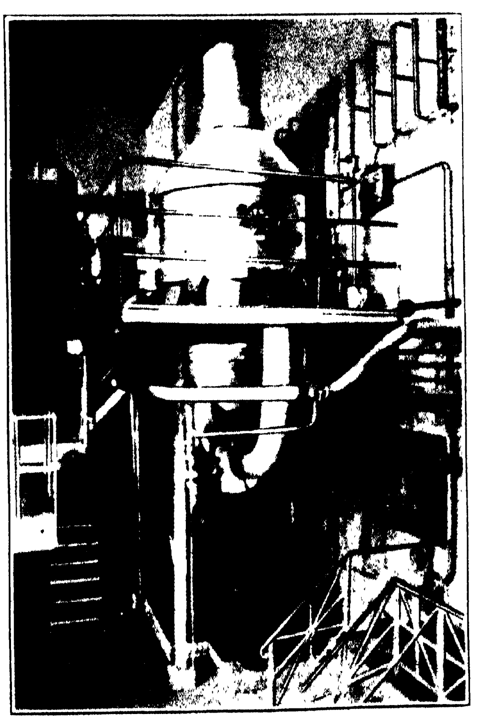


FIG. 12—ELECTRICALLY OPERATED INSTALLATION FOR EVAPORATION OF MILK

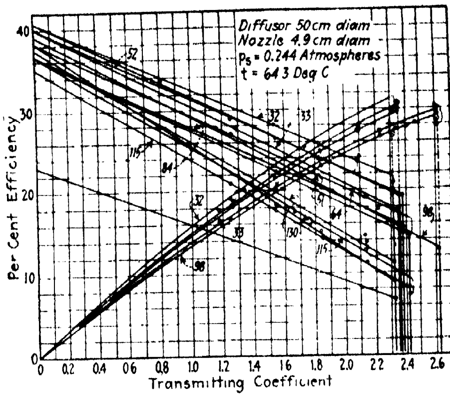


FIG. 13—THERMODYNAMIC EFFICIENCY OF INJECTOR-COMPRESSOR

The piston compressor can be built for very small quantities as well as for larger quantities of vapor. The dimensions of the piston compressor would be too great in practice for very large quantities of vapor. In that case the engine would also be too expensive in comparison to the turbo-compressor. If it is desired to evaporate under small temperature drops (and that is generally the case) then the efficiency of the piston compressor is low because the mechanical friction is great, compared to its usefulness.

The injector-compressor is of some importance. This from a thermodynamic viewpoint represents a simplification of the energy transfer of the turbo-compressor with steam-driven turbine. The transfer of energy of the turbine is characterized by the following phases: Potential energy, kinetic, mechanical, kinetic, potential. With the injector-compressor, the third stage mentioned above is eliminated and the kinetic energy is transformed directly into energy of velocity, and the latter, after being mixed with the vapors, is immediately changed back into kinetic energy. The evaporation, in the case of the injector-compressor, is in no way limited. It would be of interest to compare the three possible methods of compression in respect to their suitability for compression evaporation. This can best be done by considering the function which, bearing in mind the above question, must be chosen as the relation between capacity and that difference of saturation temperatures depending on the difference in pressure. The characteristics and efficiencies of turbo- and reciprocating compressors are known. This is not so true in the case of the injector-compressor, concerning which accurate and complete figures are not known or have not been published. This can be understood when it is remembered that correct dimensioning of the injector-compressor is of much greater importance than technical experience and practice. A consideration of the injector-compressor at this point, therefore, is made possible only by the fact that the transfer of energy has been thoroughly studied in previous theoretical and experimental investigations. It is impossible to say at this time whether the maximum conditions which have been determined can be considered as final, as the experiments have not been fully completed.

Fig. 13 shows the characteristics and efficiencies which were obtained when the dimensions of the mixture and compression apparatus were systematically changed; as abscissa, that quantity of steam was chosen which is transmitted by 1 kg. live steam; as

ordinate, the temperature rise (always based on saturation)—i.e., the thermodynamic efficiency. Characteristic of all curves is the fact that with increasing temperature the transmitting coefficient remains constant until a maximum is reached, and that then there is a sharp break in the curve and the delivery coefficient approximately decreases linearly with rising temperature. The efficiency reaches a maximum of about 32 per cent.

Comparing the characteristics of the different forms of compression, in Fig. 14, it is observed that, in the case of the turbo-compressor, there is an appreciable increase of the quantity of steam transmitted when the rise in temperature may be smaller than under normal conditions of operation. If, with increasing concentration the heat transfer, and therefore the evaporation, becomes smaller, a partial compensating effect takes place until the maximum of the increase in temperature is reached. Then, however, further decrease of the evaporation efficiency brings us into a field where the compressor "pumps" and the operation is more or less at a standstill. The pumping can be avoided by leading back a part of the vapor from the pressure side to the suction side, but this can be done only at a sacrifice of the efficiency. Attempts to avoid pumping

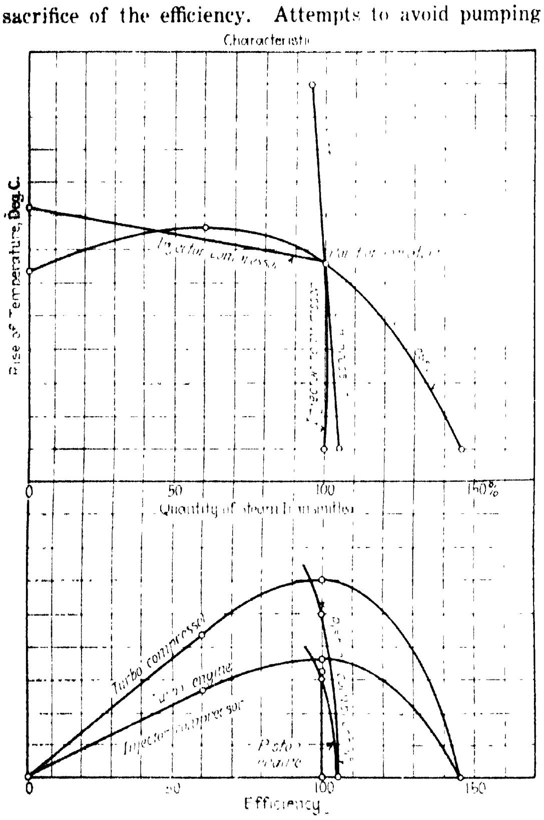


FIG. 14—COMPARATIVE CHARACTERISTICS OF DIFFERENT FORMS OF COMPRESSION

by changing the number of stages of the compression complicates the operation. If the evaporator is so dimensioned that pumping does not occur, the turbo-compressor has various characteristics favorable to its practical operation.

The piston compressor is characterized by an approximately constant transmission of steam at variable temperatures. The slight decrease in transmission at increasing temperatures is explained by the fact that with increased compression the volumetric efficiency

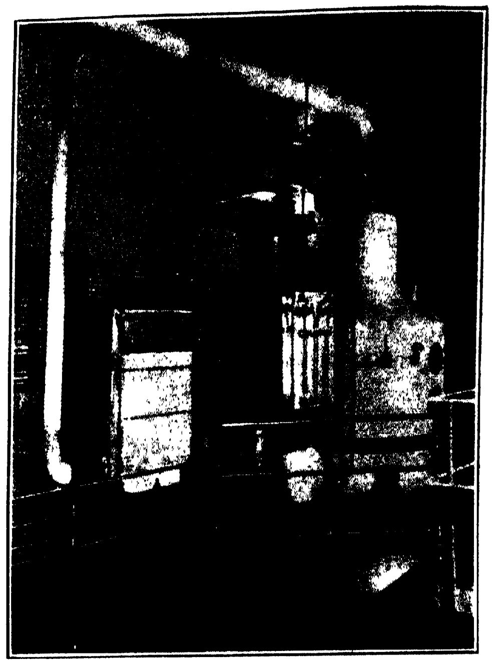


FIG. 15—VACUUM EVAPORATOR WITH INJECTOR-COMPRESSOR

decreases. The approximate constant of the steam transmission will last as long as the required capacity of the driving engine.

The injector-compressor shows a constant on the quantity of steam transmitted up to a certain rise in temperature; with a slightly increased temperature, the quantity of steam transmitted decreases. On considering the efficiencies, it may be seen that the injector-compressor under normal conditions of operation does not show up much more unfavorably than the turbo-compressor. For this reason the injector-compressor must be considered especially in the case of plants of smaller capacities in which a turbo-compressor cannot be used.

An injector-compressor cannot be used when the exhaust heat of the evaporator must be used at a temperature which is higher than the required temperature of evaporation and which is also higher than the temperature of the heating system. In that case a turbo-compressor with steam-driven turbine must be considered. Vacuum evaporating plants with injector compressor have been installed in many cases. Fig. 15 shows such a plant which evaporates 1,300 to 1,500 kg. of water per hour.

CONCLUSION

The above discussion touches on the principal points which are of importance for the consideration of an economical application of compression evaporation. It has been shown:

1. That often *general* conditions of heat economy existing in a plant are of greater importance for the choice of a system of evaporation than the economy of the evaporating system itself.

2. That for compression evaporation cases where the evaporation must take place at a certain temperature should be specially considered.

3. That for the compression of vapors, a choice must usually be made between a turbo-compressor and injector-compressor, and that piston compressors are of smaller importance.

Aims and Purposes of the American Institute of Chemistry

Establishment of Professional and Economic Community of Interest, Followed by Professional Recognition and Acknowledged Standing

BY F. D. CRANE
Newark Technical School, Newark, N. J.

THE existence, no less than the prosperity, of the British Institute of Chemistry has stood for years as a challenge to American chemists. A similar society has been talked of, reported on — and the reports pigeonholed. The New Jersey Chemical Society has been urged to try it as a state matter, but some of the most interested people have been widely scattered, and many were sure that only a national society with state chapters could live. There was a strong undercurrent of belief that chemists themselves were not quite competent to say who was a chemist—indeed, the unchallenged claim was made that no one knew what a chemist was.

And now, without in the least deciding *what* they are, some chemists are very certain that they are through with being the one learned profession in the land with no economic organization. They are fed up with "hanging separately"; it can be no worse and surely will be more companionable to "hang together." The chemists made temporary organization permanent on Feb. 5, 1923, and the American Institute of Chemistry is offering membership to all who consider themselves chemists.

Should it be supported? There are good reasons why it should, the main one, the main reason for its existence, being that it is, first and foremost, an economic organization.

WHAT THE INSTITUTE OFFERS

It takes a wholly unoccupied field in American chemistry, offering neither opposition to nor competition with any existing chemical society. It just says: "Are you a chemist? You are welcome to our fellowship; you will find other chemists and you can classify yourselves; we are united for our common good." That is something new in American chemistry; no other group has put being a chemist first. The Institute does this because the establishment and recognition of fellowship, of professional and economic community of interest, is its main purpose.

The next step, which must follow, is professional recognition and acknowledged standing. No other group, asking years of study and practice to attain proficiency and upon whose opinions life or property may depend, has ever rested so long without taking proper means to safeguard its members in the practice of their profession.

In some states a chemist may not get one hair legally abbreviated except at the hands of a licensed practitioner; in many his dead and empty arteries may not receive their due portion of the formaldehyde he, when living, may have made, except as it is administered by a state-licensed operator. In nearly all, perhaps by this time in all, states his accounts, whether he be alive or dead, will go smoothly before courts and tax collectors only if they are presented by a certified public accountant— that is, by a state-licensed bookkeeper. Meanwhile the chemists, "in dispersed phase," take what is handed them and are in economic competition with anyone who chooses to pass out cards printed "chemist" or who may have assumed a Doctorate on no firmer grounds than a marked foreign accent. "William's college degrees," so liberally bestowed in the early days of the Chemists' Club, when the dusky William "doctored" everybody, might stand today, to the man in the street, as well as any. How can anyone say whence they came when the holder bloweth as he listeth?

TO ESTABLISH CHEMISTRY AS A PROFESSION

Slowly, perhaps, but surely, the American Institute of Chemistry is going to put the practice of chemistry as a profession on as certain a foundation as any other, making that foundation broad enough to hold every honest practitioner. This is not a new duty; it is a neglected one. The profession which lacks the gumption to recognize itself deserves obscurity.

Now that chemistry has ceased to be a war baby, it again sells in a buyer's market. "The way to make money is to get hold of a creative enthusiast and keep him on wages" is a recipe for riches only as long as that kept fellow spends neither some of his time nor a little of those wages in finding out what his creation is really worth. Many chemists today are on as economically false and unsound a basis as the average farmer, and since there aren't enough of them (and their wives) to elect a chemists' bloc, it is unlikely that there will be any Chemists' Chemical Banks, with easy loans, set up for their supposed benefit. Supply and demand rule mobs but serve armies; an organized profession can foresee demands and prepare to fill them, and can locate deficits and surpluses and interchange them far better than individuals. Sellers of ideas and services too often get what is left after all else are well paid simply because they know of no better market than the one at hand. The American Institute of Chemistry proposes to study impartially the markets for substances, services and ideas, putting each tub on its own bottom and then seeing that it has a fair chance to stand. It will succeed in this, because as an economic fellowship of recognized ability it will enter a seller's market with offerings worth their price because guaranted as to quantity and quality.

Manufacture of Cane Sugar

Although the value of cane sugar has depreciated considerably, an increase in the quantity produced in the United States during 1921 is recorded in the reports of the Bureau of the Census. The total value of products for 1921 amounted to $23,153,000, as compared with $57,741,000 in 1919, representing a decrease of 59.9 per cent over a 2-year period. In compiling these statistics refineries making refined sugar from imported or domestic raw sugar have not been included, but only those manufacturing sugar, sirup and molasses directly from the cane.

The decrease in value of cane sugar has resulted in a decrease in the number of persons employed. Many of the smaller factories in operation in 1919 were reported in 1921 as idle or out of business. The decrease in number of those employed, therefore, cannot be attributed entirely to the fact that the manufacture of cane sugar is a seasonal industry, for in December, the month of maximum employment, there were 14,034 wage earners and in February and March, the period of minimum employment, approximately 1,866 — the minimum representing 13.3 per cent of the maximum.

Legal Notes

By Wellington Gustin
Of the Chicago Bar

Goods in Bankruptcy

Return of Merchandise Stored Not a Preference in Favor of Creditor

Some interesting propositions are involved in the bankruptcy case of Rosenbloom Leather Co. on petition of the Consolidated Rubber Co. The case came up on a petition to review an order of the referee denying the Rubber company the right to reclaim certain rubber products in the hands of the trustee in bankruptcy which were in the physical possession of the bankrupt at the time of the filing of the involuntary petition. 280 Federal 139.

No Absolute Sale Involved

The bankrupt was engaged in business in Michigan and apparently had contract for the sale of the Rubber company's products in the state. The Rubber company is an Ohio corporation and was not authorized to do business in Michigan. The bankrupt was to sell the Ohio corporation's products in Michigan at a price fixed by the latter, collect the money and remit the price less his compensation, which was fixed as a commission of 12½ per cent. These provisions were strictly carried out, and the court found that the facts did not constitute an absolute sale to the bankrupt.

The referee held that the transactions between the parties was a conditional sale to the bankrupt, for resale by him, and therefore void as regards the reservation, because not filed for public record as required by Michigan law; and he further held that if such agreement would thereby create an agency in the bankrupt to sell such property for the Consolidated Rubber Co., the latter would be barred from recovery by reason of its failure to obtain a license to do business in Michigan as required by statute of that state, invalidating the contracts of foreign corporation violating such statute in this respect.

Goods in Question Only Stored for Rubber Company

Now further facts disclosed showed that within 4 months prior to bankruptcy the bankrupt ceased selling the Rubber company's product and it was agreed between them that the goods which then remained with the bankrupt should be stored on the premises for the Rubber company. These were the goods involved in this suit.

The U. S. District Court held that the effect of this settlement was to release both the Rubber company and the bankrupt from their respective obligations under their earlier agreement, and to restore them to the positions occupied by them before its making. After this settlement the court held the title to this merchandise was vested in the Rubber company, if not before. This disposed of the question under the original contract between the parties as to whether the agreement was one of absolute sale with an attempted retention of title, operating as a chattel mortgage lien, in the Rubber company, a contract of conditional sale, with title remaining in the Rubber company until resale by the bankrupt, or an arrangement of pure agency.

This settlement did not effect a voidable preference in favor of a creditor. The court says on the point: "The contract under which the goods were delivered to the bankrupt having been made prior to the statutory 4 months' period before bankruptcy, for a present consideration, and the rights of the parties with respect thereto bring valid and enforceable as between them, the surrender of possession of this property was merely a delivery thereof to its owner, to which the latter was entitled, and was not a transfer by the bankrupt of his property to one of his creditors and hence such transfer did not constitute a preference." 25 Sup. Ct. 306.

Failure to Obtain License Does Not Prevent Recovery of Property

Again, the court said the referee was in error in holding that, if the relation between the parties should be treated as that of principal and agent, and not of vendor and vendee, the Rubber company would be deprived of the right to recover by its failure, as a foreign corporation, to comply with the statute of Michigan requiring such corporation to obtain a license to do business in the state and making void all contracts entered into by any such corporation in default. It is the settled rule of the Michigan Supreme Court, by which the federal court in that district is bound, that a foreign corporation which has not obtained the necessary license to do business in Michigan does not thereby lose the right to protect and recover its property from loss or injury, where such right does not depend upon a contract made in violation of this statute, but arises irrespective and regardless of any contractual rights, and that under such circumstances it does not forfeit such property but may recover possession thereof, if otherwise entitled to it, in a proper tort action, such as replevin.

There being no fraud shown or claimed in making of either the original agreement or subsequent settlement, the court said the order of the referee must be set aside.

Perkins Glue Patent Not Infringed

Application of Second Step of Process to Natural Base Permissible Under the Law

Further litigation, with a most recent decision, over the Perkins reissue patent No. 13,436 (original No. 1,020,655) comes from the United States Circuit Court of Appeals, Second Circuit. Suit was begun in the District Court by the Perkins Glue Co. against the Standard Furniture Co., of Herkimer, N. Y., and there resulted in a decree for the plaintiff. This decree has now been reversed on appeal, and the cause remanded with directions to dismiss.

In the case at bar the court points out the results reached on this patent in the Circuit Court of Appeals in the case of Solva, etc., Co., vs. Perkins, etc., Co., 251 Fed. Rep. 64.[1] These results were that the process disclosed by Perkins consisted of two parts or steps, and that each of the steps considered by itself was old, but the product was new and patentable. Without agreement or disagreement with this result the court here accepted it for purposes of present decision.

After the decision in the Solva case the mandated court ruled that only these claims remained valid

[1]See also *Chem. & Met.*, vol. 28, p. 124, Jan. 17, 1923.

"which included the two steps [of the process] and only when their use results in Perkins glue, together with such additional claims as count on such glue as a product of the two steps and no others." Subsequently to this Perkins disclaimed *inter alia* from claims 13 and 38 of the reissue patent "any process of making glue excepting where the starch or starchy product of carbohydrate subjected to the process is degenerated to the extent described in" the reissue. 280 Federal 729.

In the present case it was claimed that defendant procured starch so degenerated as to be in a condition equivalent to starch treated by Perkins' first process, and then gave to that substance Perkins' second process and so obtained Perkins' product.

Natural Product Has Properties of Degenerated Starch

Perkins' expert witness defined degeneration as "a certain proportioning of resulting viscosity, cohesiveness and adhesiveness." But defendant's evidence showed that the starchy substance or carbohydrates, called viscamite, which it used as a base for its alleged infringing glue, is a natural product, and that it received no chemical treatment whatever. The court said the fact was that the earth had been found to produce a starch which plaintiff admitted is the exact equivalent of what Perkins made by his first process.

This product of nature cannot *per se* be covered by any patent, and it certainly is not the result of any process devised by Perkins, says the court. Therefore, accepting the decision in the Solva case referred to above as interpreted and apparently acquiesced in by plaintiff, there could be no infringement, because the defendant is not using a glue which is the result of both steps of Perkins' patent.

But going further than this and examining the process used by defendant in making its glue, the court found that "starting with the natural starch base, a mixture is made ultimately containing about two and one-third parts of water to one part of starch base by weight and about 3 per cent of caustic soda based on the weight of the starch."

The court found that some accident of nature or the skill of agriculturists has produced and put on the market a cassava starch of that degree of viscosity, etc., which Perkins achieved by his degenerative process.

Applying Second Step of Process to Natural Base Does Not Infringe

With such starch the defendant by using methods as old as the Belgian patent to Gerard of June, 1874, has produced a substance which plaintiff says is Perkins glue. Perhaps it is in result, says the court, but it cannot be the same thing in a patentable sense because nature has supplied the base and Gerard the process. The only reason that justified prior courts holding Perkins' product patentably new was by finding it the peculiar result of a combination of two processes severally old. There was no such foundation for a finding in this case. Nature or the farmer (so to speak) has superseded the first half of Perkins method, and the second half was not new; the product of a natural base treated by an old process cannot be an infringement under any view of the law.

"Plaintiff has defined its product as a 'new vegetable glue as good as animal glue for veneering.' We think that this definition is not advanced by embodying it in a laudatory phrase descriptive of intended result.

"We may agree that Perkins disclosed a 'new vegetable glue'—i.e., a manufactured product. There are some manufactured products so broadly new that the same thing, however produced, may be within the invention's broad range of equivalents. This is a question of fact, but on the prior art and the evidence herein as to modern cassava starch, Perkins vegetable glue is not such a product. We think, therefore, that the lower court fell into error in substantially paying no attention to the nature of defendant's starch base, and it is directed that the decree be reversed . . . with directions to dismiss the bill . . . on the ground of non-infringement.

The Sulphur Industry of the World

For some years Italy has been the greatest exporter of sulphur. During the past 3 years, however, the United States has become the chief source of supply, owing to the exceptionally low cost of production. Japan now ranks third in importance as an exporter of this commodity. Although free or native sulphur is devoted to many different uses, it has been estimated that more than half the consumption is in the manufacture of sulphuric acid. Large quantities are also used in the sulphite process of digesting wood pulp for paper manufacture, as a fungicide for grape vines and hops and as a fertilizer, insecticide, fumigant and sheep dip. Moreover, the vulcanization of rubber, the manufacture of matches, explosives, dyes and cements, as well as photography and medicine, all draw heavily upon the sulphur supply.

During the war Japan, which next to the United States and Italy is the chief producer and exporter of sulphur, greatly increased its output. A record of 116,000 tons was reached in 1917, as compared with an average of 49,000 tons in previous years. Practically all the sulphur produced in Japan was exported previous to 1917, as there is normally very little demand for it in the home market. Since the war, however, both production and exports have decreased in large measure.

Of the total Japanese sulphur exports, 45 per cent went to the United States, the largest consumer, prior to the war. For the most part, these shipments were used in the paper-making industry of the Northwest. The difference in freight charges in shipments across the Pacific, in comparison with those from Louisiana and Texas, is the cause of the large amount still imported from Japan. The opening of the Panama Canal, however, has made the Gulf ports easily accessible to the Pacific Coast and in future the American producing regions can doubtless satisfy the home market. Australia had also relied upon Japan previous to the war for sulphur supplies, as she imported 35 per cent of the total Japanese output. However, in 1920, the last year for which figures are available, Japan exported the larger part of her reduced output to India, replacing almost entirely the Sicilian product.

American sulphur has recently been exported in large quantities. Previous to 1917, an average of 60,000 tons was shipped annually to foreign markets. Of this amount, 88 per cent went to three countries alone—45 per cent to France, 31 per cent to Canada and 12 per cent to Germany. In the first 9 months of 1922, statistics show that sulphur exports from the United States amounted to more than 400,000 tons and although each country imported a smaller quantity than previously, the export market has expanded so that these three countries used only 55 per cent of the total amount.

Synopsis of Recent Chemical & Metallurgical Literature

Byproducts Oven Heat Balance

D. S. Chamberlain and E. W. McGovern, of Bethlehem, Pa., published in *Gas Age-Record* for Feb. 17, 1923, a complete heat balance for a battery of byproduct coke ovens which gives a good check on current figures for the heat loss of endothermic reactions in the change of coal to coke.

The data used in this heat balance were obtained from a battery of Koppers ovens, which are in this case unique in that they have 106 ovens per battery. As this is the largest number of ovens per battery known to us, this operation is conspicuous in that the control is so perfect and the results so uniform. The results obtained from the following data indicate the rapid development in the construction of regenerative byproduct coke ovens.

(Basis: One gross ton of coal, dry.)

Heat Available Input	B.t.u.	Per Cent. Input
(1) Latent heat in coal	30,369,920	86.71
(2) Sensible heat in coal	3 517	0.01
(3) Latent heat in fuel gas	3,011,840	8.53
(4) Sensible heat in fuel gas	3,065	0.01
(5) Sensible heat in preheated air	1,638,575	4.74
Total input	35,026,917	100.00
Heat Distribution Output		
(1) Latent heat in coke	21,571,175	61.61
(2) Sensible heat in coke	1,240,144	3.55
(3) Latent heat in foul gas	6,760,000	19.33
(4) Sensible heat in foul gas	435,108	1.26
(5) Total heat going out stack	1,102,690	3.16
(6) Latent heat in tar	1,347,200	3.85
(7) Sensible heat in tar	19,198	0.05
(8) Heat absorbed in tar formation	45,168	0.13
(9) Radiation and convection losses	399,840	1.14
(10) Latent heat in light oil in foul gas	300,037	0.86
Total output	33,223 860	
Unaccounted for	1,803,057	5.16
	35,026,917	100.00

1,803,057 ÷ 2,240 = 804.9 B.t.u. per lb. of dry coal, the heat required to coke one pound of coal.

The difference between the heat input and the heat output, as developed from the preceding data, amounts to 804.9 B.t.u. per pound of coal. On a percentage basis of 5.16, this figure comes within the range of results as determined by Constam and Kolbe. As the endothermic reactions, taking place in the coking operation, vary with the type of coal, the indication is that the heat required to coke such mixtures as used in the byproduct coke ovens in the United States is greater than that required for English coals. The B.t.u. value of 804.9 was practically checked by a heat balance run on a battery of Semet-Solvay ovens in the early part of 1922, at which time a B.t.u. value of 788.0 was obtained, amounting to a heat loss of 5.06 per cent.

In conclusion, the advance in the development of the byproduct coke oven, in so far as a heat balance is concerned, will be made evident by a decided reduction in the latent heat in the fuel gas. This will be brought about by an oven construction that will reduce the total heat going out the stack as well as reduce the radiation and convection losses. In other words, the total gas used as fuel gas for heating the battery will eventually be reduced to a percentage of 35.0 or less.

Important Articles In Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem. & Met.* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. Those that are of unusual interest will be published later in abstract in this department but since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage. The magazines reviewed have all been received within a fortnight of our publication date.

FACTORS INFLUENCING PROPERTIES OF WOOD CELLULOSE AS ISOLATED BY THE CHLORINATION METHOD. M. W. Bray and T. M. Andrews. *Paper Trade Journal*, Feb. 22, 1923, pp. 47-49.

PAPER PULP RECOVERY. L. M. Booth. *Paper Trade Journal*, Feb. 22, 1923, pp. 51-55.

COLORING PAPER STUFF WITH COLOR LAKES. Emil Heuser and H. G. Behr. *Paper*, Feb. 21, 1923, pp. 7-12. Translated from *Papierfabricant*, Jan. 6, 1923.

NITROGEN DISTRIBUTION IN VERTICALS. C. H. Stone. *Gas Age-Record*, Feb. 24, 1923, pp. 241-243.

THE INFLUENCE OF STIRRING ON THE RATE AND COURSE OF DEVELOPMENT. S. E. Sheppard and Felix A. Elliott, Research Laboratory, Eastman Kodak Co. *J. Franklin Institute*, February, 1923, pp. 211-228.

RESISTIVITY OF VITREOUS MATERIALS. L. L. Holladay. *J. Franklin Institute*, February, 1923, pp. 229-236.

American and English Ball Clays

The Bureau of Standards has recently completed a study of the twenty-one varieties of ball clay that are used in the largest quantities in the manufacture of china, semi-porcelain, electrical porcelain, tile and sanitary ware. The results of this study have been made the subject of a recent publication by the bureau.

Determinations were made of the following data: Water of plasticity, amount passing through a 120-mesh sieve, shrinkage when dried, rate of flow of slips, cohesion when plastic, dry transverse strength when mixed with an equal amount of flint, time required to oxidize carbonaceous content at 750 deg. C., burning behavior, porosity and volume changes from Orton Seger cone 01 to cone 12 and coloring effect in a standard body.

The American clays were found to be much cleaner than the English clays and contained less coarse mineral matter and dirt which would be removed in lawning the body after blunging. The Kentucky clays were almost free from such material, and the Tennessee clays contained only a small amount, while the English clays were less desirable in this respect.

No great differences were noted in water of plasticity, the range of variation falling within a few per cent. The Dorset clay exhibited the highest shrinkage. All the clays studied warped in drying, but none of them developed cracks.

The transverse strength of equal mixtures of the clays with commercial potters flint was determined to give a better indication of the comparative bonding power of the clays in a body than would be indicated by the modulus of rupture of the clay alone. The average modulus of rupture of the Tennessee clays tested was 366 lb. per square inch, the Kentucky clays averaged 282 lb. per square inch, the clays from Dorset, England, 405 lb. per square inch, the Devonshire clays 443 lb. per square inch, and English clays, whose exact source was not known, 419 lb. per square inch. In general the English clays were stronger than the domestic, but two of the American clays compared favorably with the average English clay.

From the results obtained the rate of flow of slips from the efflux viscosimeter did not appear to be a valuable criterion of the inherent plastic qualities for use in comparing ball clays.

STRENGTH AND BURNING BEHAVIOR

The cohesive strengths of the plastic clays were determined at different water contents and are shown graphically. These results showed no distinctions which compared with the value of the clays for jiggering, as judged by practical potters.

Some of the English clays are very high in carbonaceous matter, 11 hours being required in two cases to remove completely the black core from specimens 1¼x1¼x2 in. The clays from Devonshire as a class required the longest time for oxidation. The Dorset clays and those from Tennessee contained a moderate amount of carbonaceous matter, while the Kentucky clays contained but little. It was noticed that there was a relationship between the amount of carbonaceous matter and the strength when dry, the more carbonaceous clays usually being stronger.

The burning behavior of the American and English clays was radically different. The English clays vitrified at a low temperature and remained almost constant in porosity and volume up to cone 12. No evidence of over-

burning was noticed at that temperature. There was some variation in the burning behavior of the clays from Devonshire, but the Dorset clays underwent practically the same changes in firing. The American clays showed a gradual reduction in porosity from cone 01 to cone 12. Tennessee ball clay No. 5 was the only domestic clay which vitrified at cone 8. Tennessee No. 3 matured at cone 10, and Tennessee No. 11 and Kentucky No. 4 at cone 12. The other two Kentucky clays studied were not vitrified at cone 12. Throughout the firing range studied the American clays were constantly changing in volume.

General Results

In the standard body the Tennessee clays as a class showed the best color. The Kentucky and Devon clays were fair in this regard, while the Dorset clays were comparatively poor in coloring effect.

Although the English clays have a more desirable firing behavior and greater strength when dry, the American clays contain less material to be removed in body preparation, contain less carbonaceous matter which may lead to trouble in firing, and burn to a better color in the body. Because of their better color they may be used in larger quantities, thereby overcoming in a measure their lower strength. With a slight adjustment in flux content of the body they may be successfully used to replace the English clays.

All of the results are given in tabular form and graphically when feasible. A detailed description of each individual clay is given, and a classification of ball clays based on their properties has been drawn from the results of the work.

(Paper 227, by H. H. Shotwell. The complete paper may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 10 cents).

Distilling Coal Tar in Europe

In the Feb. 10, 1923, issue of *Gas Age-Record*, R. Furness discusses in some detail the current tendencies in coal-tar distillation practice in Europe, with particular attention to the situation in England. A special point is made of the increased profit which may be realized by the tar producer if he carries on at least partial distillation in his own plant and does not sell the crude product.

Mr. Furness' article may be summed up as follows: The increased tendency toward decentralization of the tar distillation industry is a marked feature of European practice today, and is one which could advantageously be adopted in America. Special stills, which combine ease and cheapness in running, are available, and a broad fractionation into light oils, creosote oils, anthracene oils and pitch is effected with the greatest simplicity.

It has been shown that there are well-marked applications for these products of broad fractionation, and that the prices ruling are well maintained and represent several times the value of the crude tar, such as is sold to a central distillation plant.

If the producer of tar considers it economically justifiable to proceed some distance further and win from the above-noted broad fractions such derivatives as naphthalene, carbolic and cresylic acids, anthracene paste, etc., he is always sure of a ready market. New applications of all these products are constantly appearing. Even if hydrogenation of naphthalene and of phenol fail to come to maturity in the United States, the tar acids will find ready markets in the production of the millions of pounds of phenol-formaldehyde condensation products made here annually, and in the manufacture of synthetic tannins and other products of the dye and fine-chemical industries.

Finally, in many instances, a central distillation plant cannot absorb the output of tar from certain districts, and in other cases transport charges render the disposal of crude tar almost unprofitable. In these cases, distillation by the producer provides a happy alternative and one which is far more remunerative than that of disposing of the crude tar for fuel purposes.

Recent Chemical & Metallurgical Patents

Manufacture of Phosphorus—In the following patent assigned to the Ferro Chemicals, Inc., of Washington, R. Franchot and K. P. McElroy, of Washington, claim that phosphate rock may be reduced to produce phosphorus if it is heated in the presence of carbon and silica. The high temperature necessary to produce this change, which is carried out in a shaft furnace, is achieved with producer gas. The high temperature is esential to insure the fluidity of the calcium silicate slags. The effluent gases contain both

American Patents Issued Feb. 20, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem & Met* readers. They will be studied later by *Chem & Met*'s staff and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,445,621—Process for Vulcanizing Rubber and Products Obtained Thereby. Sidney M. Cadwell, Leonia, N. J., assignor to the Naugatuck Chemical Co., Connecticut.

1,445,637—Converting Aromatic Halogen Substitution Products Into Amines. Isador Miller, New York City, assignor to William M. Grosvenor, New York City.

1,445,644—Material for the Production of Carbide. James H Reid, Pittsburgh, Pa., assignor to International Nitrogen Co., Cleveland, Ohio.

1,445,645—Process of and Material for the Production of Metal Hydrates and for the Production of Gas. James Henry Reid, Readsboro, Vt, assignor to Thomas Q. Hogan, Boston, Mass.

1,445,660—Process for the Extraction of Vanadium and Radium From Carnotite Ores. Warren F. Bleecker, Boulder, Colo, assignor to the Tungsten Products Co., Boulder, Colo.

1,445,685—Organic Arsenic Compound. Johann Huismann and Jürgen Callsen, Leverkusen, near Cologne, and Wilhelm Grüttefien, Elberfeld, Germany, assignors to Farben-Fabriken vorm. Friedr. Bayer & Co., Leverkusen, Germany.

1,445,735—Method of Producing Coke. James G. West, Pittsburgh, Pa.

1,445,919—Treatment of Aluminum-Hydrate Sludge. Charles W Souder, East St. Louis, Ill. assignor to Aluminum Co. of America, Pittsburgh, Pa.

1,445,935—Agitator. Arthur C. Daman, Denver, Colo., and Thomas J. Pennington, Naugatuck, Conn.

1,445,943—Method of Treating Metallurgical Products. William A. Harty, Buffalo, N. Y., and Frank W. Moore, Thorold, Ont.

1,445,954—Production of Smokeless Fuels and Coke. Stewart Roy Illingworth, Brynfedwen, Radyr, Wales.

1,445,973—Oxygenated Blast for Metallurgical Furnaces. Montague H. Roberts, Jersey City, N. J., and Claude C. Van Nuys, New York, N. Y., assignors to Air Reduction Co., Inc., New York.

1,445,989—Concentration of Minerals. Walter O Borcherdt, Austinville, Va., assignor to the New Jersey Zinc Co., New York.

1,446,012—Process of Preparing Oxalic Acid. George Kolsky, Mamaroneck, N. Y.

1,446,160—Soluble Arsenic Compound and Process of Making the Same. Joseph F. Cullen, Midvale, Utah, assignor to United States Smelting, Refining & Mining Co.

1,446,163—Manufacture of Oxy Derivatives of Anthraquinone. Arthur Hugh Davies, Carlisle, England, assignor to Scottish Dyes, Limited, Carlisle, Cumberland, England.

1,446,185—Process for the Production of Potassium Sulphate. Camille Horst, Wittelsheim, France.

1,446,216—Diamino-Dioxyarsenobenzene-Silver Oxide Compound and Process of Making Same. Alfred E. Sherndal, New York, assignor to Herman A. Metz, New York.

1,446,301—Manufacture of Threads, Filaments and the Like of Cellulose. Horace James Hegan, Coventry, England, assignor to Courtauldo, Ltd., London, England.

1,446,307—Process for the Recovery of Sulphur, Metallic Sulphides and the Like From a Condition of Emulsion Without Filtration on Evaporation. Bertram Hunt, London, England.

1,446,375—Concentration of Oxidized Ores Walter O Borcherdt, Austinville, Va., assignor to the New Jersey Zinc Co., New York.

1,446,377—Treatment of Concentrates. Walter O. Borcherdt, Austinville, Va., assignor to the New Jersey Zinc Co., New York.

1,446,378—Filtration of Ore Pulps. Walter O. Borcherdt, of Austinville, Va., assignor to the New Jersey Zinc Co., New York.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

phosphorus and potassium, and the potassium compounds separate out first, after which the gases are still further cooled so that the phosphorus precipitates. The final effluent is filtered through charcoal to remove the last traces of phosphorus, after which the coke or charcoal containing these traces of phosphorus is returned to the furnace. (1,441,573. Jan. 9, 1923.)

Artificial Silk From Nitrocellulose—Emile Bindschedler, of Switzerland, and George Juer, of Hopewell, Va., have assigned the following process to the Tubize Artificial Silk Co. of America. It consists essentially in treating nitrocellulose with ethyl alcohol in order to remove the water from the nitrocellulose. The dried product is then treated with acetone or one of its homologs. The resulting acetone collodion is spun into filaments by forcing it through spinnerets, and the resulting product is dried by passing warm partly dried air over it. This process, by using dry nitrocellulose and dry acetone, avoids the detrimental effect noted in other cases, and produces a lustrous silk. The acetone is recovered from the air and from the drier by means of benzene and petroleum and certain acids. (1,441,203, 1,441,204 and 1,441,205. Jan. 9, 1923.)

Recovery of Nitrogen-Oxide Vapors—P. A. Guye of Switzerland and Albert Schmidt of France have assigned the following patent to L'Azote Francais of Paris. Apparently aluminum oxide if perfectly anhydrous has an affinity for nitrous vapors. This affinity increases as the temperature at which alumina is dehydrated decreases. The patent is, however, applicable to dry gases only and must be carried out at low temperatures in order to obtain the highest absorption efficiency. (1,443,220. Jan. 23, 1923.)

Process for Treating Air—Arthur B. Lamb, of Washington, D. C., has developed a method of treating air in order to free it from suspended matter of all kinds, such as dust, smoke, pollens, bacteria, etc., and in addition to remove minute particles of such materials as saliva, respiratory excreta and other germ-laden and disease-producing particles. The general principle of the machine is that of an electric precipitator, and the particles are removed by being subjected to a strong electric potential during passage of air through the apparatus. Sterile air can thus be produced for therapeutic purposes, as, for example, in hospitals, etc. (1,442,619. Jan. 16, 1923.)

Non-Corrosive Refrigerating Solution—N. A. Dubois, of Needham, Mass., has discovered a remedy for the extremely corrosive action of refrigerating solutions such as calcium chloride on refrigerating pipes, automobile radiators and other metallic substances. Calcium chloride is often used because of its high solubility in water, even at very low temperatures, but even cast-iron pipes are corroded to a very great extent. The addition of one-tenth of 1 per cent of the weight of the solution of a difficultly soluble chromate, such as zinc chromate, apparently prevents any corrosive action on the part of the solution. This is a rather surprising result, but seems to have been confirmed in a parallel laboratory experiment. (1,442,330. Jan. 16, 1923.)

Preparation of Dry Granular Calcium Acid Phosphate—C. T. Whittier, of Jersey City, has assigned the following patent to the Royal Baking Powder Co., of New York. It deals with new methods of preparing calcium acid phosphate in any desired size of particle. The present method has consisted of grinding the material as it was produced. The new method automatically produces grains of the size desired. Calcium phosphate is treated with sulphuric acid, and the calcium sulphate impurity is filtered off. This leaves a solution of monocalcium phosphate in a more or less free phosphoric acid in solution. Previously this solution was evaporated until the mass on cooling was semi-solid. Then the free phosphoric acid was neutralized in a suitable kneading apparatus. The present system neutralizes the solution of monocalcium phosphate and sprays the dilute solution into a chamber containing hot air or heated water gas. By controlling the density of the solution and the speed of spraying, particles of almost any size can be obtained as desired. (1,442,318. Jan. 16, 1923.)

Saline Solutions Free From Colloidal Silica—G. A. Blanc, of Rome, Italy, has patented a process for obtaining clear saline solutions free from colloidal silica. When many minerals, silicates and silica-containing minerals are treated with acid in order to obtain part of their constituents as soluble salt, one great difficulty lies in the fact that colloidal silica is formed and comes through into the solution, making this distinctly cloudy. The process of avoiding this consists in pouring the acid solution through a layer of the silicate rock from which the soluble materials are to be extracted in such a way as to produce no stirring whatever in the bed. The colloidal silica then replaces the soluble materials of the rock and will not clog up the granular bed in any way unless there is a mechanical disturbance. The solution may then be returned to extract further soluble material. If the layer of colloidal silica which attaches itself to the granular particles is disturbed in any way, the filter bed becomes so dense that no further filtration can be effected. (1,443,674. Jan. 30, 1923.)

Rubber Composition—Philip Schidrowitz, of London, has developed a process for producing a solution of vulcanized rubber. Previously solutions have been prepared from rubber which has been coagulated, dried and masticated. This rubber may be dissolved in naphtha, benzine or like solvents, and may be then vulcanized by heating the solution in the presence of sulphur. This process possesses the advantage of providing vulcanized rubber solution, which could not otherwise be obtained, as vulcanized rubber is relatively insoluble. On the other hand, it is a difficult operation to carry out, and the solvents used are expensive. The present process uses uncoagulated or rubber latex, properly preserved by means of ammonia or other preservatives. The ingredients and fillers may be added and vulcanization takes place in solutions. In this way a very much cheaper solution of vulcanized rubber can be obtained and may be used for impregnating cloth, muslin and other materials. (1,443,149. Jan. 23, 1923.)

The Recovery of Solids From White Water "in Paper Manufacturing"—L. M. Booth, of Plainfield, N. J., has developed a process of coagulating the solid materials in the so-called "white waters" which pass through the screen of the paper machine and settle so slowly that a great percentage of them is lost. The combination of coagulants which has been used up to the present time is sulphate of aluminum and sodium carbonate, in a ratio substantially 2 to 1. These materials are added as a white powder and coagulate the solid particles to such an extent that they may be collected for re-use in paper work. (1,443,454. Jan. 30, 1923.)

Method of Producing Carbonates of the Alkaline Earth Metals—J. H. MacMahon, of Saltville, Va., has assigned to the Mathieson Alkali Works, Inc., of Virginia, a patent whereby sulphides of alkaline earth metals may be transformed into carbonates and the byproducts satisfactorily utilized. For example, black ash from barium converters is leached in the usual manner and the clear solution of barium sulphide is treated with ammonium carbonate preferably obtained by heating the liquor coming from the bicarbonate filters of the ammonia soda process. Barium carbonate and ammonium sulphide result from this reaction, barium carbonate being filtered and washed on appropriate presses or suction filters. Ammonium sulphide in the filtrate is then treated with caustic alkalis sufficient to form the alkali sulphides and free ammonia is obtained, which is then utilized in the ammonia soda process or in some other way. (1,444,623. Feb. 6, 1923.)

Permanent Colloidal Solutions L. Lilienfeld, of Podhajce, Poland, has patented the use of alkyl and aralkylethers of cellulose, starches, dextrin and the like as protective colloids. Other colloid protectors used in salve and ointment are somewhat faulty because of a property described as brittleness which they impart to the resulting ointment. This new class of bodies seem to have no such properties and the ointments are protected from bacteria infections as well. (1,444,257. Feb. 6, 1923.)

British Patents

For complete specifications of any British patent apply to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Purifying Graphite—Natural graphite is purified from deleterious admixtures such as silica, alumina, pyrites, mica, etc., by mixing intimately with pulverized coal, charcoal or coke, and heating electrically in a retort to 2,200 deg. C. or over. The proportion of coal required is calculated on that of the impurities present so that the coal will be sufficient to unite with all the oxygen and metallic ingredients. Aluminum, iron, silicon and sulphur are in turn volatilized and may be collected in the form of their oxides in separate receptacles opened for the purpose. The silica is useful as a filtering substance, a polishing powder, etc., the sulphur dioxide for the manufacture of sulphuric acid and the metallic oxides for metallurgical purposes. (Br. Pat. 187,080. M. Langheinrich, Munich. Dec. 6, 1922.)

Lead Salts—Ores containing lead, preferably containing or with addition of oxidizable sulphur, are treated in the presence of dissolved chlorides with chlorine or hypochlorates at a low temperature until the lead is converted into tetrachloride and dissolved. Silver chloride remains with the residue and may be extracted with thiosulphate. The solution is separated and the surplus chlorine is blown out or reduced by reducing agents to obtain lead chloride or sulphate, or the solution is neutralized or rendered alkaline to obtain the lead as peroxide. After the separation of the lead the copper may be removed by cementation or electrolytically and the zinc electrolytically or by precipitation as hydroxide with lime. Arsenic may be precipitated previous to the separation of the copper, by oxidizing (if the solution has been reduced) to convert the iron into the ferric state and neutralizing—for instance, with a carbonate such as limestone or roasted copper pyrites or both. Carbonate ores may also be leached with the acid liquor to neutralize the liquor and extract ingredients from the ores. The reducing agents mentioned are wastes containing zinc or iron, oxidizable salts such as ferrous salts, sulphurous acid or its salts, sulphuretted hydrogen, sulphides, thiosulphates, or organic reducing agents such as sulphite cellulose waste liquor. When sulphurous acid is used the lead is precipitated as sulphate. (Br. Pat. 187,195; not yet accepted. A. Nathansohn, Berlin. Dec. 6, 1922.)

Casein Glue—A composition suitable for use as a glue, paint vehicle, binding agent for asbestos cement sheet, lagging compositions, paper pulp, fiber, etc., consists of casein, sodium silicate, sodium tungstate and camphor solution with or without calcium hydrate. The camphor solution is made by digesting 1 lb. of camphor in 10 lb. of spirits of wine and diluting with ether. This solution is sprayed over the casein and the solvent evaporated. The sodium tungstate is mixed with the casein, sodium silicate is added and the whole is rolled and kneaded until a powder results. This is dried and ground more finely, and the calcium hydrate added, and packed in air-tight containers. Water is added, preferably seven hours before use. Suitable proportions are casein 70 per cent, sodium silicate 27.7 per cent, camphor 0.1 per cent, sodium tungstate 0.25 per cent, and calcium hydrate about 2 per cent. (Br. Pat. 187,200. New Zealand Co-operative Dairy Co., Ltd., Auckland, New Zealand. Dec. 6, 1922.)

Lead Sulphate—The invention is related to the process described in specification 5299/15, wherein sulphate, sulphite and oxide of lead are obtained directly from the native sulphide by volatilizing the latter in an electric furnace. The present invention aims at the production of a product free from sulphite, oxide or unchanged sulphide. Figs. 1 and 2 show, in plan and elevation respectively, the apparatus employed. The finely crushed ore, which may have been previously concentrated, falls in regulated quantities from a

FIG. 1.

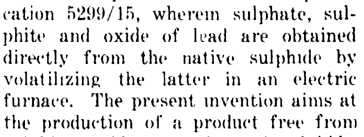
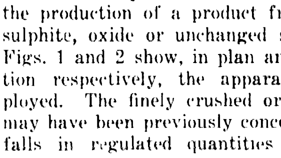


FIG. 2.



feeding apparatus through the guide tubes 7 on to the electrodes of the furnace. There are arranged in pairs 1, 1, 2, 2, etc., as shown, and are placed about 9 in. above the floor of the furnace 5. About 5 ft. above the arcs is an atmospheric intake 11 communicating through a bifurcated flue 12 with a chamber 13. A fan 14 induces a current of air over the furnace shaft 5, and the fan chambers 13 deliver into spray boxes 14″ wherein the fumes are subjected to the action of water sprays delivered from the perforated pipe 15. A chimney 16 assists the flow of air and fumes through the apparatus. The water containing the reaction products passes through launders 17 into vats 18, where it may be warmed and agitated by steam pipes 20 placed on the floor of each vat. The finely crushed sulphide falls onto the arcs and is at once volatilized. The vapors rise up the furnace shaft into the current of air passing through the top of the furnace and are there oxidized. The reaction products, having been delivered into the vats 18, are agitated, and free acid may be added, if necessary, to convert any sulphites or oxides present into sulphates. The agitation serves to float any sulphide that may have escaped volatilization. This is skimmed off, dried and re-treated. The remaining liquor is neutalized with lime water, and the sulphates finally allowed to settle, decanted and dried for use as a pigment. (Br. Pat. 189,160. J. Gitsham and H. R. Evershed, Launceston, Tasmania. Jan. 17, 1923.)

Water Softening—A reagent for softening feedwater and preventing and removing incrustation in boilers is obtained by saturating a solution of sodium carbonate at a temperature of 5 to 10 deg. C. with aluminate and hydrate of barium and adding extract of tannin. (Br. Pat. 187,647. L. F. C. M. van Weddingen, Gand, Belgium. Dec. 20, 1922.)

Inks and Paints—In a process for making ink, watercolor paints and like compositions, an insoluble base is subjected to high-speed intensive mechanical disintegration with water to form a colloidal solution, to which is added, during disintegration or not, a relatively small quantity of organic dye. The base used may be clay or zirconia, which, being opaque and in colloid form, absorbs the dye to form a product of high coloring power. The base is treated with water in a colloid mill such as described in specification 155,836 and then, after settling, is again treated in the mill with a soluble organic dye in the presence of a protective colloid—for example, gum arabic—to counteract the precipitating action of electrolytes in the water, and, if copying ink is being prepared, glycol, glycerine or the like may be added. A small quantity of disinfectant may be added to prevent decomposition of the protective colloids. After standing for a time, the ink is bottled. Instead of a colorless base, colored insoluble substances such as ultramarine or lakes may be used in the colloidal state with a correspondingly less amount of dye. For india ink or watercolor paints, colloids such as cherrytree gum may be added, and colloidal clay or colloidal carbon used as the mineral base. If tannate or gallate of iron is used as the soluble ink base, an aniline dye is added to give the desired color until the iron salt is oxidized. (Br. Pat. 187,732. Plauson's, Ltd., London. Dec. 20, 1922.)

Motor Fuel—A homogeneous mixture of alcohol and benzol, petrol or other usual liquid hydrocarbon fuel is obtained by dehydrating the alcohol before or after mixing—for example, by the addition of calcium, calcium carbide or other substance that reacts with water and forms an insoluble product, or of an absorbent such as anhydrous lime, ferrous sulphate or potassium carbonate, or by passing alcohol vapor through a column of dehydrating material as when the alcohol is manufactured. (Br. Pat. 188,336; not yet accepted. P. Loriette, Paris. Dec. 29, 1922.)

Sodium Salts—Sodium bicarbonate associated with a small quantity of other soluble salts is extracted from bicarbonated mineral waters by a three-stage process consisting in heating to at least 80 deg. C. in order to remove carbon dioxide and separating the calcium

carbonate precipitated, concentrating, and finally precipitating sodium bicarbonate by passing carbon dioxide, preferably under pressure. The mother liquor adhering to the crystals after their removal contains soluble salts other than the bicarbonate. The carbon dioxide evolved in the first operation may be utilized in the subsequent step of carbonating the liquor. (Br. Pat. 188,335; not yet accepted. Appareils et Evaporateurs Kestner, Lille. Dec. 29, 1922.)

Book Reviews

CHEMISCH - TECHNISCHE UNTERSUCHUNGS METHODEN Vol. I, 7th edition, 1099 pp illustrated Julius Springer, Berlin, 1921

Eleven years have elapsed since the appearance of the sixth edition of this work, which is still issued under the names Lunge-Berl, although the former had no part in the production of this edition. This lapse of time has necessitated a complete rewriting of the work, in which, however, the old principles have been adhered to, in that where the subject matter concerns a given industry, first the raw materials, then the intermediate products and the process control methods, and finally the finished products are taken up and their methods of testing described.

The arrangement of the book is much the same as in earlier editions, including a general section, where such operations as sampling; preparation of samples; weighing, precipitation, drying, etc.; gravimetric analysis; volumetric analysis in all its branches; gas analysis; areometry; manometry and anemometry; measurement of heat by thermometer and pyrometer; colorimetry, and calculation of analytical results are taken up in great detail. A special section includes chapters on technical gas analysis, microchemical methods, electroanalysis, analysis of solid and liquid fuels, boiler water and technical water analysis, drinking water analysis, waste water analysis and air and its testing for various traces of impurities. Further chapters in this special section take up the manufacture of the following products with the analytical methods used therein: sulphur dioxide; nitric acid from Chilean nitrate, from the air by direct synthesis and by oxidation of ammonia; sulphuric acid by the chamber and contact processes; chlorsulphonic acid; mixed and waste acids; hydrofluoric acid; sulphate and hydrochloric acid; soda, including electrolytic caustic soda; chlorine; compressed and liquefied gases; potash salts, including bromine. In this list the following subjects are new, never having been treated in the earlier editions: electroanalysis; microchemical methods; liquid fuels and brown coal tar.

The various sections have been written by experts in their respective lines, many well-known names appearing among the contributors. To some extent this has resulted in overlapping and in a few cases in contradictory statements, though the careful editing, whose earmarks appear throughout the book, has done much to prevent this.

The typographical work and the proofreading are flawless. The profuse illustrations (291), for the most part clean line drawings, make clear the descriptions of apparatus the construction of which it might otherwise be difficult to duplicate. The paper is excellent, being of the old grade which characterized the better German books before the war.

Important tables likely to be used frequently for reference in analytical work have been reprinted on only one side of sheets which accompany the book. These can be mounted and used in the laboratory.

The book is excellent in every particular and is one no research laboratory can afford to be without. If it were available in English it would be an exceedingly valuable adjunct in works laboratories as well. It is to be hoped that a translation is in preparation.

F. C. ZEISBERG.

STANDARD METHODS OF CHEMICAL ANALYSIS A Manual of Analytical Methods and General Reference for the Analytical Chemist and for the Advanced Student. Edited by *Wilfred W. Scott* M.A., in collaboration with thirty-six well-known analytical chemists. Third Edition. Two volumes. D. Van Nostrand Co., 8 Warren St., New York, 1922. Price $10 net.

The division of this edition into two volumes was made advisable by the addition of chapters on asphalts, sampling, soap, selenium and tellurium, sanitary water, molybdenum and tungsten, conversion tables, radium, rubber, solubility of substances and exposives.

Vol. I consists of three parts. Part 1 contains forty-five chapters on the analytical methods for the elements from aluminum to zirconium. Under each element, as in previous editions, the material is grouped under the headings: Physical Properties, Detection, Estimation, Preparation and Solution of the Samples, Separations, and Methods. The attempt is made to present the subjects with sufficient detail to enable one with an elementary knowledge of analytical processes to follow the directions; while long expositions, theoretical discussions and experimental data are purposely avoided. On the whole, the authors have succeeded in this attempt. In places they have been perhaps a little too brief. The analyst whose previous experience did not include considerable work on this determination would certainly have plenty of trouble following the directions for the determination of carbon in organic substances as given on page 119.

While there are naturally omissions of certain methods which one examining the book might want to see included, on the other hand much material is given here that is not readily available elsewhere. When everything is considered, this part is very well done.

Part 2 consists of six pages of qualitative tests given in tabular form and useful only in refreshing one's memory.

Part 3 presents tables and useful data and includes the usual specific gravity and conversion factor tables. In addition, on pages 710-12 there are given a great many weight, volume and energy conversion factors, which heretofore have been either wanting or scattered in various reference books.

Vol. II deals mainly with the analysis of special materials. It includes acidimetry and alkalimetry, alloys, oils, soaps, paints, cement, coal, gas, asphalts, rubber, explosives, water, standard methods of sampling and the determination of solubility. These topics are treated by men who are specialists and in general the treatments are excellent.

There are a few minor criticisms. On page 1007 we are told that "25 cc. of N/1 H_2SO_4 should contain 1.226075 grams" but the error of the burette in which it is measured is probably not less than 1 in 1,000. On page 1089, under Manganese Bronze, no method for aluminum is given, although manganese bronze often contains this element instead of manganese. Under specific gravity of oil on page 1111 the method which uses a plummet with an analytical balance might well have been included. Under coal sampling, on page 1216, the taking of a gross sample of 200 lb. for deliveries up to 100 tons is questionable practice even for small-size anthracite and certainly could not be defended for large sizes of coal. On page 1435, in the soap hardness table, the hardness for 3.5 cc. of soap solution should be 39.0 instead of 38.0. This is an error which should be obvious, but which has been carried from the original A.P.H.A. methods to several other texts.

In regard to the work as a whole, when one considers the labor of assembling and editing the mass of material here presented, he can only wonder that it has been done so well. The paper and print are good and the numerous illustrations are both well drawn and clearly described. This edition is an improvement on its popular predecessors and a valuable addition to any chemist's library.

JEROME J. MORGAN.

LOW-TEMPERATURE CARBONIZATION. Report of the Fuel Research Board for years 1920 and 1921 of the British Department of Scientific and Industrial Research. Available from His Majesty's Stationery Office, Imperial House, Kingsway, London, W. C. 2 for 2s. 3d., postpaid.

This report is a résumé of the low-temperature carbonization situation in England and a report on some extended experimental research which has been in progress for several years under the Fuel Research Board. Any investigator working in this field will find the discussion and the data presented very profitable reading.

As all of the cost data are based upon English conditions, this type of information is not readily convertible to American conditions, but the data regarding yields and the observations on the effect of retort conditions upon coke structure are of great value.

R. S. MCBRIDE.

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

No Action on Reparation Dyes as Congress Quits

Adjourns Without Clearing Up Tangle—Textile Alliance Will Soon Be Liquidated—Proceeds to Go to Education

CONGRESS has adjourned without having taken action in the matter of reparation dyes. Apparently the State Department was not prepared to recommend the form the legislation should take. The profits of the Textile Alliance are understood to have been about $1,500,000. Under the agreement with the State Department, three-fourths of that sum is to be converted into the Treasury of the United States The State Department agreed to recommend to Congress that the money be appropriated for educational and scientific work of interest to the textile and chemical industries. The remaining one-fourth is to be expended by the Textile Alliance itself for similar purposes, but in the manner it shall dictate.

When the affairs of the Textile Alliance are wound up, it is expected that approximately $1,000,000 will be turned over to the United States Treasury. At that time the State Department is expected to make its recommendation for the disposal of the money. The National Research Council has recommended that this fund be placed at the disposal of an organization to be known as the American Textile Institute, to be formed to conduct research work in behalf of the textile industry as a whole.

Ruhr Affects Situation

The entry of France into the Ruhr and the refusal of Germany to pay reparations in kind befogged the situation to such an extent that the State Department apparently did not regard the time opportune for legislation intended to prescribe a definite policy for the handling of reparation dyes and for their disposal in this country.

In that connection it may be pointed out that the German statement that delivery of dyes on reparation account would be withheld from France and Belgium cannot be taken seriously, since Germany does not handle the distribution of reparation dyes. She is required to deliver 25 per cent of her daily production to the Reparation Commission, which is charged with their allotment.

A significant feature of the situation is the resignation of Frederick S. Dickson as the advisor of the State Department on the subject of reparation dyes. Previously Mr. Dickson, as chief of the War Trade Board section of the Department of State and prior to that as the officer in charge of the dye and chemical control section of the Treasury Department, administered the import control over dyes and chemicals until that control was superseded by the new tariff act, which went into effect Sept. 22. Mr. Dickson expects to enter private employment, but is not yet ready to discuss the connection he probably will make.

Calendar

The following important technical meetings are scheduled for the immediate future

AMERICAN CHEMICAL SOCIETY
New Haven, Conn., April 3-7

AMERICAN FOUNDRYMEN'S ASSOCIATION
Cleveland, O., April 28-May 1

AMERICAN OIL CHEMISTS' SOCIETY
Hot Springs, Ark., April 30-May 1

SOCIETY OF INDUSTRIAL ENGINEERS
Cincinnati, O., April 18-20

AMERICAN CHEMICAL SOCIETY
New York, Nichols Medal Award, March 9

SOCIETY OF CHEMICAL INDUSTRY
New York regular meeting, March 23

SOCIETY OF CHEMICAL INDUSTRY
New York, joint meeting with other societies, April 20

Double Duties Hamper Trade With Ruhr

With the establishment of strict customs control around the Ruhr district by the occupying French and Belgian forces, shipments for American account in and out of this area are liable to fresh delays.

The French authorities have embargoed the principal products of the Ruhr to prevent their shipment into unoccupied territory. Upon goods leaving the country, not subject to this embargo, the French levy the regular export duties. The German Government, not recognizing the authority of the French to do this, also collects the regular tax. As a result, in addition to the difficulties of transportation to and from the Ruhr district, a new impediment is added to trade with occupied Germany.

U. S. Agriculturists Push Calcium Arsenate

Despite High Price Experts Urge Growers to Continue Use of Poison—Increased Supply Predicted

Cotton growers are justified in paying as much per pound for calcium arsenate as they receive for lint cotton. This view is held by many government specialists who are anxious that the use of calcium arsenate be continued despite the high prices. They contend it has been demonstrated that the use of this poison results in saving sufficiently great to permit its use even at higher prices than now prevail.

Arrangements have been made by the Department of Agriculture with the Air Service of the Army for the use of planes for further experiments in the application of calcium arsenate from the air. As this is written, it seems probable that Congress will approve an additional appropriation of $60,000 to be used specifically for these airplane experiments. One of the great advantages in this mode of application is that all cotton over a large area can be dusted with the poison.

Arsenate Doubles Cotton Yield

In an address on the floor of the House of Representatives, Representative Wilson of Louisiana cited concrete instances where the yield of cotton had been doubled by the use of calcium arsenate. He pointed out that the boll weevil has been responsible during recent years for an average loss of six million bales of cotton annually. When to the value of that cotton is added the losses occasioned to allied industries, the total is brought to staggering proportions, he declared.

In view of the world-wide increase in the demand for cotton, a special effort is being made by government specialists and by members of Congress from the cotton-growing states to encourage the wider use of calcium arsenate despite the high price. They recognize that the quickest way to bring production abreast with demand is to pay a price which will encourage output. At the same time the Federal Trade Commission and the Department of Justice are being relied upon to discover any effort to take advantage of the existing situation to manipulate prices.

These two government agencies are paying particular attention to the spread between the prices paid producers and those charged the ultimate consumer.

Final Dye Rules Issued by Treasury Department

Regulations for the Entry and Appraisement of Dyes Under Tariff of 1922 Officially Issued on March 2

THE regulations for the entry and appraisal of dyes and coal-tar products in accordance with paragraphs 27 and 28 of the 1922 tariff, have been officially issued by the Treasury Department under date of March 2, 1923. The rules follow:

Regulation 1. Taking Samples Prior to Entry.—An importer may be permitted under proper supervision to take samples from his own importations prior to entry of articles dutiable under paragraphs 27 and 28, and appraising officers may take samples of such articles prior to entry when deemed necessary by them.

Regulation 2. Information Required Prior to Entry.—When an importer seeks information from the appraising officer prior to entry or for the importer's convenience formal entry is withheld as herein after provided, in return therefor the importer shall furnish to the appraising officer such relevant information as he may request.

Regulation 3. Determination of Similar Competitive Articles.—(*a*) A domestic article shall be considered a similar competitive article if in the use or uses which require a major portion of the total consumption in the United States of the imported and the domestic article the imported article accomplishes results substantially equal to those accomplished by the domestic article when used in substantially the same manner.

(*b*) An imported article which is or may be used for the same purpose as a domestic article not freely offered for sale but used in the manufacture of another domestic article freely offered for sale shall be considered a similar competitive article.

Regulation 4. Lists of Competitive and Non-Competitive Article.—(*a*) The Appraiser at New York shall issue at once lists of articles which he believes to be competitive and non-competitive and shall from time to time add articles thereto or remove articles therefrom as investigation shall justify. Such lists shall be advisory only and at the top of each list shall appear the following statement:

> This list is advisory only and in no manner relieves appraising officers from the duty of independent appraisement required by law.

The appraiser shall furnish copies of such lists and amendments thereof to the Customs Information Exchange for circularization to other appraising officers and to the public upon request.

(*b*) In the case of an actual importation of a similar competitive article the appraising officer may furnish to the importer upon application in writing informaton of the American selling price, provided the appraising officer shall be satisfied that the importer after exercising due diligence has not himself been able to obtain such information and that he has submitted to the appraising officer all relevant information in his possession. All information furnished by the appraising officer shall be advisory only. In communicating such American selling price, however, the appraising officer shall not disclose the source of his information.

(*c*) In the case of non-competitive articles appraising officers shall not advise importers prior to entry concerning values.

Regulation 5. Entry of Articles on Neither the Competitive Nor the Non-Competitive List.—The Appraiser at New York upon application of an importer having an invoice of an article not named on either the competitive or the non-competitive list shall proceed immediately to ascertain to which list the article belongs, and upon such ascertainment shall add the article to such list, pending which the importer may withhold formal entry. The appraiser shall inform the importer of his action.

Regulation 6. Difference in Strength of Imported and Domestic Articles.—When an imported article is of different strength from a similar competitive article manufactured or produced in the United States, the value of the imported article shall be adjusted in relation to the selling price of the domestic article in the proportion which the strength of the imported article bears to that of the domestic.

Regulation 7. Determination of American Selling Price of Articles Not Freely Offered for Sale but Used in the Manufacture of Other Articles.—When an article is a similar competitive article as defined in Regulation 3(*b*), the value of the imported article shall be the American selling price of the domestic article freely offered for sale adjusted in the relation that it bears to the domestic article not freely offered for sale.

Regulation 8. Ascertainment of American Selling Price When an Article Is Offered for Sale at Arbitrary Prices.—When the appraising officer shall be satisfied after investigation that a similar competitive domestic article is offered for sale at an arbitrary and unreasonable price not intended to secure *bona fide* sales and which does not secure *bona fide* sales, such price shall not be considered as the American selling price, and such officer shall use all reasonable ways and means to ascertain the price that the manufacturer, producer or owner would have received, within the meaning of Section 402(*f*) of the tariff act of 1922.

Regulation 9. Where There Are Two or More Similar Competitive Domestic Articles.—Where two or more domestic articles are considered similar competitive articles compared with an imported article, the American selling price of the domestic article which accomplishes results most nearly equal to those of the imported article shall be taken as the basis for the assessment of the ad valorem rate.

Regulation 10. Articles Which Are Not Coal-Tar Products.—The words "similar competitive articles" in paragraphs 27 and 28 shall not be construed as relating exclusively to coal-tar products. An imported coal-tar product may be compared with a domestic non-coal-tar product, or an imported non-coal-tar product dutiable under paragraph 27 or 28 with a domestic coal-tar product, for the purpose of determining whether they are similar competitive articles. The rule provided in paragraphs 27 and 28 for the determination of similar competitive articles and the regulations herein provided shall be applied in such cases.

Regulation 11. Ascertainment of United States Value.—The following instructions for the ascertainment of United States value are reproduced from Treasury Decision No. 39297 of October 31, 1922.

(T. D. 39297)

United States Value of Imported Merchandise

Appraising officers instructed how to ascertain the United States value of imported merchandise as defined in Title IV, section 402, subdivision (*d*), tariff act of 1922.

Treasury Department,
Oct 31, 1922.

To Appraising Officers.

Attention is invited to the definition in Title IV, Section 402, subdivision (*d*), tariff act of 1922, of the term "the United States value of imported merchandise."

Certain questions having arisen in connection with the application of this definition to imports classifiable under paragraphs 27 and 28 of Title I of the act, the department offers the following concrete example as best illustrating its views on the procedure and computations necessary in arriving at the United States value of such merchandise:

Assume that certain dyes classifiable under paragraph 28 were exported from Germany on Sept. 15, 1922, and imported at New York on Oct. 1, 1922, and that the "such or similar imported merchandise" which subdivision (*d*), section 402, Title IV, contemplates shall be taken as the standard of comparison was selling at New York on Sept 15, 1922, in the usual wholesale quantities, etc., at $1.45 per lb. This price includes the various items for which subdivision (*d*) provides that allowance shall be made. Assume a maximum allowance of 8 per cent for profit; dividing $1.45 by 1.08 gives $1.34 and subtracting this from $1.45 leaves 11 cents as the amount of the profit included in the $1.45. Assume a maximum allowance of 8 per cent for general expenses, dividing $1.34 by 1.08 gives $1.24 and subtracting this from $1.34 leaves 10 cents as the amount of the general expenses, included in the $1.45. Assume that the cost of transportation, insurance and other, necessary expenses from the place of shipment in Germany to New York was 3 cents and deducting this from $1.24 leaves $1.21, which includes the dutiable value and the duty. Assume that such merchandise was an article which on Sept. 15 was dutiable under section 500 of the act of Sept. 8, 1916, at 30 per cent ad valorem. Dividing $1.21 by 1.30 gives $0.93 as the value upon which duty was assessed, and which is the United States value of the merchandise imported on Oct. 1, and subject to the 60 per cent ad valorem rate provided for in the proviso of paragraph 28. When the article is subject to both a specific and ad valorem rate, the specific duty will be deducted before making the division.

The amount to be deducted as duty in each case will be governed by the amount of duty actually paid on the article used as the basis for computation.

The foregoing applies to purchased goods. In the case of consigned goods the appraiser will ascertain the amount of commission paid or contracted to be paid and allow not to exceed 6 per cent of the gross selling price, in lieu of the 8 per cent profit and 8 per cent general expense. The transportation costs and duty will be ascertained in the same manner as on purchased goods.

Appraising officers will ascertain in the usual way through the special agency service or otherwise, as provided by law and regulations the facts necessary to be used in such computations.

EDWARD CLIFFORD,
Assistant Secretary.

Regulation 12. Tests.—Tests which are necessary in the appraisement of imported articles shall be made under conditions approximating as closely as practicable the conditions in which the articles will be actually used in trade or manufacture.

Regulation 13. Trade Papers as Sources of Information.—Appraising officers may consult the trade papers, but the weight to be given to the quotations and other information therein is for the determination of the officers themselves.

Regulation 14. Obtaining Information on Doubtful Questions.—Appraising officers at ports other than New York when in doubt on any question arising under paragraphs 27 and 28 shall take the question up direct with the Appraiser at New York, who shall give his advice as promptly as possible. If the appraising officer shall be dissatisfied with the advice of the Appraiser at New York, or the latter shall be in doubt on the inquiry, the question shall be submitted to the Department for an expression of its views.

EDWARD CLIFFORD,
Assistant Secretary.

Engineers to Have Museum

Mechanical Engineers Accept Smithsonian Offer for Central Unit in Washington—Others Planned

The joint committee recently appointed by the American Society of Mechanical Engineers has decided to accept the offer of the Smithsonian Institution to establish at Washington, D. C., a central historical museum of engineering, in connection with which local branches will be developed in other sections.

The museum will be a storehouse for records of American engineering achievements. It will afford opportunities for research and investigation. The plan has obtained the co-operation of the Federated American Engineering Societies, from which body the joint committee was selected by the A.S.M.E.

The Smithsonian Institution, in offering to act as custodian of collections, urged that the movement be broadened from an engineering society standpoint to that of a national museum. This idea was acceptable to the engineers and the museum will be founded on the broadest possible basis.

Stamford Chemists Hear Prof. Johnston

Points Out Errors in Existing Literature—Says Pressure Chemistry Is Normal Chemistry

At a meeting of the Stamford Chemical Society, Monday evening, Feb. 26, Prof. John Johnston of Yale University gave the principal address on "Some Effects at High Pressure." Dr. Johnston pointed out the unfortunate existence of a great many errors in the literature of the subject. This situation was, of course, not confined to data on high pressures, but was perhaps particularly noticeable there because the preliminary work had been very crude. Nearly 25 years ago it was felt in many quarters that inorganic chemistry had been completed. It was a finished subject. Then Ahbegg began his epoch-making compilations which have resulted in his Handbook on Inorganic Chemistry, now a standard reference work. This served to call attention to many of the gaps in inorganic chemistry. It began to be appreciated that the selection of an arbitrary temperature for inorganic reactions such as 25 deg. C. was somewhat ridiculous; and then a great many investigators began work at high temperatures and a few at high pressures, so that we are beginning to collect data on inorganic compounds with general relation to their critical constants.

Effects of Stress

The speaker further stated that an easy differentiation could be made between the effects of uniform and variable pressure, the latter producing stresses in the material, while the former does not. Stresses have a permanent effect on physical and chemical properties. Uniform pressure, however, causes no ultimate change. The effect of using, as a pressure medium, a substance which has a positive chemical reaction with the material compressed produces very large changes in the result. This is particularly true if calcium carbonate is measured under carbon dioxide pressure. Solubility increases seventy times within the experimental pressure range.

Dr. Johnston took particular pains to point out the fact that pressure chemistry was normal chemistry and that no abnormal effects could be traced to the influence of pressure. The statements in geological books that such and such a peculiar result was probably due to pressure must inevitably be revised, because it can be shown in the laboratory that pressure does not have any effect of that kind. Many costly industrial experiments have been attempted on the theory that pressure would have some unusual effect and many useless patents have been granted on that assumption. One of particular note was mentioned, an attempt to separate cadmium from zinc under pressure, when it could be shown from theoretical research that no such separation could possibly be effected.

New Financing Plan Adopted by A.E.S.C.

A new plan for financing the industrial standardization work of the United States, which provides for membership dues on the basis of one cent per $1,000 of gross receipts, has been formally approved by the executive committee of the American Engineering Standards Committee. And twenty of the most influential industrial executives of the country have accepted places on an advisory committee which will co-operate with the ways and means committee in the refinancing of the American Engineering Standards Committee.

In submitting the report of the ways and means committee, A. W. Whitney, chairman of that committee and of the A.E.S.C., declared that the economies which should accrue to the industries of America, through standardization, "are to be measured in billions of dollars, not millions."

New Class of Members

This report announces a new class of members in the A.E.S.C. to be known as "sustaining members," and provides a special service to "sustaining members," including information bulletins on developments in standardization work in this country and in every other country where industrial standardization is in progress.

The plan calls for the appointment of an engineer-translator who will provide translations of standards developed in foreign countries for the information service to sustaining members. The new information service will be an elaboration of the work which the A.E.S.C. has been carrying on in a small way, in calling to the attention of co-operating bodies and the technical press the important developments in standardization work, foreign as well as American.

Agriculture Department Plans Work for Color Laboratory

A committee of dye chemists has been appointed by the Secretary of Agriculture upon recommendation of W. G. Campbell, acting chief of the Bureau of Chemistry, to formulate plans of work for the Color Laboratory.

The committee consists of R. Norris Shreve, secretary of the Dye Division of the American Chemical Society; Willard H. Watkins of the National Aniline & Chemical Co., Buffalo; Louis A. Olney of Massachusetts, president of the American Association of Textile Chemists and Colorists; Dr. William J. Hale, of Michigan, chairman of the Dye Division of the American Chemical Society, and Dr. Clarence G. Derick, of Buffalo, N. Y.

The laboratory has in its past work felt the need of a more intimate knowledge of the problems of the industry as a whole throughout the country. The function, therefore, of the above-named committee will be to consult frequently with the bureau so that it may be conversant with the needs of various sections and schedule its work accordingly.

American Interests Protest British Rubber Restriction

Firestone Leads Conference Which Urges Repeal of British Law and Seeks U. S. Source of Supply

A campaign for the repeal of the British rubber restriction act and for the development of sources of crude rubber supply that will make America independent of other countries was inaugurated at a conference held last Wednesday in Washington between the automotive industries and government officials. H. S. Firestone, of the Firestone Manufacturing Co., was the leading spirit in the conference and acted as host to the visiting manufacturers. Philip H. Lockhart of the India Rubber Manufacturers' Association of Great Britain addressed the conference. He is vice-president of the Federation of British Industries, which includes 2,200 manufacturing firms and which is opposed to British restriction. He said, in speaking of the English manufacturers' attitude, that they do not like the restriction act in any shape or form. He said he felt sure the three representatives of the Rubber Growers' Association who came from England recently for a tour of the American rubber industries had returned to England with a much better comprehension of the wants of America than ever before.

Resolutions Adopted

Resolutions were passed which authorized Mr. Firestone to appoint a committee to carry on this work. This committee will be announced shortly and will immediately take vigorous steps to achieve the desired ends. Plans are now being worked out for a permanent organization. In speaking of the conference Mr. Firestone said:

> The conference clearly proved that exceptional interest had been aroused over the restrictive measure, and the enthusiasm shown by the manufacturers present indicated that they felt the time was ripe for concerted action looking to the abolition of the law.
>
> Our plans now provide for a permanent organization to carry to a successful conclusion the program designed to induce Great Britain to reconsider her unwise legislation pertaining to rubber, and to promote the development of rubber plantations in the Philippines and South America, as well as in continental United States, which latter field's possibilities were presented by Secretary of Agriculture Wallace
>
> We hope to formulate plans to give every assistance available to the Departments of Commerce and Agriculture in their respective surveys of potential rubber producing regions, realizing that the rubber industry and the general public will benefit in the end.

Ruhr Occupation Hurts East

The Far East is feeling the pinch resulting from the uncertainty as to the delivery of German chemicals more than any other section of the world, in the purview of the Department of Commerce. Prices have advanced sharply, somewhat out of proportion to advances in other countries. Whether this has been occasioned by the low state of stocks or is due to the readiness with which they have been cornered has not been determined.

Southern California A.C.S. Discusses Ceramics

F. B. Ortman Details Progress in Industry and Points Out Problems Needing Solution

At the regular monthly meeting of the Southern California Section of the American Chemical Society, held at Los Angeles on Feb. 15, F. B. Ortman, vice-president of Tropico Potteries, Inc., gave an interesting address on recent developments in the field of ceramics. Mr. Ortman classified the various clay groups to include pottery, faience, heavy clay and refractories. Glass was subdivided into building glass, pressed and blown glass, and optical glass. Enameled metal is an important development of the ceramic industries, accounting for a turnover of over $42,000,000 annually. Sanitary ware is being manufactured in rapidly increasing volume, and abrasives are assuming importance. Mr. Ortman discussed the blending of clays and the steps taken to prevent scumming and efflorescence. Details were given as to the general composition of white ware, and customery burning practice. American and European porcelain were compared.

Developments in Ceramics

An important development in the industry has occurred in connection with drying, known as the humidity method. The humidity principle involves the boxing of the shape in an atmosphere of low temperature and comparatively high humidity for a few hours until heated thoroughly and until a uniform vapor density has been attained. The temperature is then increased rapidly. The result is an absence of case hardening and a considerable economy in time. By the old method, the burning of terra cotta ware would take from 7 to 10 days. By the new method, the operation is completed, more efficiently, in 18 hours.

Mr. Ortman dealt at length with the subject of glazing, and discussed the troubles experienced, due to the difficulty of getting a glaze and body of uniform coefficient of expansion. Dealing with the subject of health regulation, the speaker discussed the use of lead in the ceramic industry. Mr. Ortman then paid a tribute to the leaders in the industry for the manner in which they disseminated information. The bars of secrecy that formerly characterized many operations in ceramics have been let down, and there are no trade secrets. Formulas are only of value in connection with the material and conditions at the factory in which they were developed. Technicians have nothing to lose and a great deal to gain by adopting a frank attitude toward their confrères.

Discussion Held

H. L. Payne, the chairman, at the conclusion of the address called for discussion, mentioning that a recent issue of *Chemical & Metallurgical Engineering*, to which he referred in complimentary terms, had an advertisement for Los Angeles refractories of exceptional qualities. T. S. Curtis, the president of the Vitrefrax Company, replied, and gave some interesting information about the products in question, and the progress being made in the erection of the company's new plant. The exact analysis of this refractory, it was learned, has baffled even the most experienced.

Mark Walker, the secretary of the section, announced that Dr. Franklin, the newly elected president of the society, who is also the president of the Southern California Section, would attend the next meeting, to be held on March 16, and deliver an address on the ammonia compounds, a subject on which he is the undisputed authority. This meeting will constitute the inauguration of a lecture tour which Dr. Franklin will undertake on his way to the Eastern States.

Bureau of Mines Car to Make a 6 Months' Trip

Contrary to the information recently published in these columns, the Bureau of Mines car "Holmes" has not been dismantled, but has started on a 6 months' trip, during which experiments will be conducted at various refractories plants. The experimental work which will be done at each of these plants is in co-operation with the Refractories Manufacturers' Association. The plants at which the experiments will be conducted follow: American Refractories Co., Baltimore; Brooklyn Fire Brick Works, Brooklyn; Lavino Refractories Co., Womelsdorf, Pa.; Kier Fire Brick Co., Salina, Pa.; Ashland Fire Brick Co., Hayward Station, Ky.; Charles Taylor Sons Co., Taylor, Ky.; Chicago Fire Clay & Retort Co., Ottowa, Ill.

Personnel for Trip

E. P. Ogden, a ceramic engineer attached to the Columbus Station of the Bureau of Mines, is immediately in charge of the technical work that will be done at these plants. The car is accompanied by Alfred Whitford, E. M. Rupp and A. H. Fessler, ceramic engineers; R. F. Lunger, fuel engineer; F. Wentzell, laboratory assistant, and W. E. Rice, the car foreman. G. A. Bole, the superintendent of the bureau's Ceramic Station, came to Washington to confer with bureau officials and the men on the car. While the car was in the railroad yards at Washington, it was inspected by a number of public officials.

South Starts Tire Making

A recent report from Birmingham, Ala., tells of the formation of the Murray Tire Co., to manufacture in that city various grades of automobile tires. The interests behind the new concern have long been engaged in marketing tires in the South, and because of the proximity of the source of such raw materials of tire making as cotton and corn they feel they can carry on manufacture there more cheaply than in any other section.

Federal Jury to Investigate Paint Makers

Attorney-General Orders Probe Into Alleged Sherman Law Violations of Paint Association

On instructions from Attorney-General Daugherty, who is investigating charges that the Paint Manufacturers' Association of the United States is violating the Sherman anti-trust law, the federal grand jury of Philadelphia began on Feb. 26 an investigation.

Accordingly Samuel R. Matlack and George B. Heckel, vice-president and secretary of the association, respectively, were called before the jury. Mr. Matlack, who is president of G. D. Wetherill & Co., Inc., denied emphatically the charges made. Mr. Heckel said he knew of no violations of the law by the association. He further stated that the association maintained a bureau in Washington to aid the government in preventing any possible abuses.

Texans Oppose Carbon Black Plants

The establishment and operation of carbon black plants in the Bethany natural gas region of Texas, permitted in a bill now before the Texas Legislature, are strongly opposed by chambers of commerce and other trade and civic organizations in the district. It is held that the operation of carbon black plants will jeopardize the natural gas supply seriously and curtail the chances for other industries to utilize the large deposits of clays, silica sands, ocher, iron ore and other raw materials in this district, as well as make similar curtailment in the supply of gas for domestic service. A carbon black plant, it is set forth, consumes more gas than a city of 25,000 persons each day, close to 100,000,000 cu.ft. of gas daily being utilized by the plants in the Monroe, La., field. It is also pointed out in the protest that such a plant furnishes employment for only a comparatively small number of persons, gives little revenue to the land owner, and is not desirable from a community and industrial viewpoint.

Olive Oil Foots Hearing Is Extended

An extension of time, in the hearing before the Treasury Department in which oil importers seek the imposition of a 10 per cent duty on olive oil foots under the new tariff act, has been granted by Assistant Secretary Clifford.

The tentative plan of the Treasury to assess this commodity has aroused much protest from soap makers. The soap interests, which asserted that the commodity is sulphured oil unfit for food, have presented their case to the department quite fully. The oil importers, who feel the free import of olive oil foots is discrimination against them, were late in presenting their side of the argument and for this reason the time has been extended.

Cotton Men Remove Hutchison

Since his election as president and managing director of the National Campaign for Boll Weevel Control, the American Cotton Association has revoked Dr. M. Reese Hutchison's appointment as managing director of research for that organization.

President J. S. Wannamaker of the American Cotton Association announces that the activities of that body are to be intensified. Plans are under way to form an independent scientific research commission which is to co-operate with state and federal agencies in studying control methods for the boll weevil menace.

Engineering Council Meets

The executive board of the American Engineering Council, which is the governing body of the Federated American Engineering Societies, will meet in Cincinnati March 23 and 24. Government reorganization and reforestration will be among the chief questions to be discussed by the engineers, who will represent thirty national and local engineering societies.

Charles H. MacDowell of Chicago is chairman of the engineering committee which is arranging the plans. Other members are S. H. McCrory, chief of the Division of Agricultural Engineering, U. S. Department of Agriculture; W. H. Hoyt of Duluth, Minn.; and J. C. Ralston of Spokane, Wash.

Assistant Patent Examiners Wanted

The United States Civil Service Commission announces an open competitive examination for assistant examiner, Patent Office, to take place on April 4, 5 and 6, 1923, at various post offices and custom houses throughout the country. Vacancies in the Patent Office at an entrance salary of $1,500 and $20 per month bonus will be filled from the results of this examination.

Those desiring to take the examination should apply immediately to the United States Civil Service Commission, Washington, D. C., for full information, stating the name of the examination which they desire to take and applying for form 1312.

Government Seeks Chemists

The United States Civil Service Commission announces open competitive examinations for the positions of chemist ($3,000 to $5,000 per year), associate chemist ($2,000 to $3,000 per year) and assistant chemist ($1,600 to $2,000 per year). The vacancies to be filled are in the Chemical Warfare Service, Edgewood Arsenal, Md. There are also some positions of similar qualifications.

Applicants can secure full information by writing to the Civil Service Commission at Washington, D. C. Application blanks, Forms 2118 and 2376, can be secured from the following places: Civil Service Commission, Washington, D. C.; the Secretary of the United States Civil Service Board, Custom House, Boston, Mass., New York, N. Y., New Orleans, La., Honolulu, Hawaii; Post Office, Philadelphia, Pa., Atlanta, Ga., Cincinnati, Ohio, Chicago, Ill., St. Paul, Minn., Seattle, Wash., San Francisco, Calif., Denver, Colo.; Old Custom House, St. Louis, Mo.; Administration Building, Balboa Heights, Canal Zone; or the Chairman of the Porto Rican Civil Service Commission, San Juan, P. I.

Applications must be filed with the Civil Service Commission, Washington, D. C., with the material required, prior to closing March 27, 1923.

Chemistry Institute Meets

At the regular meeting of the Council of the American Institute of Chemistry on Feb. 26, new applicants were elected to membership and plans completed for the circularization of American chemists on the desirability of affiliation with this strictly economic society of chemists.

Dr. Frederick D. Crane was appointed chairman of the classification committee, L. R. Seidell of the employment committee and H. G. Byers of the ethics committee. Reports were read announcing the early establishment of chapters and of the growth of interest in the plans of the Institute throughout the country. Chemists interested in the efforts of this organization to establish the professional status of chemists on an economic as distinguished from a scientific basis are urged to send their suggestions to the Council, 381 Fourth Ave., New York.

Imports Statistical Service to Expand

The Department of Commerce is planning to expand its statistical service on chemical imports. This will include the entire synthetic organic group. At present an accurate picture of the volume of many imports cannot be had, due to the lack of subdivision. For the import statistics to be of greatest value, it is necessary in many instances to describe the individual commodities or qualities of a commodity. The House Committee on Appropriations has allowed a deficiency appropriation of $150,000 with which to expand the imports statistical service.

Gas Association Convention Fixed

The American Gas Association will hold its 1923 convention at Atlantic City during the week of Oct. 15. This decision has been reached after a canvass of the entire membership of the association, which resulted in 71 per cent of the votes for Atlantic City. The convention there will be supplemented by an extended exhibition probably on the Steel Pier. In reaching this decision the committee has tentatively recommended that the 1924 convention be held in Chicago.

New Law Establishes Naval Stores Standards

The Senate Committee on Agriculture and Forestry favorably reported a bill to establish standard grades of naval stores, under direction of the Secretary of Agriculture, which was passed in the closing hours of Congress and signed by the President.

The bill as passed is a complete substitute for previous measures on this subject which have been pending before the committee. It embodies the fundamentals agreed upon between the Department of Agriculture and a committee representing producers and large consumers of naval stores.

Three standard grades of turpentine are established, "gum spirits of turpentine," made from gum from a living tree; "steam-distilled wood turpentine," which shall be wood turpentine distilled with steam from the oleoresin within or extracted from the wood; and "destructively distilled wood turpentine," which shall be wood turpentine obtained in the destructive distillation of the wood. Two classes of rosin are established, "gum rosin" and "wood rosin," with thirteen grades.

The Secretary of Agriculture is authorized to change grades or to create new grades after 6 months' notice to the trade. Sale of naval stores not within the standards, or false gradings, would be made punishable by a fine not to exceed $5,000 or imprisonment of not more than a year, or both.

Baby Element Was Expected

Chemists at the Bureau of Mines are inclined to accept the accuracy of the observations resulting in the announcement that a new element had been discovered. This element has been called hafnium, as has already been announced in our columns. Work at the Bureau of Mines has indicated the probability that an element exists which belonged to that point. The element having an atomic number of 72 was missing from the series, and on the periodic table it will come between lutecium, which has an atomic weight of 175, and tantalum, which has an atomic weight of 181.

Paper Exposition Announces Speakers

The Paper Industries Exposition, which is to be held at Grand Central Palace, New York, the week of April 9, has secured as speakers for Printers, Publishers and Advertisers day, Friday, April 13, Don C. Seitz of the New York *World* and Dr. R. E. Rindfusz, secretary American Writing Paper Co.

Mr. Seitz, who is business head of the *World*, will discuss the newsprint situation from the point of view of both manufacturer and consumer, for the *World* owns its own paper mills. Dr. Rindfusz will speak on the "Standardization of Bond and Ledger Papers," a task on which his organization, in co-operation with numerous consumers, has long been working.

Increased Paper Output In Newfoundland

An agreement which will increase the output of the paper mills of the Anglo-Newfoundland Development Co. at Grand Falls, N. F., by 100 tons per day has been arrived at between Lord Rothermere and Sir Richard Squires, representing the Government of Newfoundland. Premier Squires, in announcing the arrangement, said that no concessions were involved and that the deal was a straight business proposition. Work will be commenced on the concessions as soon as possible and, in conjunction with the Sir W. G. Armstrong Whitworth development at Humbermouth, will provide for a total increase in the dominion's paper output of 500 tons per day. When these two developments are completed Newfoundland will manufacture approximately 2,500,000 tons per annum.

Personal

R. V. AGETON, of the Bureau of Mines staff, has gone to Pitcher, Okla., to work with Dr. F. Flynn of the Public Health Service on a study being made of the dust conditions in zinc and lead mines at that point.

Dr. EDGAR C. BAIN has gone to Dunkirk, N. Y., with the Atlas Steel Corporation as research metallurgist. He still maintains contact with the National Lamp Works of the General Electric Co. through the Cleveland Wire Division, in a consulting capacity.

CHARLES A. BLOOMFIELD, head of the Bloomfield Clay Co., Metuchen, N. J., was honored on his seventy-fourth birthday, Feb. 25, by having a large framed portrait hung in the new ceramics building, Rutgers College, New Brunswick, N. J., in recognition of his accomplishments in founding the ceramics department at the institution.

A. E. BUCHANAN, JR., has resigned as assistant editor of *Chem. & Met.* to become assistant secretary of the Alumni Association, Lehigh University, Bethlehem, Pa., which is a newly created position. He was married to Miss Lois Pease on Feb. 22 and expects to assume his new duties early in March, after returning from Bermuda.

JOSEPH R. CARPENTER, a scientific assistant, has been appointed to a position in the Color Laboratory of the Bureau of Chemistry, Washington, D. C., by transfer from the Fixed Nitrogen Research Laboratory of the Department of Agriculture.

NORRIS GOODWIN is now general manager of the International Chemical Products Co., Glendale, Calif.

H. A. GREAVES and H. ETCHELLS have been awarded jointly the certificate of merit of the Franklin Institute, Philadelphia, Pa., for notable and oirginal inventions for their electric steel melting furnaces, known as the "Greaves-Etchells" type furnace.

O. S. KEENER, junior chemist, has been transferred from the Carbohydrate Laboratory, Bureau of Chemistry, Washington, to the St. Louis station. J. L. SULLIVAN, food and drug inspector, has been transferred from St. Louis to Chicago, and Inspector WILLIAM B. TIEDT has been transferred from Chicago to St. Louis.

THOMAS MIDGLEY, JR., will be presented the Nichols Medal on March 9, for his work in the development of the anti-knock compounds for internal combustion engines.

Dr. R. B. MOORE, chief chemist of the Bureau of Mines, spoke at Princeton University March 1, on radium.

J. S. NEGRU has left the editorial staff of *Chem. & Met.* to take up engineering practice with special reference to mining engineering. He will also handle industrial diamonds for diamond drilling.

W. O'NEILL, vice-president and general manager of the General Tire & Rubber Co., Akron, Ohio, gave an interesting and instructive address before the members of the Down Town Association at Hotel St. Francis, San Francisco, Calif., on Feb. 15 on the subject "What About the Rubber Industry?"

HAROLD J. PAYNE, a '22 graduate of M.I.T., who has been with the General Electric Co. at Pittsfield, Mass., since his graduation, is now an editorial assistant on the staff of *Chem. & Met.*

ALFRED I. PHILIPPS, formerly associate gas engineer, National Bureau of Standards, and lately service engineer of the American Gas Association, is now gas engineer with Arthur D. Little, Inc., Cambridge, Mass.

T. T. READ, chief of the Information Service of the Bureau of Mines, has returned from a visit to a number of South American countries.

Dr. WALTER ROSENHAIN, the English scientist, gave two brilliant lectures at Carnegie Institute of Technology, Pittsburgh, on Feb. 12 and 13. The subject of his first address was "Metallurgical Research at the National Physical Laboratory, Teddington, England," and the other was on "Strain, and Its Relation to Fractures of Metals."

GEORGE P. SHINGLER, JR., has been appointed as an associate chemist in the Leather and Paper Laboratory of the Bureau of Chemistry, Washington, D. C., by transfer from the Chemical Warfare Service.

F. C. WEBER, chemist in charge of the Animal Physiological Laboratory of the Bureau of Chemistry, resigned at the end of January, to accept a position with the Fleischmann Laboratories, New York City.

Obituary

DAVID AUGUSTUS DECROW, manager of the waterworks department of the Worthington Pump & Machinery Corporation, New York, died in East Orange on Thursday, Feb. 15, and was buried in Lockport, N. Y., Sunday, Feb. 18. He was born in Bangor, Me., and was graduated from Maine State College of Mechanic Arts of the University of Maine at Orono, in the class of 1879.

After his graduation from college, Mr. Decrow taught school for a year or more in a lumber camp in Maine. He went from Maine to Lockport in the early '80s and became associated with the Holly Manufacturing Co. as a mechanical draftsman. In 1893 he was made designing engineer, in 1900 chief engineer and in 1903 secretary of the company. During his connection with that plant he became known as a waterworks engineer and continued his work as a specialist in that line to the time of his death. Some years ago the Holly Manufacturing Co. was combined with the Snow Steam Pump Works at Buffalo, N. Y., as part of the International Steam Pump Co. Mr. Decrow went to Buffalo at the time of this change and took charge of the pumping machinery manufactured by both companies.

The International Steam Pump Co. was succeeded by the Worthington Pump & Machinery Corporation in April, 1916. Soon thereafter Mr. Decrow was called to the head office in New York as manager of the waterworks department and continued in this position until his untimely death. He is survived by his wife and two sons.

JAMES T. HEAD, for many years in charge of the production of potassium cyanide and other products at the local plant of the H. V. Davis Chemical Works, New Bedford, Mass., died Feb. 8, of Bright's disease, at the age of 72.

CHARLES PHILIP MONTO, chemical engineer, died in Kotka, Finland, Feb. 17, 1923. He was connected with the National Carbon Co., Cleveland, Ohio, the Nungesser Carbon & Battery Co. of Cleveland, Ohio, and the Superior Carbon Products Co. of Poughkeepsie. He sailed for Finland in June, 1921, to engage in the manufacture of carbon electrodes and batteries, in which business he was engaged at the time of his death, which occurred from pneumonia. His body is being brought to this country for interment in Canandaigua, N. Y.

WADE A. TAYLOR, a prominent steel manufacturer and chairman of the board of the American Zinc Products Co., Greencastle, Ind., died at Pasadena, Calif., Feb. 17, of heart disease. He was head of the Deforest Sheet & Tin Plate Co., Niles, Ohio, until that company was acquired by the Republic Iron & Steel Co. He is survived by his wife and daughter.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

Rising Prices and Production Costs Accompany Greater Industrial Activity

Increased Output of Basic Commodities and Better Business Conditions in Wholesale and Retail Trade Mark Progress Since First of Year—Labor and Transportation Difficulties Foreseen

THERE is abundant evidence that the business revival has continued to gain momentum since the first of the year. Capacity operations on the part of most manufacturing industries and the volume of wholesale trade limited only by transportation difficulties are encouraging developments of the past 30 days. As yet there is but little of the speculative bidding and duplication of orders that usually accompanies an artificial business boom, but nevertheless some apprehension is being felt because of the surging rise in prices and production costs. Further advances in raw material prices threaten to carry manufactured goods to still higher levels and thereby enhance the danger of a runaway market, speculation and paper profits. Rather it is to be hoped that before long an equilibrium can be reached in industrial conditions so that production and consumption can proceed without the violent fluctuations noted during the past few months.

Many Industries Active

Cotton goods, pig iron, steel ingots, locomotives, zinc, bituminous coal, and wood chemicals are some of the industries showing the largest output since the boom of 1920. *The Survey of Current Business* on Feb. 26 makes the following comments on these industrial activities:

Cotton consumption by textile mills in January was the third largest in our history, totaling 610,375 bales. Wool receipts at Boston were very heavy in January, with foreign wool receipts the highest since April, 1921. Silk consumption increased to 31,680 bales, while stocks declined from the December high mark.

Pig-iron production at 3,229,604 tons was the largest since October, 1920, while steel-ingot production at 3,717,071 tons in January was not exceeded since March, 1920. Unfilled orders of the United States Steel Corporation increased after 2 months of declines and made a high record since February, 1921, at 6,910,776 tons. Merchant pig-iron shipments, unfilled orders and stocks increased, but sales declined.

Shipments of locomotives were the largest since January, 1921, and unfilled orders were the highest on record, at 1,788 locomotives.

Production of zinc rose to 92,634,000 lb., the highest since March, 1920, while stocks declined to 33,148,000 lb., the lowest since the armistice.

Production of bituminous coal in January amounted to 50,123,000 tons, the highest month with one exception since December, 1920.

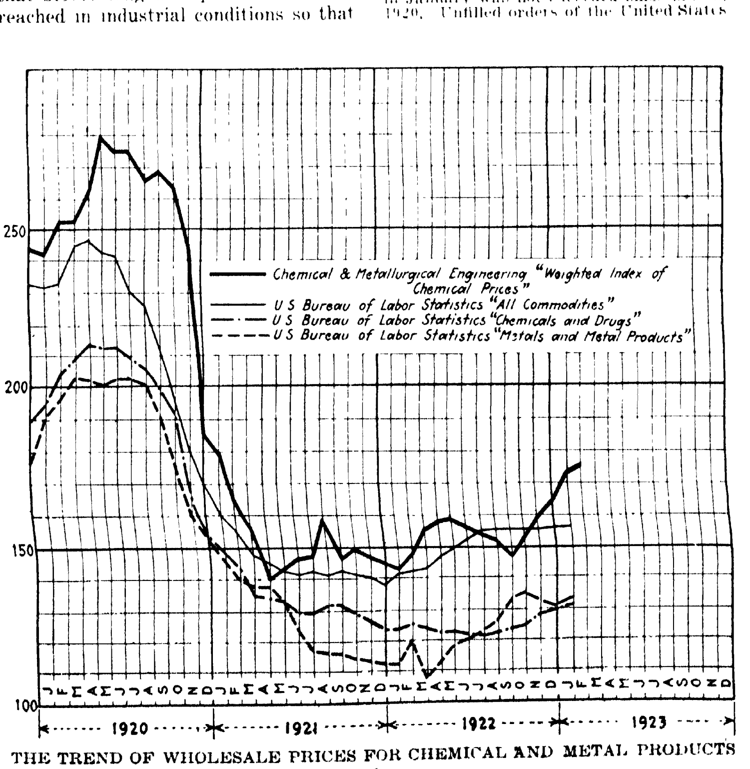
Figures on rubber tires, which have just become available, show a slightly increased consumption of rubber, but a falling off in production of tires. Shipments of tires increased and stocks were reduced.

Building contracts awarded in the 27 Northeastern States in January increased 1 per cent over December and 31 per cent over January, 1922.

Wood chemical plants produced about twice as much acetate of lime and wood alcohol in December as a year ago.

Receipts of turpentine and resin were higher than in January, 1922. Stocks of resin were larger than a year ago, but turpentine stocks were smaller.

Receipts and shipments of flaxseed were less than in December but greater than a year ago. Stocks declined to a total of only 82,000 bushels at Minneapolis and Duluth.



THE TREND OF WHOLESALE PRICES FOR CHEMICAL AND METAL PRODUCTS

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	176.71
Last week	176.38
March, 1922	156.00
March, 1921	157.00
March, 1920	252.00
April, 1918 (high)	286.00
April, 1921 (low)	140.00

The slight advance in this week's index number is due to fractional increases in the prices of caustic potash and linseed oil. Other prices were well maintained and no declines were reported.

Crude oil production continues at an altogether unprecedented rate. The American Petroleum Institute estimates that the daily average gross production for the week ended Feb. 24 was 1,784,700 bbl., as compared with 1,757,550 bbl. for the preceding week and 1,410,450 for the corresponding period in 1922.

Threatening Shortage of Labor

A factor which may act as an important check on further business expansion is the rather general shortage of labor. Many plants reported an inadequate labor supply in January, according to the United States Department of Labor. The monthly survey made by that department in 4,153 representative establishments in 43 manufacturing industries showed an increase of 1.4 per cent in the number of employees during January. The greatest increase was in the pottery industry

(36.9 per cent), due to resumption of production following a general strike. Fifty-two fertilizer plants reported an increase of 10.8 per cent. There were 3.3 per cent more workers in the 74 chemical plants that report to the department.

Chemical Prices Advance

For the past 3 or 4 months the average wholesale prices as recorded by the index numbers of the government and other agencies have been fairly constant. Closer study, however, reveals the fact that prices for certain basic commodities have stiffened considerably and this has been offset by declines in other prices. Since the first of the year the prices for the principal chemical and metal products have shown marked advances. These are indicated in the accompanying chart comparing this magazine's weighted index of chemical prices with the index numbers of the U. S. Bureau of Labor Statistics.

January Steel Production Breaks All Records

Steel production increased rather sharply in January, is increasing now, and promises to be higher still this month. January broke all records since the armistice, with the exception of March, 1920. March, 1923, is practically certain to beat that record and may possibly beat the highest record during the war. Both high points were reached on the eve of limiting influences developing. The high point in the war was in September, 1918, just before the influenza epidemic, with a rate of about 47,000,000 tons of ingots a year, while the high point since the armistice was in March, 1920, just before the "outlaw" railroad strikes began April 1, the rate being about 45,000,000 tons.

Ingot production ran at an average of about 34,500,000 tons a year for 6 months following the coal strike of April 1, 1922, then averaged 40,000,000 tons in the last 3 months of the year, and was at about 43,500,000 tons in January. Of late pig-iron production would have supported a slightly higher steel production rate than has obtained, the difference probably lying in mills replenishing pig-iron reserves, entirely depleted during the coal strike.

Business Failures Fall Off During February

Bradstreet's report on the total number of business failures during January, 1923, was 20 per cent less than the total for January a year ago, and the February total shows a decrease of 24 per cent from the like month of 1922. Measured in terms of liabilities, the January total fell 49 per cent from last year and that for February shows a decrease of 45 per cent.

These two months mark the recession from the high totals which have characterized these reports during the past 2 years.

Moderate Activity Again in Evidence in New York Chemical Market

Most Prices Well Maintained—Alkali Market Shows Improvement—Producers of Bicarbonate of Soda and Iodides Announce Advances

NEW YORK, March 5, 1923.

THE chemical market showed moderate activity during the past week, although trading was mostly for small quantities. Imported commodities continued to feature the market, due to the inability of German manufacturers to make any definite deliveries on old contracts. Permanganate of potash was very firm, and much higher prices were recorded among leading importers. Producers of bicarbonate of soda announced higher prices at the works, due to increased costs of production. The export inquiry for caustic soda showed a marked improvement and several large tonnage sales were reported to Japan and Europe. Soda ash has also shown a firmer tendency on spot. Arsenic continued along former levels, with buyers showing little disposition to purchase in round quantitties. Recent advances in copper sulphate were well maintained and the buyers showed additional interest in the general movement. Importers of glaubers salt reported a scarcity on spot and quoted \$1 per 100 lb. for shipment in bags. Manufacturers of iodides announced an increase of 15c. per lb. Importers of caustic potash were quite firm in their views and quoted much higher prices on limited stocks of spot material. Yellow prussiate of soda was somewhat weaker, due to the absence of any large buying interest.

Principal Price Changes

Alcohol—The tone of the market for methanol and denatured alcohol showed a marked improvement. Prices did not change, however, and denatured No. 1 continued at 38@40c. per gal. and methanol 97 per cent at \$1.25 per gal. in barrels.

Ammonium Sulphate—Spot goods remained in very scarce supply, due to the increased export demand. Producers reported a heavily sold up condition at the works. Resale material was quoted around \$3.85 per 100 lb., f.a.s., in double bags.

Arsenic—Spot goods ranged around 15½@15⅝c. per lb. Activity has slackened considerably and dealers were anxious to sell at fractionally lower figures.

Barium Carbonate—A better demand was reported for spot material and importers quoted \$72.50 per ton for spot goods. The general range was around \$72.50@\$75 per ton.

Bicarbonate of Soda—Leading producers advanced prices on all packages due to increased production costs. Barrels were quoted at 2c. per lb. f.o.b. works, with kegs at 2¼c. per lb.

Caustic Potash—Imported 88-92 per cent material on spot was in very scarce supply. Sales during the latter part of the week were recorded up to 8c. per lb. Shipments were quoted at 7⅝c. per lb. c.i.f. N. Y.

Caustic Soda—The export market showed material improvement, with several fair-sized sales reported to Japan and Italy at \$3.45@\$3.50 per 100 lb. The domestic market continued along firm lines, with quotations ranging around \$3.75 per 100 lb. ex-store. Contracts were quoted at \$2.50 per 100 lb., basis 60 per cent f.o.b. works.

Chlorate of Soda—A firm market was reported, with sales around 6½@6⅝c. per lb. f.o.b. works. Imported material held at the same level.

Copperas—Spot goods were quoted at 1⅜c. per lb. in barrels. Bulk material at the works held around \$16.50 per ton and \$19 in bags. The demand, however, was merely of a routine nature.

Fluoride of Soda—A quiet market was reported among importers, with quotations around 9c per lb. Domestic producers continued to quote 10c. per lb.

Iodides—Large producers announced advances on all iodides. Potassium iodide is quoted at \$3.75 per lb., with resublimed around \$4.55 per lb.

Permanganate of Potash—The market was in a very strong condition with importers quoting limited stocks on spot at 20c. per lb. Shipments were held at 18½c. per lb. duty paid. The new level represents an advance of 2c. per lb. during the past week.

Prussiate of Potash—Yellow prussiate was somewhat higher on spot, with quotations around 38@39c. per lb. The red variety remained at 80@85c. per lb. The demand showed considerable improvement.

Coal-Tar Products Active

Crude products continued very scarce on spot and producers reported a heavily sold up condition at the works. Buyers are experiencing extreme difficulties in locating appreciable quantities and the general tone of the market appeared quite strong. Naphthalene has shown material improvement and dealers have withdrawn former quotations on spot material. Phenol has also shown a marked improvement and quotations were advanced in most directions. Resale stocks have practically been taken off the market and available material now remains in first hands. Intermediates have continued in fair demand, with higher prices heard for alpha-naphthylamine, R salt and paratoluidine.

Cresylic Acid—Trading was rather quiet, due to the restricted offerings. A few odd lots on spot were quoted around \$1.50@\$1.65 per gal. Importers were said to be unable to market their material on account of the prevailing high duty.

Naphthalene—Prices were quoted at higher levels, due to the increased consuming demand. Sellers are quoting flakes at 6¾@7c. per lb. and balls at 7¾@8c. per lb.

Phenol—Cheap lots have been absorbed and higher prices were quoted by holders of spot goods. The U.S.P. prime crystals were quoted around 40@45c. per lb. The demand was quite active.

Satisfactory Business in the Chicago District

Actual Sales Not Large, but Prices Are Holding Firm—Imported Chemicals Scarce

CHICAGO, ILL., Mar. 1, 1923.

The chemical market in the Chicago district for the past 2 weeks was quiet with only a fair amount of business reported. Although no really large orders were consummated, all factors seemed satisfied with the volume they were doing. Prices held firm and as material was apparently in strong hands, there was little or no evidence of shading. Imported chemicals were all firm and in view of the conditions abroad a general advance would not be surprising.

Caustic soda was quiet and not much material moved on spot. The price was unchanged at $4.15 per 100 lb. for ground 76 per cent material and $3.50 for the solid. *Soda ash* was in routine demand and spot material was unchanged at $2.25 per 100 lb. *Caustic potash* was in good demand and the price was very firm at 8½@9c. per lb. for the imported 88-92 per cent. Importers of this material claim that the spot price is still below the replacement cost.

Alum in Better Demand

Potash alum was in better supply and the iron-free lump was available at 4½@5c. per lb. The powdered was still scarce and what was available was held at 8@8½c. per lb. *Sal ammoniac* was in good demand and the white granular of domestic manufacture was quoted at 8c. per lb. in small or moderate lots. *Ammonium carbonate* was quiet at 10@10½c. per lb. *Barium chloride* was offered in one direction at $95 per ton in ton lots. *Barium carbonate* was quiet and spot material could have been purchased at $80 per ton. Only one small lot of *white arsenic* could be located, and this was held at 17c. per lb. *Blue vitriol* was quite active, with a few outside lots still available at 6½c. per lb. *Carbon tetrachloride* was in plentiful supply and the general quotation was 9½@10c. per lb. *Carbon bisulphide* was unchanged in price and small or moderate lots were offered at 7@7½c. per lb. *Formaldehyde* was quiet, with a few outside lots quoted at 16c. per lb. *Glycerine* firmed up, but the spot price of 18½c. per lb. for c.p. material in drums was unchanged.

Due to fresh arrivals *phosphoric anhydride* was offered slightly lower at 35c. per lb. for 1-lb. tins in case lots. *Potassium bichromate* was in a firm position, with spot supplies held at 12½@13c. per lb. *Chlorate of potash* was scarce on spot, and only odd lots were available at 10@10½c. for the crystals and 9c. for the powdered. *Potassium cyanide* was unchanged at 55c. per lb. for single-case lots. *Permanganate of potash* was sharply advanced and 20@22c. per lb. was the range at which spot material was available. *Yellow prussiate of potash* was quoted at 40c. per lb. and was in fair supply. The *red prussiate* was still scarce, although slightly easier at 90c. per lb.

Linseed oil was in better demand during the past week, although the volume was far from large. Boiled oil was quoted at the close of today's market at $1.10 per gal. in single drums and similar quantities of raw at $1.08.

Turpentine continued to move slowly, but the price kept advancing. Today's market for single drums delivered to the buyers' store was $1.59 per gal.

Advances in Steel Prices Uniformly Accepted

Ingot Production Now at Record Rate of 45,000,000 Tons Per Year

PITTSBURGH, March 2, 1923.

Following advances in prices made by certain independent sheet manufacturers—other independents being out of the market—and reported a week ago, the American Sheet & Tin Plate Co. on Feb. 26 advanced its prices $3 a ton on blue annealed to 2.65c., $3 a ton on black to 3.50c., $5 a ton on galvanized to 4.60c. and $6 a ton on automobile sheets to 5c. These prices are somewhat below those of independents, which are 2.75@2.90c. on blue annealed, 3.60c. on black, 4.75c. on galvanized and 5.35c. on automobile sheets.

The leading interest was already practically sold up through June, while it had not opened order books for third quarter and will not do so for a month or two still. There was a double object in formally advancing prices at this time—to discourage customers from seeking to place additional tonnages, and to prepare the way for third quarter transactions.

At the same time the leading interest advanced its price on tin plate from $4.75 to $4.95 per base box, 100-lb. Late last week two large independent producers had formally announced advances in their prices to $5. Some independents had previously sold at $5 and even higher. Peculiar conditions exist in tin plate. Prices of steel and pig tin have advanced since order books were opened late last November for the current half year, when they were expected to decline, demand is proving remarkably heavy and shortage of labor and steel is likely to prevent full operation of the mills in the second quarter. Makers of packers' cans expect to be taken care of at a uniform price during a half year, on the ground that they sell their cans in advance, whereas tin plate mills are faced with a loss on any tin plate they may ship at $4.75, not covered by raw material bought at the former market. There is likely to be quite a range in selling prices in the next few months, according to the position and standing of the buyer.

Standard railroad spikes have been advanced, effective Feb. 27, from 2.90c. to 3.05c., for spikes $\frac{9}{16}$ in. and heavier.

No other important advances in steel products are recorded in the week, but all commodities show still more strength and there is more talk of premiums on small lots for early delivery, particularly in bars, shapes and plates.

Production at High Level

The rate of ingot production at the beginning of this month is probably well in excess of 45,000,000 tons a year. against a rate shown for January of about 48,500,000 tons. The average rate of production in 1920, a good year, and 1921, a poor year, in which there was consumption of steel and manufactures of steel previously made, was 30,000,000 tons a year—i.e., there was over 40,000 000 tons in 1920 and under 20,000,000 tons in 1921.

The very magnitude of the present demand for steel foreshadows a labor shortage in the spring, when outdoor work is to be resumed on a very large scale. The mills have a very fair labor supply now, but cannot meet competition of contractors, who simply bid whatever is necessary to get the men they must have to complete contracts. It is possible that there will be another general wage advance in the steel industry in the next month or two, even though another advance would be regarded as economically unsound.

Coke and Pig Iron

The buying movement in Connellsville furnace coke for second quarter, noted in last report as having just begun, has proceeded apace. According to the best estimate, more than 200,000 tons a month has now been placed under contract, all at $7 with the exception of one of the earliest contracts. This represents more than half the current supply, but production is going to increase, just as a number of furnaces, lately idle, are going to operate in second quarter. The market shows a strength which is remarkable and which was more or less unexpected. The coke market has taken its cue from the steel market rather than from the coal market, which has been declining and which promises prices during the remainder of the year at no more than a moderate margin above cost of production.

Pig iron is strengthening in practically all districts. In the local market bessemer has advanced 50c. in the week, and basic and foundry easily retain the advance of $1 recorded last week, at $27 and $28 respectively. Predictions are common that pig iron will soon reach $30, but such an advance is by no means assured, since consumers are already covered on very considerable tonnages for second quarter, and some idle furnaces are coming in.

Current Prices in the New York Market

FOR CHEMICALS, OILS AND ALLIED PRODUCTS

Although these prices are for the spot market in New York City, a special effort has been made to report the American manufacturer's quotations whenever available. In many instances these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported and resale stocks are reported when of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb	$0 36 -	$0 38
Acetone, drums	lb	22 -	23
Acid, acetic, 28%, bbl	100 lb	3 15 -	3 40
Acetic, 56%, bbl	100 lb	6 25 -	6 50
Glacial, 99½%, carboys	100 lb	12 00 -	12 50
Boric, crystals, bbl	lb	11¼ -	11½
Boric, powder, bbl	lb	11 -	11½
Citric, kegs	lb	49 -	50
Formic, 85%	lb	15 -	17
Gallic, tech	lb	45 -	50
Hydrochloric, 18° tanks,	100 lb	90 -	1 00
Hydrofluoric, 52%, carboys	lb	12 -	12½
Lactic, 44%, tech, light, bbl	lb.	11 -	11½
22% tech, light, bbl	lb	05 -	05½
Muriatic, 20°, tanks,	100 lb.	1 00 -	1 10
Nitric, 36°, carboys	lb	.04½ -	05
Nitric, 42°, carboys	lb	06 -	06¼
Oleum, 20%, tanks	ton	17 00 -	18 00
Oxalic, crystals, bbl	lb	.12½ -	13
Phosphoric, 50%, carboys	lb.	08 -	09
Pyrogallic, resublimed	lb.	1 50 -	1 60
Sulphuric, 60°, tanks	ton	9 00 -	10 00
Sulphuric, 60°, drums	ton	12 00 -	14 00
Sulphuric, 66°, tanks	ton	14 50 -	15 00
Sulphuric, 66° drums	ton	19 00 -	20 00
Tannic, U S P, bbl	lb	65 -	70
Tannic, tech, bbl	lb.	.40 -	45
Tartaric, imp crys, bbl	lb	30½ -	31
Tartaric, imp, powd, bbl	lb	31 -	32
Tartaric, domestic, bbl	lb.		32
Tungstic, per lb	lb.	1 00 -	1 20
Alcohol, butyl, drums, f.o.b Terre Haute	lb.	23 -	25
Alcohol ethyl (Cologne spirit), bbl	gal	4.75 -	4 95
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 188 proof No. 1	gal	38 -	40
Alum, ammonia, lump, bbl	lb.	03½ -	03¾
Potash, lump, bbl	lb	03 -	03¾
Chrome, lump, potash, bbl	lb	05½ -	05¾
Aluminum sulphate, com, bags	100 lb	1 50 -	1 65
Iron free bags	lb.	.02½ -	02¾
Aqua ammonia, 26°, drums	lb	06½ -	07¼
Ammonia, anhydrous, cyl	lb.	.30 -	30½
Ammonium carbonate, powd casks, imported	lb.	.09½ -	10
Ammonium carbonate, powd domestic, bbl	lb.	.13 -	14
Ammonium nitrate, tech, casks	lb	10 -	11
Amyl acetate tech, drums	gal	2 80 -	3 05
Arsenic, white, powd, bbl	lb	15½ -	15¾
Arsenic, red, powd, kegs	lb	13 -	13½
Barium carbonate, bbl	ton	72 50 -	75 00
Barium chloride, bbl	ton	87 00 -	90 00
Barium dioxide, drums	lb	18 -	18½
Barium nitrate, casks	lb	08 -	08¼
Barium sulphate, bbl	lb	04 -	04¼
Blanc fixe, dry, bbl	lb	04 -	04½
Blanc fixe, pulp, bbl	ton	45 00 -	55 00
Bleaching powder, f.o.b. wks, drums	100 lb	2.20 -	2 50
Resale drums	100 lb	2 50 -	2 75
Borax, bbl	lb	05½ -	05¾
Bromine, cases	lb.	25 -	27
Calcium acetate, bags	100 lb.	3 50 -	3 60
Calcium carbide, drums	lb.	04½ -	04¾
Calcium chloride, fused, drums	ton	22 00 -	23 00
Gran. drums	lb.	01½ -	01¾
Calcium phosphate, mono, bbl	lb.	06½ -	07
Camphor, cases	lb.	92 -	94
Carbon bisulphide, drums	lb	07 -	07¼
Carbon tetrachloride, drums	lb	09½ -	10
Chalk, precip.—domestic, light, bbl	lb	04½ -	04¾
Domestic, heavy, bbl	lb	03½ -	03¾
Imported, light, bbl	lb	04½ -	05
Chlorine, liquid, cylinders	lb	06 -	06½
Chloroform, tech, drums	lb	35 -	38
Cobalt oxide, bbl	lb	2 10 -	2 25
Copperas, bulk, f o b. wks.	ton	16 50 -	20 00
Copper carbonate, bbl	lb	19 -	20
Copper cyanide, drums	lb	47 -	50
Copper sulphate, crys, bbl	100 lb.	6 40 -	6 50
Cream of tartar, bbl.	lb.	.24 -	25
Dextrine, corn, bags	100 lb.	3.25 -	3 50
Epsom salt, dom., tech., bbl.	100 lb.	2 00 -	2 25
Epsom salt, imp., tech, bags	100 lb.	1 10 -	1 25
Epsom salt, U.S.P., dom, bbl	100 lb.	2.50 -	2 75
Ether, U.S.P., drums	lb.	.13 -	.15
Ethyl acetate, com., 85%, drums	gal.	.80 -	.85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 -	1.00
Formaldehyde, 40%, bbl.	lb	$0 15 -	$0 16½
Fullers earth, f o b mines	net ton	16 00	17 00
Fullers earth—imp, powd	net ton	30 00	32 00
Fusel oil, ref, drums	gal	3 55	4 05
Fusel oil, crude, drums	gal	2 30	2 40
Glaubers salt, wks, bags	100 lb	1 20 -	1 40
Glaubers salt, imp, bags	100 lb	1 00 -	1 25
Glycerine, c p, drums extra	lb	.18½ -	.19
Glycerine, dynamite, drums	lb	17 -	17½
Iodine, resublimed	lb.	4 55 -	4 65
Iron oxide, red, casks	lb.	12 -	18
Lead			
White, basic cabonate, dry, casks	lb	10 -	10½
White, in oil, kegs	lb	12¼ -	14
Red, dry, casks	lb	11½ -	12
Red, in oil, kegs	lb	13½ -	.15
Lead acetate, white crys, bbl	lb	13 -	13½
Lead arsenate, powd, bbl	lb	23	24
Lime-Hydrated, bbl	per ton	16 80 -	17 00
Lime, Lump, bbl	280 lb	3 63 -	3 65
Litharge, comm, casks	lb	10¾ -	11
Lithophone, bbl	lb	06½ -	07
Magnesium carb, tech, bags	lb	08 -	08½
Methanol, 95%, bbl	gal	1 23 -	1 25
Methanol, 97%, bbl	gal	1 25 -	1 27
Nickel salt, double, bbl	lb	10 -	10½
Nickel salts, single, bbl	lb	11 -	.11½
Phosgene		60 -	.75
Phosphorus, red, cases	lb	35 -	40
Phosphorus, yellow, cases	lb	30 -	35
Potassium bichromate, casks	lb	09¾ -	.10
Potassium bromide, gran, bbl	lb	16 -	23
Potassium carbonate, 80-85%, calcined, casks	lb	05¼ -	06
Potassium chlorate, powd	lb	07 -	.08
Potassium cyanide, drums	lb	45 -	50
Potassium hydroxide (caustic potash) drums	100 lb	8 00 -	8 25
Potassium iodide, cases	lb	3 65 -	3 75
Potassium nitrate, bbl	lb	06¼ -	.07¼
Potassium permanganate, drums	lb.	19½ -	20
Potassium prussiate, red, casks	lb	80 -	85
Potassium prussiate, yellow, casks	lb	.38 -	39
Salammoniac, white, gran., casks, imported	lb	06¼ -	.06½
Salammoniac, white, gran, bbl, domestic	lb	.08 -	.08½
Gray, gran, casks	lb	08½ -	.08¾
Salsoda, bbl	100 lb	1 20 -	1 40
Salt cake (bulk)	ton	26 00 -	28 00
Soda ash, light, 58% flat, bags, contract	100 lb	1 60 -	1 67
Soda ash, light, basis, 48%, bags, contract, f o b wks	100 lb.	1 20 -	1 30
Soda ash, light, 58%, flat, bags, resale	100 lb	1.75 -	1.80
Soda ash, dense, bags, contract, basis 48%	160 lb	1 17½ -	1 20
Soda ash, dense in bags resale	100 lb	1.85 -	1 90
Soda, caustic, 76%, solid, drums, f a s	100 lb	3 45 -	3 70
Soda, caustic, 76%, solid, drums, contract	100 lb	3 35	3.40
Soda, caustic, basis 60%, wks, contract	100 lb	2.50 -	2.60
Soda, caustic, ground and flake, contracts	100 lb.	3.80 -	3 90
Soda, caustic, ground and flake, resale.	100 lb	4 00 -	4 15
Sodium acetate, works, bags	lb	06 -	06½
Sodium bicarbonate, bbl	100 lb	2.00 -	2 50
Sodium bichromate, casks.	lb	.07¼ -	08
Sodium bisulphate (niter cake)	ton	6 00 -	7 00
Sodium bisulphite, powd., U S P, bbl	lb	04¼ -	04½
Sodium chlorate, kegs.	lb	06½ -	07
Sodium chloride	long ton	12 00 -	13 00
Sodium cyanide, cases	lb	20 -	.23
Sodium fluoride, bbl	lb	09 -	10
Sodium hyposulphite, bbl	lb	.03 -	03¼
Sodium nitrite, casks	lb	08¼ -	09
Sodium peroxide, powd, cases	lb.	28 -	.30
Sodium phosphate, dibasic, bbl	lb	.03¼ -	.04
Sodium prussiate, yel drums	lb	.18½ -	.19
Sodium silicate (40°, drums)	100 lb.	.80 -	1.15
Sodium silicate (60°, drums)	100 lb.	2.00 -	2.25
Sodium sulphide, fused, 60-62% drums.	lb.	.04 -	.04½
Sodium sulphite, crys, bbl.	lb.	.03½ -	03¾
Strontium nitrate, powd, bbl.	lb.	.09½ -	.10
Sulphur chloride, yel drums.	lb.	.04½ -	.05
Sulphur, crude	ton	18.00 -	20.00
Sulphur dioxide, liquid, cyl...	lb.	.08 -	.08½
Sulphur, flour, bbl	100 lb.	2.35 -	3.15
Sulphur, roll, bbl	100 lb.	$2 00 -	$2 50
Talc—imported, bags	ton	30 00 -	40 00
Talc—domestic powd, bags.	ton	18 00 -	25 00
Tin bichloride, bbl	lb.	.11 -	11½
Tin oxide, bbl	lb.	47 -	48
Zinc carbonate, bags	lb.	14 -	14½
Zinc chloride, gran, bbl	lb.	06 -	07
Zinc cyanide, drums	lb.	37 -	38
Zinc oxide, XX, bbl	lb.	07½ -	08
Zinc sulphate, bbl	100 lb.	2.75 -	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl	lb.	$0 80 -	$0 85
Alpha-naphthol, ref, bbl	lb.	1 05 -	1.10
Alpha-naphthylamine, bbl	lb.	35 -	38
Aniline oil, drums	lb.	.16½ -	.17
Aniline salts, bbl	lb.	.24 -	.25
Anthracene, 80%, drums	lb.	75 -	1 00
Anthracene, 80%, imp, drums, duty paid	lb.	.65 -	70
Anthraquinone, 25%, paste, drums	lb.	.70 -	75
Benzaldehyde U S P, carboys	lb.	1.40 -	1.45
Benzene, pure, water-white, tanks and drums	gal.	.30 -	.35
Benzene, 90%, tanks & drums	gal	.26 -	.32
Benzene, 90%, drums, resale	gal.	33 -	.35
Benzidine base, bbl	lb	.85 -	90
Benzidine sulphate, bbl	lb.	75 -	.80
Benzoic acid, U S P, kegs	lb.	.72 -	75
Benzoate of soda, U S P, bbl	lb.	.57 -	.65
Benzyl chloride, 95-97%, ref, drums	lb.	.25 -	.27
Benzyl chloride, tech, drums	lb.	20 -	.23
Beta-naphthol, subl, bbl	lb.	.55 -	60
Beta-naphthol, tech, bbl	lb.	.24 -	.25
Beta-naphthylamine, tech	lb.	.80 -	90
Carbazol, bbl	lb.	.75 -	90
Cresol, U S P, drums	lb	.25 -	29
Ortho-cresol, drums	lb.	.24 -	.26
Cresylic acid, 97%, resale, drums	gal	1 50 -	1 65
95-97%, drums, resale	gal	1.40 -	1 50
Dichlorbenzene, drums	lb.	.07 -	09
Diethylaniline, drums	lb.	.50 -	60
Dimethylaniline, drums	lb.	.41 -	42
Dinitrobenzene, bbl	lb.	19 -	20
Dinitroclorbenzene, bbl	lb.	22 -	.23
Dinitronaphthalene, bbl	lb	.30 -	32
Dinitrophenol, bbl	lb.	35 -	.40
Dinitrotoluene, bbl	lb	.20 -	22
Dip oil, 25%, drums	gal	.25 -	.30
Diphenylamine, bbl	lb.	50 -	52
H-acid, bbl	lb.	.80 -	85
Meta-phenylenediamine, bbl	lb.	95 -	1 00
Michlers ketone, bbl	lb.	3 00 -	3.50
Monochlorbenzene, drums	lb	.08 -	10
Monoethylaniline, drums	lb.	95 -	1 10
Naphthalene, crushed, bbl	lb.	05¼ -	.06
Naphthalene, flake, bbl	lb.	.06¼ -	07
Naphthalene, balls, bbl	lb	07¼ -	08
Naphthionate of soda, bbl	lb.	58 -	.65
Naphthionic acid, crude, bbl	lb.	.60 -	65
Nitrobenzene, drums	lb.	.10 -	.12
Nitro-naphthalene, bbl.	lb.	.30 -	.35
Nitro-toluene, drums	lb.	.15 -	.17
N-W acid, bbl	lb.	1.15 -	1.20
Ortho-amidophenol, kegs	lb.	2 30 -	2 35
Ortho-dichlorbenzene, drums	lb.	.17 -	.20
Ortho-nitrophenol, bbl	lb.	.90 -	.92
Ortho-nitrotoluene, drums	lb.	.10 -	.12
Ortho-toluidine, bbl	lb.	13 -	.15
Para-amidophenol, base, kegs	lb.	1 15 -	1.20
Para-amidophenol, HCl, kegs	lb.	1.20 -	1.25
Para-dichlorbenzene, bbl	lb	.17 -	20
Paranitraniline, bbl	lb.	.74 -	.75
Para-nitrotoluene, bbl	lb.	55 -	.65
Para-phenylenediamine, bbl	lb.	1.45 -	1.50
Para-toluidine, bbl	lb	.90 -	95
Phthalic anhydride, bbl	lb.	35 -	.38
Phenol, U.S P., drums	lb.	45 -	.50
Picric acid, bbl	lb	20 -	.22
Pyridine, dom, drums	gal.	nominal	
Pyridine, imp, drums	gal.	2.30 -	2 50
Resorcinol, tech, kegs.	lb.	1 50 -	1.55
Resorcinol, pure, kegs	lb.	2.00 -	2 10
R-salt, bbl	lb.	.60 -	65
Salicylic acid, tech, bbl	lb.	.40 -	42
Salicylic acid, U S.P., bbl	lb.	.45 -	.47
Solvent naphtha, water-white, drums	gal.	.37 -	.40
Crude, drums	gal.	.22 -	.24
Sulphanilic acid, crude, bbl	lb.	.18 -	.20
Thiocarbanilide, kegs	lb.	.35 -	.38
Toluidine, kegs	lb.	1.20 -	1.30
Toluidine, mixed, kegs	lb.	30 -	.35
Toluene, tank cars	gal.	.35 -	.37
Toluene, drums	gal.	.40 -	.43
Xylidines drums	lb.	.40 -	.45
Xylene, pure, drums	gal.	.45 -	.50
Xylene, com., drums	gal.	.40 -	.42
Xylene, com., tanks	gal.	.30 -	

Naval Stores

Rosin B-D, bbl.	280 lb.	$6.10	...
Rosin E-I, bbl.	280 lb.	6 20	$6 35
Rosin K-N, bbl.	280 lb.	6 50	6 90
Rosin W.G.-W.W., bbl.	280 lb.	7 35	8 05
Wood rosin, bbl.	280 lb.	6 25	
Turpentine, spirits of, bbl.	gal.	1 52	1 53
Wood, steam dist., bbl.	gal	1 35	
Wood, dest. dist, bbl.	gal.	1.25	
Pine tar pitch, bbl	200 lb.		6 00
Tar, kiln burned, bbl.	500 lb.		12 00
Retort tar, bbl	500 lb.		11 00
Rosin oil, first run, bbl.	gal.	43	
Rosin oil, second run, bbl.	gal	47	...
Rosin oil, third run, bbl.	gal	53	
Pine oil, steam dist	gal.	...	90
Pine oil, pure, dest. dist	gal.	...	85
Pine tar oil, ref.	gal	...	46
Pine tar oil, crude, tanks f.o b Jacksonville, Fla	gal	...	35
Pine tar oil, double ref, bbl	gal.	...	75
Pine tar, ref, thin, bbl	gal	...	25
Pinewood creosote, ref, bbl	gal.	...	.52

Vegetable Oils

Castor oil, No 3, bbl.	lb	$.12¾	$ 13
Castor oil, AA, bbl	lb	.13½	.13½
Chinawood oil, bbl.	lb.	18¾	19
Coconut oil, Ceylon, bbl.	lb.	09¼	9¾
Coconut oil, Cochin, bbl.	lb.	.09¾	10
Corn oil, crude, bbl	lb.	.12	12½
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	10	.10
Summer yellow, bbl.	lb.	12	12¼
Winter yellow, bbl.	lb	13	13¼
Linseed oil, raw, car lots, bbl.	gal	98	99
Raw, tank cars (dom)	gal	94	95
Boiled, 5-bbl lots (dom)	gal	1 02	1 04
Olive oil, denatured, bbl.	gal.	1 10	1 15
Palm, Lagos, casks	lb	08¼	08½
Palm kernel, bbl	lb.	08¾	09
Peanut oil, crude, tanks (mill)	lb	13½	13¾
Peanut oil, refined, bbl.	lb	16½	16¾
Rapeseed oil, refined, bbl	gal.	85	86
Rapeseed oil, blown, bbl	gal.	90	91
Soya bean (Manchurian), bbl	lb	12	
Tank, f o b Pacific coast	lb	10⅛	

Fish Oils

Menhaden, light pressed, bbl	gal.	$0 68	70
White bleached, bbl	gal.	72	74
Blown, bbl	gal.	76	78
Whale No 1 crude, tanks, coast	lb	06	06½

Dye & Tanning Materials

Divi-divi, bags	ton	$38 00	$39 00
Fustic, sticks	ton	30 00	35 00
Fustic, chips, bags	lb	04	05
Logwood, sticks	ton	28 00	30 00
Logwood, chips, bags	lb	02½	03½
Sumac, leaves, Sicily, bags	ton	65 00	
Sumac, ground, bags	ton	55 00	60 00
Sumac, domestic, bags	ton	35 00	
Tapioca flour, bags	lb.	.03½	.05

EXTRACTS

Archil, conc, bbl.	lb.	$0 17	$0 18
Chestnut, 25% tannin, tanks	lb	02	03
Divi-divi, 25% tannin, bbl	lb	.04	05
Fustic, crystals, bbl	lb	20	22
Fustic, liquid, 42°, bbl	lb.	08	09
Gambier, liq, 25% tannin, bbl.	lb.	.08	09
Hematine crys, bbl	lb.	.14	18
Hemlock, 25% tannin, bbl.	lb.	.04	05
Hypernic, solid, drums	lb.	.24	26
Hypernic, liquid, 51°, bbl.	lb.	.14	17
Logwood, crys., bbl	lb.	.19	20
Logwood, liq, 51°, bbl.	lb.	.09	10
Quebracho, solid, 65% tannin, bbl	lb.	.04¾	.05
Sumac, dom., 51°, bbl.	lb.	.06½	.07

Waxes

Bayberry, bbl	lb.	$0.28	$0 30
Beeswax, refined, dark, bags	lb.	30	32
Beeswax, refined, light, bags	lb.	34	35
Beeswax, pure white, cases.	lb.	.40	41
Candelilla, bags	lb.	27	29
Carnauba, No 1, bags.	lb.	40	41
No. 2, North Country, bags	lb.	.23½	24
No 3, North Country, bags	lb	.19	19½
Japan, cases	lb.	.15	15½
Montan, crude, bags	lb.	.03¾	.04
Paraffine, crude, match, 105-110 m p	lb.	.04	.04½
Crude, scale 124-126 m.p., bags	lb.	.02½	02¾
Ref., 118-120 m p, bags	lb.	.03½	03¾
Ref., 125 m p, bags	lb.	.03½	03¾
Ref, 128-130 m p., bags	lb.	.04	04¼
Ref, 133-135 m.p, bags	lb.	.04½	.04¾
Ref, 135-137 m p, bags.	lb.	.05	.05½
Stearic acid, sgle pressed, bags	lb.	.10	.10½
Double pressed, bags	lb.	.10½	10¾
Triple pressed, bags	lb.	.11	11½

Fertilizers

Ammonium sulphate, bulk, f.o b. works	100 lb.	$3 20	$3 25
F.a.s. double bags	100 lb	3 85	3.95
Blood, dried, bulk	unit	4.60	
Bone, raw, 3 and 50, ground	ton	30 00	35 00
Fish scrap, dom., dried, wks.	unit	5 00	5.10
Nitrate of soda, bags.	100 lb.	2.60	2.65
Tankage, high grade, f.o.b. Chicago	unit	4.70	4.80

Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$4 00	$4 50
Tennessee, 78-80%	ton	8 00	8 25
Potassium muriate, 80%, bags	ton	35 00	36 00
Potassium sulphate, bags	unit	1 00	

Crude Rubber

Para—Upriver fine	lb.	$0 33	$0 33½
Upriver coarse	lb	27½	28
Upriver caucho ball	lb	29½	30
Plantation—First latex crepe	lb	36¼	36½
Ribbed smoked sheets	lb.	36¼	36½
Brown crepe, thin, clean	lb	31	32
Amber crepe No 1.	lb	31	32

Miscellaneous Materials

Asbestos, crude No 1, f o b, Quebec	sh. ton	$450 00	$550 00
Asbestos, shingle, f o b, Quebec	sh ton	60 00	80 00
Asbestos, cement, f o b, Quebec	sh ton	15.00	17 00
Barytes, grd, white, f o b. mills, bbl	net ton	16.00	20 00
Barytes, grd, off-color, f o b mills bulk.	net ton	13.00	15 00
Barytes, floated, f o b St Louis, bbl	net ton	24 00	28 00
Barytes, crude f o b mines, bulk	net ton	9 00	9 25
Casein, bbl, tech	lb	11	12
China clay (kaolin) crude, f o b Ga	net ton	7 00	9 00
Washed, f o b Ga	net ton	8 00	9 00
Powd, f o b Ga	net ton	13 00	20 00
Crude f o b Va	net ton	8 00	12 00
Ground, f o b Va	net ton	13 00	20 00
Imp, lump, bulk	net ton	15 00	20 00
Imp, powd	net ton	45 00	50 00
Feldspar, No 1 pottery	long ton	6 00	7 00
No 2 pottery	long ton	5 00	5 50
No 1 soap	long ton	7 00	7 50
No 1 Canadian, f o b mill	long ton	25 00	27 00
Graphite, Ceylon, lump, first quality, bbl	lb	06	.06½
Ceylon, chip, bbl	lb	.05	05½
High grade amorphous crude	ton	35 00	50.00
Gum arabic, amber, sorts, bags	lb.	15	16
Gum tragacanth, sorts, bags	lb	50	60
No 1, bags	lb	1 75	1 80
Kieselguhr, f o b. Cal	ton	40 00	42 00
F o b N Y	ton	50 00	55 00
Magnesite, crude, f o b Cal	ton	14 00	15 00
Pumice stone, imp, casks	lb	03	05½
Dom, lump, bbl	lb	05	05½
Dom, ground, bbl	lb.	06	07
Shellac, orange fine, bags	lb	82	83
Orange superfine, bags.	lb.	84	85
A C garnet, bags.	lb.	79	80
T N, bags	lb.	80	81
Silica, glass sand, f o b Ind	ton	2 00	2 50
Silica, sand blast, f.o b Ind	ton	2 50	5 00
Silica, amorphous, 250-mesh, f o b Ill	ton	17 00	17 50
Silica, bldg sand, f o b Pa	ton	2 00	2 75
Soapstone, coarse, f.o b. Vt, bags	ton	7 00	8 00
Talc, 200 mesh, f.o b, Vt, bags	ton	6 50	9 00
Talc, 200 mesh, f o b. Ga., bags	ton	7 00	9 00
Talc, 200 mesh, f o b. Los Angeles, bags.	ton	16 00	20.00

Refractories

Bauxite brick, 56% Al_2O_3, f o b. Pittsburgh	ton	$45–50
Chrome brick, f o b Eastern shipping points	ton	50–52
Chrome cement, 40-50% Cr_2O_3	ton	23–27
40-45% Cr_2O_3, sacks, f o b. Eastern shipping points	ton	23 00
Fireclay brick, 1st quality, 9-in shapes, f o b Ky wks	1,000	40–46
2nd quality, 9-in shapes, f o b wks	1,000	36–41
Magnesite brick, 9-in. straight (f o b wks)	ton	65–68
9-in arches, wedges and keys	ton	80–85
Scraps and splits	ton	85
Silica brick, 9-in sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9-in sizes, f o b. Birmingham district	1,000	48–50
F o b Mt Union, Pa	1,000	42–44
Silicon carbide refract brick, 9-in.	1,000	1,100 00

Ferro-Alloys

Ferrotitanium, 15-18% f o b. Niagara Falls, N Y	ton	$200 00	$225 00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11½	.11½
4-6% C.	lb.	.12	.13
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	110.00	112 00
Spiegeleisen, 19-21% Mn.	gr. ton	35.00	37 00
Ferromolybdenum, 50-60% Mo, per lb Mo	lb.	1.90	2 15
Ferrosilicon, 10-15%	gr. ton	38.00	40.00
50%	gr. ton	80.00	85 00
75%	gr. ton	150.00	160.00
Ferrotungsten, 70-80%, per lb. of W.	lb.	$0.85	$0.90
Ferro-uranium, 35-50% of U per lb of U	lb.	6.00	....
Ferrovanadium, 30-40%, per lb of V	lb.	3.75	4.00

Ores and Semi-finished Products

Bauxite, dom crushed, dried, f o b. shipping points	ton	$6.50	$8.75
Chrome ore, Calif concentrates, 50% min Cr_2O_3	ton	22 00	23.00
C i f Atlantic seaboard	ton	18.50	19.00
Coke, fdry, f o b ovens	ton	8 25	8.50
Coke, furnace, f o b ovens	ton	7 00	7.25
Fluorspar, gravel, f o b. mines' Illinois	ton	21.50	....
Ilmenite, 52% TiO_2	lb.	.01½	.01½
Manganese ore, 50% Mn, c i f Atlantic seaport	unit	.33	....
Manganese ore, chemical (MnO_2)	ton	75.00	80.00
Molybdenite, 85% MoS_2, per lb MoS_2, N. Y	lb.	.65	.70
Monazite, per unit of ThO_2, c i f, Atl seaport	lb.	.06	.08
Pyrites, Span, fines, c i f. Atl seaport	unit	.11½	.12
Pyrites, Span, furnace size, c i f. Atl seaport	unit	.11½	.12
Pyrites, dom fines, f.o b mines, Ga	unit	.12	
Rutile, 95% TiO_2	lb.	.12	....
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.50	8.75
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	8.00	8.25
Uranium ore (carnotite) per lb of U_3O_8	lb.	3.50	3.75
Uranium oxide, 96% per lb. U_3O_8	lb.	2.25	2.50
Vanadium pentoxide, 99%	lb.	12.00	14 00
Vanadium ore, per lb V_2O_5	lb.	1.00	...
Zircon, washed, iron free, f.o.b Pablo, Fla	lb.	.04½	.13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	16 75
Aluminum, 98 to 99%	24.00
Antimony, wholesale, Chinese and Japanese	7 65–7.75
Nickel, virgin metal	25.00–27.00
Nickel, ingot and shot	29.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	38.00
Monel metal, sheet bars	45 00
Tin, 5-ton lots, Straits	46.75
Lead, New York, spot	8.15
Lead, E St Louis, spot	8.20
Zinc, spot, New York	7.90–8.00
Zinc, spot, E St Louis	7.60–7.70

OTHER METALS

Silver (commercial)	oz.	$0 66⅛
Cadmium	lb.	1.15
Bismuth (500 lb lots)	lb	2.55
Cobalt	lb.	2 65@2.85
Magnesium, ingots, 99%	lb.	1 00@1.05
Platinum	oz.	110.00
Iridium	oz.	260 00@275 00
Palladium	oz.	79 00
Mercury	75 lb.	70.00

INISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.75
Copper bottoms	30.75
Copper rods	20.50
High brass wire	19.50
High brass rods	17.00
Low brass wire	21.10
Low brass rods	22.00
Brazed brass tubing	24 25
Brazed bronze tubing	29.00
Seamless copper tubing	25.25
Seamless high brass tubing	23.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11 30@11.50
Copper, heavy and wire	11 25@11 50
Copper, light and bottoms	9.25@ 9.5
Lead, heavy	5 75@ 6 0
Lead, tea	3.50@ 3.7
Brass, heavy	6.25@ 6 4
Brass, light	5.35@ 5.7
No 1 yellow brass turnings	6.30@ 6 5
Zinc	3.50@ 4.0

Structural Material

The following base prices per 100 lb. are fo structural shapes 3 in. by ¼ in and larger, and plate ¼ in. and heavier, from jobbers' warehouses in th cities named:

	New York	Chicag
Structural shapes	$3.29	$3.14
Soft steel bars	3.19	3.04
Soft steel bar shapes	3.19	3.04
Soft steel bands	3.29	3 1
Plates, ¼ to 1 in. thick	3.29	3 1

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

GADSDEN—The Agricola Pipe Co., recently organized with a capital of $250,000 operating a plant at Anniston, Ala., for the manufacture of cast-iron pipe, has acquired the Campbell Co., with foundry on North 3rd St. The new owner will take possession of the property at once and purposes to make a number of improvements. It will be run for the production of cast-iron soil pipe. Otto Agricola is president, and Fred T. Agricola, secretary and treasurer.

ATMORE—The Cooper & Bannon Co., Oak Grove, Ala., has acquired a large tract of local property, heretofore held by the Pine Barren Mill Co., and plans for the establishment of a new plant for the production of turpentine.

California

SAN LUIS OBISPO—The United States Refractories Co. is planning for enlargements in its plant to cost about $60,000, including the construction of two new kilns. The company specializes in the manufacture of insulated brick, insulation powders, fire brick, etc. R. W. Hull, Sr., and J. H. Throop are heads.

GAVIOTA—Fire, Feb. 17, destroyed a large portion of the storage and distributing plant of the Associated Oil Co., with loss reported in excess of $750,000, including equipment. It is planned to rebuild. Headquarters of the company are in the Sharon Bldg., San Francisco.

MARYSVILLE—The Marysville Brick Co. has plans under way for additions to its plant to double approximately the present capacity, providing an annual output of close to 4,000,000 bricks. New electric-operated machinery will be installed. L. A. Williams is president.

LOS ANGELES—The Southwestern Shipbuilding Co., San Pedro, Los Angeles Harbor, has plans in progress for the construction of a new oil storage and distributing plant for company service, estimated to cost $300,000, with equipment.

OAKLAND—A porcelain and metal-enameling plant will be installed at the new local factory of the Koken Companies, Texas St., St. Louis, Mo., now in course of construction. The company manufactures barber chairs and kindred equipment. The new works are expected to be ready for service in about 60 days. Walter F. Koken is president.

Florida

HASTINGS—The Truman Fertilizer Co. has plans in progress for the erection of a new 1-story building at its plant.

Georgia

BUFORD—The Bona Allen Co., Inc., manufacturer of leather products, has work under way on extensions at its tanning plant for considerable increase in production, to include the installation of 200 new tanning vats and auxiliary equipment. Additions will also be made in the power department at the plant. Lockwood, Greene & Co., Atlanta, Ga., are engineers.

Illinois

CHICAGO—The Inland Steel Co., 38 South Dearborn St., has plans under consideration for enlargements in its works at Indiana Harbor, Ind., to include new open-hearth furnaces, finishing mills and other structures. It is purposed to increase the capacity about one-fourth, with heavier increase in the department devoted to the production of different grades of light steel. A preferred stock issue is being arranged to provide funds for the expansion.

CARLYLE—The Common Council has completed plans for the installation of a new filtration and purification plant at the municipal waterworks, and a call for bids on general contract has been issued. Dawson & Walraven, Springfield, Ill., are engineers.

CHICAGO—The Marquette Cement Co., 140 South Dearborn St., is taking bids on a general contract for the erection of a new 1-story building, 175x500 ft. at Elston and Redfield Aves., estimated to cost about $250,000. L. E. Ritter, Room 1707, 140 South Dearborn St., is engineer.

Indiana

JEFFERSONVILLE—The Interstate Public Service Co. will make extensions in its local artificial gas plant to increase the capacity about 300,000 cu.ft. per day. A new water-gas set and auxiliary equipment will be installed. It is purposed to have the work completed early in June.

Kansas

EUREKA—The Kansas City Refining Co., 1st Ave., Kansas City, Mo., is considering tentative plans for the construction of a new oil-refining plant in the vicinity of Eureka, estimated to cost close to $200,000. The project will be held in temporary abeyance until full field development for crude petroleum has been attained. E. W. Goebel is in charge.

Kentucky

CARTER—The Ashland Limestone Co. has perfected arrangements for the installation of a new crushing plant, with auxiliary operating departments, to develop a capacity of 3,000 tons per day. The plant will be located at Rock Crusher, near Carter. M. E. S. Posey is general manager.

Louisiana

BOGALUSA—The Great Southern Lumber Co., operating a local saw and lumber mill, will commence the construction of a branch works for the production of byproducts, including turpentine, pine oils and resin. Two processes of operation will be installed, covering the dry kiln and steaming method, and special treatment of resin timber picked from the green chain, respectively. It is purposed to have the branch plant ready for service in about 4 months.

Maryland

BALTIMORE—The Fourlock Tile Co., Candler Bldg., Market Place and Pratt St., has acquired a building formerly occupied by the General Minerals Co., vicinity of the Union Stock Yards, for a new plant for the manufacture of special interlocking concrete tile. Machinery and operating equipment will be installed at once to develop an initial capacity of about 1,000 tile daily; this output will be increased early in the spring. Tentative plans are under consideration for the establishment of branch plants at Hagerstown, Cumberland and Easton, Md. Frank H. Carter is secretary. The company was organized recently with a capital of $100,000.

Massachusetts

CHICOPEE—The Moore Drop Forge Co., Walter St., Springfield, Mass., has awarded a contract to Adams & Ruxton, Springfield, for the erection of a new 1-story building at its Chicopee Works, 75x100 ft., to be equipped as a heat-treating department. It is estimated to cost close to $70,000, including machinery. McClintock & Craig, 33 Lyman St., Springfield, are engineers.

BOSTON—The Crescent Tanning Co. has leased a floor in the building at 105 South St., for a new works. Immediate operations are planned.

Michigan

GRAND RAPIDS—The Grand Rapids Glass Co. has purchased property, 125x150 ft., at Fulton St. and Front Ave., for the erection of a new plant. Plans will be prepared at an early date.

JACKSON—The Grand Rapids Paint & Varnish Co. has plans under consideration for the erection of an addition to the local plant of the Central City Paint & Varnish Co., recently acquired. A project is also being discussed covering the construction of an entirely new works to replace the present factory, which is of old type. Alfred Hansen is resident manager.

MUSKEGON—The Brunswick-Balke-Collender Co., 629 South Wabash Ave., Chicago, Ill., has tentative plans under consideration for the rebuilding of the portion of its celluloid plant at Muskegon, recently destroyed by fire with loss estimated at $200,000, including machinery.

DETROIT—Roehm & Davison, 6440-52 Mack Ave., manufacturers of steel products, have awarded a general contract to Everett Winters, Book Bldg., for the erection of a 2-story plant addition at Mack and Beaufaite Aves., 150x152 ft., estimated to cost approximately $100,000, with equipment.

PLAINWELL—The Angle Steel Stool Co. has tentative plans under consideration for the erection of an addition to its plant.

Mississippi

MOSS POINT—The Southern Paper Co. has awarded a general contract to George J. Glover, Whitney Central Bldg., New Orleans, La., for the construction of its proposed plant additions, covering an area of about 75x800 ft., varying from 1 story to 5 stories high. The extensions will double approximately the present plant output and are estimated to cost close to $1,500,000 with machinery. A power plant will also be built. The work will be placed under way at once. George F. Hardy, 309 Broadway, New York, N. Y., is engineer.

Nevada

GOLDFIELD—The Bellehelen Merger Mines Co. has construction under way on a new mill at its local properties, to have a rating of 100 tons a day. It is estimated to cost approximately $125,000. The company is also arranging for extensive development work to include the installation of additional equipment. The Wellington Mines Co., Kansas City, Mo., is interested in the Bellehelen company.

New Jersey

STOCKTON—The Tillinghast Rubber Mfg. Co., manufacturer of rubber tubing and specialties, is planning for the rebuilding of the portion of its local mill destroyed by fire, Feb. 16, with loss approximating $100,000, including machinery. The equipment installation was valued in excess of $30,000. Walker Smith is president, and William J. McLaughlin, secretary.

BELLEVILLE—Daniel H. Higgins, Edgewater, N. J., manufacturer of dyes and kindred chemical products, has taken title to the former plant of the Thomson Machine Co., Main St., Belleville, consisting of three factory buildings on a half-acre tract of land, with aggregate of 20,000 sq.ft. of floor space. Plans are under way for the establishment of a new dye and chemical works at this location.

BLOOMSBURY—The Bloomsbury Graphite Co. has preliminary plans under consideration for the rebuilding of the portion of its plant destroyed by fire, Feb. 20, with loss estimated at $40,000, including equipment. The company manufactures graphite products, foundry facing, etc.

NEWARK—The Hamilton Tanning Co. has leased property at Wright St. and Ave. A for a term of years, comprising a 1-story building 125 ft. long, for the establishment of a new leather tannery. Immediate possession will be taken.

CAMDEN—Fire, Feb. 20, destroyed a portion of the chemical plant of the Mechling Brothers Mfg. Co., Line St. and Cooper River, South Camden. It originated in the sulphur department. An official estimate of the loss has not been announced. Plans are under consideration for immediate rebuilding.

New Mexico

SANTA FE—The Navajo Gasoline Production Co. is planning for the construction of gasoline extraction plants in the San Juan basin district.

New York

NEW YORK—The Consolidated Products Co., Inc., 15 Park Row, New York, has inquiries out for equipment for installation in a chemical plant, including disintegrators, filter presses, driers, evaporators, grinding machinery and kindred machinery.

ROME—The Rome Brass & Copper Co. has taken bids on a general contract for the erection of a new building at its Chicago, Ill., works, to be 1-story and basement,

50x180 ft., estimated to cost approximately $50,000. M. K. Williams is in charge.

Ohio

SEBRING—The French China Co. is planning for the early erection of an addition to its plant, including the installation of two new pottery kilns.

CAMBRIDGE—The Cambridge Steel Products Co., recently organized with a capital of $100,000, will take over and operate the local plant of the Cambridge Steel Co. Possession will be taken at once. Extensions and improvements are contemplated.

SEBRING—The Saxon China Co. has preliminary plans under consideration for enlargements in its plant, to include the construction of three new kilns. It is purposed to increase the output about one-third.

CAMBRIDGE—Interests which recently acquired the plant of the Guernseyware China Co. are perfecting arrangements for the early resumption of operations for the manufacture of a line of hotel chinaware. Improvements will be made in the plant and equipment for this service.

Oklahoma

TULSA—The Union Carbide Co., 30 East 42nd St., New York, N. Y., manufacturer of carbide, acetylene, commercial oxygen and kindred products, is said to be planning for the erection of a new plant in the vicinity of Tulsa, estimated to cost close to $350,000, with machinery.

Pennsylvania

READING—The Pennsylvania Electric Steel Co. has acquired the local plant of the Driscoll-Rees Steel Co. and plans to equip and utilize the property for the production of high-grade tool steel, to be produced by means of a new process. It is purposed to have the plant in full operation at an early date.

CHAMBERSBURG—The Chambersburg Gas Co. will make improvements and extensions in its artificial gas plant, with additional equipment installation estimated to cost about $60,000. Contracts are being let.

PITTSBURGH—The Pennsylvania Paper Stock Co., 516-26 1st Ave., has tentative plans under consideration for the rebuilding of the portion of its plant, destroyed by fire, Feb. 18, with loss estimated at close to $75,000.

PHILADELPHIA—Fire, Feb. 17, destroyed a portion of the acid works of the Wilson-Martin Co., Snyder Ave. and Swanson St., with loss estimated at $12,000. It will be rebuilt.

PHILADELPHIA—The Precision Grinding Wheel Co., 8301 Torresdale Ave., has filed plans for the erection of a new 1-story building at its plant.

CONSHOHOCKEN—A 1-story foundry, 125x195 ft., will be erected by the Montgomery Foundry & Fittings Co., located at Washington and Cherry Sts., for the production of iron and other metal castings. Work will be commenced early in April.

LEBANON—The Lebanon Iron Co. is planning for the immediate rebuilding of its puddle mill and adjoining buildings, destroyed by fire, Feb. 18, with loss estimated at close to $150,000, including ten furnaces and auxiliary equipment. John D. Brown is general manager at the plant.

BATH—The Pocono Foundry Co. has tentative plans under consideration for extensions and improvements in its plant.

Tennessee

CHATTANOOGA—The Southern Sheet Steel Co., recently organized with a capital of $1,100,000, is perfecting plans for the erection of its proposed new mills at Glendale, Tenn., where a site has been secured on the Tennessee River. The initial works will comprise two open-hearth furnaces, each with rated capacity of 60,000 tons per annum; a number of rolling mills, with total annual output of 55,000 tons and other miscellaneous mill and sheet mill buildings, with power house. The plant is estimated to cost close to $80,000. W. J. Lynch is vice-president and general manager.

Texas

AUSTIN—A chemical laboratory will be installed in the new biology building to be constructed on the campus, University of Texas. The structure will be 3-story, 66x191 ft., and will cost in excess of $250,000. Herbert M. Greene, Dallas, Tex., is architect.

Virginia

SUFFOLK—The American Brick Corp. will commence immediately the erection of a new plant on local site, to be equipped for an initial capacity of 25,000 to 30,000 bricks per day. It is estimated to cost approximately $35,000. R. L. Jacobs is president; and Lewis G. Brothers, secretary.

NORFOLK—Adolph Segal, Philadelphia, Pa., sugar operator, is perfecting plans for the construction and operation of a new sugar refinery on site secured at Norfolk. It will consist of a number of buildings with power house, and is estimated to cost in excess of $3,000,000, with machinery. It is expected to develop an output of close to 3,000 bbl. of refined sugar daily. Charles B. Hughes, president of the Hughes-Ellis-Howell Corp., 403 Boush St., Norfolk, is interested in the project.

NORTON—L. A. Ballenby, Norton, is organizing a company to construct and operate a local plant for the manufacture of brick and tile products. Work will soon be commenced.

Washington

NEWPORT—The Pacific Fir Co. has plans under way for the construction of a new creosoting and wood-treatment plant on local site, estimated to cost approximately $25,000.

SEATTLE—The Builders Brick Co., 3700 9th St., South, will make improvements in its plant, including the construction of a new kiln.

VANCOUVER—The Columbia River Paper Mills Co. is perfecting plans for the construction of the initial unit of its proposed new mill, estimated to cost in excess of $200,000, with machinery. F. W. Leadbeater is president.

Wisconsin

NEENAH—The Valley Paper Mills, Inc., Wisconsin Ave., will take bids about March 15 for the erection of the superstructure of its proposed new mill in the Blair Springs district, foundations for which have been laid. The plant will be 2- and 3-story, 80x670 ft., and is estimated to cost $750,000, including machinery. Cahill & Douglas, 217 West Water St., Milwaukee, are mechanical engineers for the work. G. W. Burnside is head.

Industrial Developments

RUBBER—The Kelly-Springfield Tire Co. is operating at full capacity at its plants at Akron, O., and Cumberland, Md., and will maintain this schedule for an indefinite period. The last noted mill is now giving employment to about 2,500 persons, and plans are under way for early expansion. Effective Feb. 21, the wages at the mill were advanced 10 per cent, affecting all hourly rates and piece-work production.

The Atlas Automobile Tire Co., Bethlehem, Pa., is running at maximum capacity, and in order to handle heavy incoming business plans are being arranged for extensions in the mill facilities.

The Mason Tire & Rubber Co., Akron, O., is operating at full capacity, on a basis of about 6,000 tires per day. Full production is also being maintained at the branch mill at Bedford, O., formerly occupied by the Owen Tire & Rubber Co.

CERAMIC—The Verdigris Valley Vitrified Brick Co., Independence, Kan., recently acquired by new interests, is planning for the early resumption of production at the plant, now closed down for machinery repairs. W. E. Bullis, Topeka, Kan.; and M. B. Gilkerson, Wichita, Kan., head the new organization.

General ware plants in the vicinity of East Liverpool, O., are running full, with incoming orders in excess of immediate production.

The Independent Brick Co., Trenton, N. J., is maintaining operations at regular capacity at three of its four plants. It is expected to continue on this basis for an indefinite period. Charles T. Dunham has been re-elected secretary, treasurer and general manager of the company.

The Crouse Clay Products Co., Akron, O., is maintaining full production at its plant and purposes to continue on this status for some time to come. The company has recently installed new machinery and equipment to provide for an advance of about 30 per cent in capacity.

The D. E. McNicol Pottery Co., Clarksburg, W. Va., manufacturer of Rockingham and yellow ware, is operating at full capacity with regular working force. Orders on hand insure this schedule for some time to come.

The Glenrock Brick Co., Glenrock, Wyo., is planning for the resumption of full-time production at its plant as soon as weather conditions permit, within the next 3 or 4 weeks. Continuous operations will be then scheduled for an indefinite period.

LEATHER—The Standard Kid Co., Wilmington, Del., is maintaining close to normal production at its local tannery, and is now running on a basis of about 850 dozen skins per day.

The William Amer Co., Philadelphia, Pa., is concentrating production on novelty leather at its local glazed kid tannery, with employment of regular working force. With the advent of spring, it is expected to revert to the manufacture of staples, with increased operations.

The American Hide & Leather Co., New York, N. Y., is advancing production at its different New England and Middle West tanneries, with increased working forces. For greater production in the New England district, the company has acquired the modern tannery at Peabody, Mass., formerly owned and operated by H. S. & M. W. Snyder, Inc., and will take possession early in April. It aggregates approximately 250,000 sq.ft. of floor area, and has facilities for an output of 1,500 dozen skins per day. The new owner expects to inaugurate production at the plant at an early date, with normal working quota.

PAPER—The International Paper Co., 30 Broad St., New York, N. Y., has established a capacity schedule at all of its newsprint mills for the first time in 2 years, and will continue on this basis for an indefinite period. Large working forces are being employed.

The Kennedy Car Liner & Bag Co., Shelbyville, Ind., is adopting a night shift at its paper products plant at Greensburg, Ind., using a portion of the working force heretofore employed at the Shelbyville mill, recently destroyed by fire and now being rebuilt. The extra working schedule will be continued for some time to come.

The Backus & Brooks Co., Kenora, Man., is planning to commence operations at its new local pulp mill, recently completed at a cost said to be close to $2,000,000. The plant has a rated capacity of 50 tons of material per day and it is purposed to develop operations at maximum, with full working force.

OIL—The Foco Oil Co., Franklin, Pa., recently organized to take over and operate the local refinery of the Lakeside Refining Co., is arranging for immediate production at the plant, with full working force.

Oil refineries in Western Pennsylvania are advancing production and adding to their working quotas.

The Sinclair Consolidated Oil Corp., 45 Nassau St., New York, N. Y., is operating at its Oklahoma, Kansas and other midwest plants on a production basis of about 35,000 bbl. per day. The Sinclair Crude Oil Producing Co., a subsidiary organization, has stock on hand at the present time totaling 30,000,000 bbl. of crude oil to be run through the refineries.

IRON AND STEEL—The Carbon Iron & Steel Co., Parryville, Pa., has resumed operations at its furnaces, which have been idle for more than 24 months past. Employment will be given to about 100 men.

Witherbee, Sherman & Co., New York, N. Y., have blown in the small blast furnace at their plant at Port Henry, N. Y., following relining and repairs, and purpose to keep the unit in service for an indefinite period. A larger furnace at the plant, now in course of construction, will be lighted as soon as completed.

Iron and steel plants in the Youngstown, O., district have advanced production to a point of about 90 per cent of capacity, the highest record for a number of months past.

The Gulf States Steel Co., Birmingham, Ala., is now operating five of its six blast furnaces, and will continue at maximum for an indefinite period.

The Sharon Steel Hoop Co., Sharon, Pa., is running at 100 per cent capacity at its local mills for the first time in 3 years.

The Bethlehem Steel Co. has resumed operations at the puddle mill at its Central Works, Lebanon, Pa., after an idle period of a number of months. The plant will be run on a double turn, and is said to have sufficient orders on hand to insure continuance on this basis for 6 to 8 months to come.

A total of 110 blast furnaces devoted to the production of pig iron are now in operation in the Pittsburgh, Pa., district. Practically all of the stacks that are idle are those devoted to merchant iron.

MISCELLANEOUS—The Carnegie Steel Co., is making ready to resume operations at its coke plant at the Farrell, Pa., works, which has been idle since March, 1921. Production will also be inaugurated at the benzol

and other byproduct plant units. Employment will be given to about 600 men.

The Ruggles & Raedemaker Co., Mainstee, Mich., operating salt properties, has taken over the plant and business of the Petit Salt Co., Milwaukee, Wis. The combined production makes the purchasing company one of the largest salt producers in the country. Full operations with regular working forces are planned.

The Ross-Meehan Foundry Co., Chattanooga, Tenn., specializing in the production of steel castings, is running at maximum capacity with full working force and will continue this schedule for an indefinite period.

Heavy production is in progress at the different lead and zinc properties in the Northeastern Oklahoma section. Practically every plant that can be operated profitably is on the full-time producing list.

New Companies

The Bond Chemist Shop, Inc., 338 Asylum St., Hartford, Conn., has been incorporated with a capital of $50,000, to manufacture chemicals and chemical compounds. George L. Rappoport is president, A. G. Bush treasurer, and George L. Day, vice-president and secretary.

The Tucker Chemical Mfg. Co., Paducah, Ky., has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are T. A. Miller, C. E. Pace and W. C. Richman, all of Paducah.

The Goldman Paper & Paper Stock Co., Philadelphia, Pa., has been incorporated with a capital of $250,000, to manufacture paper products. Harry Goldman, 320, Turner St., is treasurer.

The Camden Glass Works, Inc., Camden, N. J., has been incorporated with a capital of $10,000, to manufacture glass products. The incorporators are Harry Rosenthal, 105 Arch St., Camden, M. A. Mason and M. A. Maguire. The first noted represents the company.

The Al-Sano Chemical Products Co., 29 South La Salle St., Chicago, Ill., has been incorporated with a capital of $300,000 to manufacture chemicals and chemical byproducts. The incorporators are E. S. Fisher, Fern Warren and L. E. Sweitzer.

The King Tire & Rubber Co., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated with a capital of $1,[illegible],000, to manufacture tires and other rubber products.

The Star Producing Co., Albany, N. Y., has been incorporated with a capital of $200,000, to manufacture petroleum products. The incorporators are W. H. Link and T. L. Hunt, Albany. The company is represented by W. M. Miller, attorney, Schenectady, N. Y.

The Chester Brick Co., Chester, Pa., has been incorporated with a capital of $50,000 to manufacture brick, tile and other burned clay products. Edward C. Burton, Chester, is treasurer.

The United States Chemical Corp., Boston, Mass., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. Thomas L. Thistle is president and Oliver E. Brush, 1066 Commonwealth Ave., Boston, treasurer.

The Leeds Concrete Products Co., Leeds, Ala., has been chartered under state laws to establish and operate a local plant for the manufacture of concrete brick, pipe and kindred products. H. M. Judge, Leeds, is president.

The Columbia Products Corp., Newark, N. J., has been incorporated with a capital of $50,000 to manufacture asbestos products. The incorporators are R. J. and Joseph Faatz, and Arthur W. Palmer, 5 Merchant Place, Newark. The last noted represents the company.

The Monroe Board & Lining Co., Monroe, Mich., has been incorporated with a capital of $150,000, to manufacture paper products. The incorporators are William G. Gutmann, Fred J. Motz and J. Douglas Miller, 427 West Elm Ave., Monroe. The last noted represents the company.

The Hi-Power Co. of New Jersey, Inc., Hoboken, has been incorporated with a capital of $30,000, to manufacture battery fluids, chemical products, etc. The incorporators are J. D. and H. E. Pierson, and Rudolph Schroeder, 81 Washington St., Hoboken. The last noted represents the company.

The Calumet Castings Corp., 11417 South Michigan Ave., Chicago, Ill., has been incorporated with a nominal capital of $5,000 to manufacture iron and other metal castings. The incorporators are Julius C. Greenbaum, William S. Newburger and R. Wagman.

The Lubbock Cotton Oil Co., Lubbock, Tex., has been incorporated with a capital of $150,000, to manufacture cotton oil products. The incorporators are J. W. Simmons, Jr., F. J. Phillips and H. M. Simmons, all of Lubbock.

The MacLeod Foundry Co., Detroit, Mich., has been chartered under state laws to manufacture iron and other metal castings. The incorporators are Casper Brown and Malcolm MacLeod, 1128 Marlborough Ave., Detroit.

Talens & Son, Inc., Newark, N. J., has been incorporated with a capital of $50,000, to manufacture paints, varnishes, etc. The incorporators are Hilbrand Talens, W. Howard Demarest and William M. Bosman, 985 Springfield Ave., Newark. The last noted represents the company.

The Bement Oil Co., Terre Haute, Ind., has been incorporated with a capital of $250,000, to manufacture petroleum products. The incorporators are A. B. Bement, H. E. Rogers and C. A. Morrison, all of Terre Haute.

The Oxygol Corp., New York, N. Y., care of Briesen & Schrenk, 50 Church St., New York, representatives, has been incorporated with a capital of $100,000, to manufacture chemical products. The incorporators are S. J. Bohannon, B. Brehm and T. McErlean.

The R. & K. Glass Co., Wellsburg, W. Va., has been incorporated with a capital of $25,000, to manufacture glass products. The incorporators are W. D. Shields and A. J. Rowing, both of Wellsburg, and H. E. Kightlinger, Beech Bottom, W. Va.

The American Chemical Products Co., 31 New St., Newark, N. J., has filed notice of organization to manufacture and deal in chemical and oil products. The company is headed by J. William O'Connor.

The Birmingham Glass Mfg. Co., 29 South La Salle St., Chicago, Ill., has been incorporated with a capital of $250,000, to manufacture glass products. The incorporators are Harry C. Bryson, Richard T. Robb and E. R. Owen.

The Bacon Hill Brick Co., Elkton, Md., has been incorporated with a capital of $50,000, to manufacture brick, tile and other burned clay products. The incorporators are John Mattiussi and James F. Evans, both of Elkton.

The Monterey Bay Portland Cement Co., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $3,000,000, to manufacture portland cement.

The Hopewell Color & Chemical Co., Hopewell, N. J., has been incorporated with a capital of $50,000, to manufacture chemicals, colors and affiliated products. The incorporators are Peter M. Horn, Edward and W. Herbert Jones, all of Hopewell. Edward Jones, Hopewell, is the registered agent for the company.

The Indiana Sun Rise Oil Co., Patricksburg, Ind., has been incorporated with a capital of $50,000, to manufacture petroleum products. The incorporators are J. M. Henderson, N. B. Love and James Andrew, all of Patricksburg.

The Stradford Mfg. Co., Philadelphia, Pa., care of the Corporation Guarantee & Trust Co., Land Title Bldg., representative, has been incorporated under Delaware laws with capital of $1,250,000, to manufacture chemicals and chemical byproducts.

Capital Increases, etc.

The Northern Indiana Brass Co., Elkhart, Ind., has filed notice of increase in capital from $10,000 to $100,000 for proposed expansion.

The Atlas Leather Mfg. Co., East St. Louis, Ill., has filed notice of change of name to the Atlas Board & Paper Co., and in the future will specialize in the manufacture of paper products.

The Glenn-Osage Oil Co., Grand Rapids, Mich., has arranged for an increase in capital from $100,000 to $200,000.

The Hudson Oil Co. of Delaware, 135 Broadway, New York, N. Y., has filed notice of increase in capital from $3,000,000 to $5,000,000.

The Broughton Brick & Tile Co., Broughton, Ill., has filed notice of dissolution under state laws.

The Brooklyn Color Works, Inc., Stewart Ave., Brooklyn, N. Y., has arranged for an increase in capital from $30,000 to $100,000.

The Ross-Meehan Foundries, Inc., Chattanooga, Tenn., has filed notice of increase in capital from $60,000 to $1,260,000 for general expansion. G. F. Meehan is president.

The Standard Paint Co., Texarkana, Ark., has arranged for an increase in capital to $50,000 for proposed expansion. C. K. Faison is president.

The Harrisburg Shale Brick Co., Harrisburg, Pa., has called a special meeting of stockholders on April 14 to arrange for an increase in capital from $60,000 to $120,000 for general expansion. Jacob H. Foreman is secretary and treasurer.

The Goodyear Tire & Rubber Co., Akron, O., is disposing of a preferred stock issue of $14,505,800, a portion of the proceeds to be used for general financing, expansion, etc.

The Chino Copper Co., 25 Broad St., New York, N. Y., is considering a new stock issue to total $150,000, the proceeds to be used for plant extensions and improvements.

Coming Meetings and Events

American Association of Engineers will hold its annual convention in Norfolk, Va. May 7 to 9.

American Chemical Society will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

American Electrochemical Society will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York.

American Foundrymen's Association will hold a meeting in Cleveland, O., April 28 to May 4.

American Gas Association will hold its annual convention the week of Oct. 15 at Atlantic City. An elaborate exhibition of gas-making and gas-utilization equipment is planned.

American Institute of Chemical Engineers will hold its summer meeting June 20-23 at Wilmington, Del.

American Leather Chemists Association will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W. Va., June 7, 8 and 9.

American Oil Chemists' Society will hold its annual meeting at the Eastman Hotel, Hot Springs, Ark., April 30 and May 1.

American Society for Testing Materials will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

International Chamber of Commerce will hold its second general meeting in Rome, Italy, March 19-26, 1923.

Iron and Steel Institute (London) will hold its annual meeting May 10 and 11 at the House of the Institution of Civil Engineers, London, S. W. 1.

National Foreign Trade Council has postponed its annual conference from April 25, 26 and 27, to May 2, 3 and 4. It will be held in New Orleans, La.

New Jersey Chemical Society holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

Society for Steel Treating—Eastern sectional meeting will be held June 14 and 15 in Bethlehem, Pa.

Society of Industrial Engineers, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

A Paper Industries Exposition will be held in Grand Central Palace, New York City, during the week of April 9, 1923, by the International Exposition Co.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

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The Absurdity Of Dollar Gasoline

POLITICIANS, like the poor, will probably be with us always and their railings will continue sorely to try the patience of a tolerant people. With the adjournment of the Sixty-seventh Congress a sigh of relief went up from the entire country because for nine months at least we are to be immune from the radical eruptions that have characterized recent sessions of our legislators.

Most of the politicians' vituperations have been of a sort we could pass over and forget, for they could be traced to the more or less familiar prejudices and party feuds. On the very last day of the session, however, there was one flagrant piece of abuse that cannot escape without protest. We refer to the infamous report, presumably prepared by Senators LA FOLLETTE and BROOKHART, on the petroleum industry and more particularly to its evident purpose to mislead the public into believing that gasoline will shortly go to a dollar a gallon unless an export embargo is placed on it. Although absolutely no supporting evidence was brought out in the extended hearings before the Senate sub-committee, the politicians nevertheless authorized this conclusion to confirm their earlier charges and to show the world at large that they were taking the part of the poor automobile owner against the great and ruthless oil monopolies.

To the technical man the possibility of dollar gasoline, at least within the present generation, is a positive absurdity. The public's best assurance that the price of motor fuel will not soar to prohibitive levels is in the uninterrupted advance of petroleum technology as reflected in the greater utilization of crudes, in improvements and economies in refining methods and finally in the broadened utility of low-grade products through the development of cracking processes on the one hand and advances in engine design on the other.

Furthermore the production of gasoline substitutes will effectively check any such advance in prices. Industrial alcohol can be produced at a cost not greatly in excess of 25 cents a gallon. While there might be some question as to the immediate supply of raw materials for such a fermentation program, it is scarcely conceivable that there could ever be any permanent shortage of the wide variety of carbohydrate and cellulose materials that can be used for alcohol production. And, of course, our oil-shale resources represent an untapped source of petroleum substitutes that will be developed long before gasoline ever mounts to a dollar a gallon. Our friend Dr. MCKEE estimates that the shale-oil industry can prosper with gasoline at 35 cents a gallon. Nor should low-temperature distillation of coal be overlooked, for here is a demonstrated source of many valuable liquid fuels. Many other lines of fuel research and discovery might be listed, among them the experimental production in France of a synthetic gasoline from crude vegetable oils and the fact that the Germans have hydrogenated coal and coal-tar products to obtain a wide variety of fuels and lubricants. Some of these are still in the hazy status of day dreams, but dollar gasoline would undoubtedly turn many of them into lucrative commercial enterprises.

The whole fabric of the report is political buncombe, however, and as such is unworthy of serious consideration. Our principal complaint is that a legitimate industry has been forced to submit to months of senseless and costly investigation only to find that its case had been prejudged and that the "conclusions" of the committee are but a restatement of individual opinions already aired by the political demagogues.

The Purpose Of a Standard

ELSEWHERE in this issue is a brief statement by W. W. SKINNER, one of the most experienced of the government experts on the establishment of food standards. He discusses this subject with unusual effectiveness, pointing out in his comment with great force the basic reasoning in the establishment of commercial specifications and requirements of food quality.

The arguments advanced by Dr. SKINNER might equally well be applied to the commercial practices of many other industries. Of course the other industries are not subjected to governmental regulation; but the principle of fair relationship between buyer and seller applies equally. It would seem appropriate, therefore, to apply generally the three fundamental considerations which govern the federal officials in their deliberations regarding food standards. These fundamental functions of a standard, paraphrased for general application, are:

1. To define products so as to prevent unfair competition, since one effect of intelligently used standards of trade is the promotion of better business methods and better business ethics.

2. To define products so that inspection laboratories may have a uniform and generally accepted guide in applying the standards to purchases of the products.

3. To define products so that the consumer may discern quality and exercise a discriminating choice, and that the producer may know and meet such a discriminating demand. In other words, to create a condition in the commerce of chemical products where vendor and vendee speak a common language.

We commend these principles to the study of all—particularly to the manufacturers of heavy chemicals.

On the Comforts Of Patience

THE news is going around of a French invention to make artificial wool out of cotton by impregnating the fiber with a protein substance such as glue, gelatin, egg albumen or casein, which has first been broken down by an acid and then rendered insoluble in a water bath. Good wearing qualities and other merits are claimed for the new fabric.

We have no patience with troublesome skeptics that are constantly discouraging faith in invention and research. We have always felt that once the problem of the cellulose molecule is solved, we may look for all sorts of new fabrics and new materials. This invention comes a little early, but we wish to record our faith in the advent of artificial wool eventually, and to admit that some day desirable fabrics may be developed by a proteinizing process with cellulose. But development is always slow and painful. Sometimes it pays to wait! In the meantime we are not planning to array ourselves during the hot weather next summer in a suit of cotton clothes impregnated with glue. We should grow a little nervous over the possibility of sticky sequelæ of photochemical reactions as we pursue our way along the hot humid streets toward Tenth Avenue and 36th Street.

An Achievement in Current Statistics

WE HAVE often referred to the value of statistics, particularly when they are issued in time to be of current interest to industry. In this connection a recent achievement of the Chemical Division of the Department of Commerce is worthy of special comment. Statistics for the coal-tar dyes imported through the port of New York during the month of February, 1923, were carefully compiled from the customs invoices, analyzed by the dye experts of the Commerce Department and the United States Tariff Commission, and made available in mimeographed form on March 6. Certainly this is an example of dispatch which other governmental agencies might well emulate And the statistics themselves were not mere totals of poundage and value. In addition to such figures each dye was classified on the basis of its chemical composition and listed according to its Schultz number; the usual trade names were given, also the name and address of the foreign manufacturer, and, finally, the percentage of quantity by the countries of origin. A small proportion of the entries, which could not be identified on the basis of the Schultz Farbstoff Tabellen, were grouped according to their method of application - that is, as acid, basic, vat, mordant, chrome or sulphur colors.

But it may be asked, Is all the detailed work entailed in this compilation and the department's special effort to issue it so promptly really worth while? The answer, we believe, is to be found in the significant information brought out in the February report. During that month \$52,000 worth of imported dyes, or 26.2 per cent of the total, came from Italy, or was sold on the American market by Italian concerns. That fact is worth looking into, for Italy has never been regarded as a serious competitor of the I.G. The department's detailed data on the dye manufacturers, however, show that practically every pound of the Italian shipments, and a large proportion of those imported from France, were actually made in Germany. They were products granted the Italian Government as reparations and resold to American importers in order to realize their gold value. The treaty of Versailles especially provides against the resale of reparation products, but since we are not a party to that treaty we can have no grounds for an official complaint. Furthermore, the practice has already become quite general in the case of pharmaceuticals and apparently with the consent of all interested parties.

The second significant deduction from these statistics is proof of the unhappy effect that the French occupation of the Ruhr is having on the dye industry of Switzerland. Apparently the Swiss manufacturers are suffering severely from interruption of their supply of crudes, intermediates and other raw materials which usually originated in the occupied region of Germany. The amount of Swiss dyes received by the United States in February was only 10.4 per cent of the total. In the year 1921, 40.5 per cent of our dye imports was of Swiss origin.

These are facts that are of immediate importance to the domestic manufacturer of dyes and coal-tar products. At the same time they are indisputable evidence of the value of current statistics. The Department of Commerce and the Tariff Commission are to be congratulated on their excellent work, and it is to be hoped that eventually the reports may be extended to cover all of the important products of American industry.

Congress Adjourns

THE dust and smoke from the battle of the "blocs" has now settled sufficiently to permit at least partial appraisal of the outcome of the contests that were waged so violently in the last Congress. Perhaps the most conspicuous conclusion that a fair-minded appraiser reaches is the fact that this Congress was divided into groups having common interest, and not ruled by the customary party system.

Those who have opposed FORD'S Muscle Shoals proposal and the other variations in contract for lease or for sale of the power and the nitrate properties in that locality finally can rest in comfort for some months. The Congress which just closed left the situation substantially where it found it, for the Wilson Dam construction is continuing, the nitrate plants still belong to the government, and the disposal of the power from this huge development is still to be determined. In failing to secure any action upon Muscle Shoals the agricultural bloc failed in one of its most cherished objects. This same group also failed to enact the legislation providing ten million dollars for the purchase of calcium arsenate and nitrates for resale to the farmers at cost. These are two striking evidences that the interest of a single group in the community, powerful though it may be, does not dominate the Congressional situation wholly. It may obstruct, but it can seldom enact.

At the end of the session there remained without action the legislation on reclassification of the government service. Also no final action was taken on the proposed National Hydraulic Laboratory, though a favorable report to the Senate was secured. The bill proposing conservation and development of helium resources also failed through faulty management. After full and apparently very satisfactory hearings before the Public Lands Committee of the House, this bill was never given further attention because the commit-

tee finally decided that it was without jurisdiction in the matter and that the Committee on Military Affairs would have to begin all over again in the next Congress. Another bill that failed to get action in closing days was the bill for the regulation of radio communication.

Taken all together the Sixty-seventh Congress undoubtedly faced problems of exceptional magnitude and exceptional difficulty. It accomplished some things. In many more particulars it failed of accomplishment.

One feature, however, of the work of this Congress holds definite promise for chemical industry. Forced largely thereto by the Fordney-McCumber tariff act and the Muscle Shoals impasse, this Congress has given vastly more hours to the debate of chemical and chemical engineering matters than any of its predecessors. While the immediate outcome of this debate may not be wholly to the liking of those affected, still they can console themselves that they suffer in a good cause. Chemical industry needed a press agent and the Sixty-seventh Congress, following after the recent war, has proved the best it ever had.

Why Did It Break?

TWO years ago we commented editorially on the great number of unsolved and obscure problems concerning the endurance of metal to repeated loads. They appeared to be so numerous that solution by series of direct experiments—and what experiment requires more time than 100 million cycles?—seemed impossible. At that time a logical explanation of the mechanism of fatigue was in hand, but unfortunately we had no "conversion factors," so to speak, whereby we could predict the behavior of a given metal from easily determined physical properties.

In the meantime it has been proved to everybody's satisfaction that elastic metal can endure so-called "fatigue stresses" indefinitely, provided they fall within the safe range. In other words, there is no reason to fear eventual rupture of the most carefully designed and fabricated turbine shaft, even though it run on and on for years. BAUSCHINGER—one of the earliest investigators—proposed the theorem that the elastic range and fatigue range are identical. If elastic limits are taken from a tension test bar, this statement does not correspond to experience—hardened steel or annealed copper does not deform in an elastic manner—that is, the stress-strain curve really *curves* from the origin—yet both of these metals have been shown to have endurance properties as well defined as wrought iron.

Professor JENKIN, of Oxford, has recently constructed a little model which explains this apparent anomaly, and in fact will probably furnish engineers the "conversion factors" long wished for. Like all inspirations of genius, it is beautifully simple, and represents the action of crystals as they slip when overloaded. It can be set so that any crystal can have any desired internal strain, short of its own elastic limit in either compression or tension. Then its action on the aggregate—the metal piece—can be observed.

This model confirms BAUSCHINGER'S theorem entirely. It is only to be noted that the elastic limit referred to is the elastic limit of the weakest crystal in the metal. That fact we could have assumed from the microscopic work of EWING, ROSENHAIN and HUMFREY, who discovered the facts now contained in all our textbooks: that a fatigue failure starts in a crystalline slip, which gradually opens up into a crack and extends itself by splitting. Clearly slip will occur when the weakest crystal, the crystal least favorably disposed to stress, or the crystal bearing the greatest "internal strain," becomes loaded beyond its elastic limit.

What, then, goes on in hardened steel, which apparently has no elastic limit? It is a crystalline aggregate, and crystals are elastic. Experiments with the model indicate that when the crystals are stressed in all sorts of ways—some almost ready to split by tension imposed upon them by their neighbors, others working almost to their limit in compression, and the remainder with every intermediate amount—at the first increase of external load the worst-loaded crystal slips; with increasing loads more and more of the crystals less stressed initially reach their limit and slip, and so on. Plastic deformation (in part) starts from the beginning, and continues at an increasing rate. Hence, the model duplicates the stress-strain curve for hardened steel or copper. It has no straight beginning. But if the increase in load is at a moderate rate, is interrupted by rest periods, or if the day is pretty hot, the amorphous metal generated by the slips should recrystallize, and the overloaded crystals should heal, but now in the stress-free condition. Consequently, if the metal is then tested in tension, it should behave in an elastic manner as far as the previous fatigue load. And it does! By gradually increasing the fatigue load by steps—and this has also been proved by experiment—the metal can therefore be "fatigue hardened"—i.e., have all its crystals brought into the stress-free condition—and the fatigue limit would then be increased to correspond with the yield point, perhaps 20 to 30 per cent above the ordinary value.

Repeating the original heat-treatment spoils this gain, of course, for it puts into the metal the internally strained condition it had at the start. Here we pause for more information. It is easy to see how quenched alloy steel has severe internal strains, caused not only by volume changes due to differential thermal expansion, but also to partly finished transformations. But why should annealed copper?

That question can be answered by studying copper. At present we welcome the information given by these experiments. It is well known that the marine engineer brings up his engines by slow degrees and short trials, finally reaching full load. It helps run in the bearings of course, but, far more important, gives time and opportunity for the metal to slip into the unstrained condition. A proper start may add 20 per cent to the engine's strength.

Some mining companies buy crusher shafting by the carload, keeping spares on hand ready for the expected break (by "crystallization," as they call it). Starting off at full capacity, these machines are quickly and violently overloaded when cracking a big rock. Professor JENKIN'S model and the actual experiments it foreshadowed show that such usage will reduce the endurance limit 40 per cent of that when properly "fatigue hardened." Would it not be worth while to run these shafts in by short campaigns on carefully screened and sized rock?

Finally, spring manufacturers will do well to study the possibilities of the new method. Apparently in no class of steel is correct preparation by mechanical stressing more important than in heat-treated alloy steels. In fact, mechanical treatment appears to be as important as heat-treatment. And every one knows that automobile springs fail now and then.

Readers' Views and Comments

Dirt
In Steel

To the Editor of Chemical & Metallurgical Engineering

SIR:—The micrographs in the letter signed Martin Seyt in your issue of Jan. 24, showing inclusions in what was supposedly a tool steel and in an alloy steel shafting, although they served to emphasize the important bearing of inclusions on the quality of steel, seem to the writer rather unfortunate as examples, in that the polish was very poor and the magnification not stated. That these points are not trivial will be plain from the micrographs shown herewith.

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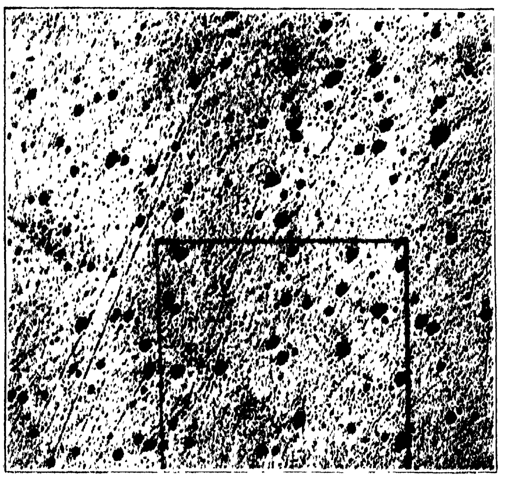

FIG 1—RAIL STEEL INCORRECTLY POLISHED × 50

FIG 2—SAME SPOT. × 100

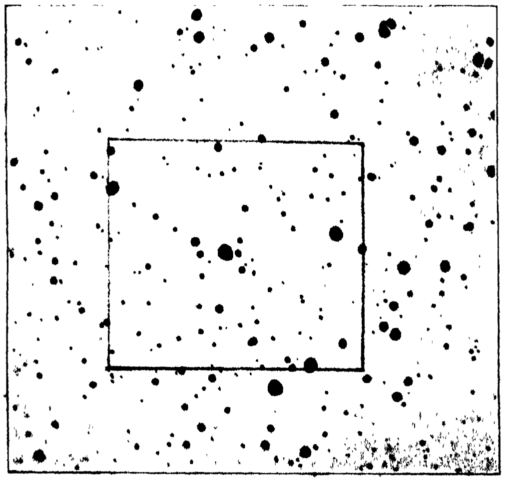

FIG. 3—SAMPLE QUENCHED AND REPOLISHED. × 50

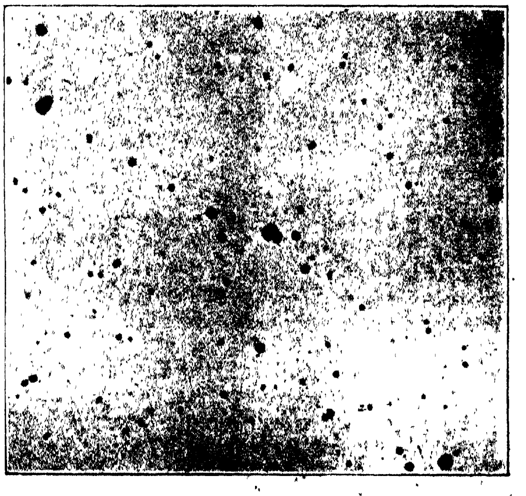

FIG. 4—SAME SPOT. × 100

judging the quality of the steel from the appearance of Fig. 1. In a cleaner steel and in a softer lower carbon steel, the difference between Figs. 1 and 2 and Figs. 3 and 4 could be even more striking. That it is necessary to state the magnification is evident if the appearance at 50 magnifications is compared with that at 100. in the same surface area there are four times as many inclusions at 50 magnifications as at 100. The area in the square at 50 magnifications makes up the whole micrograph at 100. The size of the inclusions appears almost the same at both; if anything, it is smaller at 100. This is an optical effect, a result of the slight pitting around the inclusions which cannot be avoided.

In metallographic examinations a study of the inclusions is of the utmost importance, and even more care should be used in the preparation of the specimen for observation of the unetched structure than for the examination of the structure as revealed by etching.

Associate Physicist,
Bureau of Standards,
Washington, D. C.
SAMUEL EPSTEIN.

Shore Scleroscope

To the Editor of Chemical & Metallurgical Engineering

SIR:—Noticing your article on the new model scleroscope in your issue of Feb. 14, I am reminded of the fact that I met Mr. Shore somewhere in Brooklyn when he had just completed his first instrument. In conversation with him he gave me a few of his pamphlets and asked me if I could interest some business acquaintances, and he offered me a 15 per cent commission for selling the instrument. I perfectly recall the opposition I received from various men whom I talked with regarding this scleroscope; like everything new, they laughed at it and said it was of no use to them.

This is interesting, as I have learned that at Bridgeport they have reversed the principle and are testing the hardness of steel balls for roller bearings by bouncing them over a hurdle. I merely mention this as, perhaps, a note of interest to show the progression and growth of an idea.

GILBERT E. STECHER.
Weehawken, N. J.

Food Standards*

BY DR. W. W. SKINNER
Assistant Chief, Bureau of Chemistry

AN intelligent and effective enforcement of regulatory laws requires the formulation of definite standards. Standards would necessarily be developed but gradually and laboriously by precedent, by official fiat, or by specific legal enactment, were there no definite organization specifically constituted for the purpose, since a standard is, in many instances, the fundamental starting point in the determination of whether a food product conforms to the provisions of law. However, I believe there is quite prevalent a misconception of what a standard is or ought to be. This is because the word standard is an unfortunate one for our purpose, since the older and more common use of the word standard connotes superiority or a special mark of excellence. Thus, for instance, a standard meter stick or a standard pound weight indicates a unit of measure of unusual precision or accuracy.

A standard for a food product has quite a different significance, and indicates a limit or a point from which to measure. It is a zero point, as it were, above which products are acceptable if considering desirable constituents and below which they are to be rejected. Thus it is that a product which complies with a specification may be very much short of a really excellent or superior product—indeed, it may be as judged by popular conception a rather inferior product, yet comply with the standard specifications.

The recently issued and much discussed standard for milk bread well illustrates the point. The Joint Committee, after more than 2 years of consideration of the bread schedule, concluded that a bread made from a dough in which one-third of the usual water had been replaced by milk was entitled to be designated milk bread. I am not, I hope, violating any confidence when I express the opinon that probably every member of the committee personally prefers a bread with a higher content of milk solids than is represented by the use of one-third milk, and will welcome the opportunity to change the standard to include an additional amount of milk when the trade practice has been so improved as to make such a standard feasible. I cannot in brief limits attempt even a summary of the evidence which led the committee by a unanimous vote to define milk bread as noted above, and must be content with the assertion that the evidence was convincing to the committee that a consumer would have no reason to feel deceived or defrauded if sold a product as milk bread which conformed to these specifications.

The Food Standards Committee is a court where the evidence affecting a proposed schedule is carefully considered and where a judgment is rendered based upon the evidence presented. The administrative machinery of the committee has been developed to a point where it is believed we are getting the full evidence before the committee in the most effective way. Food officials, manufacturers, producers, distributors and consumers are given an opportunity to present their views and to criticise a proposed definition or standard.

The original Standards Committee with painstaking care and with a clearness of vision as to needs almost prophetic adopted certain principles as a guide for the action of the committee, and these principles unaltered are still the guide for the committee's action. A careful consideration of these principles will convince any one, I think, that it was not the conception of the members of the original committee or of the committees which have followed that it ever was or has been the function of the committee to erect or create arbitrary ideals and then attempt to translate such ideals into standards.

The three fundamental considerations which govern the committee in its deliberations and conclusions in formulating its definitions are:

(1) To define products so as to prevent unfair competition, since one effect of intelligently enforced regulatory food laws is the promotion of better business methods and better business ethics.

(2) To define products so that food officials may have a uniform and generally accepted guide in applying the general provisions of regulatory laws to commerce in food products.

(3) To define products so that the consumer may discern quality and exercise a discriminating choice, and that the producer may know and meet such a discriminating demand. In other words, to create a condition in the commerce of foods where vendor and vendee speak a common language.

*Statement in *Food and Drug Review*, the "house organ" of the Bureau of Chemistry, February, 1923.

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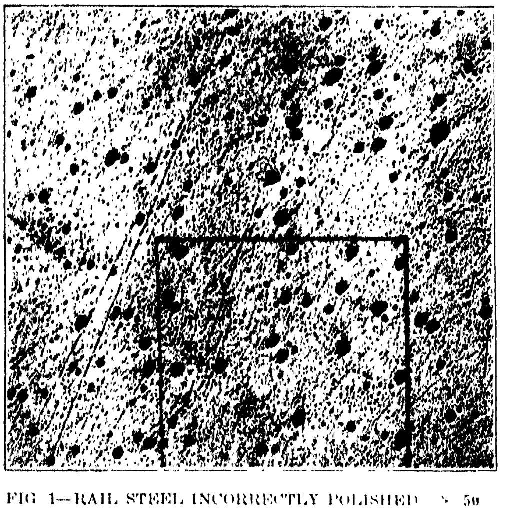

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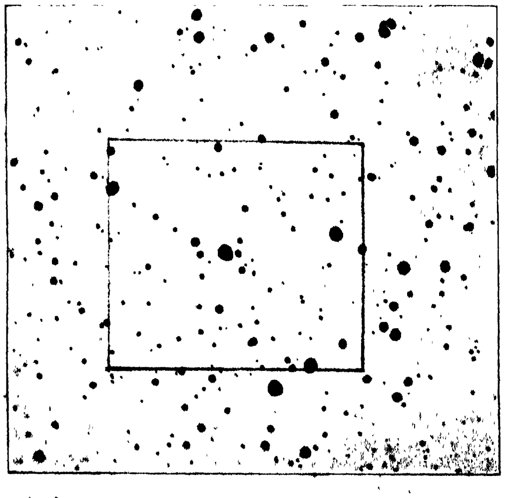

FIG. 3—SAMPLE QUENCHED AND REPOLISHED. × 50

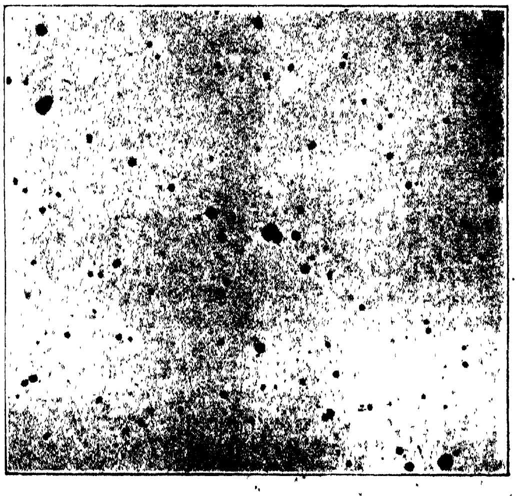

FIG. 4—SAME SPOT. × 100

Nichols Medal Awarded to Thomas Midgley, Jr.

Twentieth Anniversary of Original Presentation Goes to Engineer and Prominent Investigator in the Field of Gaseous Detonation—Address of Acceptance Reviews Anti-Knock Properties of Matter

BEFORE a notable assemblage of chemists in Rumford Hall, New York City, on March 9, the New York Section of the American Chemical Society awarded the Nichols medal to Thomas Midgley, Jr., chief engineer, fuel section, General Motors Research Corporation. The event marked the twentieth anniversary of the first presentation of the Nichols medal, which is awarded annually for the best original paper that had been published during the preceding year in any one of the three journals of the American Chemical Society. It was the unanimous judgment of the jury of award that this year the honor should go to Mr. Midgley's article on "The Chemical Control of Gaseous Detonation, With Particular Reference to the Internal Combustion Engine."

In his introductory remarks Dr. C. A. Browne, chairman of the New York Section, recalled that the medal had been established in 1902 through the generosity of Dr. William H. Nichols, past president of the American Chemical Society. The first presentation was just 20 years ago—in 1903. Under the original conditions the medal was awarded for the best paper given before the New York Section, but in 1913 the requirements were broadened to their present national scope. It was significant, Dr. Browne declared, that this year the award had been with the unanimous approval of the donors and had already received the popular assent of the chemical profession.

Midgley and His Work

"A mechanical engineer by education, yet one who quotes the periodic law freely and one for whom organic chemistry presents no terrors, such a man is Thomas Midgley, Jr.," said Professor Bancroft. "His career is the more extraordinary because he has thus upset all precedent."

Graduated from Cornell in 1911, thereafter employed until just prior to the war in connection with the rubber industry, Midgley's progress has been very rapid. Dr. Bancroft would attribute his success to his ability to correlate apparently meaningless and hopelessly scattered facts. He showed how from several different sources he has gathered together the disconnected fragments which first found expression in his working hypothesis and which have resulted in notable success in his work upon anti-knock mixtures.

Without knowing anything of the mechanism of reactions of mixtures undergoing combustion within fixed space limits, Midgley set out to study the rate of reaction under varying conditions and to analyze the phenomena of detonation in gaseous mixtures. Benzene and kerosene were used as fuel in these experiments. Investigation showed that the introduction of a foreign substance into the fuel mixture, even in minute amounts, would affect detonation, or knocking. Organic compounds of Se, Te, and especially of Pb, affected this property of knocking very appreciably. Tetra-ethyl lead entirely did away with the knock or detonation wave—in other words, the combustion of the fuel was complete before detonation occurred. A fraction of 1 per cent of these substances—as for instance, 0.04 per cent of $Pb(C_2H_5)_4$—in the fuel mixture completely eliminates the knock.

Dr. Bancroft pointed out that the significance of Midgley's work is to be far reaching. By decreasing the rate of reaction and thus allowing complete combustion of a fuel mixture, the compression is greatly increased. The saving effected means using much less fuel. In other words, Midgley's work may actually double the existing fuel supply. Unfortunately the existing type of motor in general use will not stand the compression required for the efficient use of anti-knock mixtures, and as a result the full value of the work done will not become apparent for some time.

In concluding his remarks Dr. Bancroft summarized the difficulties overcome by Midgley, commended him highly on the clear-cut manner in which his work has been carried out and congratulated him on the splendid success achieved.

Dr. Herty Presents Medal

Dr. Charles H. Herty, past-president of the New York Section, made the presentation. He called the roll of the distinguished investigators who have previously received the medal in order not only to demonstrate the esteem in which Midgley's work is held but also to emphasize the fact that his success has been attained at a comparatively early age. Best wishes for continued achievement on the part of the section attended the medal, Dr. Herty said, in making the presentation.

Acceptance and Address

In accepting the signal honor accorded him by the society, Mr. Midgley said that it was with a feeling of deepest humility that he recalled the names of the eminent investigators who were his predecessors as Nichols medalists. He asked, therefore, that he be allowed to receive the medal in the name of the organization represented by his faithful and industrious coworkers in the laboratories of the General Motors Research Corporation.

The acceptance address, entitled "Some Fundamental Relations Among the Elements and Compounds as Regards the Suppression of Gaseous Detonation," was

interpreted by Mr. Midgley in an informal discussion of the anti-knock characteristics of matter. At the outset he defined anti-knock as a property of matter whereby a material acts either as a negative or positive catalyst in the prevention of detonation in the internal combustion engine. This property is believed to be possessed by all of the elements provided the right compounds can be obtained. So far the investigations at Dayton have demonstrated that the property exists in the case of twenty-two elements and additions are constantly being made to the list. To be sure, certain compounds such as ethyl nitrite show the property in a negative sense and are referred to as negative catalysts, since they accelerate rather than suppress detonation.

The marked effect of the presence of a small percentage of diethyl selenide, one of the more important anti-knock materials, was demonstrated on the lecture platform by the combustion of a detonating mixture of acetylene and air. Tetraethyl lead, an even more powerful material, could not be used in this particular experiment because of its lower volatility.

THEORIES OF DETONATION

Mr. Midgley then reviewed certain of the theories which have been advanced in explanation of the detonation phenomena. He also showed the mathematical development of the equation generally accepted as an expression of the relation between the reaction velocity and the pressure in the wave of detonation. Those who were intertested in the thermodynamic phases of this subject were referred to Mr. Midgley's original publications in the *Journal of the Society of Automotive Engineers* and the *Journal of Industrial and Engineering Chemistry*.

In brief, the accepted theory of detonation is this: During normal combustion the differential between the pressure in the rear of the flame of propagation and the pressure in front of the flame is almost insignificant, its magnitude being less than 1 lb. per square inch. If, however, the flame front is caused to move forward at an extremely high velocity, as during detonating combustion, the pressure differential becomes enormous and the flame front is preceded by a region of dense gas at an extremely high pressure. The metallic sound, which we commonly call the knock, is caused by the impact of this high-pressure, high-velocity wave with the top and sides of the engine cylinder.

S[illegible]IFICANCE OF ATOMIC GROUPINGS

It has been [illegible] of these investigations to study a great many [illegible] particularly in relation to the influence of atomic groupings on the detonating effects obtained. The hypothesis has been advanced that the anti-knock property resides in the atom of the compound rather than in the compound as a whole. An example of the manner in which the groups modify the anti-knock property of the element is shown in the following table, which compares the relative effectiveness of three strong and one weak anti-knock elements with aniline as a standard of comparison.

The figures given are the reciprocals of the number of gram molecules required to give an anti-knock effect equivalent to that of 1 gram-mol. of aniline. The negative in the case of ethyl ether means, of course, that this compound accelerates detonation.

THOMAS MIDGLEY, JR.

Element	Derivative C_2H_5	Derivative C_6H_5
I	1.09	0.88
Se	6 9	5.2
Te	26.8	22.0
O	—0.046	0.122

A study of valence and bonding conditions in a wide variety of compounds has brought out a number of significant principles. The influence exerted on the detonating effects of the compound by the different atomic groupings was shown in a chart giving the anti-knock values of a number of elements when combined with hydrogen, alkyl and phenyl groups. Important studies have been made with the derivatives of carbon with the idea that the fuel itself may possess special anti-knocking properties. Starting with aniline (6C) and continuing with toluidine (7C), xylidine (8C), etc., it was found that the number of carbon atoms in the molecule bore a definite relation to the anti-detonation characteristics of the fuel and this relation could be plotted to yield smooth curves.

In concluding his address, Mr. Midgley stressed the fact that much more investigation was necessary to round out and complete the work on the chemical control of gaseous detonation. As is usually the case with pioneering in any field, the work of Midgley and his associates has blazed a trail through a fertile field of investigation. Others must follow. Many interesting problems are yet to be solved.

Important Gift to British Society

Sir Alfred Yarrow has presented $500,000 to the Royal Society for the promotion of scientific research, and in conveying his gift, records his conviction that a patriotic citizen cannot do better than give money for "the development of science, upon which the industrial success of the country so largely depends."

The Commercial Banker's Function In Business

An Interview with William Post, Chairman of the Executive Committee, Central National Bank of Philadelphia

BY CHARLES WADSWORTH, 3D
Assistant Editor of *Chemical & Metallurgical Engineering*

PERHAPS it was an unwarranted assumption that the engineer is almost completely unfamiliar with the practice and theory of commercial banking. If it was, we beg to assume the entire responsibility for it. During our interview Mr. Post was most patient in answering the questions which were asked, and the questions were those of a man without experience or contact with the field of commercial banking.

"When in Rome, Do as the Romans Do"

So runs the proverb, and it is sane advice, but inadequate. It makes no provision for finding out what the Romans do nor how they do it. Our suggestion would be to corral a wise Roman and get him to teach you what and how.

When we wanted to find out how a man or a corporation could borrow money from a bank to keep a chemical plant going, we went to a banker. Said he: "The subject of commercial credits is exceedingly intricate. By the way, have you read the 'Four C's of Commercial Credit,' by William Post? Well, you ought to read that first." Without more ado we took a train for Philadelphia and had a talk with Mr. Post. So it was we found our wise Roman.

For over 50 years he has been a banker, a human banker who will not reduce commercial credits to mathematics, and the substantial growth of the bank shows the wisdom of this course. He was one of the pioneers in credit analysis and his rich experience is projected for a fortunate community in his book. His spirit is a type of leaven which the business community needs.

Not unnaturally the first question had to do with the function of the commercial bank as far as industrial plants are concerned. In reply Mr. Post remarked that some, perhaps many, people believed that the commercial bank actually financed new ventures, supplying the necessary first capital for establishing a business. This of course can never be the case, as a brief consideration of the situation will show. The funds at the bank's disposal are funds deposited with it by its clients to be repaid upon demand—lodged with the bank for safe keeping.

Of course, good banking practice as well as government regulations provide that a definite cash reserve on deposit be maintained. The remainder of the money on deposit is available for loans and other investment. But let us assume that a bank were permitted to make loans on long-time credit or even to contribute a part of a capital investment. What would happen? For one thing, a certain part of the loans made as capital investment would be lost in new ventures, because of unforeseeable risks. In other words, part of the depositors' money would be gone or the bank's working capital impaired. The risk in such investment is no part of commercial banking. Similarly during the life of a long-term credit loan it is possible for conditions so to change that the lender bank would find it necessary to liquidate its investments because of an imperative demand for cash. So it is the result of seasoned experience to place a time limit on commercial credits, which is usually from 90 days to 4 months and should not even in exceptional examples exceed 6 months.

Thus it will be seen that contrary to a widespread impression a commercial bank does not and should not play any part in the establishment of industrial enterprises. An inventor or engineer who has an idea and no money must not expect a bank to finance him. The original capital should come from investment channels—individuals or stockholders.

A bank may begin to assist an enterprise after it has been successfully started and it should and will continue its assistance and support as long as the business remains healthy, vigorous and honest. Sometimes it is necessary for banks to stick by old clients when they are in a tight place. This will be to protect a good client unavoidably drawn into a rather hard situation, or to protect loans already made. Except for such instances a commercial bank must confine itself to liquid business; it is in no sense a doctor for sick business, though it will foster and aid new business up to a safe point.

What, then, are the criteria developed for evaluating a business from the banker's standpoint? How shall the banker decide to grant or not to grant a loan?

This, Mr. Post remarked, is the whole problem of commercial banking in a nutshell. In such an interview as this it is possible only to indicate the kind of estimate which the banker must make. To develop the subject adequately would require a volume, and even then the text would be colorless. Commercial credit is a problem of individual cases and only the most flexible type of generalization can be made. The variables are many and any effort to reduce the problem to rigid mathematical determination will result in unsafe banking. Woe betide the banker who looks only at the financial statements of an enterprise without full knowledge of the men behind the statement, for

financial statements are only as dependable as their authors.

The banker looks for three things in a prospective borrower. They are Character, Capacity and Capital. These, with the fourth "C"—Collateral—are the four big factors to be considered in extending bank credit. Capacity alone is distinctly a dangerous prospect, for an unscrupulous operator with plenty of ability, though he may pay bills as a matter of policy until a pinch comes, may then not hesitate to conceal quick assets and leave the creditors a meager skeleton to pluck. So too Character alone would frequently be unable to meet his debts—and Capital unsupported by Character and Capacity finds himself a mendicant more frequently than not.

If Character and Capacity be linked, the banker has a very fair prospect. When supported by these, even limited capital may satisfy the banker that his support is merited. The mathematical banker may shake his head and say "No" when a more human confrère will win a lifelong friend and a strong account for his bank by encouraging a loan to the comparatively new business, accompanied by modest capital. Let Capital be linked with Character and Capacity and the combination can be beaten only by the addition of undoubted Collateral to the group, in which case the commercial loan should be most secure.

Collateral a Quicksand

Before discussing a few of the significant phases more specifically it should be remarked that collateral is a quicksand which it is necessary to scrutinize with experience and care. Collateral loans are much sought after by banks, and yet it is probable that more losses result from them than from straight single name paper. The reason for this seems to be that collateral loans are made up on many types of collateral—nor are they watched with as great care as other loans. The collateral is taken in at a desirable margin, but the bank often neglects to check the intrinsic worth in the collateral or to note its fluctuations and keep margins built up.

The problem is by no means solved by referring to the four C's of commercial credit. It is merely defined. The classification enables us to think more clearly and with a proper balance, unconfused by the complexity of the subject. The technique of evaluating character, capacity, capital and collateral must be elaborated in a more comprehensive way than an interview will permit. Let me illustrate, however, the method of approach. Capital is variously listed depending both on the type of organization and the attitude of the author of the financial statements. A banker must analyze the statement with both those things in mind. Some firms will capitalize intangible assets such as good will, patents, trademarks and the like; some business houses write down the values of fixed assets such as land, buildings and machinery in a conservative way that will be desirable. In some corporations common stock represents real value, in others it will be tucked in to make resources and liabilities match. These are but a few of the questions to be answered on this one point.

Again, a proposition must be in bankable shape to receive commercial credit. This means among other things that the quick or liquid assets, which include cash on hand or on deposit, bills and accounts receivable and merchandise, should be approximately twice as great as the quick liabilities. This so-called 2 to 1 ratio is perhaps the most widely recognized and practiced generalization in commercial loaning by banks. Naturally it is not rigid and during the war period and days of readjustment it had to be abandoned. Honest customers operating largely upon government orders had to be aided regardless of the ratio of their assets and liabilities. Then, as in the past, banks had need to violate conservative practices. Thus it is that the commercial banker works. He must be a constructionist aiding worthy enterprises with his every resource. For so he will prosper as an integral part of the community.

Mineral Production in Ontario

Abstract of an Address by Canadian Bureau of Mines Head With Particular Emphasis on Nickel and Iron

While addressing the Engineering Institute of Canada in Ottawa recently, John McLeish, director of the Department of Mines, Canada, stated that a very large proportion of the important minerals of commercial value in Canada are to be found in the Province of Ontario. The nickel deposits at Sudbury supply over 80 per cent of the world's demand. They also possess very large ore resources and are at present sufficiently developed to maintain the present industry for more than 100 years. Favorable results have already been obtained in the demonstration of new uses for nickel. The question at present under consideration is the development of a market to replace that which armor plate formerly provided.

The total value of mineral production in Ontario increased from approximately 15 millions in 1902 to more than 25 millions in 1906, and in 1913 amounted to nearly 60 millions. Through increased production and high prices, a value of 95 millions was reached in 1918 or approximately 45 per cent of the total value of the production for all Canada. In 1919, the first year following the war, production dropped to 68 millions, rose the next year to nearly 82 millions, dropped in 1921 to 54 millions and is again on the up grade, having reached about 65 millions in 1922.

Turning to the iron situation, Ontario has not, as yet been able to develop a successful and continuous ore industry. Ores of merchantable grade in the natural state have not been available in large quantities. There are, nevertheless, large resources in low-grade ores, principally magnetite and siderite, which should be put into commercial form. The most serious attempts have been on the siderite ores at Magpie and the magnetites at Sellwood, north of Sudbury. Both of these have been successful in producing an excellent furnace product but the cost is still too high to justify continued commercial operations.

Constancy of Platinum Thermocouples

Life tests of the pure platinum and platinum-rhodium wire prepared at the Bureau of Standards for thermo-couples have been carried out by the heat division. These tests are the same as those applied to commercial couples which were recently reported by Fairchild and Schmitt in *Chem. & Met.*, Jan. 25, 1922 (vol. 26, p. 158). Results thus far obtained indicate that couples of material purified, melted, and drawn to wire at the bureau are appreciably superior to the best commercial couples previously tested.

Industrial Importance of the Metallic Soaps

Striking Properties of These Relatively Unfamiliar Substances Indicate a Wide Range of Commercial Applications

BY HILTON IRA JONES

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AUTHOR'S NOTE: This work was originally begun in 1910 in connection with a problem for the American Kellystone Co. on the waterproofing of its products. It was again resumed in 1918 in connection with the work of Robert DuBois for his Master's degree. It was at this time directed toward the preservation of eggs (see *Journal of Industrial and Engineering Chemistry*, August, 1920). It was continued during 1919-1921 as a part of the work of Gladys Trevithick for her Master of Science degree. During the past year it has been carried further as a part of our work on the waterproofing and mildew-proofing of canvas for the Redpath Bureau.

METALLIC soaps, as the term is used in this article, refer to the stearic, palmitic, oleic and hydrogenated-oil soaps of magnesium, copper, aluminum, zinc, lead, nickel, calcium, cadmium, antimony, strontium, tin, cobalt, barium, iron (ferrous and ferric), silver, mercury (-ous and -ic), arsenic, chromium, bismuth, magnesium, ammonium and lithium, all of which have been prepared and systematically studied. The water-soluble soaps of the alkali metals are not included in this classification.

Although these materials are not familiar articles of commerce, they are nevertheless important products from an industrial viewpoint. Their actual as well as potential uses cover a wide range of industries. They find a large market in the manufacture of lubricating greases. Another important use is in paint and varnish as driers. One of the greatest present and potential uses of the metallic soaps is in the waterproofing of cloth. Minor uses are found in disinfectants, in medicine, in taxidermy and in dry cleaning. More detailed reference to the industrial applications of the metallic soaps will be found elsewhere in this article.

PREPARATION ON THE CLOTH

Most metallic soaps, because of their great insolubility in water, are prepared by precipitation. A warm water solution of the alkali soap of the desired acid is added to a water solution of the salt of the desired metal, and the precipitate of the metallic soap is pressed dry and later dissolved; or else the material to be waterproofed is impregnated first with the one solution and then the other, thus precipitating the metallic soap within the pores of the object. One of the large tent companies formerly treated all its canvas in this way. This is a less efficient and desirable method for reasons presently to be shown. Often the aluminum soaps are precipitated within the fiber of cloth, especially canvas, by an electrolytic process. In this process the cloth is passed through a warm bath of the soap, squeezed out between pinch rolls, and passed directly into the "electric bath," where it runs between aluminum electrodes. The precipitating aluminum hydroxide combines with the soap in the cloth, thus precipitating the aluminum soap in the fiber.

METALLIC SOAP "SOLUTIONS"

While we speak of a soap's "solubility," it is doubtful if any soap ever forms a true solution. The solutions are apparently in all cases colloidal emulsions. The alkali soaps, however, form with water what generally pass for true solutions. The presence of many oils, such as kerosene, gasoline, paraffine and the like, often even in very small amounts, produces a great increase in the fineness of the colloidal aggregate. This fact explains, of course, the added cleaning and detergent power possessed by soap in case some of these oils are added—hence the "naphtha soaps" and the score of washing compounds, which are mainly paraffine plus, say, a little ultramarine. The surface tension is also raised as the colloidal aggregate becomes finer. Indeed, the colloidal dispersion and the surface tension bear, it seems, a definite relation to each other.

Most dry metallic soaps—for example, aluminum stearate—are as insoluble in gasoline, alcohol, chloroform and the like as they are in water. The freshly prepared wet soap is readily soluble. If once the soap is dried, the colloidality is destroyed and water cannot easily again be incorporated with it. The solution in the other paraffine oils works the same as gasoline. It is remarkable the amount of water these oil emulsions of the metallic soaps will "take up." They are much like lanolin in this respect. This solution of the metallic soaps has always presented difficulties. Often "smooth" solutions will be obtained, and then again they will settle out. In fact, the published directions for using such commercial solutions as are on the market seem to take it for granted they will be colloidal failures and settle. So they admonish the consumer to "shake or stir thoroughly." The making of solutions of metallic soaps is the old problem of mayonnaise dressing. The trick is to get the true colloidal state, and the second is to keep it so. The temperature of the precipitation seems to be an important factor. Below a certain critical temperature, for example, copper stearate comes down as a non-colloidal granular mass. But when freshly precipitated from a hot solution above this critical temperature (as it should be), it is tremendously sticky, and reminds one of chewing gum. Cold, it is a hard, brittle wax, similar to molasses candy. This wax is readily soluble in gasoline and other paraffine oils to form a mucilaginous, colloidal solution, which can be kept indefinitely without settling. Many substances, of course, like acids, and conditions, like freezing, will break the colloid and make the soap settle out. In the formation of such a solution, the water is as essential as the oil.

STABILIZING EFFECT OF ADDED WAX

It has been found that the addition of colloid waxes, such as lanolin or beeswax, has a remarkable stabilizing effect on the colloid. Such solutions may be evaporated and the wax heated to 45 deg. C. for weeks without the colloid being in any way affected. Pure sugars crystallize readily from pure solvents. A mixture of sugars crystallizes with difficulty, especially if impure. So a mixture of colloids is more stable than a single pure one. This fact is of the greatest importance, since the usefulness of the metallic soaps depends largely upon their being maintained in colloidal condition.

The pure metallic palmitates and stearates are almost impossible to maintain as colloids without the addition of one of these waxes. This fact explains why their use has been so often disappointing. On the other hand, the oleates are generally so soft as to render the finished product, say canvas, sticky and they also tend to turn rancid with age. We have found that the use of hydrogenated-oil soaps seems to solve both difficulties. There seems to be no single hydrocarbon solvent in which the dry metallic soaps are soluble. They are all soluble whe

wet and freshly prepared by precipitation. But the best solvents vary with the metal and the acid. Commercial lead soap with linoleic acid goes into solution easily in almost all hot petroleum solvents and comes out again from the cooled solvent almost completely within an hour. The nickel soaps separate out in several days. The ferrous iron soaps go into solution easily and come out again in a few hours increased in weight (due to oxidation). The ferric soaps are much more insoluble. Wet aluminum soaps are soluble in gasoline, turpentine and benzene. The oleates of calcium, magnesium and iron dissolve readily in glycerine. The ammonium soaps are all very soluble in water. Lead, magnesium and copper soaps, if wet, are soluble in alcohol and ether. Zinc oleate is soluble in carbon bisulphide, etc.

The literature on the solubility of the numerous metallic soaps is chaotic and unreliable because the colloidal character and the part played by the water and other factors have not been recognized. For example, one author states that "aluminum soap is very insoluble in nearly all solvents." This is true only if it has been allowed to dry. The wet freshly prepared soap is readily soluble in several solvents. The addition of a little colloidal wax, as lanolin, will completely alter the solubility. The whole matter of preparing these colloidal emulsions of the metallic soaps is complex and not well understood.

Colloidal Properties

The same chaotic state seems even more pronounced when we examine the literature relative to the properties of these metallic soap solutions. This is probably because their colloidal character has not always been recognized. Moreover, the characteristics of such colloids have been little known, but much has been surmised. Their properties are due, it seems, somehow to the extreme fineness of the particles in suspension. These conditions vary within wide limitations, but in a general way this condition apparently begins with dimensions somewhat smaller than the wave length of light and extends downward well into such dimensions as theory ascribes to the molecules of crystalloids. Such solutions are micro-heterogeneous systems distinguished from true solutions of molecules or ions by the possession of surfaces of contact with all the properties implied by this. These properties will naturally be very marked because of the enormous surface provided by the minute state of subdivision. These enormous surfaces provided enable such colloids to adsorb in the interface a great variety of substances and these often in surprising amount. Always the substance used to produce this dispersion, which for lack of a better term Graham called a "peptizing agent," will be most adsorbed. This in the case of these metallic soaps is nearly always water. This explains the unusual waterproofing character of these soap colloids and makes plain why they must be maintained on the fiber in colloidal state. As the soap-impregnated fiber is wetted a swelling takes place—exactly analogous to the swelling of gelatine in water, and the pores of the fiber are absolutely sealed. Extremes of heat and dry air, and especially high concentrations of the violet and ultra-violet light rays, such as we get in New Mexico and Arizona, for example, all tend to destroy the colloidal properties of the soaps in the canvas, which then gradually dust out and are carried away by the continual beating of the wind. Thus the metallic soaps precipitated directly on the fiber, as in the double dip or "electric process," are soon lost and made valueless. Those prepared with the addition of colloidal waxes as mentioned are more stable.

These colloids will also take up all manner of perfumes, essential oils, dyes and pigments, and in fact anything soluble either in the water or the oil. They will adsorb many things soluble in neither, especially if the material is colloidal. They form, consequently, an ideal vehicle for medicinal salves, plasters and ointments. These facts might well lead to several valuable changes in the present pharmacopea—e.g., the substitution of colloidal zinc soap for the ordinary powdered zinc stearate. Their tremendous surface tension makes them great detergents. They will be incorporated as a part of many soaps when these facts are realized. Sufficient sodium tungstate may be incorporated with these metallic soap colloids so that the canvas is fireproof as well as waterproof.

The efficacy of many drugs and poisons appears to depend upon the fineness of the subdivision—that is, the exposed surface area. This suggests the use of these colloidal metallic soaps in all manner of sprays, in fungicides—e.g., copper soaps—medicines, as colloidal mercury and the like. We have found that extraordinarily small amounts of colloidal copper soap will produce unexpected protective effects against mildew and the like.

These striking effects of the metallic soaps that lend them so well to a multitude of uses provide their own undoing in one case. There are certain colloidal clays, like the Denver mud and fullers earth, as is used in petroleum refining, which have, as is well known, great adsorbing powers, especially for colloidal substances which they thus tend to remove from the more crystalloidal (less colloidal) sugars, oils, etc. When a metallic soap-protected canvas is unrolled and rolled up again on a wet clayey ground, the clay is obviously pressed into the very fiber of the canvas and there it adsorbs the colloidal soap and entirely removes it from the cloth. The very properties which make the soap valuable as a waterproofing and mildew-proofing substance facilitate its removal by the clay. No method of preventing this action of these clays has come to light.

As we can obtain supersaturated solutions of crystalloids and small additions of certain substances tend to increase this possible supersaturation disproportionally, so there appears to be no definite solubility in respect to colloidal suspensions. The finer the state of subdivision the more will dissolve, the more stable the colloid will be and the greater will be the surface tension, as well as the detergent and adsorbing power. Such stabilizers are now generally called "protective colloids," because they protect the colloidal particles from separating out. They are themselves generally colloidal.

Industrial Applications

Lubricating Greases. The properties of these various metallic soaps have already caused them to be put to a great number of practical uses. The use in greases is one of the best known. The greases on the market may be divided into four main groups:

1. Greases with alkali soaps used as hardeners.
2. Greases made with fatty oil and lime soaps.
3. Greases with both alkali and lime soap.
4. Greases made with rosin oil and lime soaps.

These vary greatly in composition and kind. They contain anywhere from 5 to 50 per cent of soap and by varying the proportions of soap and filler, greases of any desired consistency can be made. Zinc, aluminum, magnesium and lead soaps are also used in greases and lubricating oils. Lead soaps are especially used in a class of lubricants known as "anti-friction greases." Lead soaps are hard at low temperatures, viscous at ordinary temperatures, but sufficiently fluid under the heat of friction.

Paint and Varnish Driers. Another great present-day use of metallic soaps is in paints and varnishes as driers. Lead and manganese oleates are mostly used. The former is made by saponifying litharge with olive or cottonseed oil; the latter by the direct action of manganese carbonate on oleic acid. The enormous surface obtained by using these colloidal soaps of the metals explains their effectiveness. In case high temperatures are used in hastening the oxidations, the varnishes are spoken of as baking japans. The ordinary linoleates, and resinates of lead and manganese, which form the basis of so-called driers, act by catalysis causing a rapid oxidation of the oil or varnish to which they are added. Lead and manganese form both a lower and a higher oxide which readily pass from one to the other. When present in the film in the higher state of oxidation they give up half their oxygen to the oil, then take up more from the air and so act continuously as catalytic agents to pass along oxygen from air to oil. In this the manganese soaps are more active than the lead. Other metallic soaps such as nickel and cobalt, which readily change from one state of oxidation to another, may be used in these driers, but they appear to have no advantage over the lead and manganese compounds. It is remarkable the catalytic effect produced by minute traces of these metallic colloids. With less than one-tenth of 1 per cent, the effects are very marked. The greatest danger is the use of too much, since it is likely to continue to act slowly even after the film has hardened and so in time to destroy the strength and elasticity. Such driers are generally not used in spirit varnishes nor baking japans.

Waterproofing. The waterproofing of objects by means of the metallic soaps furnishes one of its greatest present and potential uses. The use in waterproofing of cloth has already been mentioned. Our process for sealing eggs with colloidal solutions of aluminum soap has already been published. We are now working on similar processes for preserving fruits and vegetables. Most attempts at waterproofing cements and the like have depended upon the direct precipitation. This has generally resulted unsatisfactorily because of the tendency of the precipitate to lose its colloidal character. This is especially noticeable in case of the aluminum soaps precipitated in concrete, and the magnesium oxychloride cements. We have found that the use of protective colloids tends to prevent this loss of colloidality. By similar solutions coupled with protective colloids we have obtained excellent results in the weatherproofing and rustproofing of iron. Such solutions form an ideal vehicle for aluminum and bronze powders and also various oxides.

Medicines. Dzevagoviskii and Stepanova[1] have studied the disinfecting power of naphthalic acid, cresolated and formaldehyde soaps. We have found that the germicidal power of such soaps is much surpassed by the incorporation into ordinary soap of colloidal mercury oleate. These colloidal organic compounds of mercury are much to be preferred to inorganic mercurials, as they are not injurious to the skin. Similar colloidal copper soaps have unexpected fungicidal properties. Vermorel and Dantory[2] have written of these.

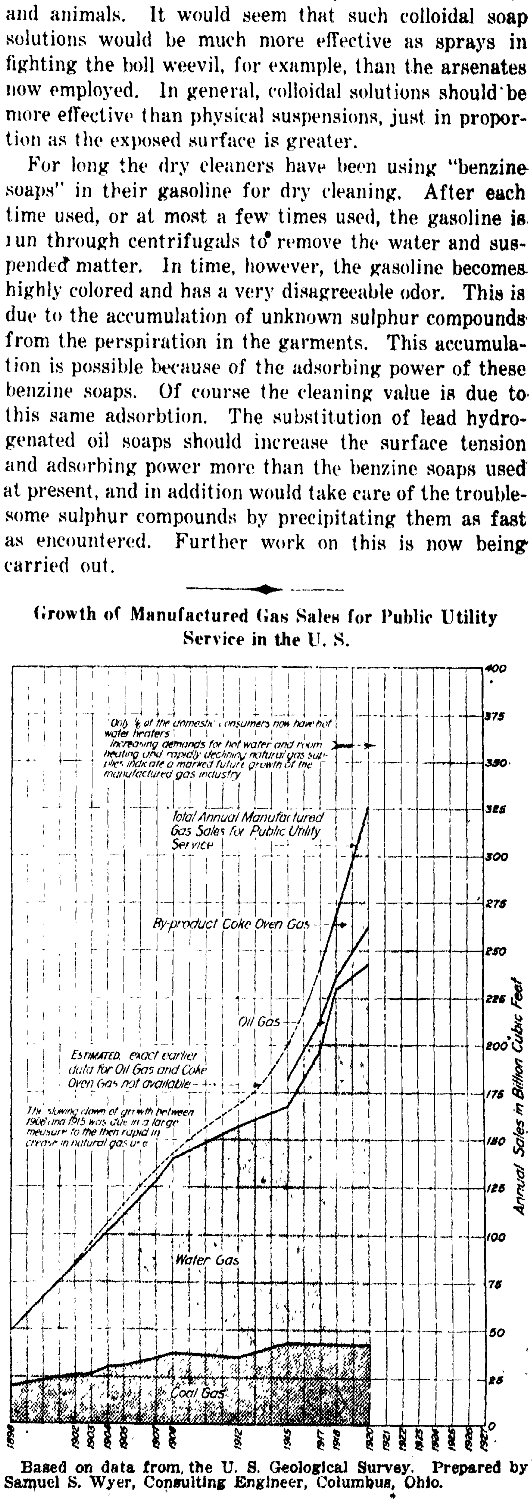
Most metallic soaps will dissolve in both the alcohol (glycerine) or the fatty acid. Such solutions of the calcium and iron soaps are valuable in medicine for lime insufficiency, especially in the case of nursing mothers and in anemics. They would be more widely used if the value of colloidal drugs were generally realized.

Miscellaneous. In laundering the formation in the fabric of insoluble soap precipitates, especially of iron, causes a marked deterioration in the strength of the cloth.

Arsenite soaps containing camphor have long been used by taxidermists in preserving the skins of birds and animals. It would seem that such colloidal soap solutions would be much more effective as sprays in fighting the boll weevil, for example, than the arsenates now employed. In general, colloidal solutions should be more effective than physical suspensions, just in proportion as the exposed surface is greater.

For long the dry cleaners have been using "benzine soaps" in their gasoline for dry cleaning. After each time used, or at most a few times used, the gasoline is run through centrifugals to remove the water and suspended matter. In time, however, the gasoline becomes highly colored and has a very disagreeable odor. This is due to the accumulation of unknown sulphur compounds from the perspiration in the garments. This accumulation is possible because of the adsorbing power of these benzine soaps. Of course the cleaning value is due to this same adsorbtion. The substitution of lead hydrogenated oil soaps should increase the surface tension and adsorbing power more than the benzine soaps used at present, and in addition would take care of the troublesome sulphur compounds by precipitating them as fast as encountered. Further work on this is now being carried out.

Growth of Manufactured Gas Sales for Public Utility Service in the U. S.



Based on data from the U. S. Geological Survey. Prepared by Samuel S. Wyer, Consulting Engineer, Columbus, Ohio.

[1] *Arch. Sci. Biol.*, vol. 14, pp. 283-303.
[2] *Compt. rend.*, vol. 152, pp. 1263-5.

Modern Methods for Making Cupola Mixtures

Diagrams Are Useful to Determine Amounts of Available Pig Iron to Weigh Into Mixture in Order to Secure Castings of Required Composition — Silicon and Manganese May Both Be Easily Predetermined if Three Piles of Pig Iron Are in the Yard

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OF the many factors which contribute to the economic production of iron castings, one of the most important is the proper proportioning of the metal mixtures used in the foundry. As the prices of raw metals are based largely on their compositions, it is imperative that the most economical mixtures of metals be used. The price of pig iron is dependent upon the elementary constituents in the metal. As the silicon and manganese contents increase or the sulphur and phosphorus contents decrease, the price advances. Likewise, scrap metals are sorted into groups according to the previous uses of the metal parts; which is indirectly a classification based on the composition of the metals. The cost of any ferro-alloy is determined on the basis of its important elementary constituents. Since these materials are purchased as chemical compounds, their true values will be obtained only when they are used as chemical compounds and mixed so as to produce the desired analysis in the product.

It is recorded by Thomas D. West that previous to 1890 practically all of the foundries in the United States had purchased pig iron on the basis of the appearance of the fractured surfaces of the metal. The metal with the most open grain structure was used for the softest castings and the close-grained iron was melted for hard castings. The practice of using the "fracture grading" method in preparing cupola charges led to many foundry troubles and unreliable properties in the castings. The foundry industry has been slow in adopting the practice of mixing metals by analysis and even today there are foundries where little attention is given to proportioning the metal mixtures used in cupola charges.

One of the important demands on iron castings today is uniformity in hardness. This requirement has resulted from the modern practice of rapid production in the machine shop. Machine tools are equipped for multiple operations and if castings of non-uniform hardness are machined, the adjustments of the tools will not remain fixed and a delay in production and inaccuracies will result. It is not uncommon to find an industry paying a premium for castings with uniform machinability. This condition may be obtained by controlling definitely the metal mixtures for the cupola so as to obtain a uniform composition which will result in uniform physical properties in the castings.

As the physical properties of the metals are dependent upon their chemical compositions, definite compositions may be established for castings for specific uses. The service requirements of gears, grate bars, stove plate, steam cylinders, car wheels and sash weights are entirely different and therefore the analysis of the metal used in each of these types of castings should be different. The limits or range of composition of the castings to be produced must be established first. Then the proportions of scrap metals and pig iron for the metal charges must be determined.

The Use of Scrap Metals

The results of experience and a knowledge of the compositions produced after melting will enable a foundryman to decide upon the pig iron and scrap proportions suitable for a given type of castings. The relative amounts of pig iron and scrap which will produce solid castings that will pass rigid inspection should be used. From 0 to 100 per cent scrap iron may be used in the metal charges for the cupola. Castings produced from all-scrap mixtures are generally hard and of inferior quality. The average practice is to use from 40 to 60 per cent of selected iron scrap in the metal charges.

In every foundry a certain proportion of the metal poured is returned to the cupola to be remelted in later charges. This scrap, which is sometimes called "home scrap" or "returned foundry scrap," consists of defective castings and sprues from previous heats. The amount of this scrap varies from 25 to 50 per cent of the total metal poured.

In addition to the returned foundry scrap, it is generally necessary to purchase some iron scrap from outside sources. Also, it may be desired to use some steel scrap in the charges for certain types of castings. There is an advantage in obtaining uniform grades of purchased scrap. The composition of the returned foundry scrap will be approximately the same as the castings produced. It is necessary to estimate or actually determine the average analysis of the purchased iron and steel scrap. This information is required when figuring the metal charges.

Changes in Composition Due to Melting in Cupola

Before the amounts of the components in a metal charge can be computed it is necessary to determine the effect of the melting process on the elements in the metal charges. The change in composition of the metal mixture before and after melting will depend largely upon the practice of melting; and for a given installation and a definite practice this variation in composition will remain the same for all heats. By using mixtures of known composition and analyzing the resulting cast metal, the effect of cupola melting on the elements in the charges may be established.

Silicon is partly oxidized in the cupola and the loss is about 10 per cent of the silicon in the metal mixture. Therefore an excess of silicon will be required in the metal charged over the amount specified in the castings.

The manganese content of the metal mixture is also decreased during the melting of the metal in the cupola. A manganese loss of 15 per cent of the original manganese content is generally assumed.

The sulphur content of the metal is increased upon remelting, as the metal takes up sulphur from the fuel. The metal gains in sulphur about 0.02 per cent when melted with coke containing less than 0.75 per cent sulphur.

The action of the remelting process as related to phosphorus is mainly that of concentration, although coke contains about 0.01 per cent phosphorus, which may be dissolved in part by the metal. Phosphorus and sulphur are not oxidized during the melting process, but may be removed from the metal to some extent by the slag. If the average phosphorus content of the metal mixture is below 0.80 per cent, an increase of 0.02 per cent phosphorus in the metal may be used in computing metal mixtures. While it is possible to assume certain changes in the elementary content of the metal charges during melting, it is better practice to determine these factors experimentally for a given cupola practice.

The raw metals are generally procured within the maximum limits of the sulphur and phosphorus requirements of the castings produced. The desired manganese content may be obtained by proportioning the metal charges or by the addition of manganese to the molten metal. The pronounced influence of silicon on the properties of cast iron warrants the practice of using this element as the determining factor in calculating metal mixtures.

After establishing the analysis of the castings, the scrap proportion and the changes incurred in melting, it is possible to determine the exact amounts of the components in each metal charge. In order to illustrate specific methods for making metal mixtures, some hypothetical compositions are used.

The desired analysis of castings and the compositions of pig iron and scrap metals available are given in Table I.

As 10 per cent of the silicon in the total metal mixture is lost in melting, the average silicon required in the metal mixture is found by dividing 1.80 per cent by 0.90 (1.00 minus 0.10), which gives 2.00 per cent silicon in the metals charged into the cupola. The average manganese content of the total metal mixture is obtained by dividing 0.70 per cent by 0.85. The sulphur and phosphorus increase during the melting process, but not in direct proportion to the amounts of these elements in the raw metals. Sulphur increases 0.02 per cent. Therefore the average sulphur content of the total metal mixture is found by subtracting 0.02 per cent from the maximum sulphur content of the castings. The percentage of phosphorus is arrived at by subtracting 0.02 per cent from 0.50 per cent.

A proportion of 50 per cent pig iron and 50 per cent scrap iron is assumed in the charges figured here by way of illustration. Of the total scrap, three-fifths is returned foundry scrap (30 per cent of total mixture), which will have approximately the same analysis as the castings, and two-fifths is purchased scrap (20 per cent of total mixture), which consists of machinery castings. The average analysis of the scrap is found by adding three-fifths of the foundry scrap analysis to two-fifths of purchased scrap analysis.

The average composition of the pig iron mixture may be found by multiplying the average composition of the scrap by its percentage, subtracting this product from 100 times the composition of the total metal mixture charged and then dividing by the percentage of the pig iron used.

$$\frac{(100 \times 2.00) - (1.74 \times 50)}{50} = 2.26 \text{ per cent silicon in pig iron mixture.}$$

$$\frac{(100 \times 0.82) - (0.70 \times 50)}{50} = 0.94 \text{ per cent manganese in pig iron mixture.}$$

As the combined pig iron mixture must average 2.26 per cent silicon, it will be necessary to mix two lots of pig iron with silicon contents above and below this amount. If piles A and B are used, it will be necessary to find the exact amount of metal from each of these piles for one metal charge. The pig iron mixture may be determined by the use of algebra or the application of a simple formula or by a graphical method.

Let M = pounds of metal in one charge.
Let X = pounds of metal from pile A
Then $(M - X)$ = pounds of metal from pile B.
The total silicon in the mixture equals the sum of silicon from piles A and B.

$$(M \times 2.26) = (X \times 2.83) + (M - X) \times 1.34$$
$$2.26M = 2.83X + 1.34M - 1.34X$$
$$0.92M = 1.49X$$
$$\frac{0.92M}{1.49} = X = 0.62M \text{ lb. of metal from pile A.}$$
$$\text{and} \quad \frac{0.57M}{1.49} = 0.38M \text{ lb of metal from pile } B.$$

By the method given above, the proportions of the two piles of pig iron which will produce the exact silicon content in the mixture will be derived. The manganese, sulphur and phosphorus contents of the mixture may be obtained by multiplying the proportions of the two piles of pig iron by the amounts of their elementary constituents.

The Use of Formulas in Making Metal Mixtures

$(0.62 \times 0.96) + (0.38 \times 0.98) = 0.97$ per cent manganese in mixture.

$(0.62 \times 0.04) + (0.38 \times 0.03) = 0.036$ per cent sulphur in mixture.

$(0.62 \times 0.40) + (0.38 \times 0.38) = 0.39$ per cent phosphorus in mixture.

The proportions of metal from two piles of pig iron which will give the desired silicon content in the mixture may be derived by the use of formulas.

Let L = per cent silicon in low-silicon pig iron.
Let H = per cent silicon in high-silicon pig iron.
Let D = per cent silicon desired.

If piles A and B are used, then according to the equations derived in the previous algebraic problem:

$$\frac{D-L}{H-L} = \frac{2.26-1.34}{2.83-1.34} = \frac{0.92}{1.49} = 62 \text{ per cent} = \text{ratio of metal in one charge from high silicon pig iron, pile } A.$$

$$\frac{H-D}{H-L} = \frac{2.83-2.26}{2.83-1.34} = \frac{0.57}{1.49} = 38 \text{ per cent} = \text{ratio of metal in one charge from low silicon pig iron, pile } B.$$

Graphical Methods for Determining Metal Mixtures

A graphical method for determining the proportions of high- and low-silicon pig iron in a mixture having a desired silicon content may be applied as follows: Use piles A and B with the analysis of the pig iron mixture as given in Table I. Refer to Fig. 1 for graphical solution.

First, lay off in any convenient scale, on a base line, the amount of percentage of metal in one charge.

TABLE I

	Silicon, Per Cent	Manganese, Per Cent	Sulphur, Per Cent	Phosphorus, Per Cent
Desired analysis of castings	1.80	0.70	0.08	0.50
Changes in composition	0.20	0.12	+0.02	+0.02
Composition of total metal mixture charged	2.00	0.82	0.06	0.48
Pig iron—pile *A*	2.83	0.96	0.04	0.40
Pig iron—pile *B*	1.34	0.98	0.03	0.38
Pig iron—pile *C*	2.00	0.80	0.04	0.43
Returned foundry scrap (30 per cent of mix used)	1.80	0.70	0.08	0.50
Purchased scrap (20 per cent of mix used)	1.65	0.70	0.08	0.45
Average analysis of scrap (50 per cent of mix used)	1.74	0.70	0.08	0.48
Composition of pig iron mixture (50 per cent of mix used)	2.26	0.94	0.04	0.48

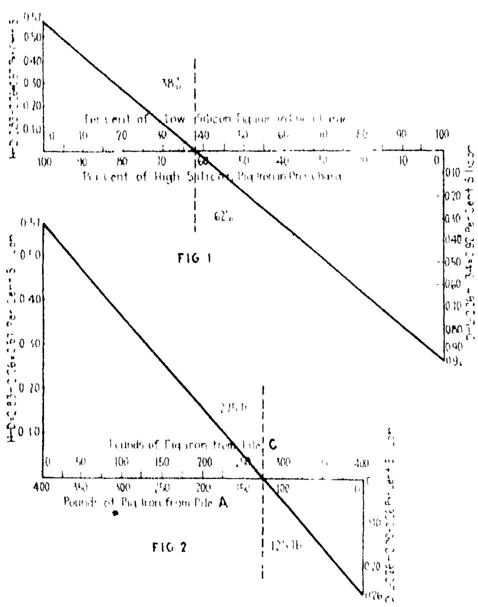
Second, find the difference in the high and desired percentages of silicon in the metal.

Third, plot this difference in any convenient scale, at right angles to one end of the base line.

Fourth, find the difference in the desired and low percentages of silicon in the metal.

Fifth, plot this difference in the same scale as was previously used, at the other end of the base line and in the opposite direction.

Sixth, connect the extremities of the graph by a straight line. The point of intersection will then divide the base line into two parts corresponding to the proportions of high- and low-silicon pig iron in the mixture.



FIGS. 1 AND 2—METHOD OF ESTIMATING CHARGE FOR DESIRED SILICON CONTENT IN CASTINGS

The portion of the total mixture lying adjacent to the *H-D* line represents the amount of metal with a low content of the special element. The portion of the base line lying adjacent to the *D-L* line represents the amount of metal with a high content of the special element.

To illustrate the graphical method by another example: suppose it is desired to mix piles *A* and *C* to obtain 2.26 per cent silicon in the pig iron mixture containing 400 lb. of metal. The solution is given in Fig. 2.

To Obtain Exact Quantities of Two Elements in a Mixture

In the previous problems the amount of pig iron from each of the two piles was found which would give a definite content of one element, silicon, in the final castings. A pig iron mixture may be proportioned to give definitely two elements in the resulting product, providing there are available at least three piles of pig iron with analyses within a limiting range. It is rarely desired to control more than two elements in a metal mixture for cast iron.

In order to determine whether it is possible to obtain the required silicon and manganese contents from three

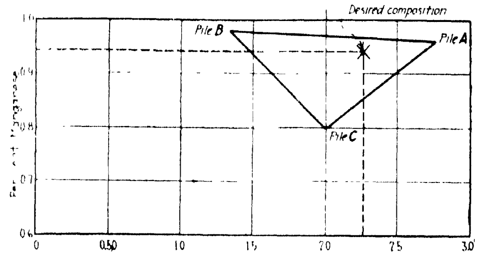


FIG. 3—SCHEME FOR DETERMINING WHETHER AVAILABLE PIG IRON SUPPLIES WILL FURNISH THE DESIRED COMPOSITION

piles of pig iron containing different amounts of these elements, a chart is prepared with two ordinates at right angles on which increasing amounts of silicon and manganese are laid off from the origin. The three points corresponding to the compositions of the three piles of metal are plotted on the chart and connected with straight lines. If the locus of the point representing the required silicon and manganese falls within the triangle, it is possible to mix the three piles of pig iron to obtain the exact silicon and manganese required. All combinations of silicon and manganese represented by points lying outside of the triangle cannot be produced exactly from the three compositions available.

On Fig. 3 the points corresponding to the compositions of the three piles of pig iron given in Table I are plotted. Also, the point corresponding to the desired silicon and manganese in the pig iron mixture is shown. As this point lies within the area of the triangle, it is possible to obtain the desired silicon and manganese in a mixture of the three piles of pig iron. The amount of metal from each of the piles may be determined as follows:

Let M = lb. of metal in total pig iron mixture.
Let X = lb. of metal from pile A.
Let Y = lb. of metal from pile B.
Then $M - X - Y$ = lb. of metal from pile C.

First, balance the equation for silicon

$$2.83X + 1.34Y + 2.00\,(M - X - Y) = 2.26M$$
$$2.83X + 1.34Y + 2.00M - 2.00X - 2.00Y = 2.26M$$
$$0.83X - 0.66Y = 0.26M$$

Second, balance the equation for manganese

$$0.96X + 0.98Y + 0.80\,(M - X - Y) = 0.94M$$
$$0.96X + 0.98Y + 0.80M - 0.80X - 0.80Y = 0.94M$$
$$0.16X + 0.18Y = 0.14M$$

Third, solve for X and Y

$X = 0.55M$ lb. of pig iron from pile A.
$Y = 0.29M$ lb. of pig iron from pile B.
$M - X - Y = 0.16M$ lb. of pig iron from pile C.

Manganese May Be Increased by Ladle Additions

If there is not a sufficient range of composition of pig iron on hand to allow the control of both silicon and manganese in the mixture, or if the manganese is too low in the pig iron available, the manganese content of the metal may be increased by the addition of ferromanganese to each ladle of molten metal. For this purpose, ferromanganese containing 80 per cent manganese is generally used. About one-half of the

manganese added in the ladle is lost by oxidation or in the slag. As the melting point (2,210 deg. F.) of this alloy is close to the melting point of cast iron, the ferromanganese should be crushed, preheated and stirred well into the molten metal.

The task of computing metal mixtures in the foundry may be neglected, unless some simple means is provided for arriving at the correct mixtures. To facilitate the rapid and accurate determination of the charges for cast iron, charts may be prepared from which the relative quantities of the different metals making up the charges may be read directly.

The curves in Fig. 4 have been plotted to obtain directly all possible combinations of any piles of pig iron which will have an average silicon content of 2.10 per cent. Using this figure as the origin, decreasing percentages of silicon are laid off on the base line toward the right. On the left side of the chart are arranged, in columns, the scrap and pig for every possible mixture. Each lot of high-silicon pig is represented by a curve. In order to find the correct mixture of any two cars of pig iron which will produce the desired composition in the castings, a line is drawn

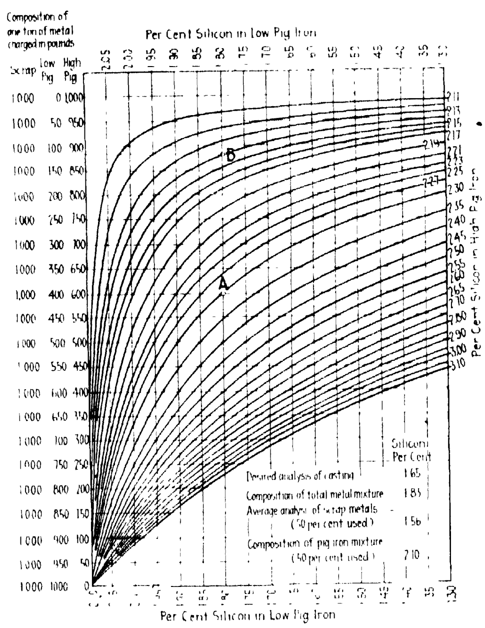


FIG. 4—CURVES FOR ESTIMATING MIXTURES FOR 2.10 PER CENT SILICON CASTINGS

vertically from a point on the base line which corresponds to the silicon in the low-silicon pig to the intersection of the curve which represents the per cent silicon in the high-silicon pig iron; and from this point of intersection a horizontal line is drawn to the left which will indicate the proper weights of scrap, low-pig and high-pig for each charge.

If it is desired to use three or more lots of pig iron to a charge, the mix for any two lots must be found first and then any proportion of the different mixes may be added up to give the full charge.

As an example: Suppose the scrap metals average 1.56 per cent in silicon and there are two cars of pig iron on hand containing 1.80 per cent and 2.30 per cent silicon. Point *A* in Fig. 4 is the intersection of the two curves and the horizontal line through this point indicates that a full charge will consist of 1,000 lb. of scrap, 400 lb. of low-silicon (1.80 per cent) pig iron and 600 lb. of high-silicon (2.30 per cent) pig iron. If in addition to the two cars of pig iron there is in the foundry yard a small pile of 440 lb. of pig iron containing 2.14 per cent in silicon, then the correct charge may be found as follows: It is shown on the chart (point *B*) that 120 lb. of low-silicon (1.80 per cent) pig iron must be mixed with 880 lb. of high-silicon (2.14 per cent) pig iron or that one-half of this mixture will use up all of the 2.14 per cent silicon pig iron. Therefore one-half of this mixture must be added to one-half of the mixture from the two cars in order to give the total charge, which will consist of 1,000 lb. of scrap, 260 lb. of 1.80 per cent silicon pig iron from car, 300 lb. of 2.30 per cent silicon pig iron from car and 440 lb. of pig iron from yard.

In the preparation of similar charts it is first necessary to determine the silicon content of the pig mixture, the total charge and the proportion of scrap to be used. When these values are established, the curve for each high-silicon pig iron may be plotted.

m = lb. of pig iron in one charge.
x = lb. of low-silicon pig in one charge.
$(m - x)$ = lb. of high-silicon pig in one charge.
q = per cent silicon in low-silicon pig iron.
r = per cent silicon in high-silicon pig iron.
s = per cent silicon in pig iron mixtures.

$$(q \times x) + [r \times (m - x)] = m \times s$$

$$\text{therefore } x = \frac{(m \times s) - (m \times r)}{q - r}$$

By fixing m and s and keeping r constant for any curve, x may be found for different values of q. When the points are plotted on co-ordinate paper a set of curves similar to those in Fig. 4 will be produced.

When the melting practice has been established and a chart has been prepared, all possible mixtures may be taken directly from the chart. Slight variations in the analysis of scrap will produce only small changes in the composition of the resulting metal. A separate chart must be used for each different composition of metal required. As most foundries have not more than three standard compositions of castings and the average composition of scrap metals need not vary excessively, a few charts may be prepared and used to great advantage.

Engineering Societies Library

It is perhaps not as widely known as it should be that the United Engineering Societies maintain a very large and efficient library in the Engineering Societies Building, 29 West 39th St., New York City. This library is open to all members of these societies, and to other engineers by courtesy. Members are permitted to withdraw certain books from the shelves, which are mainly duplicates. Most of the readers in the library, however, are interested in matters contained in recent technical periodicals, or are making an extensive search to exhaust a certain subject.

At present the library contains about 117,000 volumes, 32,000 pamphlets and 3,000 or 4,000 miscellaneous pieces of literature. While these are not entirely indexed, in the last 3 years about 150,000 cards have been added to the catalog. There is now available 50,000 subjects presented to prospective readers in a systematic and logical relation. These subjects are handled in two different ways: The searcher who wishes to exhaust his field will find all entries arranged from the large group down to the most minute in one place. The casual reader who wants a minute subject has an alphabetic subject index available.

Legal Notes

By Wellington Gustin
Of the Chicago Bar

Schroder Roofing Patent Invalid

Crushed Slate Used for This Purpose More Than Two Years Before Application

The United States Circuit Court of Appeals has held the Schroder patent No. 1,007,146 invalid because anticipated. The decision was made in a suit brought by the Staso Laminated Slate Co., owner of the patent, against the Stowell Manufacturing Co. 280 Fed. 107.

Crushed Slate Claimed Superior to Ground Product

The patent is for a prepared roofing, which consists of a body portion having a coating of adhesive waterproofing material, such as asphalt and an outer protective coating of crushed slate. The alleged novelty in this patent is twofold: Material and method of application of crushed slate, applied by rolling in contact with an adhesive coating of asphalt. Ground slate had been used in the John's patent of 1872, No. 125,574. It was claimed that crushed slate is superior to other kinds of slate material, because slate laminates when crushed and the laminæ when rolled and pressed together match and overlap one another, so as completely to cover the asphalt coating and give a smooth surface and uniform color which cannot be obtained with a gravel, sand or other crystalline covering. This result cannot be secured, so it was claimed, by the use of ground or powdered slate, because it has no laminæ to match and overlap one another.

The defendant contended that the patent was invalid because Edward J. Schroder was not the original and first inventor, claiming that A. C. Hall was the inventor of substantially the construction described and claimed in the patent which had been in public use or on sale in the United States more than 2 years before the aplication for the Schroder patent.

Similar Product Marketed in 1906

Defendant cited the roofing called "Slateoid" manufactured by the Trinidad Asphalt Manufacturing Co. of St. Louis. This word was registered as a trademark by the company in 1906. It appears that A. C. Hall was employed by the Staso Mills, or Staso Milling Co., of Boston, Mass., as its superintendent from 1906 to 1913. That company was making slate dust in 1906 which was used in making paint and linoleum. This dust had to be screened, and it occurred to Mr. Hall that the larger screenings would make a good material for roofing. He sent samples to various roofing manufacturers, among whom was the Trinidad Asphalt Manufacturing Co. It approved the material and ordered two carloads. The factory of the Staso company was therefore equipped for crushing slate ordered by the Trinidad company. Eight carloads was shipped to that company. The Staso company called the material "torpedo slate." The Trinidad company made and sent sample of Slateoid to the Staso company, and these samples were, Hall testified, like the material manufactured by the Staso Laminated Slate Co. and submitted to him at the trial.

The Trinidad company showed that it manufactured and sold 9,394 squares of "Slateoid," enough to cover 1,657 average size houses, before Sept. 9, 1908, which was 2 years before the application for the Schroder patent. On March 21, 1907, Frank W. Torpening, of the Trinidad company, filed an application for a patent on the Slateoid roofing made by his company. Claim 2 specifies: "A roofing sheet comprising a pliable body, a non-hardening bond applied to said body, and a layer of crushed slate imbedded in said compound, substantially as set forth."

Earlier Application for Patent on Identical Material Rejected

This application was rejected by the Patent Office on the ground that substitution of crushed slate for other material did not constitute invention. This application was filed 3½ years before the Schroder application, using the identical material, crushed slate, and applied in identically the same way.

Complainant disposed of the Trinidad roofing by saying that it was only an experiment and a complete failure, that its manufacture was abandoned, and therefore it should not be held as an anticipation. The court, however, held that such conclusions were not justified by the evidence. It found that substantially the same roofing was successfully manufactured out of the same material, by the same method as described in the Schroder patent more than 2 years before his application. Hence the patent in suit was anticipated and invalid.

The enterprise of the patentee and his assignee was commercially successful. The roofing has been applied in large quantities, both in the form of sheets or roll roofing or shingles. Commercial success is often indicative of invention, but it is not always so, for it may be due to other causes, said the court.

Novel Claim for Damages

Concern Asks Refund for Goods Delivered to It but Not Exportable Because of Embargo

A novel claim for damages is involved in an action brought by the Bencoe Exporting & Importing Co. against the Erie City Iron Works and the John O'Brien Boiler Works Co. The facts appear to be that plaintiff took an order from a Japanese corporation for 300 tons of boiler plates in July, 1917, to be shipped to Yokohama. In order to get the plates plaintiff made a contract with the Aetna Co. to purchase "300 tons of boiler plates for export to Japan," the price being so much per pound "f.o.b. mill Pittsburgh base . . . shipping instructions to be given later." Thereafter the Aetna Co., for the purpose of in part fulfilling its contract, in turn further contracted with the defendant, Erie Works, for 200 tons of the boiler plates. It further appears that at least a part of this order was to be filled through the O'Brien Boiler Works, which in turn had a contract for plates from the Illinois Steel Co. In August, 1917, the President of the United States had ordered that no boiler plates should be delivered for export after certain dates.

Plaintiff charges that the defendant conspired to obtain 200 tons of plates from the Illinois Steel Co. under the latter's contract with the O'Brien Works, by concealing the fact that they were intended to be shipped in fulfillment of an export contract and were not to be

used by the O'Brien Works itself in domestically manufacturing boilers. Having obtained the plates, the defendants shipped the same to the order of the Erie Works in the form required by irrevocable letter of credit previously obtained from the plaintiff. Having been thus paid for, the plates were delivered to plaintiff, but owing to the governmental restrictions they could not be exported nor used to fulfill plaintiff's contract with the Japanese corporation. Plaintiff filed its complaint in two counts, asking $45,000 as damages under the above statement and $50,000 for loss of the sales from the following facts as set out:

The substance of the second cause of action is that on and after Oct. 2, 1917, the plaintiff sold for export certain articles which under the regulations then existing were exportable, providing a license therefor were obtained pursuant to the orders of the President of the United States. The complaint continues that the acts of defendants set forth in the first cause of action, "in procuring by fraud the manufacture and shipment of the boiler plates, were discovered by government agents and reported to the Department of Commerce and by the latter attributed to plaintiff," whereby said department refused all licenses to plaintiff and it lost the sales aforesaid. Its damages were put at $50,000.

The U. S. District Court gave judgment on demurrer and dismissed both causes of action. On appeal the U. S. Court of Appeals reversed the judgment as to the first cause of action and affirmed it as to the second. As to the second, it says a complaint, alleging that illegal acts of defendants were erroneously or stupidly imputed to plaintiff by governmental agents, in consequence of which plaintiff was refused a license to export certain merchandise, the sale of which it had contracted, does not state a cause of action against defendants for damages in the absence of any allegation that defendants communicated with the government agents or in any way caused or contributed to their error.

Exportable Attribute Involves More Than Physical Properties

The court, however, does hold that the first cause of action is a good one, though it is novel and most interesting. The lower court held that the reference in the contract to export of the goods was no more than a "description." Plaintiff contended that what he bought were plates "for export to Japan" and the knowledge that this was plaintiff's bargain was passed on from the Aetna Co. to the Erie Works and to O'Brien. The lower court held the contract required no more than the delivery to plaintiff in the United States of plates physically complying with requirements as to quality, size, etc. Hence since plaintiff had got plates physically acceptable, he had no cause of complaint, for no fraud had been worked on him by anyone, and he got "exactly what he had contracted for." The fact that plaintiff's goods, exactly as contracted for, had been procured for him by frauds or falsehoods worked on the Illinois Steel Co. and the United States was quite immaterial. In terms of the rule of law the lower court held there was no concurrence of fraud and damage to the damage of plaintiff.

But the Court of Appeals could not read the complaint as making the exportable quality or attribute of these boiler plates no more than descriptive. Instead it found that it was part of the original bargain between plaintiff and the Aetna Co., and part of the fractional bargain between Aetna Co. and Erie Works, and something communicated to and known by O'Brien, that plaintiff was not getting what he was entitled to and was not obtaining fulfillment of his contract, unless the plates tendered him had not only the stipulated physical qualities but possessed also the political or legal and additional quality or attribute of exportability.

"Whether there ever was such a singular and burdensome contract we do not know; but we hold it clear that an agreement of that kind is possible, and would be legal, and further that it is such a contract that plaintiff has with reasonable clarity alleged. Therefore he is entitled to an opportunity of proving it before a jury," says the court. (280 Federal Rep. 690.)

Etching Reagent for Steels Containing Chromium and Vanadium

Considerable attention has been paid at the Bureau of Standards to the problem of finding an etching reagent by which chromium carbide could be distinguished from vanadium carbide in a positive and satisfactory manner. Only one out of about twenty reagents tried seemed likely to be of much use in this connection. This is a hot solution of potassium permanganate and sodium hydroxide, etching in which for 1 minute darkens chromium carbide to a strong brown-red or brown color, or rather, the carbon is eaten out, giving the walls of the cavity thus formed a dark brown-red color, while vanadium carbide remains uncolored and apparently unattacked.

Another but less positive means of distinction is that obtained by electrolytic etching with a weak current in a dilute aqueous solution of ammonia or sodium hydroxide. The chromium carbide is eaten out, leaving a dark brown-red or brown cavity, while the vanadium carbide is eaten out apparently at a slower rate, leaving cavities which appear light and not at all darkened.

Second Sorby Lecture

Dr. Cecil H. Desch, professor and dean of the faculty of metallurgy in the University of Sheffield, delivered the "Second Sorby Lecture" on "The Services of Henry Clifton Sorby to Metallurgy." The Sorby lectureship has been instituted by various Sheffield engineering associations to commemorate the work of Dr. Sorby, who rendered such signal service to science in general, and to the special branch of microscopy in particular. It is expected to have a lecture delivered each year by an eminent scientific authority on some subject which arises out of Dr. Sorby's work, and thus promote an increased interest in scientific research. E. J. Thackery, at Sheffield University, is acting as secretary of the fund.

Helium From Canadian Natural Gas

From the physical laboratory at the University of Toronto comes the report that a process for liquefying helium gas has been perfected by Prof. J. C. McLennan. Several years ago Professor McLennan discovered that helium existed in large quantities in natural gas in Canada, and since then various experiments have been made by him to discover such a process.

In 1919 a semi-commercial plant was constructed in Calgary for the extraction of helium from natural gas, the natural gas being piped to Calgary from the Bow Island Field.

Synthetic Ammonia By the Claude Process*

An Outline of Georges Claude's Claims as to the Advantages in the Installation and Operation of Plants Using the Superpressure Method as Compared With the Haber-Bosch Process for Fixation of Atmospheric Nitrogen

TODAY, the production of synthetic ammonia on a commercial scale is well established. As is already well known, the principal process is that of Haber, which is based on the fact that nitrogen and hydrogen are caused to react under the simultaneous influence of pressure (200 atmospheres), heat (about 600 deg. C.) and a catalyst (essentially iron). The process developed by Georges Claude is based on much the same principle, but uses far greater pressure. The difficulties encountered in the use of this superpressure are three in number: Safety, operating difficulties, and cost.

Safety—Obviously, the use of such high pressure calls for very careful selection of materials. There are on the market, however, steel and alloys satisfactory for making tubes which will resist 1,000 atmospheres pressure at 600 deg. C., and catalyzing tubes which will resist more than 5,000 atmospheres. Thus the safety factor is one of construction rather than of construction material.

Operating Difficulties—The main requisite is that the joints be tight. It is known, however, that this depends more on the size of the joint than on the pressure it has to withstand. Considering the relatively small sizes used in the superpressure apparatus to handle the same amount of gas, a tight joint for 1,000 atmospheres, other conditons being equal, is smaller than that needed for 100 atmospheres in some other processes.

Cost—The production of superpressure is not particularly difficult. It will be noted that an ordinary compressor of five cylinders having relative cylinder volumes of 300, 100, 30, 10, and 3 (See Fig. 1) giving 300 atmospheres pressure, will become a supercompressor by the addition of a sixth cylinder having a relative volume of 1, and will be capable of giving 900 atmospheres pressure. Accordingly the additional cost of producing the superpressure is proportionally small.

*Abstracted and translated by J. S. Negru and S. D. Kirkpatrick from papers appearing in the *Mémoires et Comptes Rendus de la Société des Ingénieurs Civils de France*, Bulletin of April-June, 1922

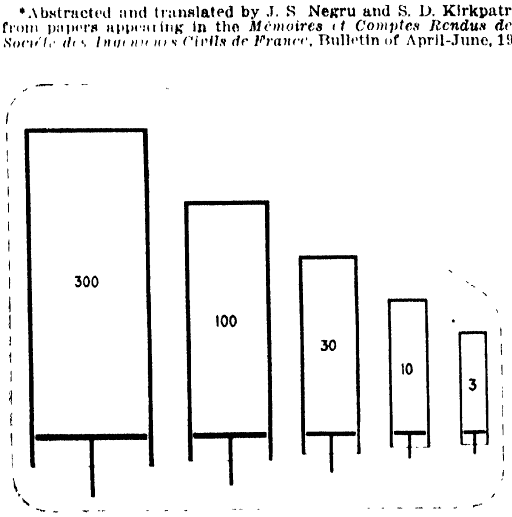


FIG 1—VOLUME RELATION IN A SUPERCOMPRESSOR
The addition of a sixth cylinder of relative volume 1 added to the five other cylinders changes the 300-atm. compressor into a 900-atm. supercompressor.

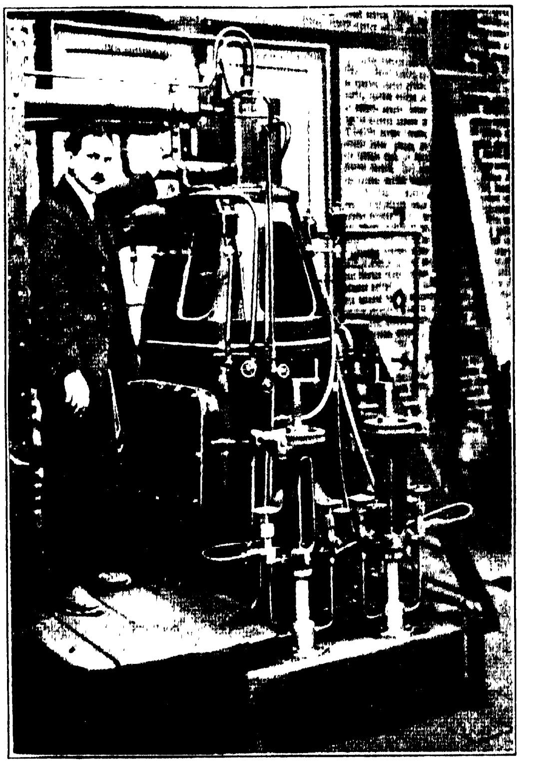


FIG 2—A SUPERCOMPRESSOR AT THE GRANDE PAROISSE PLANT
This compresses 700 cu.m. of gas per hour to 900 atm

Fig. 2 shows the size of a two-stage supercompressor capable of supplying pressure at 900 atmospheres to the volume of gas required for a daily production of 5 tons of ammonia or 25 tons of ammonium sulphate. The operation of the supercompressor is comparatively simple and is said to require no special attention. Fig. 3 shows the assembly of the compressor and the supercompressor. It is an eight-stage apparatus of 300 hp., compressing 700 cu.m. of gas per hour to 900 atmospheres. This particular installation is at the Grande Paroisse plant.

SUMMARY OF ADVANTAGES CLAIMED

The advantages of the superpressure process have been summarized by Mr. Claude as follows:

While the efficiency of the Haber process in terms of ammonia production is 6 per cent, that of the Claude process can reach 25 per cent. This was proved by actual experimentation carried out in the latter part

of 1917. The curves of Fig. 4 show the relation between the pressure and efficiency in ammonia production at temperatures between 500 and 700 deg. C. Curve I shows the theoretical relation, curve II the relation obtained by extrapolation, based on the results obtained by the Haber process, and curve III the relation as plotted from Claude's experiments.

The increased efficiency is not obtained as a result of increased expense, since the work of obtaining superpressure increases only proportionately with the logarithm of the pressure, and if it costs, say, 2.3 to obtain 200 atmospheres pressure, it will cost only 3.0 to obtain 1,000 atmospheres pressure.

It will be recalled that in the Haber processes the gases are forced to pass through the catalyzer tubes many times, and each time the ammonia produced is withdrawn. By the use of the superpressure process, the reaction is highly intensified and larger amounts of ammonia are formed in smaller volumes. Thus for capacities of 100 cu.m. of gas per hour per liter of catalyzer space Claude produces over 5 kg. of ammonia per kilogram of catalyst per hour instead of 0.5 kg. by the Haber process.

The essential characteristic of the superpressure process, of course, is that the installation is in miniature, and this brings with it a great advantage as to

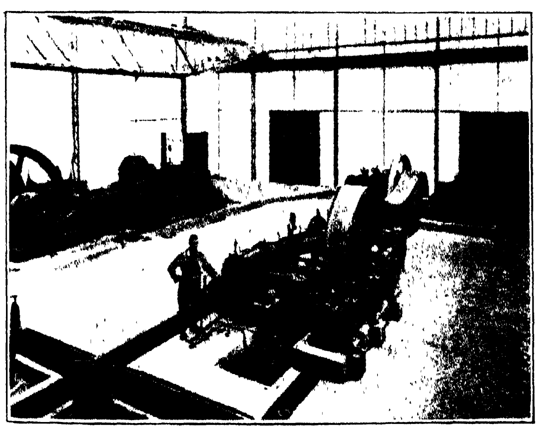


FIG. 3—A 300-HP. SUPERCOMPRESSOR

This machine is for a 5-ton NH_3 plant at Grande Paroisse, compressing 700 cu.m. of gas per hour to 900 atm

cost of installation and operation. Thus Fig. 5 shows the structure for the five catalyzer tubes of a 5-ton per day ammonia plant. Tubing not larger in diameter than a man's thumb is sufficient for a flow of 700 cu.m. of gas per hour. Fig. 6 shows the assembly of the condensation, extracting and storage equipment required by a plant of 2 tons per day of ammonia. These figures show clearly the small size of plants which are reported to be working with entire satisfaction.

With 1,000 atmospheres pressure, at which an efficiency in ammonia production of 25 per cent is easily obtainable, the vapor pressure of the ammonia produced is 250 atmospheres. As the maximum vapor pressure of ammonia at ordinary temperature is only about 7 atmospheres, it is only necessary to pass the reaction gases through a worm pipe condenser immersed in water to liquefy theoretically $(250 - 7) \div 250 = 97.2$ per cent of the ammonia produced. On the other hand, in the Haber process, a 6 per cent efficiency for ammonia production at 200 atmospheres yields a product under only 12 atmospheres of pressure as compared with 250

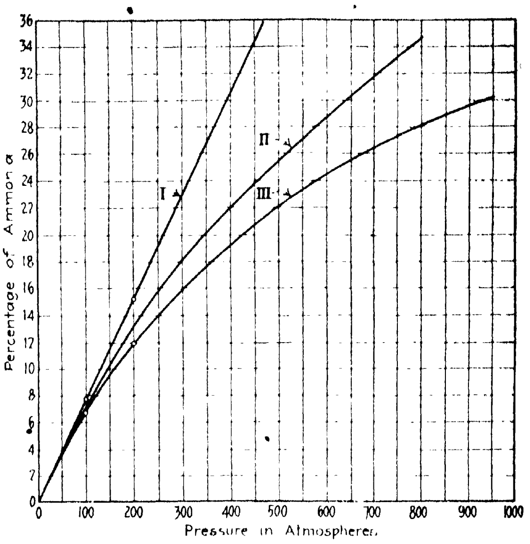


FIG. 4—RELATION BETWEEN PRESSURE AND EFFICIENCY AT THE SAME TEMPERATURES

Curve I—Theoretical relations. Curve II—Extrapolation with Haber's results. Curve III—Claude's experimental results.

in the Claude process, and less than 50 per cent of the formed gas could be condensed with a worm pipe condenser immersed in water. In the Haber process, therefore, it is necessary to remove the ammonia by injecting water under 200 atmospheres pressure, an operation not needed in the Claude process. Furthermore, in the Haber process the water solution of ammonia must be distilled in order to recover the ammonia. Therefore the expense of installation, labor and heat adds to the cost of the final product. In the Claude process, on the other hand, liquid ammonia is obtained as the first product.

Another fundamental difference in the two processes is that in the Haber process the gases must be passed through the catalyzer tubes many times, thus requiring expensive pumps and circulating equipment. In the Claude process it is sufficient to pass the gases through three or four consecutive catalyzer tubes which are separated simply by water coolers. The Claude process therefore does not require the costly heat-exchanging equipment required by the Haber process.

Another very important advantage is allied with the purity of the gases. In the Haber process very high

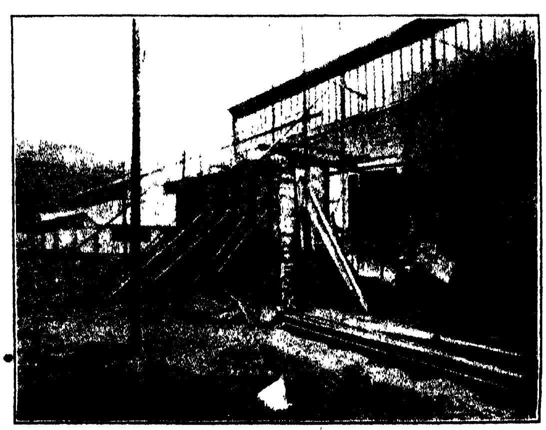


FIG. 5—STRUCTURE CONTAINING FIVE CATALYZER TUBES FOR A 5-TON AMMONIA PLANT

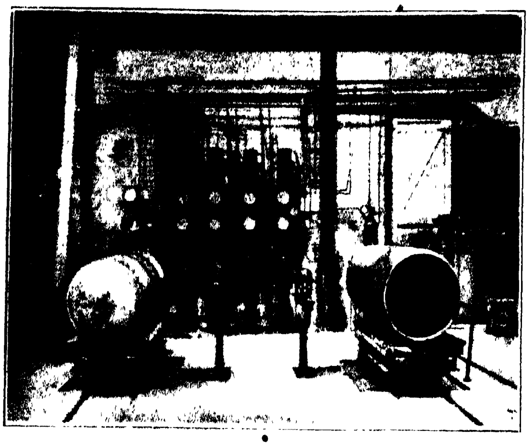


FIG. 6—ASSEMBLY OF THE CONDENSATION, EXTRACTION AND STORAGE EQUIPMENTS FOR A 2-TON AMMONIA PLANT

purification is indispensable. Hence costly absorption towers, batteries of pumps, injectors for circulating under 200 atmospheres pressure the purifying solutions of cuprous formate, caustic soda, etc. In the Claude process these installations are not needed. Here the gases containing as high as 4 per cent of carbon monoxide can be used with entire safety. It is sufficient to pass the supercompressed gases through a simple tube containing reduced iron heated at 300 and 400 deg., whereupon the oxygen burns to water and the carbon monoxide into water and methane, the water being drained out periodically and the methane being without harmful properties as far as the catalyst is concerned. By this simple arrangement the catalyst can last 200 hours.

One of the principal difficulties which was encountered in the superpressure process was to absorb the large amount of heat generated by the reaction. In the Haber process the quantity of heat generated is relatively small, since only 11 per cent of the gases react. In the Claude process, on the other hand, 40 per cent of the gases react under 1,000 atmospheres pressure in a very small volume. As much as 60,000 calories per hour are generated in a tube only 10 cm. in diameter and 2 m. long. This enormous quantity of heat has to be eliminated, and the elimination must take place under the most favorable temperatures so as not to freeze the tubes by too low a temperature and not to destroy the chemical equilibrium by too high a temperature, since this would also destroy the tubes. The problem to be solved was to maintain the catalyst at the most favorable temperature—namely, about 550 deg. C.—and it is necessary that the gases reach the catalyst at this temperature. In the Haber process this is realized by heating the incoming gases with exhaust gases. In the Claude process the special construction of the catalyzer tubes solves the problem of cooling the catalyst, and at the same time enables the heating of the incoming gases with the heat from the catalyst. The catalyzer tubes are constructed as is shown[1] in Fig. 7. The cold incoming gases at A are heated progressively by absorbing the heat of the catalyst in the tube E. This tube is so proportioned that by the time the reaction gases reach the catalyst at the top they are already heated to the required temperature.

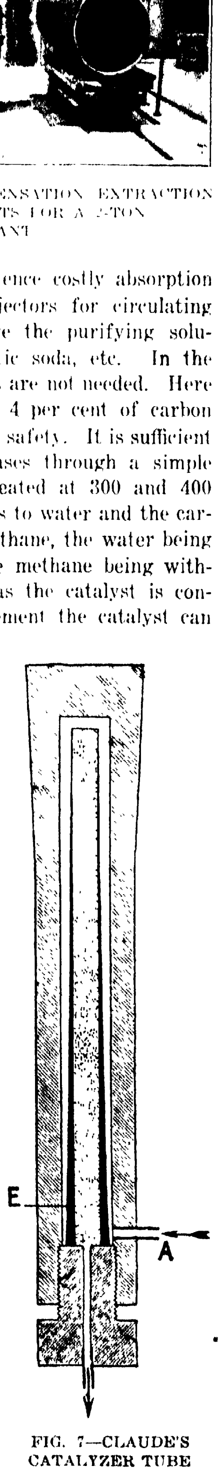


FIG. 7—CLAUDE'S CATALYZER TUBE

By this arrangement both the catalyst and the gases reaching it are at the most favorable temperature without the need of any additional heat exchanges. Furthermore, excessively high temperatures are not reached, so the life of the tube is not endangered.

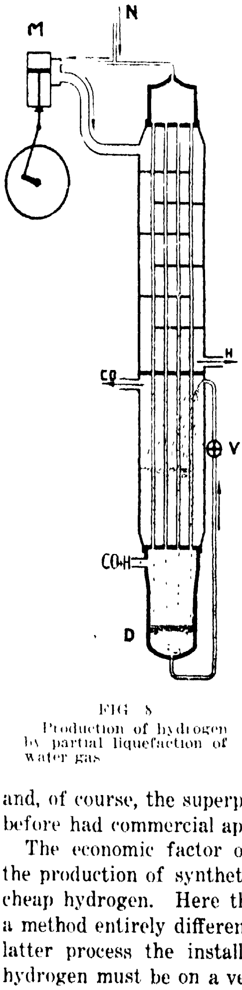


FIG. 8
Production of hydrogen by partial liquefaction of water gas

This arrangement also has the great advantage of permitting the easy handling of the tube and the substitution of tubes with new catalyzing material, much the same way in which shells are loaded into heavy guns.

It is significant that in the Haber patent reference is made to the use of pressures of 200 atmospheres and more, so that it is now rumored that the Badische Aniline & Soda Fabrik would like to claim the application of the superpressures used by Claude. However, all of the literature of Haber and the Badische company states clearly that they had in view only the highest pressures which were then used industrially, and, of course, the superpressures of Claude have never before had commercial application.

The economic factor of predominant importance in the production of synthetic ammonia is the problem of cheap hydrogen. Here the superpressure process uses a method entirely different from that of Haber. In the latter process the installations for the production of hydrogen must be on a very large scale. In the Claude process the installation for this work is on a very much reduced scale and can easily be installed at places where hydrogen is already being produced as a useless byproduct. Thus utilization could be made of the exceptionally cheap source of hydrogen at coke works to be found in all of the leading industrial centers.

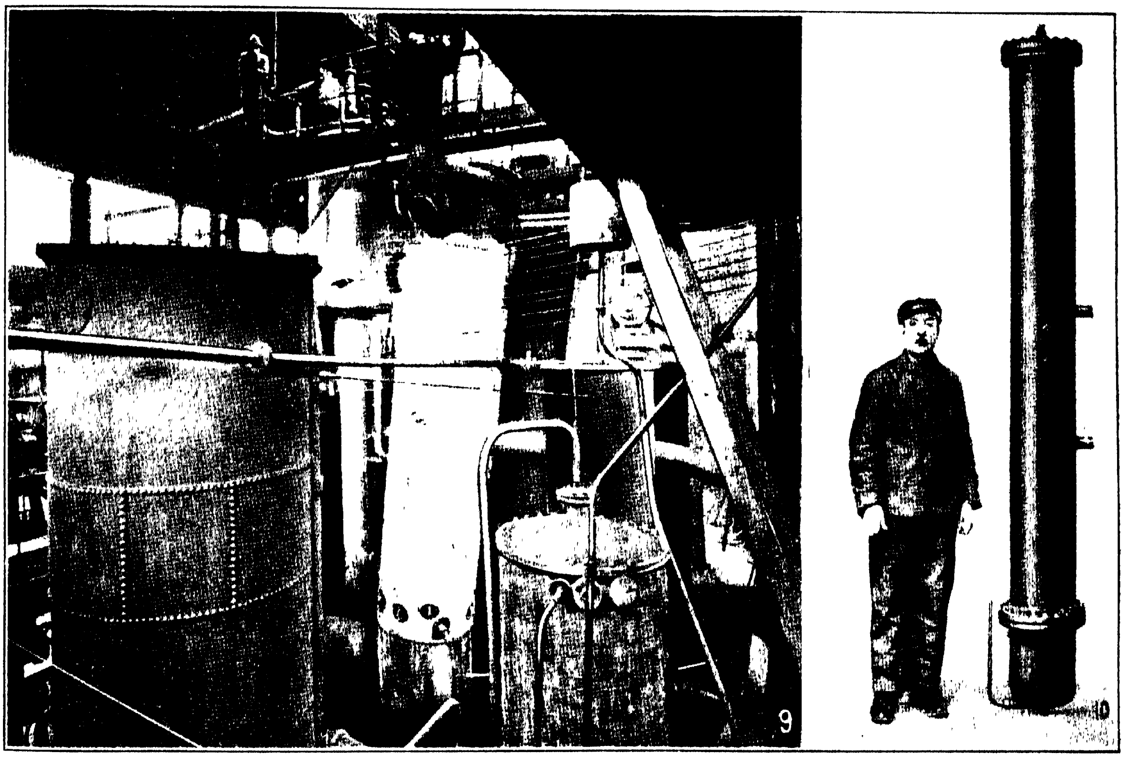
[1]It may be of interest to mention here the typical example of the relation between the chemical and metallurgical industries. The synthesis of ammonia would have been retarded many years if there were no metallurgical products which could resist simultaneously the wide range of temperatures and pressures needed in this important chemical industry. The success of Claude's process is largely to be attributed to the fact that he had unusually good tubes. These were made of an alloy known as B.T.G. of Imphy, which resists perfectly not only the temperatures and pressures used but also the action of the gases. Léon Guillet made a thorough study of this alloy, the chemical analysis of which is C, 0.44; Ni, 60.40; Cr, 8.70; W, 2.52; Mn, 1.80; Fe, 24.73.

It is true, of course, that this crude hydrogen is in realty a complex mixture of hydrogen with nitrogen, carbon monoxide, methane, ethane, butane, ethylene, carbon dioxide, hydrogen sulphide, etc., but Claude has succeeded in purifying it economically. This purification is based on the principle of gas liquefaction, hydrogen being the most difficult to liquefy.

This, of course, is in a field in which Claude's name is already well known. As early as 1903 he had studied the mixture of equal volumes of CO and H (water gas). The gases compressed and purified were cooled and forced to enter a multi-tubular cylinder. (See Fig. 8.) The lower part of the cylinder is immersed in a bath of boiling carbon monoxide, yeilding a temperature of —190 deg. C. at atmospheric pressure. At this temperature, the greater part of the CO in the mixture is liquefied, collected at *D*, and fed through the valve *V* to the exterior bath. The remaining hydrogen and the unconaensed carbon monoxide continue to ascend the tower, where they encounter even a lower temperature at which all of the carbon monoxide is liquefied. This last temperature is produced as follows: Only the pure compressed hydrogen enters the cylinder *M*, where it expands and becomes much colder. This is then returned to the multi-tubular cylinder, thus producing the needed low temperature to liquefy the remainder of the CO in the ascending gases.

The principal difficulty encountered was that at a temperature of —210 deg. C., needed to condense all of the carbon monoxide, there was no known lubricant which could be used to enable smooth working of the motor. This has been solved, however, by a very simple expedient. As the ultimate aim is to have the mixture of pure nitrogen and hydrogen, the introduction of nitrogen before the hydrogen entered the cylinder *M* is not at all harmful. This nitrogen is immediately liquefied after each expansion and the liquid nitrogen acts as a lubricant, since it freezes only at —210 deg. C. This very simple solution of the problem has been a very helpful step toward the practical success of the superpressure process. And so, instead of having an installation of the size shown in Fig. 9, merely two tubes of the size shown in Fig. 10 will be sufficient for the production of 24,000 cu.m. of pure hydrogen per day.

The problem of purification of hydrogen from coke-oven gas is solved in practically the same manner as has been described for water gas, and an apparatus installed at the coke plant of the Béthune Coal Co. now gives 800 cu.m. of pure hydrogen per hour. A plant is now being erected at this same works which will produce 3 tons of ammonia per day, using this source of hydrogen.



FIGS 9 AND 10—COMPARATIVE SIZE OF HABER AND CLAUDE INSTALLATIONS FOR HYDROGEN PURIFICATION
Two tubes of Fig 10 are sufficient to produce the same amount of pure hydrogen as the Haber installation shown in Fig. 9 (24,000 cu.m. per day)

This, it would seem, is the beginning of the practical realization of Claude's plans to have a number of small plants located near the sources of cheap hydrogen and convenient for the cheap manufacture of the finished product (fertilizer).

It may be mentioned that as a byproduct of the operation for the extraction of pure hydrogen from coke-oven gas it will be possible cheaply and completely to extract both the benzol and ethylene.

Although the present variations in the foreign exchanges and labor costs render all figures quite empirical, it may be stated that according to Claude's claims the cost of installation per ton of synthetic ammonia by the superpressure process is less than half the cost when using t' Haber process. The relative simplicity of operation of Claude's process and the fact that it can be installed in small units are also to be taken into consideration.

Influence of Cooling Rate on Properties of Carbon Steel

AT THE recent meeting of the American Institute of Mining and Metallurgical Engineers, Francis B. Foley and Joseph Winlock, of the Bureau of Mines, presented the results of an extended investigation, directed by the late Henry M. Howe, on the "Influence of Temperature, Time and Rate of Cooling on the Physical Properties of Carbon Steel." They had ⅝-in. bars of well-made acid open-hearth steel, with 0.34, 0.52 and 0.75 per cent carbon. These were heated at a uniform rate in groups in a special electric tube furnace and cooled at various rates, ranging from a retarded furnace cooling (0.01 deg. C. per second through Ar) to a 4-second quench in water, followed by air cooling (20 deg. C. per second).

In the so-called "basal" experiments the temperature of annealing (T_{max}) was 10 deg. C. above Ac_3. This temperature was retained 10 minutes, it having been found that this was sufficient to show no ferrite in a quenched and tempered specimen. Longer times and higher temperatures were also investigated.

Optimum values of the physical properties seem to occur with a cooling rate of about 2 deg. C. per second at Ar (resulting from a 2-second quench in water followed by air cooling, $T_{max} = Ac_3 + 10$). Faster cooling rates lower the ductility and impact resistance; slower cooling rates lower all properties measured. A great mass of basal experiments have been summarized in the following equations, in which c is the percentage of carbon, and R is the rate of cooling in deg. C. per second between Ac_3 and 585 deg. C.:

Proportional Limit

$$= 21{,}750\,(1 + \tfrac{1}{2}c) + [(115{,}225c - 101{,}100c^2 - 12{,}250)\sqrt{R}]$$

Yield Point

$$= 25{,}000\,(1 + c) + [(89{,}680c - 86{,}185c^2 - 8{,}080)\sqrt{R}]$$

Tensile Strength

$$= 50{,}000\,(1 + c) + [(7{,}023 - 11{,}450c + 50{,}780c^2)\sqrt{R}]$$

$$\text{Stress of Rupture} = 118{,}000 + 33{,}200\sqrt{R}$$

$$\text{Per Cent Extension in 2 in.} = 52.1 - 61.4c + 22.1c^2$$

$$\text{Per Cent Contraction of Area} = (79 - 61c)\,R^{.05}$$

$$\text{Charpy Impact} = (51.25 - 111.5c + 64.27c^2)\,R^{.29}$$

$$\text{Brinell Hardness} = (97 + 80c) + [100c\sqrt{R}]$$

It is usually thought that more rapid coolings result in greater hardness at the expense of ductility. As a matter of fact *all* measured physical properties[1] get better with increasing speed of cooling up to the mild quench from $Ac_3 + 10$ deg. C. represented by 2 seconds in water and balance in air. Another unusual fact is found when results of these basal experiments are compared with those having higher and longer periods of heating. It is found that hardness (tensile strength, elastic limit and Brinell number) increases when the 0.52 and 0.75 C steels are quenched from higher temperatures (increasing T_{max}), but *all* properties deteriorate with longer time at T_{max}. Time and temperature have hitherto been supposed to act in the same direction, and they do so in the 0.34 C steel—high T_{max} and long time both damaging the metal. Ductility (elongation, contraction and impact) is impaired by both time and temperature in all carbons, but, as just noted, hardness shows apparent anomalies. These may be studied by examining the relationship between diffusion and grain growth, or coalescence.

It is apparent that the actions going on above Ac_3 are largely diffusion of impurities (including carbon) into austenite, an effect which is practically complete within 30 minutes. As the temperature rises, a second effect appears—namely, the growth of austenite grain. Furthermore, the time spent at or just below the Ar range is largely occupied by the coagulation of the cementite and pearlite formed by the break-up of solid solution.

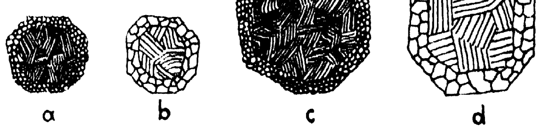
Now, the ferrite shells in a slowly cooled steel inherit the position of the austenitic grain boundaries—if the austenite was overheated for some time the apparent grain size of the cooled steel reflects that fact. However, the cooling of that austenite may have been at such a rate that the minute ferrite and cementite particles thrown out of solid solution (both in ferrite shells and pearlite cores) are extremely fine grained. Then the coarse grain marked by open ferrite shells would be illusory.

The authors illustrate this by the diagram, Fig. 1.

We may therefore have a fine-grained ferrite-carbide structure in a small network *a*, produced by a fairly rapid cooling of a fine-grained austenite; a coarse-grained ferrite-carbide structure in a small network *b*, which results from a very slow cooling of a fine-grained austenite; a fine-grained ferrite-carbide structure in a large network *c*, which results from a fairly rapid cooling of a large-grained austenite; a coarse-grained ferrite-carbide structure with a large network *d*, which results from a very slow cooling of a large-grained austenite.

The ferrite network of annealed hypo-eutectoid steels must be considered a segregate. If this segregate is made up of very fine crystals it is less harmful than one made up of large crystals. Likewise, the grains of pearlite may consist of coarse or fine carbide and ferrite crystals. It is desirable to produce a structure like *a*; but *c* is far better than *b*.

High temperature anneals give coarse-grained, homogeneous austenite, which upon cooling at mild rates gives a structure like Fig. 1 (*d*). As ferrite is the predominant constitutent in the 0.34 C steel, this treatment will do the most damage by producing what is apparently a very coarse grain, and a general deterioration of qualities ensues. On the other hand, uniform austenite will reasonably be responsible for more uniform and fine crystalline pearlite grains of high quality, so that in the higher carbon steels, where the pearlite is the major constituent, hardening and strengthening of the pearlite grain will occur simultaneously with a lower ductility of the pearlite shells.



a b c d

FIG. 1—NETWORK AND GRAIN-SIZE OF FERRITE AND RELATIVE COARSENESS OF PEARLITE LAMELLA

The deduction may be made from all these experiments that ductility and toughness in hypo-eutectoid steel are products of free ferrite, fine crystal structure in both the pearlite and the ferrite binder, and homogeneity in chemical composition.

[1] Except contraction in area, which remains stationary.

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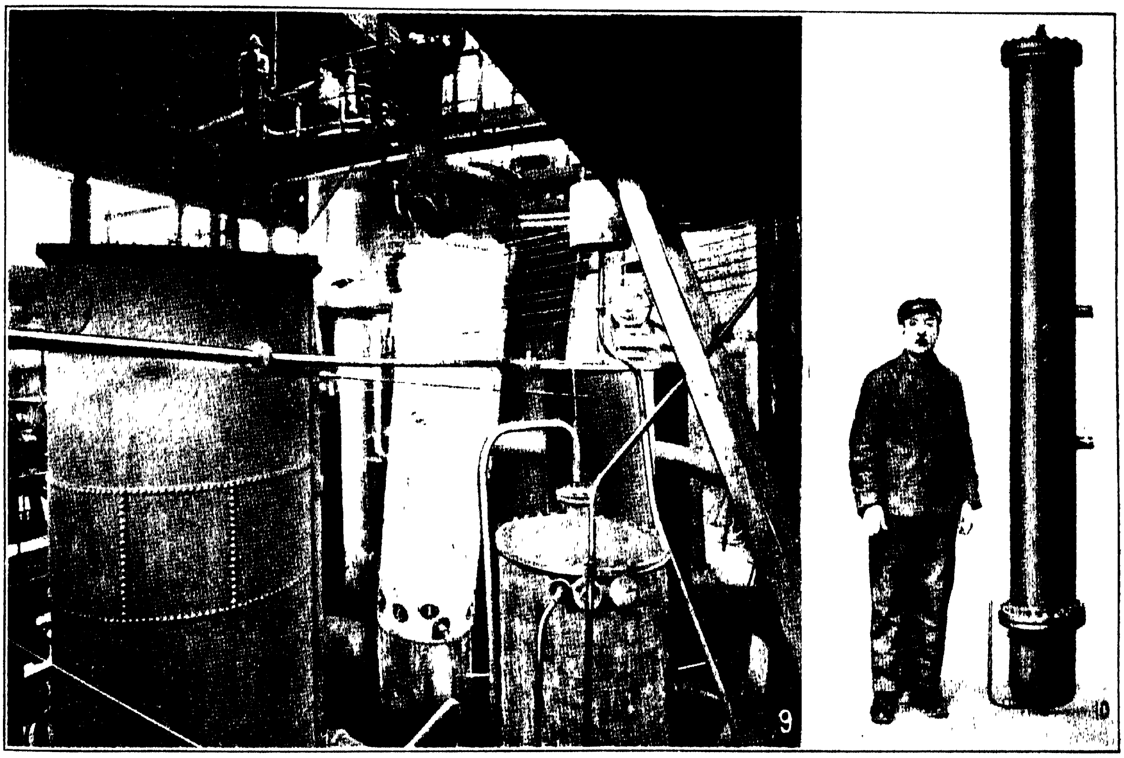

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The principal difficulty encountered was that at a temperature of —210 deg. C., needed to condense all of the carbon monoxide, there was no known lubricant which could be used to enable smooth working of the motor. This has been solved, however, by a very simple expedient. As the ultimate aim is to have the mixture of pure nitrogen and hydrogen, the introduction of nitrogen before the hydrogen entered the cylinder *M* is not at all harmful. This nitrogen is immediately liquefied after each expansion and the liquid nitrogen acts as a lubricant, since it freezes only at —210 deg. C. This very simple solution of the problem has been a very helpful step toward the practical success of the superpressure process. And so, instead of having an installation of the size shown in Fig. 9, merely two tubes of the size shown in Fig. 10 will be sufficient for the production of 24,000 cu.m. of pure hydrogen per day.

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of the commonest ideas is that it is due to grinding the wood in the mechanical pulp mill at too high a temperature, and this idea is put forward in one of the latest books on the pulp and paper industry. In the writer's opinion this idea is quite wrong, except in so far as a high grinding temperature tends to produce considerable flour stock and makes the pulp "slow." In the presence of pitch this fine stock is likely to be picked up by the soft pitch, causing immediate trouble, while a "freer" stock, ground at a lower temperature, would not be so likely to behave thus.

Apart from this it seems obvious that the mere mechanical operation of grinding wood on a stone, even at temperatures as high as 185 deg. F., cannot conceivably cause pitch trouble to originate. Theoretically, the higher the temperature of grinding the less should be the pitch trouble, as the higher temperatures would tend to split off volatile terpenes and modify the so-called rosin-fat which causes the trouble. In connection with this question of temperature of grinding, it is interesting to consider that in Norway about 15 years ago (if not now) both the "hot" ground and "cold" ground processes of making mechanical woodpulp were practiced side by side in the same mill, and the writer had the opportunity of observing these two processes in several of the Norwegian mills at that time. Samples of hot-ground and cold-ground pulp from these mills were extracted by ether, giving the results shown in Table II. The wood used in the Norway samples is believed to have been entirely Norway spruce, the chicoutimi sample being 90 per cent spruce and 10 per cent balsam, and the North Shore sample probably 100 per cent slow grown spruce.

TABLE II—ETHER EXTRACTION OF HOT AND COLD-GROUND PULP

Wood	Per Cent Ether Extract Hot Ground	Per Cent Ether Extract Cold Ground
Norway, *Honefos C*		0.37
Norway, *Vittingfos "V"*		0.35
Norway, *Honefos L*	0.35	
Norway, *Honefos A*	0.30	
Norway, *Vittingfos E*	0.50*	
Canada, *Chicoutimi V*	0.32	
Canada, *North Shore*	0.31	

* Probably an experimental error

There is not much comfort in these figures for the paper mill men who say that "hot" grinding causes pitch trouble. One would suppose from their argument that the hot-grinding process actually increased the pitch content of the ground wood. This latter is interesting when we consider sulphite pulp.

Another idea prevalent in the paper mill in times of pitch trouble is that balsam fir causes the trouble. This idea apparently is based on nothing more substantial than the fact that the bark of balsam exhibits much "Canada balsam"—a gummy deposit, noticeable by everyone. Of course all this bark is "rossed" off before the wood is used, so that theory seems scarcely logical. Again, jackpine has been frequently described as the offender in pitch troubles, with little more justification than in the case of balsam. The other tree or trees—namely, black and white spruce—which comprise the majority of the wood used, seem to have been hardly considered as a possible source of pitch trouble, yet we are told that the spruces contain rosin or pitch ducts, while balsam contains none. Jackpine of course is resiniferous.

Extraction Tests

By Soxhlet extractions of the various woods, first with ether and then with alcohol, we get somewhat different figures for the various woods. The figures of different experimenters do not agree very well. "Green" wood gives different figures from "seasoned" wood of the same species, and the amounts of ether-alcohol extracts vary with the particular part of the tree examined, so that no very definite figures can be given. Table III gives some figures obtained by the present writer.

TABLE III—SOLVENT EXTRACTION TESTS ON WOODS

Sample	Wood	Per Cent Ether Extract	Per Cent Alcohol Extract	Total Extract
1	White spruce (seasoned)	0.40	0.36	0.76
2	Black spruce (seasoned)	0.24	0.36	0.60
3	Balsam (seasoned)	0.85		
4	Balsam (green)	1.20	1.35	2.55
5	Balsam (punky) (rotten)	0.87	1.71	2.58
6	Jackpine (seasoned) (large tree)	2.70	0.99	3.69
7	Jackpine (green) (small tree)	3.24	1.71	4.95
8	Jackpine (river) (seasoned)	2.37	0.77	3.14

TABLE IV—SOLVENT EXTRACTIONS BY JOHNSEN AND HOVEY

Wood	Per Cent Ether Extract	Per Cent Alcohol Extract	Per Cent Total Extract
White spruce	0.516	0.473	0.989
Black spruce	0.32	0.367	0.687
Balsam fir	0.48	0.94	1.42
Jackpine	1.17	0.442	1.61

TABLE V—SOLVENT EXTRACTIONS BY RICHTER

	Ether Extract	Alcohol Extract
Fresh balsam	0.45—0.85	1.15—3.65
Fresh spruce	0.70—1.80	0.70—1.94

TABLE VI—ROSIN-FAT CONTENT OF PULP WOODS

Wood	Per Cent Total Resin	Per Cent Soluble in Petroleum Ether
Black and white spruce	0.80	56
Balsam	1.70	38
Jackpine	1.85	54

In reference to Table III, numbers 1, 2, 3 and 6 were sample slabs, cut from large trees by the forestry department and well seasoned in a dry atmosphere over a relatively long period. No. 4 balsam was a freshly cut 7-in. diameter log, cut 6 miles south of Shawinigan Falls and brought in by sleigh. No. 5 balsam was a 4½-in. diameter log grown in the Abitibi district and probably cut from dead standing timber, as it was badly deteriorated. This sample shows the effect of seasoning, in a decrease in ether soluble constituents and increase in alcohol-soluble substances. No. 7 was from a 5½-in. diameter jackpine, cut by the writer personally for the purposes of this investigation. It was cut in the bush, about 70 miles beyond La Tuque, on Sept. 26, 1922, and the extractions made within 3 days of the cutting. No. 8 was from a 5¾-inch jackpine log taken from the river on Oct. 5, 1922. This was evidently not "green" wood, as it contained only 20 per cent of moisture. Apparently it was seasoned wood, river driven for a short time. The figures therefore are comparable with those of No. 6.

Table IV gives a set of figures obtained by Johnsen and Hovey.

It will be noticed that there are quite large variations between the several sets of figures. On the whole, it might be judged from these figures that balsam and jackpine would most likely be the trees to give pitch troubles.

Referring back to the statement that so-called "pitch" contains about 50 per cent of "rosin-fat," which is the cause of pitch troubles and which is soluble in petroleum ether, we are led to consider Table VI, based on Johnsen and Hovey's figures. From these figures we

see that spruce extract has the highest rosin-fat content, followed closely by jackpine extract, and with balsam much the lowest of the three.

Table VII gives a series of extractions made on ground woodpulp during times of pitch troubles and also during normal operation. We see by this table that there was less ether-soluble rosin in the pulp during pitch trouble times than in the periods of normal operation.

TABLE VII—ROSIN-FAT CONTENT OF GROUND WOOD PULP DURING PITCH TROUBLE AND IN NORMAL OPERATION

Date	Per Cent Ether Extract		Per Cent Alcohol Extract	Per Cent Total Extract	Pitch Troubles
7/20/21	0 45				Yes
11/3/21	0 38	0 55	1 25	1 63	Yes
11/2/21	0 82		0 98	1 80	Yes
11/10/21	0 83		0 61	1 44	Nil
11/10/21	0 70		0 86	1 56	Nil
6/12/14	1 22				
6/13/14	0 55				
6/15/14	0 89	0 85			Absent
6/16/14	1 05				
6/17/14	0 38				
8/29/14	1 03				

Table VIII gives a series of extractions on sulphite pulp mainly during pitchy periods. Referring to Table VIII, No. 1 shows the figures for "green" wood from the river. No. 2 shows figures for partly seasoned wood from the log pile. The extracts in No. 2 are lower than in No. 1. No. 11 was the case mentioned above, where the pitch was found to consist very largely of brass fragments, from machine wire. The figures show a low amount of resin. The reason for pitch trouble in this case was the highly contaminated (with dirt) state of the stock running on to the paper machine and a badly adjusted machine wire. The figures of Table VIII show, on the average, higher extractions during pitchy days, but otherwise there is nothing particular to be learned from them. The figures for jackpine sulphite show large amounts of ether extractions, yet no pitch troubles were experienced, probably due to the fact that the wood was seasoned.

TABLE VIII—ROSIN-FAT CONTENT OF SULPHITE PULP

Test No.	Date	Description	Per Cent Ether Extract	Per Cent Alcohol Extract	Per Cent Total Extract	Pitch Troubles
1	6/1-10/15/20	Average B C P S	1 36	0 68	2 04	
2	12/1/19-3/15/20	Average B C P S	1 02	0 63	1 65	
3	7/20/21	B C P S	1 29			Yes
4	10/27/21	B C P S	1 41	0 29	1 70	Yes
5	11/2/21	B C P S	1 67	0 75	2 42	Yes
6	12/11/21	L P S	1 33			Yes
7		Swedish Sulphite	1 15			
8		U S A G N S	1 46			
9	10/10/13	L P S	1 75	0 60	2 35	Yes
10	9/21/15	B C P S	1 53	0 86	2 39	Yes
11	1919	B C P S	1 27	0 38	1 65	Yes
12	3/3/21	Jackpine B C P S	2 23	0 42	2 65	Nil
13	3/4/21	Jackpine B C P S	2 02	0 43	2 45	Nil

In the whole series of extractions given above for wood, ground wood and sulphite, there is little which points out the cause of pitch forming on paper machines. There have been a number of attempts at explanation by various people, some of the explanations being quite opposed to one another. Cooper states that the trouble originates in the acid system, due to leaks in the gas line, forming particles of calcium sulphate, around which the pitch forms. The present writer has never found excess SO_3 in the burner gases during pitch trouble times and has always held the opinion that the trouble originates in the sulphite pulp alone, to a certain extent irrespective of what species of wood is being cooked, and that only by certain modifications in the cooking process can this trouble be overcome.

Prevention of Pitch Troubles

It has been commonly taken for granted that balsam fir and jackpine are the original culprits, and few persons seem to have thought of spruce as a possible starting point, yet spruce is still the main factor in newsprint making. Wimmer[1] makes some very significant remarks in relation to pitch troubles, emphasizing the following:

1. Many mills using spruce for sulphite are bothered by pitch.
2. To avoid pitch trouble, allow wood to season properly and use hot water to wash stock.
3. It is proved that excessive heat in cooking destroys pitch entirely.
4. When using green or half dry wood (spruce) use a higher free SO_2 and less combined.
5. Use a specially high percentage of MgO in the lime.
6. Put all relief liquor down drain.
7. Arrange for special cooking, so as to reach a temperature of nearly 160 deg. C. before blowing.
8. Use felt covered riffler boards and change often.

These remarks, especially the ones relating to cooking at a high temperature, are most significant, as they are quite in line with what the present writer has found to be the case, working quite independently. Wimmer also stresses spruce as causing the trouble.

The figures in Table VIII show that the wood, in going through the sulphite cooking process, does not lose much of its "pitch" as expressed in ether and alcohol extracts. Lieber states that only about 4 per cent is actually removed in the cooking process, the remaining 96 per cent being left in the cellulose when it is blown out of the digester. This fact alone ought to indicate that it is the sulphite pulp and not groundwood pulp which causes pitch trouble. The writer has examined numerous batches of sulphite pulp during pitchy periods and frequently found relatively large quantities of pitch fragments.

Determining Proper Cooking Temperature

During the past summer pitch troubles were very bad at intervals and a strong endeavor was made to find a remedy. During an especially troublesome period it was noticed that a quantity of twisted and cracked spruce logs were coming from the river. Some of these logs showed much resinous deposit and one particular log, about 9 in. in diameter, was put on the log splitter and split lengthwise. The log had a long wind-crack down the length of the wood and this was filled with a sticky semi-liquid deposit of brown rosin, clearly showing where the pitch trouble was coming from. There was such a large quantity of this sticky deposit that it offered an excellent opportunity for extended investigation. To try the effect of variations in cooking temperature on the pitch, the writer inclosed numerous samples of this pitch in sealed glass tubes, with spruce wood chips and bisulphite cooking liquor and cooked these at varying temperatures.

The results of several of the experiments were most significant and it was found that the pitch remained soft and runny at temperatures up to nearly 300 deg. F. (149 deg. C.), but as this temperature was nearly reached, the pitch began to harden and at temperatures

[1]*Pulp and Paper Magazine* (Canada), vol. 15, No 19

between 150 and 155 deg. C. a decided modification took place in the previously runny pitch. This change, which resulted in a decided hardening of the resinous matter, probably was due either to a splitting off of volatile terpenes or to a drastic modification of the rosin-fat constituent. On opening the tubes it was found that the pitch had not only hardened very materially but had nearly lost its sticky quality. In a tube that had been kept at a maximum heat of about 145 deg. F. the pitch was, if anything, more sticky than when it was put into the tube.

These experiments showed conclusively that 150 deg. C., or about 302 deg. F., was a critical temperature for the pitch and suggested at once that temperatures not below these should be used in cooking if pitch trouble was to be avoided. Previous to this, the common practice in cooking had been to reach a maximum temperature of about 143 to 144 deg. C. In the light of the above experimental results, the cooking temperature was at once put up to a maximum of 150 to 155 deg. C., with the gratifying result that the pitch troubles in the paper mill showed a most conspicuous decrease, and that during the warmest and most pitchy month of the year—August.

It is suggested that to avoid pitch troubles, the following points be observed:

1. Throw aside all logs showing evidence of wind-cracks and showing resinous matter.
2. Bring the temperature of the cook before blowing to at least 150 deg. C. and preferably to 155 deg. C. for, say, half an hour to an hour. (Possibly less time would do.)
3. Keep the stock, whether groundwood, sulphite or machine stock, free from dirt, including such things as undissolved dyestuffs.
4. Keep the groundwood pulp as "free" as is possible in good practice.
5. Keep the temperature of the dilute stock running on the paper machine as low as is practicable.
6. Season all wood as far as is practicable.

SUMMARY

1. Groundwood pulp is probably never the starting point of pitch troubles.
2. Spruce wood and not balsam or jackpine is probably the first cause of pitch trouble.
3. Experiments carried out by the writer show that if pitchy pulp be raised to temperatures above 150 deg. C. in the digester, pitch troubles on machines are almost eliminated.
4. When using pitchy wood (green) the manner in which sulphite cooks are made, particularly as regards temperature, determines whether pitch trouble will occur or not.

Correction

In the Feb. 28 issue of *Chem. & Met.*, in an account of the recent national boll weevil meeting at Atlanta, Ga., we included part of the address on the arsenic and calcium arsenate shortage as having been delivered by "Howard Armbruster" of New York.

As will probably have been surmised by our readers, the author's correct name is Howard W. Ambruster, whose previous contributions to *Chem. & Met.*, will be remembered as having prophesied months ago the acute shortage of arsenic which finally developed as a result of the boll weevil situation.

Dealers Forbidden to Pose as Manufacturers

Progressive Action Taken in Paint Case by Federal Trade Commission

The Federal Trade Commission has recently decreed that a firm advertising as a manufacturer and not owning or controlling a factory is engaging in unfair competition. The American Turpentine Co., a firm trading under the name of the North American Fibre Products Co. and situated in Cleveland, Ohio, advertised in such a way as to indicate that its products (paints, varnishes, etc.) were manufactured in its own factories. Purchasers were thereby led to believe that they were saving the cost of a middleman.

On investigation, it was discovered that neither the American Turpentine Co. nor the North American Fibre Products Co. owned or controlled factories located in various cities throughout the United States, and that these factories listed in their advertisements were in reality those of manufacturers from whom they purchased goods for resale purposes. The commission has therefore issued an order that a firm must not advertise as a manufacturer unless factories are actually owned or operated by it.

Sulphur-Free Lye Used for Odorless Manufacture of Chemical Pulp

The majority of the cellulose industries in Sweden have adopted a newly invented method of producing cellulose, under the supervision of E. L. Rinman, according to a recent article in *Canadian Chemistry and Metallurgy*. Lyes are used that are free from sulphur, and chemical products of high value are produced from the organic substances that have been dissolved by the waste lye. The sulphate method uses sulphur-bearing lyes and consumes as fuel the organic substances contained in the waste lyes. In the actual production of cellulose, the two methods are not unlike. They differ essentially, however, in the comparison of the boiling solvent, as well as in the further treatment of the waste lye.

By the use of a sulphur-free lye, Dr. Rinman has succeeded in making the manufacture of cellulose entirely odorless, thereby overcoming a difficulty which countless efforts in the past have failed to remove. Moreover, considerable economic advantage results from the utilization of the large amount of organic substance, comprising from 50 to 60 per cent of the volume of the wood which normally escapes during the boiling of the cellulose and passes into waste lye.

Spontaneous Changes in Precision Balances

The Bureau of Standards has carried out successive tests on two of its highest grade analytical balances. These balances have been used constantly but with extreme care for some years. Both balances showed appreciable changes in the ratio of the arms of the beam which could not be explained as the result of wear of the knife edges. The bureau considers that these alterations are the effect of spontaneous changes in the beam, probably caused by the gradual release of stresses set up during the manufacture of the balance. This study corroborates evidence of such changes noted in many balances of this type and supports the long-established policy of recommending that analytical and similar balances be checked occasionally by the users.

Synopsis of Recent Chemical & Metallurgical Literature

Marketing of Chromite

The chemical industry is one of the large consumers of chromite, which it uses for the manufacture of sodium and potassium chromates and bichromates, chromium pigments and various derivatives used in tanning and dyeing. Edward Sampson, of the U. S. Geological Survey, in an article in the Feb. 24 issue of *Engineering & Mining Journal-Press*, makes the following statement regarding the industrial consumption of chromite:

"Recently one of the largest importers made an estimate for me of what he considered the present requirements of these industries. The following are his figures as compared with the 1918 estimate of the War Industries Board:

ESTIMATED CONSUMPTION OF CHROMITE, IN PER CENT OF TOTAL

	1918	1922
Ferrochromium	52	40
Refractories	17	35
Chemicals	31	25

"The 1918 estimate was on the basis of a consumption of 130,000 tons and the 1922 estimate is on the basis of a consumption of about 110,000 tons, which is probably too high."

Domestic sales, imports and apparent consumption of chromite in the United States in 1917 and 1917-21 are shown to have been as follows:

(In Long Tons)

Year	Domestic Sales	Imports	Apparent Available Supply
1913	255	65,180	65,435
1917	43,725	72,063	115,788
1918	82,430	100,142	182,572
1919	5,079	61,404	66,483
1920	2,502	150,275	152,777
1921	282	81,836	82,118

How Chromite Is Sold

Chromite is usually sold on yearly contract or in shipload lots. Sampling is by an independent chemist, and payment is made according to his report. The common terms are 75 per cent on arrival of steamer, and the balance on report of sampler.

The basis on which the price is fixed varies according to the use to which the ore is to be put. Ore for refractories is sold at a flat price with a guaranteed chromic oxide content—for example, 40 per cent, rejectable if below 38 per cent. A minimum quantity of silica is guaranteed in ore for refractory purposes—generally a minimum of from 5 to 8 per cent. Ore for ferrochromium and for chemicals is paid for according to the chromic oxide content. At present such ore is sold on the basis of 50 per cent Cr_2O_3, with an adjustment per unit above or below that figure. The unit is 1 per cent of Cr_2O_3 per long ton. During the war domestic chromite was sold on direct unit-price basis, the unit price varying according to the grade of the ore. The sale of chromite by the long-ton basis is a reflection of the fact that British interests have long controlled the market.

Nitrogen Distribution in Vertical Retorts

The problem of the reaction of nitrogen in coal during treatment in gas works is one of the important problems of the gas industry today. In the *Gas Age-Record* for Feb. 14, 1923, C. H. Stone, of the Rochester Gas & Electric Corporation, discusses the subject of the distribution of nitrogen in the products of carbonization obtained from vertical retorts.

It is stated that the subject of nitrogen is particularly important at the present time, due to the increased production of ammonia which follows on the increased use of the byproduct oven for gas production.

Yield of Ammonia

At present only 15 to 25 per cent of the nitrogen in the coal is recovered as ammonia, the remainder going mostly into the coke, partly into the tar, and partly into the gas. In the A.G.I. report for 1908 we find that for horizontal retorts 43.31 per cent of the total nitrogen in the coal goes into the coke as nitrogen; 2.98 per cent goes into tar as nitrogen; 15.16 per cent goes to liquor and gas as ammonia; 1.43 per cent goes to liquor and gas as cyanogen; and 37.12 per cent goes into the gas as nitrogen, or is accounted for as lost.

The *Journal* of the Society of Chemical Industry, vol. 23, page 581, states that the ammonia yield is 34 per cent more in vertical retorts than in horizontal, and the following table is given for the distribution of nitrogen:

N_2	Foster	Knoblauch	McLeod	Short
As NH_3	14.50	12-14	17.1	15.16
As CN	1.56	2.0	1.2	0 43
In coke	48 68	50 0	58 3	43 31
In tar			3 9	2 98
In gas	35 26	30 0	19 5	37 12

Yields by Various Processes

The following table gives some idea of the yield of ammonia from various methods of retorting coal. Of course the yield obtained varies from day to day with the kind of coal, with the heat used, with the amount and duration of the charge, with the amount of steam admitted, and other factors. This table gives also results from two horizontal retorts and one inclined retort in order to form a basis of comparison between the different types of retorts. Bolz in *Journal of Gas Lighting* gives the ammonia produced in per cent from different kinds of installations as follows:

Bolz	Dessau	Munich Chamber	Incl Retorts	Incl Retorts	Hor. Retorts
0.325	0 325	0 26	0 26	0.26	0.26

Inclines—Frank Huber, *Proc. A G L*, 1914, average for 13 years, NH_3, 5 002 lb

As shown by these figures, there is a wide divergence both in the yield of ammonia and in the distribution of the nitrogen in products of carbonization. For this reason it is necessary to make determinations of these figures for every individual installation, and with that fact in mind the author of this paper investigated the plant with which he is connected at Rochester, N. Y.

The Investigation at Rochester

The installation at Rochester consists of U.G.I. vertical retorts, each holding 1 long ton of coal. These retorts are ordinarily charged at intervals of 11¾ hours. The temperatures used are 2,300 deg. F. at the bottom and 1,600 deg. F. at the t' of the retort. The gas passes directly from the retort through the hydraulic main to a primary condenser of the Doherty washer-cooler type, in

Important Articles In Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem. & Met.* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. Those that are of unusual interest will be published later in abstract in this department; but since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage. The magazines reviewed have all been received within a fortnight of our publication date.

GAS PRODUCERS T R Wollaston. *Iron and Coal Trades Review*, Feb. 9, 1923, p. 196

HEAT-TREATMENT OF ELECTRIC CARBON AND ALLOY FORGING STEELS Larry S Barton. *Forging and Heat Treating*, February, 1923

COPPER-ALUMINUM-NICKEL ALLOYS. Leon Guillet. *Rev Met.*, February, 1923

LEACHING AND EVAPORATING: Account of Discussions by Chemical Engineering Group, Society of Chemical Industry, under Chairmanship of J. A. Reavell. *Chem.*, pp 147-8, Feb. 16, 1923

PROBLEMS CONNECTED WITH SAPONIFICATION OF FATTY OILS H. M. Langton. *J. Soc Chem Ind*, pp. 51-57T, Feb. 16, 1923

SOME NEW DERIVATIVES OF BITUMINOUS COAL Archibald R. Pearson. *J. Soc. Chem Ind*, pp 69 72T., Feb. 16, 1923.

ELIMINATION OF WASTE IN PAPER MAKING B T McBain. *Paper*, Feb. 28, 1923, vol 31, No 19, pp 7-9.

CHINA CLAY INDUSTRY Supplement *Chem Age* (London), Feb. 17, 1923.

EFFICIENCY OF THE BASIC OPEN-HEARTH PROCESS *Iron and Coal Trades Review*, Feb. 9, p 183.

NEW ELECTRICALLY OPERATED TOP-ROLL BALANCING GEAR *Iron and Coal Trades Review*, Feb 2, p. 161.

NEW DESIGN OF CONTINUOUS FURNACE. *Iron and Coal Trades Review*, Feb 2, p. 155

THE FLOW OF METAL DURING FORGING. *Forging and Heat Treating*, January, 1923, p 25

TECHNICAL VOCABULARY OF THE FOUNDRY. *Brass World*, January, 1923, p. 4

which it is cooled by a spray of weak ammonia liquor. It then passes to the exhauster, through a second washer-cooler, to the intensive scrubber, purifiers, light oil scrubber, feeder and holder.

The coal used at Rochester showed 1.75 per cent nitrogen and the coke showed 1.16 per cent. Therefore 0.94 per cent of the weight of the coal was the amount of nitrogen to be distributed among the products of carbonization. This is with an assumed make of 70 per cent coke. The total free nitrogen in the gas which came from the coal was 1.73 per cent by volume. Of the nitrogen in the products of distillation we find the following distribution:

	Per Cent Nitrogen by Weight
Lower hydraulic	
Liquor and tar contain as NH_3	0.10
Tar contains as CN	0.000007
Liquor contains as CN	0.00045
Upper hydraulic	
Tar contains as NH_3	0.13
And primary liquors contain as NH_3	1.37
Tar contains as CN	0.00048
And primary liquors contain as CN	0.016
Primary tar contains as NH_3	0.77
Primary tar contains as CN	0.00039
Gas contains as NH_3	21.94
Gas contains as CN	2.64
Gas contains as nitrogen	73.01

Calculating the ammonia from all sources, the results are as follows:

Total yield	Lb.
From coal	5.58
In gas at outlet of primary	976.47
In lower hydraulic tar and liquor	4.45
In upper hydraulic tar	5.91
In primary tar	34.44
In primary and upper hydraulic liquors	61.03
For the 12-hour test, all sources	1082.30
Now 0.94 per cent of the weight of coal is nitrogen, would yield	4441.00

so that we find 1082 × 100 ÷ 4441, or 24.4 per cent, of the possible ammonia yield was obtained. This shows pretty conclusively where there is room for improvement.

RESULTS FROM THE TEST

Incidental to the test the following was ascertained:

	Gal
Total tar and liquor from the lower hydraulic for 24 hours (*w*)	473.6
Total tar from the upper hydraulic for 24 hours (*x*)	5249.8
Total tar from the primary hydraulic for 24 hours (*y*)	2555.4
Total liquor from primary and upper hydraulic for 24 hours (*z*)	1317.6
Grains of ammonia per gal in (*w*)	151.5
Grains of ammonia per gal in (*x*)	15.8
Grains of ammonia per gal in (*y*)	188.7
Grains of ammonia per gal in (*z*)	648.4

From the study several conclusions may be drawn:

1. About one-half of the nitrogen in the coal goes into the coke.
2. Of the remainder nearly three-quarters goes into the gas as nitrogen.
3. The total ammonia recovered is only about one-quarter of what it might be if all of the nitrogen in the products of distillation were made into ammonia.
4. Most of the cyanogen goes off with the gas.
5. There is but little cyanogen in any of the liquors or tars, at least in those prior to the secondary condenser.

As for the ammonia, it is clear that a large part of the nitrogen of the coal not only goes to waste, but does actual damage in lowering the calorific value of the gas. It is believed that a method can and will be devised whereby a much larger percentage of the nitrogen will be recovered as ammonia, which will provide needed materials for other manufacture. In conclusion, the author states that no account has been taken of nitrogen in organic combinations other than cyanides. He states that he believes this amount to be too small to be of consequence, but that he will examine into the matter later.

Ingot Defects in Acid Open-Hearth Steel

F. Pacher presents a lengthy review of the problem of sound ingots in *Stahl und Eisen*, 1922, vol. 42, pp. 485-492, 533-540 and 537-577. The sources of defects due to tapping, ingot molds, casting and the character of solidification are enumerated. Some interesting experiments on water and oil mixtures are noted, and certain deductions bearing on the behavior of molten steel and slag are discussed. The respective advantages of top-pouring and of bottom-casting are given. At the moment top-casting is finished, the metal at the top of the mold is the hottest—that circumstance favors the soundness of the ingot. On the other hand, the metal rises more slowly when bottom-casting, and a cleaner skin is generally obtained; these advantages, however, are bought at a price, and the dimensions of the ingots are to be taken into account if they are to be realized.

During the solidification period the steel is subject to dangers arising from uneven temperature conditions and from mechanical forces; thus the quality of the best-melted steel may be seriously impaired. The most serious danger lies in the piping, which is usually accompanied also by axial sponginess and by contraction cavities and cracks. In practice an effort is made to pour at the correct casting temperatures; conditions insuring that temperature will incidentally help to lessen the piping area.

The chemical composition of steel plays an insignificant rôle when compared with changes which result from defects arising during casting and cooling down of the ingot. Therefore every means must be taken to avoid these defects and to obtain sound ingots.

Influence of Phosphorus on Brasses

A. Portevin has discussed this question before the Nancy Congress of the Technical Foundry Association of France. The question having been put to him whether any deleterious effects may result from the presence of phosphorus in cast brasses, two series of alloys with increasing amounts of phosphorus were prepared and tested. In the first series (α brass) the copper content was about 68 per cent, in the second ($\alpha + \beta'$ brass) about 58 per cent. Both sand-cast and chill-cast bars were tested. The results tabulated in the paper show that up to 0.05 per cent phosphorus does not affect the mechanical properties in any considerable degree; on the contrary, if 0.50 per cent is reached, a considerable decrease in resilience and in elongation after rupture occurs.

Microscopical investigations show that phosphorus is responsible for the occurrence of a new constituent, most probably the phosphide Cu_3P. This constituent appears in the first series when the percentage of phosphorus reaches 0.05 per cent, and in the second series after 0.50 per cent. These figures may be taken to represent the solubility of phosphorus.

The velocity of cooling does not seem to affect the rate of separation of the phosphides, neither does it alter the relative amounts of α and β' in the second series of alloys.

It follows that up to the content of 0.05 per cent, phosphorus would not cause any inconvenience in brasses; it will, however, be different with higher amounts.

In his concluding remarks the author draws attention to the fact that phosphorus will not act as a deoxidizer in brasses, as the heat of formation of the oxide of zinc is greater than that of phosphorus, and consequently the former will remain in solution even in the presence of phosphorus. For its elimination more powerful deoxidizers, like magnesium or aluminum, would be needed.

Reclamation of Used Petroleum Lubricating Oils

In Technologic Paper 223 of the U. S. Bureau of Standards, Dr. W. H. Herschel and A. J. H. Anderson describe a series of tests with an apparatus for reclaiming oil which has been subjected to severe conditions of service. By the use of a coagulant it was found that reclaimed oils could be obtained which would stand the usually accepted tests such as viscosity, flash point and sediment, although the flash point was slightly lowered. The authors do not regard the tests as conclusive in regard to the efficiency of the process in reducing the organic acidity, since the oils they used had not been in service long enough to become very acid. The necessity of reducing this acidity to a low value is, however, open to question, since there appears to be no danger that the acidity would ever become high enough to cause corrosion, except perhaps of lead and zinc. The cause of sludge formation in a used lubricating oil is not at all clear, but it appears to differ from an emulsion in requiring considerable time for its development. As an oil continues in use for some time it accumulates dust, carbon and other materials in a finely divided state, and the most probable explanation appeared to be that the sludge is a case of a permanent emulsion due to carbon or dust in a colloidal condition. However this may be, it is evident that all finely divided as well as coarse impurities should be removed from used oils in reclaiming them.

Recent Chemical & Metallurgical Patents

Converting Formates Into Oxalates—According to the invention described in this patent, the formate is converted directly into the oxalate without the addition of any foreign substance, in the presence of air, and by simply and efficiently arranging and controlling the heat zones to which the formate is subjected. The apparatus in which this reaction is carried out provides for passing the formate through a preliminary heating zone by which it is rendered plastic and then subjecting it to heat not greater than 220 deg. C., by which the formate is rendered molten. At this temperature the formate is stable and there is no liability that it will be converted into carbonate. Having slowly raised the temperature of the formate to 220 deg. C., the liquid formate is then suddenly raised to the temperature necessary to drive off its molecule of hydrogen—i.e., to a temperature between 360 deg. C. and 440 deg. C. This is accomplished by spreading the liquid formate thinly over hot surfaces at the requisite temperature. By this means the liquid formate is converted into oxalate almost instantly—that is to say, the conversion does not take more than 2 or 3 seconds. From this brief outline of the process it will be recognized that the quantity of carbonate produced is negligible. The great difficulty heretofore existing in the manufacture of oxalate from formate has been to raise the temperature to the point at which it converts the formate into oxalate so rapidly that carbonate formation will be prevented (1,445,162; Herman W. Paulds, assignor to Royal Baking Powder Co. Feb. 13, 1923.)

Preventing Evaporation of Stored Liquids—Among the more important patents affecting the petroleum industry is one recently granted to Frank A. Howard, George H. L. Kent and James M. Jennings, covering the invention of a foam or foam-producing liquid intended to float upon the surface of volatile liquids such as crude petroleum, gasoline and the like, for the purpose of preventing evaporation. The foams described are permanent or stable in character—that is, they do not break down for a considerable storage period. They retain their fluent condition during their entire life, or they may be such as to congeal or solidify at ordinary atmospheric temperatures.

The liquid base for the preparation of a foam in accordance with the present invention may contain from 5 to 15 per cent of water, although preferably between 5 and 8 per cent. From 3 to 10 per cent of glue is incorporated in the liquid together with 5 to 15 per cent of cornstarch or an equivalent starchy material. Glucose or an equivalent material, such as blackstrap molasses, and glycerine are incorporated in the liquid, the combined proportion of these added constituents being from 40 to 80 per cent. From 4 to 8 per cent of calcium chloride is included in the mixture. Apparently this increases its tensile strength at low temperatures. A suitable setting agent, such as ferrous sulphate, is incorporated in the extent of from ½ to 2 per cent. From ½ to 1½ per cent of a suitable foaming agent, such as the sodium salt of sulphonic acids obtained from mineral oil sludge, may be incorporated, together with a suitable preservative as desired.

An example of a suitable foam-forming liquid, prepared in accordance with this patent, would be as follows: glucose, 50 per cent; glycerine, 24 per cent; cornstarch, 10 per cent; calcium chloride, 5.5 per cent; glue, 3 per cent; ferrous sulphate, 0.1 per cent; sulphonic acid salt, 1 per cent, borax, 1 per cent, and water, 5.4 per cent. (1,443,538; assigned to the Standard Development Co. Jan. 30, 1923.)

Nitrocellulose Composition—Hans T. Clarke has discovered that a nitrocellulose composition of desirable properties can be obtained by compounding cellulose nitrate with the salicylates of the higher aliphatic alcohols, such as normal butyl salicylate, amyl salicylate and isobutyl salicylate. The ingredients are combined by the use of a common solvent.

He incorporates in 400 to 600 parts of an acetone and methyl alcohol mixture, 100 parts of nitrocellulose, 20 to 60 parts of fusel oil, normal butyl alcohol, isobutyl alcohol and 1 to 70 parts of normal butyl salicylate. The ingredients are of commercial grades,

American Patents Issued Feb. 27, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem & Met.* readers. They will be studied later by *Chem. & Met.'s* staff and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,446,461—Method of and Apparatus for Measuring Gas. Charles W. Hinman, Winchester, Mass; Nathaniel C Nash, Jr, executor of said Charles W. Hinman, deceased.

1,446,480—Process and Apparatus for Fume Control. Robert S Perry, New York, and Paul W. Webster, Pelham Manor, N. Y, assignors to Perry & Webster, Inc, New York.

1,446,546—Method and Apparatus for the Fixation of Nitrogen. Charles H Buettner, Cincinnati, Ohio

1,446,550—Process of Removing Impurities From Resorcin. Thurston N. Dissosway, Flatbush, N. Y., assignor to Dissosway Chemical Co., Inc., Brooklyn, N. Y.

1,446,551—Process of Purifying Resorcin. Thurston N. Dissosway, Brooklyn, N. Y., assignor to Dissosway Chemical Co., Brooklyn, N. Y.

1,446,578—Process of Making Sulphates. Harry Pauling, Berlin, Grunewald, Germany.

1,446,606—Process and Apparatus for Extraction of Oils From Vegetable Matter. Matthew Whitehead, Kingston-upon-Hull, England, assigor of one-half to Ernest Scott, Kingston-upon-Hull, England

1,446,637—Manufacture of Lithopone. Frank G. Breyer, Palmerton, and Clayton W. Farber, Bowmanstown, Pa., assignors to the New Jersey Zinc Co., New York.

1,446,651—Continuous Evaporator for Vegetable and Fruit Pulps. Fernando C. Marzo, Placentia, Calif.

1,446,736—Manufacture of Hydrogen and Oxygen. Farley Granger Clark, Toronto Ont., Canada.

1,446,737—Treatment of Raw Rubber and Like Plastic Substances. Samuel Cleland Davidson, deceased, late of Belfast, Ireland, Alfred Agar, Holywood, Ireland, and Hugh Taylor Coulter, Belfast, Ireland, executors.

1,446,778—Process for Electrical Precipitation of Suspended Particles From Gases. Gustav A. Witte, Philadelphia, Pa, assignor to International Precipitation Co. Los Angeles, Calif.

1,446,818—Production of Diarylguanideno. John Young, Caldwell, N. J., and Elmer G. Crookman, Buffalo, N. Y., assignors to National Aniline & Chemical Co, Inc, New York.

1,446,844—Drying Kiln. Alexander R. Duff, Toronto, Ont., Canada.

1,446,863—Gypsum Calcining Apparatus. Sheldon E. Townley, East Orange, and Frederick E. Townley, Newark, N J

1,446,872—Process of Making Organic Oxides. Benjamin T Brooks, Bayside, N. Y.; assignor to Chadeloid Chemical Co, a corporation of West Virginia

1,446,873—Process of Making Chlorhydrins of Organic Liquids. Benjamin T Brooks, Bayside, N. Y., assignor to Chadeloid Chemical Co., a corporation of West Virginia.

1,446,874—Process of Dehydrating Chlorhydrins. Benjamin T. Brooks, Bayside, N. Y., assignor to Chadeloid Chemical Co., a corporation of West Virginia.

1,446,888—Method of Treating Fibrous Material. Eduard Dyckerhoff, Blumenau, Germany.

1,446,933—Process for the Manufacture of Black Carbonaceous Pigment. Vernon H. Schnee, Ithaca, N. Y.

1,446,953—Process for the Recovery of Tin and Iron Products From Tinned-Iron Waste. Harry V. Welch, Los Angeles, and Walter A Sheek, Long Beach, Calif assignors to International Precipitation Co., Los Angeles, Calif.

1,446,984—Method of Revivifying Spent Catalysts and Apparatus Therefor. Thomas Midgley, Jr., Dayton, Ohio, assignor, by mesne assignments, to General Motors Research Corporation, Dayton, Ohio

1,447,008—Fuel and Method of Producing Same. Lindon W. Bates, Mount Lebanon, N. Y.

1,447,014—Ejecting Apparatus for Exhausting Air or Other Fluids. Raymond N. Ehrhart, Pittsburgh, Pa., assignor to Elliott Co., Pittsburgh, Pa.

1,447,052—Method and Apparatus for Removing Liquid and Salt Deposits From Gas Wells. Michael M. Sweetman, Kansas City, Mo.

1,447,128—Self-Regulating Ammonia-Making Process. Luigi Casale, Rome, Italy, assignor to Casale Ammonia Co., Lugano, Switzerland.

1,447,143—Manufacturing of Lead Alloys. Walther Mathesius, Charlottenburg, Germany.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

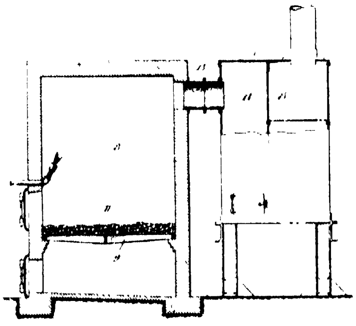
having sufficient purity to provide the necessary transparency and comparative freedom from color required by the finished film. The ingredients are thoroughly mixed and filtered if desired. The film made from this solution still contains the higher alcohols in part with the nitrocellulose and butyl salicylate, and these have the effect of enhancing the stability of the film as well as increasing its flexibility. (1,444,333; assigned to the Eastman Kodak Co. Feb. 6, 1923.)

Cellulose - Ether Composition — In order to provide a solvent which will dissolve such large proportions of cellulose ethers that thick or viscous solutions may be obtained for use in plastic and film-making arts, and also to provide a cellulose-ether solution which may be manufactured into a strong, flexible, transparent film, Stewart J. Carroll has secured a patent for a special combination of solvents. He has discovered that a satisfactory and useful solvent may be prepared by mixing various alcohols with phenyl propyl alcohol. For instance, he combines methyl alcohol, ethyl alcohol, propyl alcohol, isopropyl alcohol, butyl alcohol (normal, iso or secondary) and fusel oil or the amyl alcohols, either singly or in various mixtures, with phenyl propyl alcohol. The proportions may be very greatly varied in a very useful range, from 50 to 10 parts by weight of alcohol mixed with 50 to 90 parts of phenyl propyl alcohol. The patent points out that the phenyl propyl, being of comparatively low volatility, remains in considerable amounts in the film and imparts useful properties to it. (1,444,331; assigned to Eastman Kodak Co. of Rochester, N. Y. Feb. 6, 1923.)

Cellulose-Ether Composition—A patent designed to accomplish somewhat the same object as outlined in the patent just described (1,444,331) has been granted to William R. Webb and assigned to the Eastman Kodak Co. In the process described in this patent a cellulose-ether such as water-insoluble ethyl cellulose is dissolved in a mixture of ethylene chlorhydrin and methyl alcohol or other lower monohydroxy aliphatic alcohol. The proportions recommended are 1 part of ether to 4 to 6 parts of ethylene chlorhydrin. (1,444,406. Feb. 6, 1923.)

Manufacture of Anthraquinone and Phthalic Anhydride—Heretofore one of the principal methods of preparing anthraquinone has been by the high-temperature catalytic air oxidation of anthracene, the anthracene being in more or less high state of purity—that is to say, it contained from 70 to 100 per cent of anthracene. It is now reported that anthraquinone can be produced efficiently from anthracene press cake by the oxidation of the anthracene in the press cake; that phthalic anhydride is produced at the same time by the oxidation of the phenanthrene in the press cake; and that the carbazol present in the press cake may be recovered by prior separation before the substances are passed over the catalyst. Or, if desired, the carbazol may be allowed to remain and a large proportion of it passes over the catalyst unchanged and can be recovered along with the products of oxidation. The catalyst used for this operation consists of vanadic oxide, although oxides of molybdenum or chromium may be employed. (1,444,068. H. D. Gibbs, assignor to E. I. du Pont de Nemours & Co. Feb. 6, 1923.)

Recovery of Potash From Distillery Waste—Carl Haner, Jr., of Baltimore, has assigned to the U. S. Industrial Alcohol Co. a patent for recovery of potash from the distillery waste or slop left after the alcohol has been separated from the alcohol producing material. As indicated in the diagram, the distillery waste is forced through nozzle 1 into the heated chamber 8. The chamber is originally heated by means of a bed of coal labeled 11. Later the process is self-supporting as far as heat is concerned. Potash separates as an



ash from the burning waste and falls to a large extent through the grate bars 9 and is collected in the clean-out pit. The gases pass through pipe 13 into a chamber 14, down which the gases are forced by means of a baffle plate 15. The potash which remains in the flue gases is thus separated out here and cleaned out occasionally through the clean-out doors. It will be noted that the waste is sprayed upward in the combustion chamber and furthermore during the operation the grate bars must be raked with a rabble to facilitate the passage of the potash. (1,444,833. Feb. 13, 1923.)

Refractory—As a lining for heating furnaces in general, and for electric furnaces in particular, Charles A. Scharshu has patented and assigned to the General Electric Co. a refractory consisting of a mixture of crystallized magnesia, calcined magnesia and a carbonaceous binder, heated to from 1,700 to 1,800 deg. C. under conditions permitting elimination from the surface of the carbon residue resulting from decomposition of the binder. The mass is thus converted into a sub-vitreous condition by condensation of sublimed magnesia in intercrystalline spaces.

It is claimed for a refractory lining made in this way that it may be used without appreciable softening at the highest temperatures used in electric steel furnaces and at these temperatures the lining is converted into a mass so hard that it has a metallic ring at operating temperatures. It is also claimed that the lining so made has great resistance to chemical action of slags even at the highest temperatures. This lining is strong mechanically and has not cracked or deteriorated under an almost indefinite number of furnace runs. There is no expansion or contraction at temperatures up to 1,800 deg. C. (1,444,527. Feb. 6, 1923.)

Solidifying Materials—This invention is for the purpose of solidifying various materials, more particularly those which change during the process of manufacture from a viscous condition to a crystalline condition with the evolution of heat. Materials of this kind are combined by boiling the ingredients in a container and the resulting mixture is then permitted to cool. Due to the evolution of heat during the process of crystallization, a great deal of time is necessary for the cooling to take place, and with some mixtures such a high temperature is reached that the mass fuses and becomes difficult to grind. Also, if allowed to solidify in large masses, the material becomes difficult to remove from the containers.

The objects of the present invention are to expedite the crystallization of the material, to enable it to be easily ground, to eliminate much of the work incident to removing the material from the container and generally to simplify the process.

The method employed is as follows: The material while in liquid form is spread in a thin layer on a cooling surface in the form of a drum. It remains on this surface until cool and in a viscous condition. The drum is cooled by the circulation of a cooling medium through its interior. It is revolved by mechanical means and in the course of its revolutions a scraper removes the viscous material from its surface at the desired point. After the material is removed from the cooling drum it is spread out on a traveling belt, on which the crystallization takes place. Since the material is in the form of a thin layer on this belt while the crystallizing process is under way, the heat evolved is readily dissipated, hence shortening the time required for solidification. The conveyor is made sufficiently long for the crystallization to take place completely, and at the end of the conveyor the crystallized material is dumped off into a bin, hopper, car or wherever may be desired. (1,445,004. Edwin Cowles, assignor to the Electric Smelting & Aluminum Co., of Lockport, N. Y. Feb. 13, 1923.)

Pure Liquid Hydrocyanic Acid—W. G. Dingle was awarded patent 1,304,745 dated May 27, 1919, relating to the preparation of crude liquid hydrocyanic acid. The present patent deals with the production of pure liquid hydrocyanic acid. This is accomplished by condensing the gas to liquid form and reconverting it into gas before it is finally condensed. (1,445,303. Feb. 13, 1923.)

British Patents

For complete specifications of any British patent apply to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

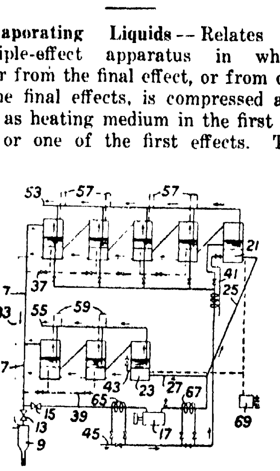
Treating Silicates—Insoluble minerals containing alkali metals, such as feldspar, are heated with fusible salts at a temperature not higher than about 650 deg. C., or less if the heating is effected under pressure. The reaction mixture is extracted with water and the soluble alkali salts separated in known manner. Suitable fusible salts mentioned are the chlorides of calcium, barium, iron, zinc, manganese and aluminum; magnesium sulphate; and barium nitrate. Mixtures of these salts may be employed. In an example, 100 parts of ground feldspar are heated with about 200 parts of calcium chloride at a temperature of 650 deg. C., and the resultant mass extracted. Hydrated calcium chloride may be used if the heating is effected under pressure. (Br. Pat. 188,454. Plauson's, Ltd., London. Dec. 30, 1922.)

Cellulose Ethers—The inventor proposes to reduce the quantity of water present during etherification by addition of dehydrating compounds, in amounts preferably less than half the weight of the cellulose. The amount of caustic alkali or other base used in the etherification is at least equal to and preferably exceeds in the ratio of 3:1 to 10:1 or more the weight of water present or added. By the use of such water-binding agents, the alkali is more firmly seated on or united to the cellulose, and the etherification may be carried out with reduced quantities, even down to theoretical quantities, of alkali and etherifying agent. Suitable water-binding agents are the oxides of the alkali and alkaline earth metals, the hydrides of calcium and magnesium, the metals calcium, barium and sodium, and sodamide and sodium ethylate powder.

The compounds formed by the union of the water-binding agent with the water present may constitute in part or wholly the alkali or base necessary for the etherification; the hydroxides of the alkaline earth metals may be employed as the base, but with these, being weaker, the etherification may be conducted at temperatures higher than those necessary with the caustic alkalis.

In order better to control the temperature during the removal of the water, the water-binding agents are preferably incorporated in the presence of diluents or solvents such as benzol, toluol, carbon tetrachloride, ether, ligroin or benzene, and the mixture is strongly cooled; the solvents or diluents may also be employed during the etherification. The initial material is either cellulose or a near conversion product insoluble in dilute alkali at ordinary temperatures, or alkali-soluble cellulose derivatives from which such alkali-insoluble cellulose or conversion products may be reconstituted, or such reconstituted products themselves. In examples, cellulose impregnated with water is kneaded with sodium oxide either alone or with an addition of caustic soda and preferably in the presence of a diluent such as benzol, while cooling strongly, and to the mass which contains either no water or a very reduced quantity, diethyl sulphate is added, the temperature being maintained at 60 to 80 deg. C., or even at ordinary temperature or lower; instead of diethyl sulphate the corresponding methyl ester may be used, the temperature in this instance being maintained at 0 deg. C. or lower, for example, at —5 to —10 deg. C.; cellulose impregnated with water and caustic soda is kneaded with calcium oxide, preferably in the presence of benzol, etc., while strongly cooling, and the etherification is effected by the addition of diethyl sulphate with or without the addition of a further quantity of solid caustic soda, the temperature in this instance being between 60 and 130 deg. C. Alternatively, the water-binding agents may be added partly or entirely during the etherification. Specifications 12854/12 and 6035/13 are referred to. (Br. Pat. 187,639. H. Dreyfus, London. Dec. 20, 1922.)

Evaporating Liquids—Relates to multiple-effect apparatus in which vapor from the final effect, or from one of the final effects, is compressed and used as heating medium in the first effect or one of the first effects. The



energy required for the compression is derived from a natural direct source of mechanical energy, such as a fall of water, and heat losses are made up by steam from an electrically heated boiler, the energy for which is derived from the same source. The ordinary steam supply and condensing arrangements are retained in order that the amount of evaporation effected by the steam and by the energy of compression may be varied. Liquid is added to the vapors before or after compression, so as to absorb the superheat and generate makeup vapors. As applied to the apparatus described in specification 187,-260, in which a number of multiple-effect plants with overlapping temperature ranges are used and in which the final effects of each plant are connected to a main 7 which leads by a valve 13 to a condenser 9, a branch pipe provided with a valve 15 leads to a compressor 17, the compressed vapors being led by pipes 25, 27 to the heating spaces 21, 23 of the first effects of each plant. The condensates from each effect are cooled by flashing off vapor into effects at lower pressures and pass by a main 33 to the condenser 9. The liquid to be evaporated fed through a pipe 45 may be preheated in coils 65, 67 by the vapor before or after compression and by non-condensible gases withdrawn from the heating spaces of the first effects of each plant by valved pipes 41, 43. Non-condensible gases from the later effects are withdrawn by pipes 37, 39 leading to the main 7. The liquid to be evaporated is fed in parallel to the effects of each plant and the concentrated liquid is withdrawn in parallel through pipes 53, 55, vapors being flashed off to cool the liquid by connections 57, 59 to effects at lower pressures. Steam may be supplied to the heating spaces of the first effects from an electrically heated boiler 69. (Br. Pat. 188,703. T. Rigby, Westminster. Jan. 10, 1923.)

Preventing Incrustation and Corrosion—To prevent or reduce the corrosive or fouling action of water on the walls of a boiler or on brass, copper, tin, rubber, glass, earthenware and the like, a mixture of one or more soluble chlorides and one or more soluble chromates or bichromates is added to the water. Sodium, potassium, ammonium or zinc chromate is preferably used. (Br. Pat. 188,778. E. R. Jones and W. S. Smith, Westminster. Jan. 10, 1923.)

Ferric Oxide Absorbent Gel—Ferric oxide is prepared in a form suitable for use in the absorption or adsorption of condensible gases and vapors. A ferric hydroxide gel precipitated from a ferric salt solution is washed, filtered, pressed and dried slowly, first at a moderate temperature and then at a higher temperature. The hydroxide gel is preferably precipitated from a concentrated ferric salt solution by means of a dilute caustic alkali or alkali-carbonate solution, the precipitant being slowly added to the ferric salt solution, with agitation, until a thick paste is obtained. The precipitate is washed with water containing small amounts of dissolved matter, filtered and pressed into slabs or extruded through holes in a die. The first drying is effected slowly at a temperature of 26 to 36 deg. C., a hard brittle product being obtained. The second drying is accomplished either in a current of air at a temperature of 110 to 160 deg. C., or in a vacuum, in which case the temperature is preferably raised slowly from 100 to 160 deg. C. and may afterward be slowly increased to 250 deg. C. (Br. Pat. 188,786. B. Lambert, Oxford. Jan. 10, 1923.)

Phenylglycine—Phenylglycine is obtained from trichlorethylene and aniline by a modification of the process of specification 173,540. One molecular proportion of trichlorethylene is slowly pumped into a mixture of slightly more than one molecular proportion of aniline and a base such as milk of lime at 170 to 180 deg. C. An example of the method is given, the phenylglycine salt obtained being worked up in the usual manner. (Br. Pat. 188,933. British Dyestuffs Corp., Ltd., and M. Wyler, of Blackley, Manchester. Jan. 10, 1923.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

World Petroleum Output Shows Increase in 1922

American Petroleum Institute Estimates 11 Per Cent More Production Than in Previous Year

Mexican Official Figures Show Drop

THE American Petroleum Institute estimates the world's petroleum production in 1922 at 851,540,000 bbl., compared with 765,065,000 bbl. reported by the U. S. Geological Survey for 1921. The increase in 1922 amounted to 84,475,000 bbl., or 11.3 per cent.

The United States produced 551,197,000 bbl. in 1922, or 64.7 per cent of the total world production. In 1921 the United States produced 472,183,000 bbl., or 61.7 per cent of the world production in that year. The increase in the United States production in 1922 amounted to 79,014,000 bbl., or 16.7 per cent. Mexico produced 185,057,000 bbl. in 1922, amounting to 21.7 per cent of the world production. In 1921 Mexico produced 193,397,587 bbl., or 25.3 per cent of the total production that year. The decrease for Mexico in 1922 amounted to 8,340,587 bbl., or 4.3 per cent. In 1922 the United States and Mexico combined produced 86.4 per cent of the world production and in 1921 87.0 per cent. Substantial increases in production in 1922 are shown by Persia, Peru, Sarawak, Argentina and Venezuela, while Colombia showed its first commercial production.

Wherever possible 1922 production figures are official final figures or official estimates. In converting the figures of certain countries from tons to barrels, equivalents are stated in United States barrels of 42 gal., based upon the average specific gravity of the oil of each country. All the figures shown for 1921 are those reported by the U. S. Geological Survey.

Estimated World Petroleum Production	1922, Bbl	*1921, Bbl
United States	551,197,000	472,183,000
Mexico	185,057,000	193,397,587
Russia	35,091,000	29,150,000
Persia	21,154,000	16,672,540
Dutch East Indies	16,000,000	16,958,105
Roumania	9,817,000	8,368,000
India	7,980,000	8,000,000
Peru	5,332,000	3,699,280
Poland (Galicia)	5,110,000	5,167,000
Sarawak	2,915,000	1,411,000
Argentina	2,674,000	1,747,410
Trinidad	2,445,000	2,354,000
Venezuela	2,335,000	1,433,000
Japan and Formosa	2,004,000	2,447,000
Egypt	1,188,000	1,255,000
France	494,000	392,000
Colombia	323,000	
Germany	200,000	200,000
Canada	179,000	190,338
Italy	31,000	34 400
Algeria	9,000	2,688
Others	5,000	2,652
Total	851,540,000	765,065,000

* Figures for 1921 are those of the U S Geological Survey.

The Institute estimates that the daily average gross crude oil production in the United States for the week ended March 3 was 1,795,400 bbl., as compared with 1,784,700 bbl. for the preceding week, an increase of 10,700 bbl. The daily average production east of the Rocky Mountains was 1,165,400 bbl., as compared with 1,154,700 bbl., an increase of 10,700 bbl. California production was 630,000 bbl., the same as the previous week.

The following are estimates of daily average gross production for the weeks ended March 3, Feb. 24, 1923, and March 4, 1922:

Daily Average Production
(Figures in Barrels)

	1923 Mar. 3	1923 Feb 24	Difference	1922 Mar. 4
Oklahoma	414,400	406,550	Inc 7,850	345,500
Kansas	80,600	80,950	Dec. 350	82,000
North Texas	51,100	50,250	Inc 850	50,850
Central Texas	120,550	124,050	Dec 3,500	205,150
North Louisiana	71,300	70,750	Inc. 550	116,500
Arkansas	105,600	103,750	Inc 1,850	34,300
Gulf Coast	104,450	106,450	Dec 2,000	107,950
Eastern	108,000	107,000	Inc. 1,000	110,000
Wyoming and Montana	109,400	104,950	Inc. 4,450	57,800
California	630,000	630,000		310,000
*Total	1,795,400	1,784,700	Inc. 10,700	1,420,050

* Daily average production.

The total production of petroleum in Mexico during the year 1922 was 185,057 249 bbl., a decrease of 9,698,463 bbl. from the previous year, when the total production was 194,755,712 bbl., according to figures compiled by the Mexican Service Bureau from the official documents of the Secretaria de Hacienda y Credito Publico.

Of the total 46,763,959 bbl. was produced in the Tampico district, an increase of 4,653,302 bbl. over the previous year, and 138,280,924 bbl. in the Tuxpam district, a decrease of 14,362,098 bbl. from the previous year. In addition to these two fields, the Mexican Eagle produced 12,366 bbl. in the Isthmus. The production of the Tuxpam-Isthmus zones is light oil and that of Tampico is heavy oil, with the exception of 1,450,279 bbl. of heavy oil produced in the Tuxpam district by well No. 2, Molino, of the Penn-Mex. Fuel Co. and wells Nos. 2 and 6, San Gerenimo, of the Mexican Eagle.

The largest producer was the Huasteca Petroleum Co., with 55,604,871 bbl., all of which was light oil and represents 30 per cent of the entire Mexican production. This is an increase of 26,140,165 bbl. over the previous year, or 88.7 per cent (in addition the Mexican de Pretroleo, South America, another subsidiary of this company, produced 1 833,554 bbl. of heavy oil). This is a remarkable showing in view of the fact that the entire production was in the south fields, where there has been a considerable amount of salt water invasion.

The exports from Mexico for the year 1922 were 180,872,239 bbl., an increase of 8,557,907 bbl. over the previous year, when 172,304,332 bbl. was exported. This increase of exports was due in a large measure to the increased production of Huasteca Petroleum Co. and the drawing of oil from storage by the other companies. The largest exporter was the Huasteca Petroleum Co., with 39,508,879 bbl., which consisted mainly of 32,315,793 bbl. of fuel oil and 5,892,654 bbl. of crude gasoline.

Calendar

The following important technical meetings are scheduled for the immediate future:

AMERICAN CHEMICAL SOCIETY
New Haven, Conn., April 3-7

AMERICAN FOUNDRYMEN'S ASSOCIATION
Cleveland, O., April 28-May 1

AMERICAN OIL CHEMISTS' SOCIETY
Hot Springs, Ark., April 30-May 1

SOCIETY OF INDUSTRIAL ENGINEERS
Cincinnati, O, April 18-20

SOCIETY OF CHEMICAL INDUSTRY
New York, regular meeting, March 23

SOCIETY OF CHEMICAL INDUSTRY
New York, joint meeting with other societies, April 20

S.O.C.M.A. Annual Meeting Hears Herty and Garvan

Speakers Analyze Situation and Outline Future Plans—Need of Co-operation Is Keynote of Meeting

PAST progress and future plans largely featured the address of Dr. C. H. Herty at the annual meeting of the Synthetic Organic Chemical Manufacturers held March 7 at the Hotel Pennsylvania, New York City.

F. P. Garvan also spoke, bringing out many points of interest both to manufacturers and to the public. He emphasized the absolute necessity of co-operation if the American dye industry is to progress. Education of the people to the menace of foreign monopoly was also stressed as an essential to a healthy state of the American industry.

Dr. Herty's remarks, broad in scope, threw much light on the situation and upon the activities of the association, which he outlined from the trials and triumphs of the past year to the plans for the coming year. Dr. Herty opened his remarks by saying:

"The constitutional year just ending may well be designated one of the most remarkable periods through which any branch of industry has passed. Faced at the outset with a Congressional investigation, avowedly proposed with hostile intent; engaged for months in a struggle for legislation assuredly protective against a vicious foreign competition; shaken for a while to its very roots by an unexpected governmental attack upon the governmental authorized holding of important patents; bearing throughout this period the brunt of a general industrial depression; surely these have been times to try men's souls. And yet at the close of the year we find the clouds dispersed, our industry enjoying a far larger measure of sympathetic public understanding, constantly increasing cordial relations between producers and consumers, ample contentment with the quality and price of our products and consequent placing of orders which insure prosperous times ahead."

Public Support Gaining

The problem of molding intelligent public opinion, of showing the public the real nature and significance of the dyestuff industry, is difficult but not impossible. Dr. Herty cited the public support which is being given to the industry by the medical profession, which is coming to realize the importance of the industry to the public health of the nation. The work of the Chemical Foundation in regard to fostering public opinion of the right sort by showing the vital importance of chemistry to every line of human endeavor was highly praised.

In commenting upon relations with Germany, he spoke of the protest offered by the association against the revival of the patent convention of 1909. The matter is still unsettled and is likely to become an issue of decided importance. Co-operation with the U. S. Army in the study of war essentials and the advance of public welfare through doing away with stream and air polution also were discussed.

Commercial development, especially through the assistance of information furnished by government bureaus, was urged as an indication of progress.

President Herty said in conclusion:

Portentous Changes Imminent

"As we begin this second year of our association's existence, portentous changes seem imminent in world conditions of the chemical industry. No one can predict what may result from the occupation of the Ruhr and from the dislocation of normal business activity in all parts of the occupied area in Germany. Official statements of the Department of Commerce make clear that already prompt forwarding of exports is being seriously hampered; doubtless the embargo on shipments from the Ruhr to others parts of Germany will soon make its demoralizing influence felt in a shortage of crudes and intermediates.

"The nation which purposely inflated its currency, partly for the sake of regaining control in foreign markets, is now paying the price of such debauchery. Whatever the outcome, the fact is once again brought home closely that as to the products of our industry America must make itself forever independent. Therefore upon us is laid afresh the responsibility of seeing that this independence is gained.

"How can it be done? The industry must seriously set about the task of expanding our lines of products as quickly as possible, so that no consumer may feel the need of looking beyond our shores to cover fully his every need. To do this the research chemist must be given fullest opportunity to lead the way, the best of engineering talent must be employed to translate effectively the results of laboratory research into terms of highest efficiency in plant operations, and financing must be sound.

"It is no inviting field into which novices may rush, but the experience gained during the past 5 years must be utilized to the maximum. The daily evidences of how brilliantly that experience has been achieved gives full conviction that the task will be fully met. It is an inspiring thought that over and above the normal satisfaction arising from work well done and reasonable profits justly earned there stands the loftier feeling that through the success of our efforts we are contributing directly to the security of the nation, the health of our people and the economic independence of our country."

A sidelight showing the consumer's growing interest in American chemical industry appears in a letter written by John P. Wood, president of the American Woolen Association, to Dr. C. H. Herty, in which he writes:

"It would have given me a great deal of pleasure, for myself and on behalf of those whom I represent, to renew the assurance so often given in the past of our very sincere and earnest desire for the prosperity and for the most complete and successful development of the American dye and chemical industries."

Officers of the Association

The board of governors of the Synthetic Organic Chemical Manufacturers Association of the United States elected for the coming year are: President, Charles H. Herty; treasurer, F. P. Summers, Noil Chemical & Color Works, New York City.

Dyestuffs Section—F. E. Signer, vice-president Butterworth-Judson Corporation, New York City; August Merz, Heller & Merz Co., Newark, N. J.; C. N. Turner, Newport Chemical Works, Passaic, N. J.; F. P. Summers, Noil Chemical & Color Works, New York City; George H. Whaley, John Campbell & Co., New York City.

Crudes and Intermediates Section—F. W. Pickard, vice-president E. I. du Pont de Nemours & Co., Wilmington, Del.; S. W. Wilder, Merrimac Chemical Co., Boston, Mass.; R. N. Wallach, Grasselli Chemical Co., New York City; William S. Weeks, Calco Chemical Co., Bound Brook, N. J.

Fine Organic & Medicinal Chemicals Section—A. S. Burdick, vice-president Abbott Laboratories, Chicago, Ill.; Herman Seydel, Seydel Chemical Co., New York City; G. F. Richmond, Antoine Chiris Co., New York City.

Boll Weevil Campaign Elects Officers

Organized activity is well under way at the headquarters of the National Campaign for Boll Weevil Control. Dr. Miller Reese Hutchison, president and general manager, whose position in regard to the American Cotton Association is clear since he has definitely announced his severance of all connection with the same, is drawing men of prominence into the new organization. These appointments include Frank S. Bragg, vice-president Union & Planters' Bank & Trust Co., Memphis, Tenn., treasurer; general counsel, John D. Martin, Memphis, Tenn.; secretary, A. B. Meserlin, New York; assistant treasurer, Floyd Swift, Union & Planters' Bank & Trust Co., Memphis, Tenn.; assistant secretary, M. V. Birney, New York.

Australian Sulphur Duty Favors Britain

The Australian Government has decided to allow the importation of sulphur for use in the manufacture of superphosphates free of duty from Great Britain. Sulphur from other countries will be subject to a duty of 10 per cent.

A.E.S.C. to Standardize Scientific Symbols

Conference Reveals Strong Sentiment for Unified Technical Abbreviations—Foreign Help Sought

A recent conference held in New York City under the auspices of the American Engineering Standards Committee revealed a sentiment among engineers, scientists, government officials, business paper editors and industrial executives in favor of the unification of technical and scientific abbreviations and symbols.

It was agreed that the standardization of abbreviations and symbols would result in decided mental economies. The present situation with respect to the use of abbreviations and symbols in engineering, scientific and other technical fields is comparable to a language which has degenerated into a multiplicity of dialects, each of which has to be translated for the users of the others. Abbreviations and symbols constitute an ever-growing and important part of the language of engineers, scientists, industrial editors and other technical men. The use of one symbol or abbreviation for several different terms and the use of several different symbols or abbreviations for one meaning are, however, at present causing a great deal of confusion, misunderstanding and often serious errors.

Foreigners to Co-operate

The conference was called upon requests from the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the Association of Edison Illuminating Companies, to consider abbreviations and symbols, but after some discussion of the subject it was thought desirable to include as a part of the project the graphical symbols which are used in engineering drawings, diagrams and the like for representing instruments and apparatus and components of them.

It was agreed that the co-operation of foreign standardizing bodies should be sought in the development of the work. The importance of international uniformity in symbols is great on account of the international character of much engineering and scientific work, and the importance of reference books and periodicals in foreign languages.

The work will go forward under a committee organization developed in accordance with the rules and procedure of the A.E.S.C.

Congress Starts Metal Inquiry

The gold and silver industries are to be investigated during the Congressional recess. Miners, smelters and railway executives are to be called to Washington to confer with the commission conducting the inquiry. The object of the investigation is to locate the causes of the depressed condition of the industry, including the production, marketing, transportation, sale and uses of gold and silver. Also the effect of decreased production upon commerce, industry, exchange and prices will be looked into.

Tariff Board Splits on Flexible Plan

The Tariff Commission has split on the question of the general policy to be followed in administering the elastic provisions of the new tariff law, and the differences of opinion have been put before President Harding for decision. Upon his return from Florida the President is expected to determine the general line of activity to be carried on by the commission.

Meanwhile the commission has decided to proceed with the investigation of the cost of production of twenty-five or thirty commodities, which have been made the subject of complaints, calling for an equalization of costs through the elevation or reduction of customs duties. The list of these commodities will be announced shortly.

Plans for Procedure

Field investigations into the costs of production of the chosen commodities, which include chemicals and textiles, will be made and public hearings are to be held. It is stated by the commission that it will be 2 months or so before sufficient information has been gathered to warrant commencement of the hearings.

The Tariff Commission is enlarging its staff for this work and announces appointment of a chief and an assistant economist. Dr. John R. Turner, dean of the Washington Square College of New York University, has been appointed chief economist of the Tariff Commission.

Dr. A. L. Faubell, also of the Washington Square College, was named as assistant chief economist. Their university duties, it is said, will require their attention until May 15, after which date they will assume their new posts with the Tariff Commission.

Reforestation for Paper Pulp Industries

Paper Makers' Interest in Timber Growth Increases—Many Firms to Aid Work

As a result of the increasing scarcity of natural forest acreage available for exploitation by paper pulp interests, the manufacturers in this line are more and more turning their attention to reforestation of cut-over lands.

In this connection, the Chateaugay Pulp & Paper Co., Chateaugay, N. Y., has recently arranged with the New York State Department of Conservation for the planting of 150,000 Norway spruce trees for artificial reforestation for paper pulp supply. The Bogalusa Paper Co., Bogalusa, La., has transferred to the state for technical forest management a total of 53,000 acres of land. It is proposed to co-operate with the state for the scientific growth of timber to insure permanent raw material supply for the local mills. The Mead Pulp & Paper Co., Dayton, Ohio, has been conducting a series of experiments in the Ohio Valley district for reforestation with woods adaptable to pulp production, and plans to develop a large mileage for this purpose.

In Maine, three paper companies are now giving active attention to future raw material source, utilizing spruce as well as pine. The Eastern Manufacturing Co., Bangor, is giving over land for this development, as are the Orono Pulp & Paper Co., Orono, and the Pejepscot Paper Co., Brunswick.

The Canadian Department of Forestry is working with the Price Brothers Co., Quebec, for the reforestation of land for mills of this organization. So far, 900 square miles has been turned over to the department for a pulp wood forest.

Tariff Commission Studies Foreign Discrimination

Unfair Treatment of U. S. Products Causes Complaints—Cottonseed Oil a Case in Point

THE retaliatory provisions of the new tariff bill may be invoked if the present investigations of the Tariff Commission confirm the numerous complaints of discrimination against American commodities by foreign countries.

The commission expects to complete its study of these complaints shortly. If the State Department agrees to the procedure initial steps in retaliation will then be taken. This will be difficult, according to the commission, because much of the discrimination is under the cloak of most favored nation clauses of commercial treaties.

Cottonseed Oil Case

Italian imports of American cottonseed oil are an example. Italy has a most favored nation clause in its commercial treaty with the United States, but at the same time imposes a higher duty upon cottonseed oil than upon other oils usable for similar purposes. While the duty so imposed would apply equally to other nations, the fact remains that nearly all of the cottonseed oil originates in this country and the high customs rate on the commodity in comparison with other oils is considered as in effect a discrimination.

Other countries against which complaints of discrimination have been brought are Canada and Finland. Canada has a preferential tariff agreement with Great Britain and in addition agreements with France and Japan which are complained of as operating in discrimination of this country's products. American automobile manufacturers complain that French cars enjoy a 30 per cent advantage compared with their product on entering Finland.

Iota Sigma Pi of Yale Invites Women Chemists

The Yale Chapter of Iota Sigma Pi, national honorary society for women in chemistry, announces that it extends a cordial invitation to all women in any branch of chemistry to attend the meeting of the American Chemical Society at New Haven, April 2 to 7. A special program is being arranged by the young ladies in the departments of chemistry and physiological chemistry in the Graduate School of Yale, and they also expect to take care of the entertainment of visiting women chemists.

Iota Sigma Pi is represented by active chapters in a number of the leading universities of the country and is proving a very valuable means of encouraging interest in the subject, especially in graduate work. The requirements for membership are a completion of forty year-hours of chemistry with a grade of B, but the major portion of the membership is composed of graduate students and women actively engaged in chemistry. Mme. Curie is one of the honorary members of the organization.

Announcement will be made later of the special features of the program concerning this organization and the name of the speaker, a noted woman chemist, who will deliver a special address some time during the A.C.S. meeting.

Hafnium Samples Coming to America

The first definite information upon the discovery of hafnium is contained in a letter from Dr. G. Hevesy of Copenhagen, the discoverer, to Dr. George F. Kunz, president of the New York Mineralogical Club. Dr. Hevesy wrote as follows:

"We investigated a great number of zirconium minerals from all parts of the world, and we found in all these specimens 5 to 10 per cent of hafnium. Taking into account Clark's estimate of the zirconium content of the earthcrust (0.018 per cent), our estimate of the hafnium content of the earthcrust, one to one hundred thousand, is certainly not too high. All commercial preparations of pure zirconium contain 1 to 5 per cent of hafnium."

Dr. Kunz's Opinion

Dr. Kunz, in commenting upon the discovery, said:

"We are awaiting with the greatest interest more detailed information regarding the special properties of this element. It is too early to say what commercial value it will have or what use will be made of it, but the discovery of new fundamental elements is so rare that this in itself is noteworthy. It may even exist in greater quantities than these two eminent scientists believe."

Zirconium, from which the element was extracted, is in free commercial distribution, and is used in the manufacture of refractive substances.

Match Manufacturers Form Merger

Corporation Perfected to Meet Competition of Powerful Companies Will Be Third Largest of Its Kind

A merger of nine of the small match companies of the United States has been formed under the name of the Federal Match Corporation in order to obtain collectively the strength needed to compete with the larger companies in the field.

The consolidation of these companies represents about 20 per cent of the business of the country, and will result in economies through centralized management, purchasing, reduced freight costs and sales expense.

Companies Forming Merger

The companies forming the Federal Match Corporation are: Fred Fear, Bloomsburg, Pa.; the Pennsylvania Match Co., Bellefonte, Pa.; Union Match Co., Duluth, Minn.; Reliable Match Co., Ashland, Ohio; Indiana Match Co., Crawfordsville, Ind.; National Match Co., Joliet, Ill.; Wheeling Match Co., Wheeling, W. Va.; Cleveland Match Co., Cleveland, Ohio, and Minnesota Match Co., Duluth, Minn.

The total net assets of the companies are about $5,000,000, and the authorized capital stock of the newly formed Delaware corporation is $6,000,000. Preferred stock, of which about $5,000,000 is to cover the net assets of the corporation, will be issued. It is not planned to offer any of the stock issued to the public. Heavy timber purchases and operation of block plants are features in the plan to meet the competition of large companies already in the field.

Mines Bureau Expands

To provide for the additional duties which have been entrusted to the Bureau of Mines by the Congress and by the Secretary of the Interior, Director Bain has announced an organization change creating a leasing branch of the bureau. The new branch is to be under the immediate supervision of A. W. Ambrose, the assistant director, who also will act as consulting engineer to all branches of the bureau on matters relating to petroleum and natural gas.

The name of the investigations branch of the bureau is changed to research branch. Dorsey A. Lyon, the chief metallurgist of the bureau, has been placed in charge of the research branch with the title of assistant director. As assistant director, he will continue to perform the duties of supervisor of the bureau's experiment stations.

F. J. Bailey, as assistant to the director, will be in charge of the operations branch of the bureau. T. T. Read has been appointed supervising mining engineer. C. E. Julihn will succeed him as chief of the information service. Francis Winslow will succeed Mr. Julihn as chief mining engineer of the War Minerals Relief Commission.

Mammoth Oil Well Found in Venezuela

The recent bringing in of one of the largest oil wells the world has ever known, with a daily production of more than 100,000 bbl., has greatly stimulated interest in oil development in Venezuela, where a number of American and British companies are in lively competition with one another to open up promising fields in which they have secured concessions.

Many of the concessions which these companies have obtained date back to the days of former President Castro, while a few run back into the last century. The present Venezuelan Government, however, is respecting all these concessions, no matter when acquired, and concerns which are operating under them are doing so without any trouble, according to advices received here.

Among the British companies operating are the Venezuelan Oil Concession, the Colon Development Co., the British Controlled Oil Fields, Inc., the North Venezuelan Co., and the Caribbean Petroleum Co.

Air Reduction Enters the Cyanide Field

It has been recently announced that the Air Reduction Co., Inc., of New York has joined with Los Angeles capitalists in the formation of a company to be known as the California Cyanide Co. to engage in the manufacture of liquid hydrocyanic, sodium cyanide and kindred products. The Air Reduction Co. itself is one of the two largest producers of oxygen, nitrogen, acetylene and oxyacetylene and welding apparatus in the United States. Among its directors are P. A. Rockefeller, Robert W. Goelet, Samuel F. Pryor, Guy Cary, Frederick B. Adams, John McHugh and Frederick W. Allen, of Lee, Higginson & Co.

A Million Dollar Concern

The interests in southern California which have joined with the Air Reduction Co., Inc., are headed by F. W. Braun, of Los Angeles, long known as a pioneer in the application and use of liquid hydrocyanic in citrus fruit tree fumigation, as well as in the use and application of sodium cyanide in mining operations. Mr. Braun has accepted the presidency of the California Cyanide Co. Steps have been taken by the two groups involved to raise more than a million dollars for working capital for the new company, and work on a new plant will be started immediately.

A ten-acre tract on Boyle Avenue may be selected as the site for the plant. Associated with Mr. Braun in executive and directorate capacities in the new corporation are John Pike, vice-president; J. D. Neuls, in charge of field work; R. W. Poindexter, in charge of laboratory and research work; H. W. O'Melveny, S. F. Pryor, L. F. Loree and C. C. Adams, directors.

Commerce Department to Amplify Coal-Tar Reports

While the February report of the Department of Commerce giving in detail imports of coal-tar dyes at New York during that month was an improvement over the first report of this character, that for January, in that it showed the quantity proportion of each shipment by country of origin, it has been announced that an effort will be made to amplify these statistics further hereafter. The future amplification will not be in the direction of further information regarding dye imports, it is said, but will be an effort to add statistics of other coal-tar products.

The importance of giving information of imports of coal-tar intermediates, as well as finished products, has been recognized and it is probable that the first extension of the service will be inclusion of intermediates in the monthly reports. Some of the intermediates are imported in a condition so nearly finished that without information of the volume of such receipts domestic producers do not have the full picture. It is known, for instance, that considerable indoxyl is coming into the country, about 95 per cent completed for indigo and requiring only a little air until finished.

Later, if the finances of the statistical department will stand the strain, it is hoped by the chemical division of the Department of Commerce to add coal-tar chemicals other than dyes and also synthetic organic chemicals from other than a coal-tar base.

Navy Department to Have Helium Plant

The Navy Department has requested the Bureau of Mines to design and install a plant at the Lakehurst flying field for the repurification of helium. The plant is to have a capacity of 10,000 cu.ft. of helium per hour. It will combine high-pressure purification and charcoal purification at low temperatures. The high-pressure cycle will step up the helium from 85 to 94 per cent. The charcoal will boost it from that point to practically 100 per cent. The plant will be completed this fall. The design of the new plant is being made by Dr. R. B. Moore, the bureau's chief chemist.

Naval Stores Export Corporation Requests Charter

Rosin and turpentine of all kinds will be exported by the Naval Stores Export Corporation of New Orleans if the papers which have been filed with the Federal Trade Commission meet with approval. The corporation would include in its organization about twenty firms doing business at present in Florida, Louisiana and Alabama. At the present time the United States produces about 75 per cent of the world's total supply of naval stores, of which more than half is exported. In 1921 the value of our exports of these commodities was over $11,000,000.

Limits Alsace Potash Exportation

French Bill Leases Mines for 75 Years and Outlines Plan of Distribution

No potash in the future will be exported from Alsace until French requirements have been met. This is in accordance with a bill recently passed by the Chamber of Deputies, which acts as a pendant to that recently voted ratifying the agreement with the Badische Anilin and Soda Fabrik, whereby the Alsace mines are to be leased for 75 years. Both bills provide for the production of fertilizers essential to agriculture by companies organized on national lines and working on the co-operative principle. It is estimated that the Alsace mines should produce a quarter million tons of potash annually.

Bureaus Co-operate to Study Corrosion

To avoid any duplication of work, a co-operative arrangement has been completed between the Bureau of Mines and the Bureau of Standards for the handling of studies being made of corrosion. The work is confined mainly to the corrosion problem as it affects metals and alloys exposed to mine waters.

Despite the fact that corrosion has been one of the most active deteriorating agents throughout the entire history of the use of metals, the factors underlying the phenomena of corrosion are little understood. It is with the idea of illuminating this subject that the Bureau of Mines and the Bureau of Standards are contemplating more active work on it. Considerable progress already has been made, particularly in the devising of methods whereby corrosion can be brought about quickly in the laboratory to an extent which would require years of exposure under ordinary conditions.

Professor Paterno Honored

The Italian Association of General and Applied Chemistry has appointed a committee under the presidency of P. Ginori Conti, to arrange a celebration in honor of the seventy-fifth anniversary of Professor and Senator E. Paterno.

As a permanent memorial of the occasion, the committee has decided to establish a memorial fund for the "Paterno medal," which will be conferred annually upon the author of the most important contribution to chemistry, regardless of his nationality.

In order that the endowment of this medal may be given an international character, the committee welcomes contributions from the chemists of the world in support of the medal. Subscriptions from American chemists may be forwarded to the Division of Chemistry and Chemical Technology of the National Research Council, Washington, D. C., for transmission to the Italian committee.

Fertilizer Monopoly Seen by Trade Commission

The mixed fertilizer business in the United States is increasingly passing into the control of seven large companies and their subsidiaries, the Federal Trade Commission reported to the Senate March 3 in response to the Norris resolution for information. The report indicated a tendency toward price control through uniform contracts making dealers virtually agents.

Co-operative buying by farmers was described as the most important factor in lowering the price. The American Agricultural Chemical Co. dominates the fertilizer situation in the North and the Virginia-Carolina Chemical Co. in the South, according to the report. Their combined output is about one-third of the country's total. These two companies, with the International Agricultural Corporation, the F. S. Royster Guana Co., the Armour Fertilizer Works, Swift & Co. and the Baugh companies and subsidiaries, produced 65 per cent of the commercial fertilizer in 1921, compared with 58 per cent in 1916.

Oil Leases Denied to Aliens

The decision of the Interior Department holding that companies in which aliens have a controlling interest cannot obtain leases of American oil lands was reaffirmed in a decision announced March 6 in the case of the Roxana Petroleum Corporation. Approval of the decision was said to be the last official act of Secretary Fall before he retired from office.

The policy of the government regarding alien control of domestic oil supplies was announced in 1922, but had never been tested until the Roxana company appealed from the department regulation which prevented it from carrying out operations designed to take over extensive lands held by the Creek tribe in Oklahoma. In the hearing granted the company by the Interior Department, it was developed that although it was a domestic corporation, more than 65 per cent of its stock was owned by Dutch and British interests.

Potters Plan Convention

The annual meeting of the United States Potters' Association, postponed from December last, will be held at the Hotel Astor, New York, April 10-12. A feature of the meeting will be a report of the research committee of the organization, of which A. V. Bleininger, Homer Laughlin China Co., Newell, W. Va., is chairman. It is expected that President Frank P. Judge, National China Co., Salineville, Ohio, will be re-elected to this office. Charles F. Goodwin will be re-elected secretary-treasurer and historian. At the last annual meeting at Washington, D. C., fifty-eight companies in the general ware line were registered, representing 633 kilns, with three companies in the sanitary ware branch of the industry, representing 87 kilns.

Reparation Dyes Resold in U. S. by Italy

Of the dyestuffs imported into the United States in February, 26 per cent were reparation dyes, sold on the American market by Italians, according to statistics recently made public by the Department of Commerce. According to this report every pound of dyes brought in from Italy and much of those from France were made in Germany.

Officials of the Tariff Commission say these dyes were granted to the Italian Government as reparations and resold to American importers. It is the well-established policy of Italy to take reparations in any goods whatever and convert them into gold.

Helium to Fill Dirigible

Helium will be used for the inflation of the balloon in the navy's first rigid dirigible, ZR-1, which is being built at Lakehurst, N. J. The dirigible will require 2,000,000 ft. of the gas. Although the United States possesses helium in comparatively large quantities, this plan will draw heavily upon the supply. Nevertheless, helium is to be used regardless of cost, in order to reduce the explosion risk to a minimum.

The recent navy appropriation bill increased the amount allowed for the production of helium, permitting the continuous operation of the plant at Fort Worth. It was planned to produce 12,000,000 cu.ft. during the next fiscal year. At that time the combined helium stocks of the army and navy were 1,822,000 cu.ft.

Bureau of Mines Reviews Rain-Making Scheme

Method of Precipitating Rain and Dissipating Fog Described by Dr. Moore, the Bureau's Chemist

Dr. R. B. Moore, chief chemist of the Bureau of Mines, has authorized the following statement in connection with the work of L. F. Warren and Dr. W. D. Bancroft in connection with the dissipation of clouds and the precipitation of rain with electrified sand:

About 2 years ago Mr. Warren came to my office several times and talked over the plans of himself and Dr. Bancroft in the dissipation of clouds and fog and the possible precipitation of rain from such clouds. He explained his ideas and I encouraged him, because the scheme at least showed possibilities of success, although its value could be determined only by actual trial I am very glad to know of the results of the recent tests and that my judgment was not entirely wrong.

Use of a Dielectric

The method consists in charging a dielectric, such as fine sand, with a static charge, and then sprinkling this sand over the top of a cloud by means of an airplane As everyone knows, clouds consist of minute particles of water, a large proportion of which are charged. All the particles in the same cloud are charged either pos'tively or negatively, and therefore as they carry the same sign, they repel one another when they come into too close contact. This militates against the coalescence of the particles to a size that allows them to fall through the atmosphere in the form of rain. Anything which will dissipate the charge on the particles will help coalescence, and therefore will assist in precipitation.

There was no doubt in my mind 2 years ago that the scheme of Mr. Warren would have at least partial success. The whole question that had to be proven, however, was to what extent precipitation in the upper part of the cloud would have on the rest of the cloud below. In other words, would the effect be cumulative so that the whole cloud could be dissipated? This point could be cleared up only by trial.

The Apparatus Used

I have had no opportunity for personal observation in connection with tests already made, but I have read the affidavits of the observers and also of the army fliers who took part in the tests. From these affidavits it appears that a single airplane has been able to dissipate a cloud a mile or two long and over 1,000 ft. deep in a few minutes by using about 100 lb of charged sand

The apparatus which Mr. Warren uses for charging the sand is not by any means perfected, and he is able to get only 12,000 or 14,000 volts on the particles. In addition, it has not been possible so far to charge more than a small proport'on of the sand grains I see no reason why the voltage cannot be increased with improved apparatus up to 30,000 volts or even more, and also why the percentage of charged grains cannot be greatly increased Under such conditions a still greater effect should be obtained with a given weight of sand

Possible Utility

The work is still in its initial stages and it is difficult to state definitely its possibilities in the future. No trials have yet been made on fog, as the conditions have not yet been favorable for an airplane to go up in a fog and make the tests

Fogs are a combination of mists or "clouds" in contact with the earth, mixed with more or less smoke Whether it will be more difficult or easier to get rid of such fogs than has been the case with clouds high up in the air is yet to be determined, but the methods certainly show great promise and justify a complete investigation by a satisfactory series of trials with improved apparatus If such fogs can be dissipated, the results would be of tremendous value to cities such as London and San Francisco, besides being of great use to the Air Service in connection with its flying fields

Refractories Investigation Begins

The Bureau of Mines laboratory car "Holmes" is now at the plant of the American Refractories Co. in Baltimore, where initiatory work on the co-operative investigation between the Refractories Manufacturers Association and the bureau has begun. The objects of this investigation are to decrease fuel consumption in burning refractories, to shorten the time of burning, and to improve the quality of the product.

Paint Men Not Indicted

The United States District Attorney in Philadelphia has announced that the findings of the federal grand jury will lead to no indictments against the Paint Manufacturers Association of the United States or any of its members. Charges of price fixing, restraints of trade and other alleged violations of the Sherman anti-trust law were investigated.

California Chemists Are Active

On March 2, Professor Blasdale of the University of California addressed the California Section of the American Chemical Society of San Francisco on "Equilibria in Solutions Containing Carbonates and Chlorides of Sodium and Potassium." G. H. West also read a paper on "The Manufacture and Purification of Oil Gas."

Discriminating Law Hits Bauxite Producers

The Legislature of Arkansas has passed a bill that proposes a production tax of 25c. per ton on bauxite produced in the state. This amounts to 2½ per cent, based on the average price of bauxite ($10) in 1921 and 1922; 3.9 per cent, based on the average selling price ($6.38) of domestic bauxite in 1921, and 5.2 per cent, based on the average selling price of the domestic product before the war. That the new measure is discriminatory is indicated by the fact that coal is taxed but 1c. per ton and timber bears a burden of only 7c. per 1,000 ft.

The effect of the measure, if signed by the Governor, may well be to curtail production of bauxite in the state, which contributes 90 per cent of the domestic supply. Such curtailment would stimulate foreign competition and prove highly detrimental to the exploitation of domestic deposits.

Obituary

Frederick Bennett Randall, secretary and treasurer of the Mann Linseed Oil Co., Buffalo, N. Y., with which he had been for many years, died recently.

In the sudden death on March 1 of Prof. Harry Harkness Stoek, the coal industry lost one of its foremost investigators and the chemical and metallurgical industries lost a friend whose advice and counsel have been reflected in many fundamental studies of our fuel problems.

Professor Stoek had been professor of mining engineering and head of that department in the University of Illinois since 1909. After being graduated from Lehigh University in 1887 and completing a year of post-graduate work in mining and metallurgy at the same institution, he spent a number of years as a mining engineer in the coal field

PROF. H. H. STOEK

of Pennsylvania. Returning to Lehigh in 1900, he was instructor in mining, metallurgy and geology. It was in this capacity he became familiar with the iron and zinc industries of eastern Pennsylvania, as well as the anthracite coal mines of that section.

For 9 years prior to September, 1909, Dr. Stoek was managing editor of *Mines and Minerals*. Later on in connection with other editorial work he revised and edited the mining publications of the International Correspondence School, "Coal and Metal Miners' Pocketbook," Fulton's "Coke," Lake's "Prospecting for Gold and Silver" and "Examination Questions for Certificates of Competency in Mining" and prepared for the United States Geological Survey a chapter on "Anthracite" included in the Twenty-second Annual Report of the Survey. His own publications include several well-known volumes on coal mining, mining education and the problems of coal storage. It was toward the last-named problems that his more recent efforts have been directed. He had just been appointed by the American Engineering Council to serve on a committee of engineers to make a detailed study of storage for commercial and industrial purposes. During the Christmas holidays he aided in the preparation of the preliminary report on coal storage for the Federal Fact-Finding Coal Commission, of which he was a member.

Professor Stoek was a widower at the time of his death. His wife was Miss Miriam Ricketts, of Wilkes-Barre, Pa., to whom he was married Dec. 20, 1894. He is survived by one daughter, Miss Leigh Stoek, of Urbana, Ill. He was just past 57 years of age, having been born in Washington, D. C., Jan. 16, 1866.

IRA A. SHOFF, chief engineer, West Penn Steel Co., Brackenridge, Pa., since its organization in 1908, died on February 28.

Personal

LEASON H. ADAMS, of the Geophysical Laboratory, spoke before the Chemical Society of Washington, March 8, on "Reactions and Properties of Substances at High Pressures."

PERRY H. BASCOM and CLEO HAROLD KIDWELL, formerly with Raymond F. Bacon, consulting chemical engineer at 50 East 41st St., New York, have organized the firm of Kidwell & Bascom, Inc., with offices and laboratory at 27 Thames St., New York. The new firm will do consulting chemical engineering work and developmental research. Raymond F. Bacon is a director of the firm, and Elizabeth N. Kidwell is bacteriologist.

Dr. CHARLES B. BAZZONI, professor of experimental physics, University of Pennsylvania, spoke before the Franklin Institute, March 8, on "Ionization and Resonance Phenomena."

Dr. HENRY R. CURME, formerly a non-resident Fellow of the Mellon Institute of industrial Research, connected with the staff of the Carbide & Carbon Chemicals Corporation, Clendenin, W. Va., has accepted a position with Savell, Sayre & Co., Inc., Niagara Falls, N. Y.

FRANCIS B. DAVIS, JR., connected with E. I. du Pont de Nemours & Co., Wilmington, Del., in an engineering capacity in different departments for a number of years, has been appointed assistant general manager of the pyralin department, and will assume his new duties about March 15. During the war period he was identified with the black powder department as division superintendent, and later was successively assistant engineer, resident engineer and assistant manager at the guncotton plant at Hopewell, Va. He acted as assistant manager in connection with the construction of the Old Hickory guncotton and smokeless powder plant for the United States Government. At the close of the war he was appointed vice-president and general manager of the du Pont Chemical Co.

Dr. HARRY ESSEX, professor of physical chemistry at Syracuse University, addressed the Syracuse Section of the American Chemical Society on March 9. His subject was "Isotopes."

General AMOS A. FRIES gave an interesting address at the February meeting of the Delaware Section of the American Chemical Society, Wilmington, on "Chemical Warfare Materials—What They Are, How Produced and Their Peace-Time Uses."

Dr. WILLIAM D. HARKINS, professor of physical chemistry at Chicago University, gave a course of three technical lectures, March 7, 8 and 9, at Carnegie Institute of Technology, Pittsburgh, on "Isotopes and the Building and Disintegration of Atoms."

CHARLES H. MACDOWELL, president of the Armour Fertilizer Works, sailed for Europe recently and expects to return about the middle of April.

Dr. ROYAL A. MEEKER has been appointed Commissioner of Labor and Industry of the State of Pennsylvania by Governor Pinchot, to succeed Dr. Clifford B. Connelley. Dr. Meeker has been chief of the scientific division, international labor office, of the League of Nations since August, 1920. Previously, from 1913 to 1920, he served as United States Commissioner of Labor Statistics by appointment of President Wilson. Since 1916 he has been secretary and treasurer of the International Association of Industrial Accident Boards and Commissioners. Dr. Meeker is a native of Pennsylvania and attended the Iowa State College, Columbia University and the University of Leipzig.

Dr. EDMUND S. MERRIAM of Marietta, Ohio, has resigned as chief chemist for the Safe-Cabinet Co. in order to resume his consulting work in connection with natural gas, casinghead gasoline and carbon black.

F. P. PALMER, a member of the metallurgical staff of the Carpenter Steel Co., Reading, Pa., gave a comprehensive and illuminating address on the subject of "Tool Steel" at the meeting of the Lehigh Valley Chapter of the American Society for Steel Treating, Easton, Pa., March 1.

CHARLES W. PHELLIS, general manager of the Pyroxlin plastics division of E. I. du Pont de Nemours & Co., has resigned to follow personal interests. Mr. Phellis is widely known in the explosive industry of the U. S.

EDGAR S. ROSS, for a number of years engaged in research dealing with production of metallic tantalum and columbium and more recently chemist and metallurgist for McKechnie Bros., Inc., of Philadelphia, has recently accepted an industrial fellowship at the Mellon Institute of Industrial Research, University of Pittsburgh.

C. A. UNDERWOOD, formerly chief chemist of the American Refractories Co., at Joliet, Ill., has been transferred to the sales department at New York as New England representative.

SAMUEL M. VAUCLAIN, president of the Baldwin Locomotive Works, has accepted an invitation from Dr. Thomas S. Baker, president of the Carnegie Institute of Technology, to address the general assembly of students March 14.

Dr. F. C. WEBER, for many years chemist in the Bureau of Chemistry, has resigned to accept a position with the Fleischmann Co., New York City.

JOHN MORRIS WEISS, consulting chemical engineer, of Weiss & Downs, New York, has been selected by the Manufacturing Chemists' Association to serve as its representative on the recently formed sub-committee on benzol poising of the Chemical Section of the National Safety Council.

EDGAR C. WELBORN and WILLIAM CHAPIN HUNTINGTON announce the formation of a partnership to extend the work heretofore carried on under the name of E. C. Welborn. They will continue to make business surveys of industrial enterprises.

The Social Organization of Hungarian Engineers has elected the following officers for the coming year: President, Alexander Strobl, Chemical Engineer; vice-president, Dr. Adalbert Elek, of the Rockefeller Institute; secretary-treasurer, Julian J. Wittal, M.E. (132 Nassau St., New York City). This organization, which comprises in its membership most of the engineers of Hungarian extraction, had a very successful dance-dinner at the Hotel McAlpin, on March 3. The Hungarian Consul-General attended.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

Business Profits in 1922

Study of Net Earnings of Important Industrials Offers a Better Index of Business Than Statistics of Production, Consumption, Sales and Prices

THE season of annual reports is with us again and careful students of business are profiting by an opportunity to examine industrial earnings and to compare them with records of past years. While current statistics of production and consumption have offered a fairly precise measure of business activity, there has existed no accurate measure of that more important aspect of business, the amount of net profits. Recently in connection with its "Monthly Review of Credit and Business Condition" the Federal Reserve Bank in New York has tabulated the published statements of net profits for the year 1922 of 122 concerns engaged in production, wholesale and retail trade and public service.

Table I and the accompanying chart show the results of this tabulation by 10 separate groups and in the aggregate for all groups. There is also shown the net operating income of the 193 Class I railroads. In each case the 1919 figures are taken as a basis of 100 per cent.

In every group 1922 net profits were larger than net profits in 1921, but there is large variation between the different groups in the amounts of increase which they show. In 4 of the 10 groups, and in the case of the railroads as well, 1922 net profits were equal to or larger than those of 1919. The aggregate figures for the 10 groups, however, show 1922 figures considerably below those for either 1919 or 1920, reflecting reduced earnings in the steel and other metal industries.

In general, the figures show that 1922 net profits were highest, in relation to 1919, in those industries which deal most directly with the individual consumer. This is true in the cases of food and food products, public utilities, tobacco and clothing. On the other hand it is significant that in the industries of the type of the chemical and metallurgical producers whose production is directed to supplying industry rather than the final consumer, profits in 1922 lagged considerably behind those in 1919 or 1920. The railroads show consistent gains since the year 1920, but even so the percentage of net operating income to property valuation continues to be less than 5½ per cent specified in the law.

A further reflection of changing business conditions is found in the number of concerns which reported deficits. Of the 122 concerns reported, the number showing deficits in each year were as follows:

1919	5
1920	9
1921	34
1922	18

The report points out that in interpreting these data it should be borne in mind that they are simply for a group of concerns, figures for which were available, and are not necessarily typical of all the concerns which deal in the products represented. In a few cases where it has been necessary, fiscal years not corresponding exactly with the calendar years have been used.

Annual reports for a number of prominent companies in the chemical and allied industries will be found on page 520.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	176.76
Last week	176.71
March, 1922	156.00
March, 1921	157.00
March, 1920	252.00
April, 1918 (high)	286.00
April, 1921 (low)	140.00

The prices of all commodities represented by this index number remained at the same level reported last week. A very minor increase in the price of salt cake was responsible for the slight change in this week's index number

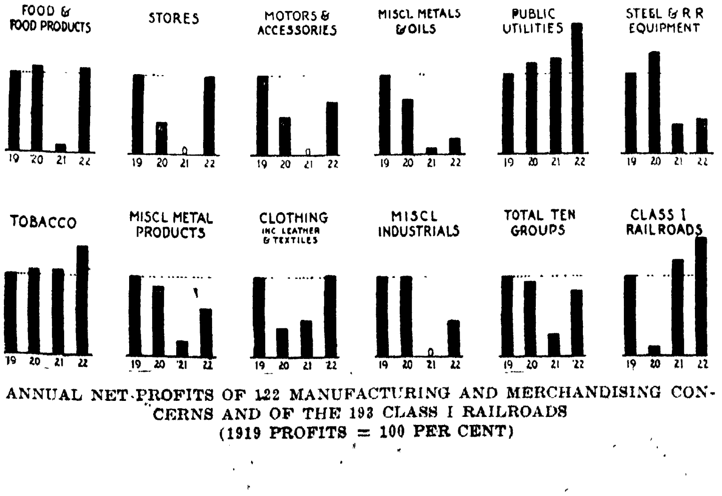
TABLE I—INDUSTRIAL EARNINGS IN 1919, 1920, 1921 AND 1922

(Computations of net profits have been before dividends, but after all fixed charges and tax deductions.)

(Thousands of Dollars)

Group	No. of Corporations	1919	1920	1921	1922
Food products	15	51,501	55,255	10,270	54,408
Stores	7	41,447	16,658	*9,938	40,752
Motors	11	53,767	25,757	*23,576	36,408
Miscellaneous metals and oils	8	10,851	7,544	959	2,313
Public utilities	24	59,970	67,872	71,513	97,222
Steel and railroad equipment	14	140,626	176,661	50,466	62,738
Tobacco	9	29,118	30,822	31,007	39,902
Miscellaneous metal products	10	24,996	22,038	5,281	15,228
Clothing (including leather and textiles)	12	28,193	10,312	13,371	28,670
Miscellaneous industrials	12	36,952	36,913	*13,025	17,175
Total 10 groups	122	477,421	449,832	136,328	394,816
Class I RR's	193	516,290	58,152	615,946	776,421

* Deficit



ANNUAL NET PROFITS OF 122 MANUFACTURING AND MERCHANDISING CONCERNS AND OF THE 193 CLASS I RAILROADS
(1919 PROFITS = 100 PER CENT)

Goodrich Earns $3,000,000

The annual report of the B. F. Goodrich Co. for 1922 shows that net sales of the company's products amounted to $93,649,710.08. From this was deducted manufacturing, selling and general administrative expenses of $86,631,163.84 and depreciation and interest provisions of $4,806,060.16. This leaves a net profit (including the miscellaneous income) of $3,047,769.66.

U. S. Gypsum Doubles Earnings

The United States Gypsum Co. and subsidiary companies report for 1922 shows total earnings after expenses incident to operations, etc., of $4,370,770, contrasted with $2,639,552 in 1921, and a surplus after dividends of $2,080,493, against $910,587 in the preceding year. At the end of 1922 the total surplus was $5,615,795, against $3,535,302 on Dec. 31, 1921.

Mathieson Alkali Earnings Show Big Gains in 1922

The Mathieson Alkali Works, Inc., shows its earnings for 1922 to have been $1,633,886 after deducting expenses and other charges. This contrasts with earnings of $366,036 in 1921. The 1922 surplus after dividends was $823,365 as against a deficit of $241,893 in the previous year. The Mathieson company's surplus on Dec. 31, 1922, amounted to $1,949,716, as contrasted with $1,308,432 at the end of 1921.

National Lead Reports Big Earnings

The net earnings of the National Lead Co. for 1922 were $4,927,548 after deducting all expenses, including tax reserves. In 1921 the company's earnings were $3,481,512.

In addition to providing for the regular dividends on the preferred stock, the profits are sufficient to pay $15.59 a share on the outstanding common stock, which totals $20,655,400. Last year the earnings available for the common stock were equivalent to $8.50 per share.

Corn Products Earns $15,453,918

During the year ended Dec. 31, 1922, the Corn Products Refining Co. had a total net income, according to its recent annual report, of $15,453,918, as compared with $10,742,374 in 1921. E. T. Bedford, the president of the company, points out in his letter to the stockholders that the company's surplus was reduced by $20,000,000 as a result of readjustment in the value of operating plants and certain intangible assets such as good will and patent rights.

The consolidated balance sheet on Dec. 31, 1922, shows cash holdings of $1,663,060, as compared with $1,457,805 in 1921.

Better Activity as Prices Advance in New York

Phenol, Acetone, Tin Salts and Barium Carbonate Feature Chemical and Allied Markets

Advances were quite general throughout the list during the past week and the market was fairly active. Manufacturers of acetone announced a new advance due to the increased production costs. Producers of tin salts raised their prices on account of the increase in the metal. One of the outstanding features of the week's trading was the sharp advance in phenol. Scarcity of spot supplies, together with a heavily sold up condition at the works, was directly responsible for the sharp increase. Producers of potassium nitrate announced a reduction of 1c. per lb., on account of the lack of consuming interest. The new level has brought some noticeable trading into producing quarters. Dealers in arsenic report a quiet market, temporarily at least, with quotations fractionally lower for spot and shipment material. Trading in barium carbonate has been more pronounced, with importers somewhat higher on spot. The alkali market continued to improve for export. Caustic soda inquiries were more numerous and several fair-sized sales were reported by the export association. Soda ash continued along steady lines. Oxalic acid, bichromate of potash and soda, copper sulphate, permanganate of potash and caustic potash were very firm throughout the interval, with quotations somewhat higher among first hands.

Principal Price Changes

Acetone—Leading producers announced an advance of 1c. per lb. on carload quantities. Quotations range around 22@22½c. per lb. The demand continues along moderate lines.

Arsenic—Trading has been rather quiet during the week, with resale dealers offering spot goods at 15@15½c. per lb. Shipments were held at 15½c. Consumers have not shown any desire to purchase at present high levels.

Barium Carbonate—This product has shown material strength and leading importers are asking $75 per ton for spot goods. Goods afloat were held around $70 per ton.

Bleaching Powder—Producers reported sales at $2.20 per 100 lb. f.o.b. works for nearby shipments. The market is in a very strong position, with most producers well sold up. Resale lots were quoted around 2½c. per lb.

Caustic Soda—Dealers quoted the market firm at $3.45@$3.50 per 100 lb. f.a.s. There has been an appreciable improvement during the interval, with several large sales reported to South America and Japan. Domestic caustic on spot was quoted at $3.50 per 100 lb. for carload lots and $3.75 for smaller quantities, ex-store.

Caustic Potash—Higher quotations were reported for spot material. Importers quoted 88-92 per cent at 8@8¼c. per lb., with several fair-sized sales at this figure. Higher importing costs, together with the scarcity of spot stocks, were directly the cause of the increased activity.

Phenol—Spot prices have been sharply advanced, due to the extreme scarcity of spot material and the heavily sold up market at the works. Goods on spot were held around 50c. per lb., but actual trading was mostly for small lots. The new level represents an increase of over 15c. per lb. during the past 10 days and also establishes a new high price since January, 1919.

Potassium Nitrate—Manufacturers announced a reduction on all grades. Pure doubled refined granulated is quoted at 6¾c. per lb., in barrels, the powdered at 7¼c. and the large crystals at 7¾c.

Potassium Bichromate—Dealers were somewhat firmer in their views on spot goods, and quotations were fractionally higher. Producers quoted spot material around 10c. per lb. f.o.b.

Potassium Permanganate—Spot offerings were quite scarce, and dealers quoted around 19½c. per lb. Consuming demand has shown an appreciable increase.

Prices Advance Materially in the St. Louis Market

Higher Quotations on Many Items Due to Curtailment of Imports by Ruhr Occupation

St. Louis, March 8, 1923.

Important and striking advances in the drug market since our last letter were the naming of higher schedules on salicylates, bismuth and iodide preparations. In the industrial chemical market there were also a number of important items that were materially advanced, this due principally to developments in the Ruhr situation. Shipments of chemicals from that part of Germany have been materially curtailed, and would not be surprising if they ceased altogether in the near future. The potash salts are the most affected by the curtailment, and spot stocks are hardly obtainable, with prices the highest for many months. Other industrial chemicals and alkalis have also been strengthened considerably, resulting in a heavy buying movement. Transportation facilities are somewhat better, but are still below normal; however, it is the opinion of those directly interested that conditions will greatly improve in the next month or 6 weeks.

Alkalis

The alkali market is firmer now than at any time in the recent past, and while there has been no general increase in schedules, business has been brisk. *Caustic soda* has not changed in price, though a decided improvement in volume of business transacted is reported. *Soda ash*, in sympathy with caustic, is showing improvement.

Schedules have not changed on this item, but prices are firm. *Bicarbonate of soda* has strengthened considerably, 25c. per 100 lb. having been added to the regular schedule recently. Good business on this item is reported. *Sal soda* has been rather quiet recently, though no price reductions have been made. Factors on this item expected this condition to improve.

General and Special Chemicals

Heavy *mineral acids* are going well with a firm market. There have been no startling developments in the *citric acid* market, and while there was a slight increase, the market is still lacking volume. The demand for *oxalic acid* has been very light and the market weak. *Tartaric acid* has not been moving in heavy volume, but the season is approaching when a greater demand should be forthcoming. *Aqua ammonia*, 26 deg., is moving along quiet lines with no change in price. There has been no change in *white arsenic powdered*, and the market is ruling today at 16@16½c. f.o.b. New York. Spot stocks are very scarce and buying is light. Since the advance on bismuth and iodide preparations a very satisfactory business is being transacted. *Glycerine* remains very firm; in fact, is a producers' market. The demand is excellent; prices are holding at 18½c. in drums both for open market and contract quotations. There is a pronounced scarcity of *phenol*, and domestic producers are not in a position to take care of the business. The imported article has advanced and considerably higher prices are expected to prevail in the next few weeks. The spareness of stocks is holding *permanganate of potash* in a strong position and spot goods are hardly obtainable. *Potash carbonate* and *caustic* are much stronger and ruling at higher prices. As a result of the higher market on phenol, *salicylates* have also advanced and stocks in the hands of producers are limited. *Sulphur* is moving in good volume and numerous sales are being reported. Prices are generally firm and declines are not expected. The zinc market is advancing steadily, and *spelter* is quoted today at $7.85 per 100 lb. St. Louis. Excepting during the war period this is the highest price obtained in the spelter market for many years. The *zinc dust* market is also in excellent condition and is advancing in sympathy with the spelter. *Zinc sulphate* is quoted today at 3¼@3⅜c. f.o.b. St. Louis in carload lots and 4c. f.o.b. St. Louis in less than carload lots, with a good volume of business transacted.

Vegetable Oils and Paint Materials

Turpentine is still very firm, the price today being the same as of our previous report, the 5-bbl. price being $1.54 per gal., single barrels $1.58. *Linseed oil* has taken a 3c. advance and is now being quoted at $1.03 per gal. in 5-bbl. lots, $1.13 in single barrels, with the usual differential for boiled over raw oil. *Castor oil* has taken another advance and is now quoted at 15c. lb. in drums. The market is entirely in the hands of producers, with one of the largest factors reporting a shortage of supplies.

Producers in this market report a lively business with firm prices and an increased demand. *Floated barytes* is quoted at $26@$28 in carload lots f.o.b. shipping point, with a $4 differential for single-ton lots. Gilders' *whiting* in carloads is quoted at $18@$20. *Commercial whiting* is quoted at $17 per ton in carloads, with a $3 differential for ton lots applying to both grades.

Iron and Steel Production Reach Record Rates

Market Gaining Strength With Advancing Prices and Heavy Turnover

PITTSBURGH, March 9, 1923.

Production of pig iron and steel has within the last 2 or 3 weeks exceeded the highest rate attained since the armistice, in March, 1920, and is in line, barring accidents, to break the high record of all time, reached in September, 1919. Already the rate in both pig iron and steel is above the greatest production ever attained in a full calendar year.

So far as the market itself goes, there is appearance of greater and greater strength week by week. During January and February the strong features were the advances in finished steel products, with a very heavy turnover in actual tonnage in January. In February one of the outstanding strong points was the refusal of many mills to sell beyond certain dates. In the past week two strong points have been advances in both pig iron and semi-finished steel, with the spread of a delivery premium market in some finished products.

Price Premiums Common

In bars, shapes and plates the basis price or regular market remains at 2.25c., but there are few sellers at this level, and then only for very late delivery. Bars are moving in small lots for early shipment at premiums of from $3 to $5 a ton, while occasionally shapes have gone at such premiums. Plates present the strongest prompt market, as some fairly good-sized tonnages, chiefly for oil tank work, have gone at 2.60c., or $7 a ton premium.

Wire products are difficult to buy at any price, and the market is relatively inactive, with heavy deliveries being made on old contracts. Tubular goods are also very difficult to buy. Consumers and jobbers may be fairly well covered, but their active inquiry would not so indicate. Orders are frequently sent to mills without previous inquiry, and such orders are frequently scaled down in tonnage or rejected entirely. The National Tube Co. has withdrawn as a seller of line pipe or oil country goods, except that it will accept some orders from regular customers, subject to price ruling at date of shipment, and at least one independent has adopted the same policy.

The sheet prices of the Steel Corporation, as recently advanced to 2.65c. for blue annealed, 3.50c. for black, 4.60c. for galvanized and 5c. for automobile sheets, are practically nominal, the company having been sold out for second quarter for some time, while it will hardly open order books for third quarter before about the middle of April. Independents, instead of getting on a uniform basis, as was recently the prospect, are showing a wider range of position. Some have not opened order books even for April shipment, others are quoting for April and others for second quarter, while prices are not uniform. The more common quotations are 2.75c. for blue annealed, 3.60c. for black and 4.75c. for galvanized. Yesterday the Wheeling Steel Corporation and Superior Steel Co. announced advances in their prices to 3.85c. for black and 5c. for galvanized. Automobile sheets alone are uniform in the independent market, mills having opened order books last week for second quarter at 5.35c.

Semi-Finished Steel Irregular

Expectation lately has been that the Steel Corporation would name a $40 price on semi-finished steel for second quarter to the few customers it has retained and that independents would make the same price to their regular customers. In the past week, however, the McKinney Steel Co., Cleveland, has sold some fair-sized tonnages in sheet bars and slabs at $45, Youngstown basis. That figure represents the only market now quotable. A prediction is that the corporation price will be $40 and that independents will split the difference to regular customers, making a price of $42.50.

Is the End in Sight?

While all the superficial market indications are of increasing strength week by week, it is obvious that the market has been stiffening at a dangerous pace and some observers have already grown very suspicious of the future. Clearly the steel market for some time past has not been one that could continue indefinitely. It has not had in it the elements of self-perpetuation. A given batch of purchases has not paved the way for another, but rather has produced price advances and made the mills more reserved about selling additional tonnages. What is occurring is simply a "movement," and thus the question is simply how long it will last. Particular uncertainty exists on account of some mills not having sold far ahead. If mills had all pursued the same policy, as they did before the war, the market could turn quiet at any moment, and production, shipments and consumption would proceed at a high rate for the major part of the year, the industry running on "momentum." That is what it did in 1907, through October. If the market should turn quiet in the near future some mills might in a short time find themselves in need of orders.

Current Prices in the New York Market

FOR CHEMICALS, OILS AND ALLIED PRODUCTS

Although these prices are for the spot market in New York City, a special effort has been made to report the American manufacturer's quotations whenever available. In many instances these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported and resale stocks are reported when of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb	$0 36	- $0 38
Acetone, drums	lb	22	- 23
Acid, acetic, 28%, bbl	100 lb	3 15	- 3 40
Acetic, 56%, bbl	100 lb.	6 25	- 6 50
Glacial, 99½%, carboys.	100 lb.	12 00	- 12 50
Boric, crystals, bbl	lb.	.11½	- 11½
Boric, powder, bbl.	lb.	11	- 11½
Citric, kegs	lb	49	- .50
Formic, 85%	lb.	15	- 17
Gallic, tech	lb.	45	- 50
Hydrochloric, 18° tanks, 100	lb.	.90	- 1 00
Hydrofluoric, 52%, carboys	lb.	.12	- .12½
Lactic, 44%, tech, light, bbl	lb.	.11½	- .12
22% tech, light, bbl	lb	.05½	- 06
Muriatic, 20°, tanks, 100	lb	1.00	- 1 10
Nitric, 36°, carboys.	lb	.04½	- 05
Nitric, 42°, carboys.	lb.	06	06½
Oleum, 20%, tanks	ton	17 00	- 18 00
Oxalic, crystals, bbl	lb	.12½	- 13
Phosphoric, 50%, carboys	lb.	08	- 09
Pyrogallic, resublimed	lb.	1 50	- 1 60
Sulphuric, 60°, tanks	ton.	9 00	- 10 00
Sulphuric, 60°, drums	ton	12 00	14 00
Sulphuric, 66°, tanks.	ton	14 50	15 00
Sulphuric, 66° drums	ton	19 00	- 20 00
Tannic, U S P, bbl	lb	65	70
Tannic, tech, bbl	lb.	.40	- 45
Tartaric, imp crys, bbl	lb.	.30½	- 31
Tartaric, imp, powd, bbl.	lb.	.31	- 32
Tartaric, domestic, bbl	lb.	...	- 32
Tungstic, per lb	lb.	1.00	- 1.20
Alcohol, butyl, drums, f o b Terre Haute.	lb.	.23	- .25
Alcohol ethyl (Cologne spirit), bbl	gal.	4.75	- 4.95
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 188 proof No. 1	gal.	.38	- 40
Alum, ammonia, lump, bbl	lb.	.03½	- .03¾
Potash, lump, bbl	lb.	.03	- 03¼
Chrome, lump, potash, bbl	lb	.05½	- .05¾
Aluminum sulphate, com, bags	100 lb	1 50	- 1 65
Iron free bags	lb	02¼	02½
Aqua ammonia, 26°, drums	lb.	.06½	- 07½
Ammonia, anhydrous, cyl	lb.	.30	- 30½
Ammonium carbonate, powd casks, imported	lb.	.09½	- 10
Ammonium carbonate, powd domestic, bbl	lb.	.13	- .14
Ammonium nitrate, tech., casks	lb.	10	- 11
Amyl acetate tech, drums	gal.	2 80	- 3 05
Arsenic, white, powd, bbl.	lb.	15	- 15½
Arsenic, red, powd, kegs	lb	12½	- 13
Barium carbonate, bbl	ton	75 00	- 77 00
Barium chloride, bbl	ton	87.00	- 90 00
Barium dioxide, drums	lb.	18	- 18½
Barium nitrate, casks		08	- 08½
Barium sulphate, bbl	lb.	04	- 04¼
Blanc fixe, dry, bbl	lb	04	- 04½
Blanc fixe, pulp, bbl	ton	45 00	- 55 00
Bleaching powder, f.o.b. wks, drums	100 lb	2 20	- 2 50
Resale drums	100 lb	2 50	- 2 75
Borax, bbl.	lb	05½	- 05¾
Bromine, cases	lb	28	- 30
Calcium acetate, bags	100 lb.	3.50	- 3 60
Calcium carbide, drums	lb.	04½	- 04¾
Calcium chloride, fused, drums	ton	22 00	-23 00
Gran drums	lb.	01½	- 01¾
Calcium phosphate, mono, bbl	lb.	.06½	- 07
Camphor, cases	lb.	.91	- .93
Carbon bisulphide, drums	lb.	07	- 07½
Carbon tetrachloride, drums	lb.	.09½	- 10
Chalk, precip—domestic, light, bbl	lb.	04½	- 04½
Domestic, heavy, bbl.	lb.	.03½	- 03¾
Imported, light, bbl	lb.	.04½	- 05
Chlorine, liquid, cylinders	lb.	06	- 06½
Chloroform, tech, drums	lb.	35	- 38
Cobalt oxide, bbl	lb.	2 10	- 2 25
Copperas, bulk, f o b wks.	ton	16 50	- 20 00
Copper carbonate, bbl.	lb	19	- 20
Copper cyanide, drums	lb	47	- 50
Copper sulphate, crys, bbl,	100 lb.	6 40	6 50
Cream of tartar, bbl	lb.	.24	- 25
Dextrine, corn, bags	100 lb.	3.25	3 50
Epsom salt, dom., tech, bbl.	100 lb.	2.00	- 2.25
Epsom salt, imp., tech., bags.	100 lb.	1.10	- 1.25
Epsom salt, U.S.P., dom., bbl.	100 lb.	2.50	- 2 75
Ether, U.S.P, drums	lb.	.13	- .15
Ethyl acetate, com, 85%, drums	gal.	.80	- .85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95	- 1.00
Formaldehyde, 40%, bbl	lb	$0 15	- $0 16½
Fullers earth, f o b mines	net ton	16 00	- 17 00
Fullers earth—imp, powd	net ton	30 00	- 32 00
Fusel oil, ref, drums.	gal	3 55	- 4 05
Fusel oil, crude, drums.	gal	2 30	- 2 40
Glaubers salt, wks, bags	100 lb	1 20	- 1 40
Glaubers salt, imp, bags	100 lb	1 00	- 1.25
Glycerine, c p, drums extra	lb	18½	- .19
Glycerine, dynamite, drums	lb	17	- 17½
Iodine, resublimed	lb	4 55	- 4 65
Iron oxide, red, casks	lb.	.12	- .18
Lead			
White, basic cabonate, dry, casks	lb.	.10	- .10½
White, in oil, kegs	lb	12½	- 14
Red, dry, casks	lb	11½	- 12
Red, in oil, kegs	lb	13½	- .15
Lead acetate, white crys, bbl.	lb	13½	- 14
Lead arsenate, powd, bbl	lb	23	- 24
Lime-Hydrated, bbl	per ton	16 80	- 17 00
Lime, Lump, bbl	280 lb	3 63	- 3.65
Litharge, comm, casks.	lb	10½	- 11
Lithophone, bbl	lb	06½	- 07
Magnesium carb, tech., bags	lb	08	- 08½
Methanol, 95%, bbl	gal	1 23	- 1 25
Methanol, 97%, bbl	gal	1 25	- 1 27
Nickel salt, double, bbl.	lb	10	- 10½
Nickel salts, single, bbl	lb	11	- 11½
Phosgene		69	- 75
Phosphorus, red, cases	lb.	35	- 40
Phosphorus, yellow, cases	lb	30	- 35
Potassium bichromate, casks	lb.	.10	- 10½
Potassium bromide, gran., bbl	lb.	.16	- 23
Potassium carbonate, 80-85%, calcined, casks	lb.	.05½	- 06
Potassium chlorate, powd	lb	07	- 08
Potassium cyanide, drums	lb.	.45	- 50
Potassium hydroxide (caustic potash) drums.	100 lb.	8 25	- 8 50
Potassium iodide, cases	lb	3.65	- 3 75
Potassium nitrate, bbl	lb	.06½	- .07½
Potassium permanganate, drums	lb.	.21	- 22
Potassium prussiate, red, casks	lb.	.80	- .85
Potassium prussiate, yellow, casks	lb.	.37½	- .38
Salammoniac, white, gran, casks, imported	lb.	.06½	- .06¾
Salammoniac, white, gran, bbl, domestic	lb	.08	- .08½
Gray, gran., casks	lb	08½	- .08¾
Salsoda, bbl	100 lb	1 20	- 1 40
Salt cake (bulk)	ton	26 00	- 28 00
Soda ash, light, 58% flat, bags, contract	100 lb.	1.60	- 1.67
Soda ash, light, basis, 48%, bags, contract, f o b. wks	100 lb.	1.20	- 1 30
Soda ash, light, 58%, flat, bags, resale	100 lb.	1.75	- 1 80
Soda ash, dense, bags, contract, basis 48%	100 lb.	1.17½	- 1 20
Soda ash, dense, in bags, resale	100 lb.	1.85	- 1.90
Soda, caustic, 76%, solid, drums, f a s.	100 lb.	3.45	- 3 70
Soda, caustic, 76%, solid, drums, contract.	100 lb.	3.35	3 40
Soda, caustic, basis 60%, wks, contract.	100 lb	2.50	- 2 60
Soda, caustic, ground and flake, contracts	100 lb	3.80	- 3 90
Soda, caustic, ground and flake, resale	100 lb	4 00	- 4 15
Sodium acetate, works, bags	lb	06	- 06½
Sodium bicarbonate, bbl	100 lb	2 00	- 2 50
Sodium bichromate, casks	lb	.07½	- 08
Sodium bisulphate (niter cake)	ton	6.00	- 7 00
Sodium bisulphite, powd, U S P, bbl	lb	04½	- 04½
Sodium chlorate, kegs	lb	.06½	- 07
Sodium chloride	long ton	12 00	- 13 00
Sodium cyanide, cases	lb	20	- .23
Sodium fluoride, bbl	lb.	.09	- 10
Sodium hyposulphite, bbl.	lb	.03	- 03½
Sodium nitrite, casks.	lb	08½	- .09
Sodium peroxide, powd., cases	lb.	.28	- 30
Sodium phosphate, dibasic, bbl.	lb.	.03½	- 04
Sodium prussiate, yel drums	lb.	.19	- .19½
Sodium silicate (40°, drums)	100 lb.	.80	- 1.15
Sodium silicate (60°, drums)	100 lb.	2.00	- 2.25
Sodium sulphide, fused, 60-62% drums.	lb.	.04	- .04½
Sodium sulphite, crys., bbl	lb.	.03½	- .03¾
Strontium nitrate, powd., bbl.	lb.	.09½	- .10
Sulphur chloride, yel drums.	lb.	.04½	- .05
Sulphur, crude	ton	18.00	- 20.00
Sulphur dioxide, liquid, cyl	lb.	.08	- .08½
Sulphur, flour, bbl.	100 lb.	2.35	- 3.15
Sulphur, roll, bbl	100 lb.	$2.00	- $2.50
Talc—imported, bags	ton	30 00	- 40 00
Talc—domestic powd., bags.	ton	18 00	- 25 00
Tin bichloride, bbl.	lb.	.13½	- 14
Tin oxide, bbl	lb.	.52	- .54
Zinc carbonate, bags	lb.	14	- .14½
Zinc chloride, gran, bbl	lb.	06	- .07
Zinc cyanide, drums	lb.	37	- .38
Zinc oxide, XX, bbl	lb.	.07½	- .08
Zinc sulphate, bbl	100 lb.	2 75	- 3 00

Coal-Tar Products

Alpha-naphthol, crude, bbl	lb.	$0 80	- $0.85
Alpha-naphthol, ref, bbl.	lb.	1.05	- 1.10
Alpha-naphthylamine, bbl	lb.	.35	- .38
Aniline oil, drums	lb.	.16½	- .17
Aniline salts, bbl	lb.	.24	- .25
Anthracene, 80%, drums	lb.	.75	- 1.00
Anthracene, 80%, imp., drums, duty paid	lb.	.65	- .70
Anthraquinone, 25%, paste, drums	lb.	.70	- .75
Benzaldehyde U S P, carboys	lb.	1 40	- 1.45
Benzene, pure, water-white, tanks and drums	gal.	.30	- .35
Benzene, 90%, tanks & drums	gal	26	- .32
Benzene, 90%, drums, resale	gal.	.33	- .35
Benzidine base, bbl.	lb.	85	- .90
Benzidine sulphate, bbl	lb.	75	- .80
Benzoic acid, U S P., kegs	lb.	72	- .75
Benzoate of soda, U S P., bbl.	lb.	.57	- .65
Benzyl chloride, 95-97%, ref, drums	lb.	.25	- .27
Benzyl chloride, tech, drums	lb.	.20	- .23
Beta-naphthol, subl, bbl.	lb.	.55	- .60
Beta-naphthol, tech, bbl	lb.	.24	- .25
Beta-naphthylamine, tech.	lb.	.80	- .90
Carbazol, bbl	lb.	.75	- .90
Cresol, U S P., drums.	lb.	.25	- .29
Ortho-cresol, drums	lb.	.24	- .26
Cresylic acid, 97%, resale, drums	gal	1.40	- 1 50
95-97%, drums, resale.	gal.	1.40	- 1 50
Dichlorbenzene, drums	lb.	.07	- .09
Diethylaniline, drums	lb.	50	- .60
Dimethylaniline, drums	lb.	.41	- 42
Dinitrobenzene, bbl	lb.	19	- .20
Dinitroclorbenzene, bbl	lb.	22	- 23
Dinitronaphthalene, bbl.	lb.	.30	- .32
Dinitrophenol, bbl	lb.	.35	- .40
Dinitrotoluene, bbl	lb	.20	- .22
Dip oil, 25%, drums	gal.	25	- .30
Diphenylamine, bbl	lb.	50	- .52
H-acid, bbl	lb.	.80	- .85
Meta-phenylenediamine, bbl.	lb.	95	- 1 00
Michlers ketone, bbl	lb.	3.00	- 3.50
Monochlorbenzene, drums	lb.	.08	- .10
Monoethylaniline, drums	lb.	95	- 1.10
Naphthalene, crushed, bbl	lb.	.06	- .06½
Naphthalene, flake, bbl.	lb.	.07½	- .08
Naphthalene, balls, bbl.	lb.	.08½	- .09
Naphthionate of soda, bbl	lb.	58	- .65
Naphthionic acid, crude, bbl.	lb.	.60	- .65
Nitrobenzene, drums	lb.	.10	- .12
Nitro-naphthalene, bbl.	lb.	.30	- .35
Nitro-toluene, drums	lb.	.15	- .17
N-W acid, bbl	lb.	1 15	- 1.20
Ortho-amidophenol, kegs	lb.	2 30	- 2 35
Ortho-dichlorbenzene, drums	lb.	.17	- .20
Ortho-nitrophenol, bbl.	lb.	.90	- .92
Ortho-nitrotoluene, drums	lb.	.10	- .12
Ortho-toluidine, bbl	lb.	13	- .15
Para-amidophenol, base, kegs	lb.	1 15	- 1 20
Para-amidophenol, HCl, kegs	lb.	1.20	- 1 25
Para-dichlorbenzene, bbl	lb	.17	- .20
Paranitraniline, bbl.	lb.	.74	- .75
Para-nitrotoluene, bbl	lb	.55	- .65
Para-phenylenediamine, bbl.	lb.	1 45	- 1.50
Para-toluidine, bbl	lb.	90	- .95
Phthalic anhydride, bbl	lb.	35	- .38
Phenol, U S P., drums	lb.	.50	- 55
Picric acid, bbl.	lb.	20	- .22
Pyridine, dom, drums	gal.	nominal	
Pyridine, imp, drums	gal.	2 30	- 2 50
Resorcinol, tech, kegs	lb.	1 50	- 1 55
Resorcinol, pure, kegs	lb.	2 00	- 2 10
R-salt, bbl.	lb.	.60	- .65
Salicylic acid, tech, bbl	lb.	.40	- .42
Salicylic acid, U.S.P, bbl	lb.	.45	- .47
Solvent naphtha, water-white, drums	gal.	.37	- .40
Crude, drums	gal.	.22	- .24
Sulphanilic acid, crude, bbl	lb.	.18	- .20
Thiocarbanilide, kegs	lb.	.35	- .38
Toluidine, kegs	lb.	1.20	- 1.30
Toluidine, mixed, kegs	lb.	.30	- .35
Toluene, tank cars	gal.	.35	- .37
Toluene, drums	gal.	.40	- .43
Xylidines drums	lb.	.40	- .45
Xylene, pure, drums	gal.	.45	- .50
Xylene, com., drums	gal.	.40	- .42
Xylene, com., tanks	gal.	.30	- ...

Naval Stores

Rosin B-D, bbl.	280 lb.	$6 15 – .....
Rosin E-I, bbl.	280 lb.	6 25 – $6 40
Rosin K-N, bbl.	280 lb.	6 55 – 6.95
Rosin W G.-W.W., bbl.	280 lb.	7 35 – 8 05
Wood rosin, bbl.	280 lb.	6 25 –
Turpentine, spirits of, bbl.	gal	1 53 – 1 54
Wood, steam dist., bbl.	gal.	1 35 – .
Wood, dest. dist., bbl.	gal.	1 25 –
Pine tar pitch, bbl.	200 lb.	.. – 6 00
Tar, kiln burned, bbl.	500 lb.	.. – 12 00
Retort tar, bbl.	500 lb.	.. – 11 00
Rosin oil, first run, bbl.	gal.	.43 – ..
Rosin oil, second run, bbl.	gal.	.47 – .....
Rosin oil, third run, bbl.	gal.	.53 – .....
Pine oil, steam dist	gal.	.... – .90
Pine oil, pure, dest. dist.	gal.	.... – 85
Pine tar oil, ref.	gal.	.... – .46
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal.	.... – .35
Pine tar oil, double ref., bbl.	gal.	.... – .75
Pine tar, ref., thin, bbl	gal.	.... – 25
Pinewood creosote, ref., bbl.	gal.	.... – .52

Vegetable Oils

Castor oil, No 3, bbl.	lb	$ 13½ – $.13¾
Castor oil, AA, bbl.	lb	14 – 14½
Chinawood oil, bbl	lb.	.19 – 19½
Coconut oil, Ceylon, bbl.	lb.	09½ – 9¾
Coconut oil, Cochin, bbl.	lb.	09¾ – 10
Corn oil, crude, bbl	lb.	.12 – .12½
Cottonseed oil, crude (f.o.b. mill), tanks.	lb.	.10 –
Summer yellow, bbl.	lb.	.12 – 12½
Winter yellow, bbl.	lb.	.13 – 13½
Linseed oil, raw, car lots, bbl.	gal	98 – 99
Raw, tank cars (dom.)	gal.	94 – 95
Boiled, 5-bbl lots (dom.)	gal.	1 02 – 1 04
Olive oil, denatured, bbl.	gal	1 10 – 1 15
Palm, Lagos, casks.	lb	08½ – 08¾
Palm kernel, bbl	lb.	08½ – 09
Peanut oil, crude, tanks (mill)	lb.	13½ – 13¾
Peanut oil, refined, bbl	lb	16½ – 16¾
Rapeseed oil, refined, bbl.	gal	.85 – 86
Rapeseed oil, blown, bbl.	gal.	90 – .91
Soya bean (Manchurian), bbl	lb.	12 – ..
Tank, f.o.b. Pacific coast.	lb.	.10½ – .....

Fish Oils

Menhaden, light pressed, bbl.	gal	$0 68 – .70
White bleached, bbl.	gal.	72 – 74
Blown, bbl.	gal.	76 – 78
Whale No 1 crude, tanks, coast	lb	06 – 06½

Dye & Tanning Materials

Divi-divi, bags	ton	$38 00 – $39 00
Fustic, sticks	ton	30 00 – 35 00
Fustic, chips, bags	lb.	04 – 05
Logwood, sticks	ton	28 00 – 30 00
Logwood, chips, bags.	lb.	02½ – .03½
Sumac, leaves, Sicily, bags.	ton	65 00 –
Sumac, ground, bags.	ton	55 00 – 60.00
Sumac, domestic, bags.	ton	35.00 – ...
Tapioca flour, bags	lb	.03½ – .05

EXTRACTS

Archil, conc., bbl	lb.	$0 17 – $0 18
Chestnut, 25% tannin, tanks.	lb	02 – 03
Divi-divi, 25% tannin, bbl.	lb.	04 – 05
Fustic, crystals, bbl	lb	20 – 22
Fustic, liquid, 42°, bbl	lb.	.08 – 09
Gambier, liq., 25% tannin, bbl	lb.	.08 – 09
Hematine crys., bbl	lb.	.14 – 18
Hemlock, 25% tannin, bbl.	lb.	.04 – .05
Hypernic, solid, drums	lb.	.24 – .26
Hypernic, liquid, 51°, bbl.	lb.	.14 – .17
Logwood, crys., bbl.	lb.	.19 – .20
Logwood, liq., 51°, bbl.	lb.	.09 – .10
Quebracho, solid, 65% tannin, bbl	lb.	.04½ – .05
Sumac, dom., 51°, bbl.	lb.	.06½ – .07

Waxes

Bayberry, bbl	lb	$0 28 – $0 30
Beeswax, refined, dark, bags	lb.	30 – 32
Beeswax, refined, light, bags	lb	34 – 35
Beeswax, pure white, cases	lb	40 – 41
Candelilla, bags	lb.	27 – .29
Carnauba, No 1, bags.	lb.	.40 – 41
No 2, North Country, bags	lb.	.23½ – .24
No 3, North Country, bags	lb.	.19 – .19½
Japan, cases	lb.	.15 – .15½
Montan, crude, bags.	lb.	.03½ – .04
Paraffine, crude, match, 105-110 m.p.	lb.	.04 – .04½
Crude, scale 124-126 m.p., bags	lb.	02½ – 02¾
Ref., 118-120 m.p., bags	lb.	.03¼ – .03½
Ref., 125 m.p., bags	lb.	03½ – .03¾
Ref., 128-130 m.p., bags	lb.	.04 – 04¼
Ref., 133-135 m.p., bags	lb.	.04¼ – 04½
Ref., 135-137 m.p., bags	lb	05 – .05¼
Stearic acid, sgle pressed, bags	lb.	13½ – ...
Double pressed, bags	lb.	.14½ –
Triple pressed, bags	lb.	.16 – .....

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb.	$3.20 – $3.25
F.a.s. double bags	100 lb.	3 85 – 3.95
Blood, dried, bulk	unit	4.60 – ...
Bone, raw, 3 and 50, ground	ton	30.00 – 35.00
Fish scrap, dom., dried, wks.	unit	5.00 – 5.10
Nitrate of soda, bags	100 lb.	2.60 – 2.65
Tankage, high grade, f.o.b. Chicago	unit	4.70 – 4 80

Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$4.00 – $4.50
Tennessee, 78-80%	ton	8.00 – 8 25
Potassium muriate, 80%, bags	ton	35.00 – 36 00
Potassium sulphate, bags	unit	1.00 –

Crude Rubber

Para—Upriver fine	lb	$0 33 – $0 33½
Upriver coarse	lb	27½ – .28
Upriver caucho ball.	lb	29½ – 30
Plantation—First latex crepe	lb	34½ – 35
Ribbed smoked sheets	lb.	34½ – .35
Brown crepe, thin, clean	lb.	31 – 32
Amber crepe No. 1	lb.	31 – .32

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh ton	$450 00 – $550 00
Asbestos, shingle, f.o.b., Quebec	sh ton	60 00 – 80 00
Asbestos, cement, f.o.b., Quebec	sh ton	15 00 – 17 00
Barytes, grd., white, f.o.b mills, bbl.	net ton	16 00 – 20 00
Barytes, grd., off-color, f.o.b mills bulk	net ton	13 00 – 15 00
Barytes, floated, f.o.b St Louis, bbl	net ton	24 00 – 28 00
Barytes, crude f.o.b. mines, bulk	net ton	9 00 – 9 25
Casein, bbl., tech	lb.	11 – 12
China clay (kaolin) crude, f.o.b Ga	net ton	7 00 – 9 00
Washed, f.o.b Ga	net ton	8 00 – 9 00
Powd., f.o.b. Ga.	net ton	13 00 – 20 00
Crude f.o.b. Va	net ton	8 00 – 12 00
Ground, f.o.b. Va.	net ton	13 00 – 20 00
Imp., lump, bulk	net ton	15 00 – 20 00
Imp., powd	net ton	45 00 – 50 00
Feldspar, No 1 pottery.	long ton	6 00 – 7 00
No 2 pottery	long ton	5 00 – 5 50
No 1 soap	long ton	7 00 – 7 50
No 1 Canadian, f.o.b. mill	long ton	25 00 – 27 00
Graphite, Ceylon, lump, first quality, bbl	lb	06 – .06½
Ceylon, chip, bbl.	lb.	05 – .05½
High grade amorphous crude	ton	35 00 – 50 00
Gum arabic, amber, sorts, bags	lb	15 – 16
Gum tragacanth, sorts, bags	lb	50 – 60
No 1, bags	lb	1 75 – 1 80
Kieselguhr, f.o.b Cal.	ton	40 00 – 42 00
F.o.b N.Y.	ton	50 00 – 55.00
Magnesite, crude, f.o.b Cal	ton	14 00 – 15 00
Pumice stone, imp., casks	lb	03 – 05½
Dom., lump, bbl	lb	05 – 05½
Dom., ground, bbl	lb.	06 – 07
Shellac, orange fine, bags	lb	82 – 83
Orange superfine, bags.	lb.	84 – 85
A C garnet, bags.	lb	79 – 80
T N, bags	lb	80 – 81
Silica, glass sand, f.o.b Ind	ton	2 00 – 2 50
Silica, sand blast, f.o.b Ind	ton	2 50 – 5 00
Silica, amorphous, 250-mesh, f.o.b. Ill	ton	17 00 – 17 50
Silica, bldg. sand, f.o.b Pa	ton	2 00 – 2 75
Soapstone, coarse, f.o.b. Vt., bags	ton	7 00 – 8 00
Talc, 200 mesh, f.o.b., Vt., bags	ton	6 50 – 9.00
Talc, 200 mesh, f.o.b. Ga., bags	ton	7 00 – 9.00
Talc, 200 mesh, f.o.b. Los Angeles, bags.	ton	16.00 – 20.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	ton	$45–50
Chrome brick, f.o.b. Eastern shipping points	ton	50–52
Chrome cement, 40-50% Cr_2O_3	ton	23–27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23 00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b Ky wks.	1,000	40–46
2nd quality, 9-in shapes, f.o.b wks	1,000	36–41
Magnesite brick, 9-in. straight (f.o.b wks.)	ton	65–68
9-in arches, wedges and keys.	ton	80–85
Scraps and splits	ton	85
Silica brick, 9-in sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9-in sizes, f.o.b. Birmingham district.	1,000	48–50
F.o.b. Mt. Union, Pa	1,000	42–44
Silicon carbide refract. brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N.Y.	ton	$200.00 – $225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11½ 11½
4-6% C.	lb.	.12 – .13
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	110.00 – 112 00
Spiegeleisen, 19-21% Mn.	gr. ton	35.00 – 37.00
Ferromolybdenum, 50-60% Mo, per lb Mo	lb.	1.90 – 2.15
Ferrosilicon, 10-15%	gr. ton	38 00 – 40.00
50%	gr. ton	86.00 – 89.00
75%	gr. ton	150.00 – 160.00
Ferrotungsten, 70-80%, per lb. of W	lb.	$0.85 – $0.90
Ferro-uranium, 35-50% of U, per lb. of U	lb.	6.00 – ....
Ferrovanadium, 30-40%, per lb. of V	lb.	3.75 – 4.00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$6.50 – $8.75
Chrome ore, Calif concentrates, 50%, min Cr_2O_3	ton	22 00 – 23.00
C i f Atlantic seaboard	ton	18 50 – 19.00
Coke, fdry., f.o.b. ovens	ton	8 25 – 8.50
Coke, furnace, f.o.b ovens	ton	7 00 – 7.25
Fluorspar, gravel, f.o.b. mines' Illinois	ton	21.50 – ....
Ilmenite, 52% TiO_2	lb.	.01½ – .01¾
Manganese ore, 50% Mn, c.i.f Atlantic seaport	unit	.33 – ....
Manganese ore, chemical (MnO_2)	ton	75.00 – 80.00
Molybdenite, 85% MoS_2, per lb MoS_2, N.Y	lb	.65 – .70
Monazite, per unit of ThO_2, c.i.f., Atl seaport	lb	.06 – .08
Pyrites, Span., fines, c.i.f Atl seaport	unit	.11½ – .12
Pyrites, Span., furnace size, c.i.f Atl seaport	unit	.11½ – .12
Pyrites, dom. fines, f.o.b. mines, Ga	unit	.12
Rutile, 95% TiO_2	lb.	.12 – ....
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.50 – 8.75
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	8.00 – 8.25
Uranium ore (carnotite) per lb of U_3O_8	lb	3.50 – 3.75
Uranium oxide, 96% per lb U_3O_8	lb	2.25 – 2.50
Vanadium pentoxide, 99%	lb	12 00 – 14.00
Vanadium ore, per lb V_2O_5	lb.	1 00 – ....
Zircon, washed, iron free, f.o.b Pablo, Fla.	lb	.04½ – .13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	16.75–17.00
Aluminum, 98 to 99%	24.00
Antimony, wholesale, Chinese and Japanese	7.65–7.75
Nickel, virgin metal	25.00–27.00
Nickel, ingot and shot	29.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	38.00
Monel metal, sheet bars	45.00
Tin, 5-ton lots, Straits	46.75–47.25
Lead, New York, spot	8.25
Lead, E St Louis, spot	8.30–8.40
Zinc, spot, New York	7.80–7.90
Zinc, spot, E St. Louis	7.50–7.75

OTHER METALS

Silver (commercial)	oz.	$0.67
Cadmium	lb.	1.15
Bismuth (500 lb lots).	lb.	2.55
Cobalt	lb.	2.65@2.85
Magnesium, ingots, 99%	lb.	1.00@1.05
Platinum	oz	110.00
Iridium	oz.	260 00@275.00
Palladium	oz.	79.00
Mercury	75 lb.	69 00@70.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.75
Copper bottoms	30.75
Copper rods	20.50
High brass wire	19.50
High brass rods	17.00
Low brass wire	21.10
Low brass rods	22.00
Brazed brass tubing	24.25
Brazed bronze tubing	29.00
Seamless copper tubing	25.25
Seamless high brass tubing	23.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.30@11.50
Copper, heavy and wire	11 25@11.50
Copper, light and bottoms	9.25@ 9.50
Lead, heavy	5.75@ 6.00
Lead, tea	3.50@ 3.75
Brass, heavy	6.25@ 6.40
Brass, light	5.35@ 5.75
No 1 yellow brass turnings	6.30@ 6.50
Zinc	3.50@ 4.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.29	$3.14
Soft steel bars	3.19	3.04
Soft steel bar shapes	3.19	3.04
Soft steel bands	3.29	3.19
Plates, ¼ to 1 in. thick	3.29	3.14

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

HOLT—The Central Iron & Coal Co has awarded a general contract to the Ingalls Iron Works, Birmingham, for the erection of a new 1-story plant for the manufacture of cast iron and steel pipe. The estimated cost is reported in excess of $80,000

BIRMINGHAM—The Alabama Hide & Tallow Co, 1608 9th Ave., North, has plans in progress for the rebuilding of its tallow and grease works recently destroyed by fire with loss of about $18,000. Additional equipment will be installed Charles Barber heads the company.

SHEFFIELD—The Alatep Lead Products Co., recently organized, has plans under way for the construction of a new plant for the manufacture of lead battery plates and other lead specialties.

BIRMINGHAM—The Sanitary Chemical Co., recently organized, has plans under consideration for the immediate establishment of a local plant for the manufacture of a line of chemical specialties F T Bell heads the company.

EAST BIRMINGHAM—Following the completion of the first unit of its new pipe manufacturing plant, the McWane Cast Iron Pipe Co, Birmingham, is perfecting plans for the construction of another unit. It is purposed to increase the size of the present foundry, 108x310 ft, to a length of 510 ft. The initial plant will have a rated daily output of 8,000 ft of cast-iron pipe, giving employment to about 150 men J R McWane is president, and James D Sample, vice-president

California

SAN FRANCISCO—The National Lead Co, 485 California St., has awarded a contract to Dyer Brothers, Golden West Iron Works, Kansas St, for the erection of a new 1 story plant at 17th Ave. and East 10th St, Oakland, to cost about $37,000

SAN FRANCISCO—The Jewell Steel & Malleable Co, 1375 Potrero Ave., has awarded a contract to Barrett & Hilp, 918 Harrison St., for the erection of a 1-story addition to its plant to cost about $13,000, exclusive of equipment

Connecticut

SOUTH COVENTRY—The Willimantic Paper Co. is making ready for operations at the plant formerly occupied by the South Coventry Paper Co., recently acquired, and a number of alterations and improvements will be carried out It is expected to commence producton before the close of the month.

Florida

SEBRING—The Town Council is considering the installation of a filtration plant and system at the municipal waterworks, comprising the former plant of the Sebring Light & Water Co., lately acquired for municipal property. Joseph Rawthorne is superintendent

Georgia

ATLANTA—The Atlanta Glass Mfg. Co has acquired a local site and plans for the erection of a new plant for the manufacture of glass bottles and other containers.

WRENS—The McNair-Young Oil Co has tentative plans under consideration for the rebuilding of its local oil plant, partly destroyed by fire, Feb. 23, with loss approximating $50,000, including equipment

TIFTON—The plant of the Tift Silica Brick Co has been acquired by W. W. Pace, Jr., together with a large tract of adjoining property. The new owner will take possession immediately, and plans for general improvements for increased production. The plant will specialize in the manufacture of white silica bricks

FORT VALLEY—The Emergency Products Co., recently organized, is planning for the establishment of a local plant for the manufacture of insect powders and kindred chemical specialties Edward Chambers heads the company.

Indiana

EAST CHICAGO—Following a consummation of the proposed merger of the Youngstown Sheet & Tube Co, Youngstown, O, and the Steel & Tube Co. of America, Chicago, Ill, under the direction of the first-noted organization, plans are being perfected for extensions and improvements in the Steel & Tube Co plants at East Chicago and Indiana Harbor A number of new mills will be built The project is estimated to cost in excess of $5,000,000, with machinery

INDIANAPOLIS—The Chandler & Taylor Co, South Addison St, is planning for the rebuilding of its 1-story foundry, 175x300 ft, destroyed by fire, Feb 24, with loss estimated at $85,000, including equipment The new structure will be approximately the same size The company manufactures steam engine boilers and kindred products. William M Taylor is president

Iowa

MASON CITY—The Cerro Gordo Brick & Gravel Co. is considering plans for the construction of a new brick-manufacturing plant, estimated to cost approximately $40,000 C I Snyder is secretary

Kansas

WICHITA—The Western Glass Co., 531 North Market St., has taken bids on a general contract and will soon make award for the erection of a new 2-story and basement building, 75x130 ft, estimated to cost about $35,000 Edward Forsbloom, Sedgwick Bldg, is architect

Louisiana

NEW IBERIA—The local Chamber of Commerce is considering plans for the establishment of a sugar refinery in or near the city The Parish Farm Bureau, headed by A A Theriot and Louis Pesson, is also interested in the project. It is purposed to select an engineer to prepare plans in the near future.

Maryland

BALTIMORE—Plans are being completed for the erection of a 1-story foundry at the plant of the Bartlett-Hayward Co., Scott and McHenry Sts., manufacturer of machine castings, etc. Parker, Thomas & Rice, Union Trust Bldg., are architects.

HAGERSTOWN—The Elestano Mining Co., 3 Hamilton Row, is planning for the installation of smelting equipment at its new tin ore plant now being established. The company was recently incorporated.

Massachusetts

SPRINGFIELD—The Springfield Gas Light Co. will make extensions and improvements at the purifier building at its local artificial gas plant to cost $23,000. Plans have been completed

BOSTON—The Penn Metal Co, 65 Franklin St., has purchased the local plant and business of the Midvale-Cambria Steel Co., Philadelphia, Pa, covering primarily the steel rod and bar branch of production. The new owner will continue the operation of the mill pending the completion of a new steel rod mill at its own plant, now in course of erection, and later will remove the Midvale works to this location. Expansion in production is planned.

Michigan

MARINE CITY—Sidney C. McLouth is planning for the immediate rebuilding of his foundry, partially destroyed by fire, Feb. 21, with loss estimated at $25,000, including equipment. The plant is devoted primarily to the production of steel castings.

WYANDOTTE—The Michigan Alkali Co., operated by the J. B. Ford Co., has tentative plans under consideration for the erection of a new 2-story plant on Biddle St.

HOLLAND—F. B. Parish has acquired the local foundry of the Holland Engine Co., and will operate the plant as an individual enterprise for the production of iron and steel castings. Extensions and improvements are planned to include the installation of additional equipment.

Missouri

ST. CHARLES—The Crucible Oil & Refining Co., St. Joseph, Mo., has preliminary plans in progress for the construction of a local refining plant, to include a byproducts department for the production of miscellaneous oils The company also operates a works at Wichita, Kan.

ST LOUIS—Tentative plans are being prepared for the construction of a new 1-story foundry at the plant of the Green Car Wheel Mfg Co., 3000 North Broadway. Klipstein & Rathran, Chemical Bldg., are architects

ST LOUIS—The Frictionless Metal Co. has leased property at Cass Ave. and Collins St., comprising a 3-story building, for the establishment of a new plant for the manufacture of babbitt metal The installation of machinery will be commenced at an early date The company is now operating a plant at Richmond, Va., as well as a Canadian branch at Montreal, Que., and it is purposed to remove both of these plants to the new location at a later date. C W Bourne is president.

Montana

GREAT FALLS—The Sunburst Refining Co., recently organized with a capital of $300,000 as a subsidiary of the Sunburst Oil & Gas Co, is perfecting plans for the construction of a new oil-refining plant on local site, with initial capacity of about 4,000 bbl per day. It is estimated to cost close to $150,000 with machinery L. C. Stevenson is president of the parent organization and heads the new company. W. M. Parker is construction engineer in charge.

EAST HELENA—The American Smelting & Refining Co, 120 Broadway, New York, has plans in preparation for the construction of an addition to its local smelting plant, estimated to cost approximately $200,000, including equipment. The extension will be used to handle the increased output from the Hercules and Tamarack mines in the Cœur d'Alene district.

New Jersey

TRENTON—The Trenton Potteries Co., manufacturer of sanitary ware, will immediately commence construction of a 4-story addition to its Equitable Pottery at Lalor and Hancock Sts A 1-story kiln building will also be constructed The new structures will cost about $80,000. S. W Mather & Sons, Greenwood and Canal Sts., have the general building contract.

NEWARK—The Electrified Water Co. has leased the 1-story building at 232 Halsey St. for the establishment of a new plant for the production of water-purifying materials and water-purification systems. The company is operating a number of plants in different parts of the country, and purposes to establish a new works at Los Angeles, Cal. Alfred H. Brundage is president.

NEWARK—The Celluloid Co, 290 Ferry St., has filed plans for the erection of a 1-story addition to its plant at 65-67 Westcott St., estimated to cost approximately $14,000.

BLOOMINGDALE—The Seamless Rubber Co., recently organized, has commenced the installation of machinery in a local building for the establishment of a new plant for the manufacture of hard rubber goods. It is purposed to inaugurate production at an early date.

JERSEY CITY—The Ault & Wiborg Co., 12th St., manufacturer of printing inks, etc., has filed plans for alterations and extensions in its local plant, to cost about $9,000.

TRENTON—George L. Atkins, Langhorne, Pa., has acquired the local foundry of the Reeves Foundry Co., Ward Ave., at a sheriff's sale for a consideration of $72,717. The plant has been closed for a number of months past. The new owner is said to be arranging for the organization of a company to operate the foundry for the production of iron and steel castings.

New York

BUFFALO—The City Council is arranging a bond issue of $2,800,000, of which amount $1,700,000 will be used for the installation of the proposed new filtration plant at the municipal waterworks.

NEW YORK—The Harlem Sugar Co., 2445 8th Ave., has completed plans for the construction of a new 2-story building, 75x100 ft., on the Southern Blvd., near St. Ann's

Ave., estimated to cost about $75,000. Charles Clark, 441 East Tremont Ave., is architect.

BUFFALO—The Federal Concrete Products Co. has made application to the City Council for permission to build a new plant at Kensington and Wyoming Aves., for the manufacture of cement and concrete products, to consist of a main 1- and 2-story building, 80x110 ft., and adjoining structure, 24x67 ft., estimated to cost approximately $30,000, with equipment. Walter E. Jones is president.

North Carolina

BELMONT—The Continental Brick & Tile Co, Chapel Hill, N. C., has commenced the erection of a new plant at Belmont for the manufacture of brick and tile products. Initial production will be devoted to brick with output of about 30,000 per day J G Gullick is president.

Ohio

LISBON—The American Vitrified Products Co is said to be planning for the early rebuilding of the portion of its plant destroyed by fire, March 2, with loss estimated at about $100,000, including equipment.

Oklahoma

SAPULPA The Star Gasoline Co, has commenced the construction of a new gasoline absorption plant in the Boggy farm section, to be equipped for an initial output of 2,500 gal per day

Pennsylvania

LOCK HAVEN—The Harbison-Walker Refractories Co, Farmers' Bank Bldg, Pittsburgh, is said to have preliminary plans under consideration for the construction of a new firebrick and refractory manufacturing plant in the vicinity of Lock Haven

SHARON—The Sharon Brick & Clay Co, recently organized by H. D Beegle, New Galilee, Pa, and associates, has taken over the local plant and business of the Sharon Clay Products Co., secured for a consideration of about $100,000. The new company plans for immediate operations and will make improvements and extensions to develop an output of about 250,000 bricks a week

PHILADELPHIA—The Philadelphia Salt Co, Delaware and Oregon Aves, manufacturer of chemical products, has filed plans for the erection of a new 1-story plant addition, estimated to cost $20 000

BOWMANSTOWN—The Aluminum Pigment & Products Co, Bowmanstown, recently organized, will locate its proposed new plant at this place instead of at Lehighton, Pa, a previously announced A general contract for the building has been awarded to Charles Fenstermacher, Lehighton, and a portion of the initial equipment installation will be handled by the Fuller Lehigh Co, Fullerton, Pa The plant will be devoted to the manufacture of aluminum pigments

NEWCASTLE—The Grasselli Power Co has tentative plans under consideration for the rebuilding of its press mill, recently destroyed by fire. The estimated loss has not been announced Headquarters of the company are in the Guardian Bldg., Cleveland, Ohio

Tennessee

KNOXVILLE—The Cherokee Brick Co. has purchased a tract of more than 20 acres of land in the Chestnut Ridge section, and plans for the early erection of a new brick-manufacturing plant, with initial daily output of about 40,000 bricks. The company was organized recently with Roy Newman as president, and J. C. Wright, secretary and treasurer.

ERWIN—The Southern Potteries Co., recently taken over by new interests, has tentative plans under consideration for the construction of a new unit, comprising about seven kilns, with various production departments. Other improvements will be made at the pottery for increased output. Charles W. Foreman heads the company. G F Brandt is in charge of factory production.

Texas

DALLAS—The Standard Spring & Axle Co, 2614 Main St., will install a heat-treating department at its new plant at 2816 Main St., on which work has been commenced. L. K. Weaver is president and treasurer.

SAN ANTONIO—The Kahn Oil Co. is planning for the installation of a new laboratory at its plant. C. H. Nunn is chemist, in charge.

Industrial Developments

CERAMIC—The Crescent China Co., Alliance O, is advancing production at its pottery and has commenced operations at the new 7-kiln plant, recently completed. The pottery will run full for an indefinite period.

The Auburn Shale Brick Co, Auburn, Pa, is arranging for early curtailment at its plant for necessary machinery repairs and plant improvements The plant will be closed for a few weeks and will then resume on a full capacity schedule

The Andalusia Brick Co, River Falls, Ala, is operating at full capacity and plans are under consideration for improvements to provide for greater output The company was recently acquired by new interests, headed by C L Benson

The E. H. Sebring China Co., Sebring, O, is running at full capacity with full working force, and will continue on this basis for an indefinite time The company has plans under consideration for the construction of two additional kilns at the pottery.

The Hazleton Brick Co, Hazleton, Pa, is making a number of improvements at its plant, including repairs to machinery, and plans to resume production early in the spring, giving employment to a full working force

The Gratztown Brick Works, West Newton, Pa recently acquired by new interests, has resumed production after a shutdown for about 24 months It is expected to maintain capacity operations for a number of months to come Eugene Servi heads the new company

Lenox, Inc, Trenton, N J, manufacturer of fine chinaware, has added a number of employees to its working force, including former operatives recently on strike, who have returned on an open shop basis, as lately established by the company. Operations are close to normal and will be maintained on this basis

RUBBER The Traveler Rubber Co, Bethlehem, Pa., is operating at full capacity with normal working force Incoming orders are in excess of the plant output and it is currently estimated that the company is now about 35,000 tires behind in deliveries Preliminary plans are under consideration for enlargements in the plant

In connection with proposed plans for maximum spring production, the Goodyear Tire & Rubber Co., Akron, O, has increased immediate output from 28,000 to 30,000 a day The mill is now giving employment to close to 14,000 workers Manufacture will be further advanced as soon as additional employees are available

The B F Goodrich Co Akron, O, has increased production in the tire departments at its mills from 18,000 to 20,000 tires per day A full working quota is being employed.

CEMENT—The Coplay Cement Co., Coplay, Pa, has resumed production at its Mill "B" following a shutdown for several weeks past, owing to necessary repairs and alterations in machinery. It is expected to develop capacity at an early date, with full working force

The Signal Mountain Portland Cement Co, Chattanooga, Tenn, is pushing construction on its new local mill, and expects to commence production late in April or early in May giving employment to a large working force The plant represents an investment of close to $2,000,000.

According to statistics compiled by the Portland Cement Association, mills throughout the country are running better than 65 per cent capacity, gross, an increase of 80 per cent as compared with this same time a year ago.

IRON AND STEEL—The Replogle Steel Co., New York, is making repairs at its large blast furnace at Catasauqua, Pa., including relining, with day and night working forces. The stack is expected to be ready for resumption within a few weeks.

The Wheeling Steel Corp., Wheeling, W Va., has blown in its Top Mill blast furnace, following a suspension since last August. The stack will give employment to about 100 men. All plant units of the company are now on the active list, operating at close to 75 per cent of normal.

The wages of puddlers and rollers in the Youngstown, O., district have been advanced 2.1 per cent and 2.5 per cent, respectively.

The Ulster Iron Works, Dover, N. J., are making ready to resume production at their puddling mills on West Clinton St. Plans are under way for extensions in the plant, to include the installation of two more furnaces and the erection of a mill to cost approximately $100,000. The working force is being increased in the different departments.

A total of 50 out of 51 steel mills are now in operation in the Niles, O., district, the single mill being that of the Mahoning Valley Steel Co, a shutdown of the unit being necessary on account of a breakdown. It is expected to be on the active list within a few weeks

MISCELLANEOUS—The Scott Paper Co., Philadelphia, Pa, is maintaining capacity production at its mills at Chester Pa., with employment of full working force This shedule will be maintained indefinitely.

The Tennessee Copper & Chemical Co, 61 Broadway, New York, has opened its new acid phosphate plant at Cincinnati, O., and will develop capacity production immediately It is said that the entire spring production of the new unit has already been completely sold

The Atlas Mineral Products Co, Mertztown, Pa, manufacturer of paint specialties, is running full with regular working force It is stated that orders on hand insure the continuance of this schedule for at least 6 months to come.

The Mathieson Alkali Works, Providence, R I is now operating at about 90 per cent of maximum capacity, as compared with less than 75 per cent at this same time a year ago

New Companies

THE CAMEL CHEMICAL CO., Portland, Ore., has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are C W. Hall, W B Potter and George J Dreis The company is represented by S S Johnson, 909 Wilcox Bldg., Portland.

THE BURROWLITE NICKEL STEEL CO., care of the Corporation Trust Co. of America, du Pont Bldg, Wilmington, Del, representative, has been incorporated under Delaware laws with capital of $1 000 000 to operate a metal smelting and refining plant.

THE WAGGONER REFINING CO, Electra, Tex, has been incorporated with a capital of $300,000, to manufacture refined petroleum products. The incorporators are W. T, E P., and G. L Waggoner all of Electra.

THE MID-WEST WALL PAPER MILLS, INC., Fuller Tract, Logan Ave, Joliet, Ill, has been incorporated with a capital of $95,000, to manufacture paper products The incorporators are William E Lamb William M. Kearney and Thomas J Reardon.

THE FUNDY PAINT CO, Brooklyn N Y., care of E N Baar, 51 Chambers St., N. Y., representative, has been incorporated with a capital of $20,000, to manufacture paints, varnishes, etc The incorporators are E. R. Bagarozy and M Craushaar

THE SPRINGFIELD BRICK CO., Springfield, Mass, has been incorporated with a capital of $97,500, to manufacture brick, tile and other burned clay products Clayton H. Goodell is president, and Harold E Clark, treasurer, both of Springfield. The last noted represents the company.

THE ANGLO-AMERICAN ANILINE & CHEMICAL WORKS, INC., care of the Colonial Charter Co, Ford Bldg, Wilmington, Del, representative, has been incorporated under Delaware laws with capital of $450,000, to manufacture chemicals and chemical byproducts, dyes, etc

THE SWATARA CHEMICAL CO, Hummelstown, Pa., has been incorporated with a nominal capital of $5,000, to manufacture chemicals and chemical byproducts William Karmany, Hummelstown, is treasurer.

THE WEST VIRGINIA CHEMICAL CO., Fairmont. W. Va, has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are J. M. Moran and H. H. Curry, both of Fairmont.

THE INTERNATIONAL PRODUCTS CO., 333 Ardmore Ave., Trenton, N. J., has been incorporated with a capital of $50,000, to manufacture paints, varnishes, etc. The incorporators are John R Turner, Alfred F McCabe and Charles J. Hofman.

THE COLUMBIAN COLOR & CHEMICAL CO, Brooklyn, N. Y., care of Gilroy & Hyman, Woolworth Bldg., representatives, has been incorporated with a capital of $20,000, to manufacture chemical products, colors and affiliated specialties. The incorporators are J. J. and F. J. Sullivan, and J. R. Cusack.

THE ELLWOOD BRICK & TILE CO., care of Delaware Registration Trust Co., 900 Market St., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $75,000, to manu-

facture brick, tile and other burned clay products.

THE MARSHALL REFINING CO., 332 South Michigan Ave., Chicago, Ill., has been incorporated with a capital of $100,000, to manufacture petroleum products. The incorporators are Frank Sullivan, Harry N. Weinberg and Paul M. Godehn.

THE MONESS CHEMICAL CO, New York, care of A. M Silverman, 276 5th Ave, representative, has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. The incorporators are J. M. and E. Moness, and L. D. Malin.

THE BROOKS CHEMICAL CO, New Cumberland, W. Va, has been incorporated with a capital of $15,000, to manufacture chemicals, compounds, etc. The incorporators are C. L. Gray, John R. Platinburg and George W. McNeil, all of New Cumberland

THE LINSEED OIL PRODUCTS CO, Philadelphia, Pa., has been incorporated with a nominal capital of $5,000, to manufacture linseed oil and other oil products J H Webster, 34 East Willow Grove Ave, Philadelphia, is treasurer.

THE MANNING FERTILIZER CO, Manning, S. C., has been incorporated with a nominal capital of $50,000, to manufacture fertilizer products. Charlton Durant is president, and C. R. Sprott, secretary and treasurer, both of Manning.

Industrial Notes

MCCLELLAN & JUNKERSFELD, INC., engineer and contractor, of Philadelphia and New York, has added to its staff N B Ambler, J. T. Brusky, Harrison E Kleffel and Thomas Richardson. Renshaw Born has also recently been added to the staff and is in charge of the Philadelphia office at 112 South 16th Street.

THE CUTLER STEEL CO, of Pittsburgh, announces the appointment of W. F Furman as district manager, with headquarters at 50 Church St, New York. Mr. Furman was for many years with the American Locomotive Co and more recently the Eastern representative of the LeMoyne Steel Co, of Pittsburgh The general sales office of the company, which has been maintained for the past 2 years at 50 Church St., New York City, has been transferred to the Bowman Bldg., Pittsburgh, Pa. W. H Waddington, vice-president in charge of sales, will make his headquarters at the Pittsburgh address.

THE UEHLING INSTRUMENT CO., Paterson, N. J., has placed Royal E. Terhune in charge of the northern New Jersey sales territory. Mr. Terhune was formerly associated with the Uehling laboratories John E. Arnold, 15½ South 4th St, Tulsa, Okla, has been appointed an agent for the Oklahoma territory and H. R. N. Johnson, 917-A Marquette Ave, Minneapolis, has been appointed agent for the Minnesota, North Dakota and South Dakota territory. Walter C. Lange, 20 West Jackson Blvd, recently returned to the Chicago territory after 2 months spent at the Paterson plant, assisting in the development of the new Uehling CO, or combustible, recorder. This company also announces that it has appointed Mitsui & Co. representatives in Japan and China for Uehling CO_2 recording equipment and other Uehling power plant instruments and gages The head office of Mitsui & Co is located in Tokio and their New York branch is at 65 Broadway.

THE WEBSTER MFG CO, of Chicago, Ill and Tiffin, O, announces further expansion in connection with its Canadian business by starting a new corporation—Webster-Inglis, Ltd—which will be located at 14 Strachan Ave., Toronto, Ont., Canada The facilities of this plant will enable the company to design and manufacture elevating, conveying and power transmission machinery along the same lines as are now manufactured by the Webster Mfg. Co

THE HARRISBURG MFG & BOILER CO, of Harrisburg, Pa., recently opened a sales office in the Park Row Bldg., New York City. The company builds boilers, tanks, steel stacks, breechings and special steel plate and structural steel jobs. It also has large machine shops and makes a specialty of contracting to build entire lines of machinery for companies not having their own shops.

JOSEPH T. RYERSON & SON, INC., Chicago, Ill., announces that Clyde M. Carr has retired as president, on account of poor health. He has not taken an active part in the management of the firm for the past 2 years. He will continue, however, as a director. At the regular annual meeting of the directors, Joseph T. Ryerson was elected president. Joseph T. Ryerson, the grandson of the original Joseph T., succeeds to the presidency with a background of 22 years in the steel business. He was born in 1880 and immediately after graduating from Yale in 1901 went to work for the American Sheet Steel Co., now the American Sheet & Tin Plate Co., at its mill in Vandergrift, Pa. In October, 1902, he started with Joseph T Ryerson & Son at Chicago and in 1904 was elected treasurer, becoming vice-president in 1922

THE COMBUSTION ENGINEERING CORP., New York, announces that T J. Cleary, who has recently opened an office in Atlanta, Ga., for the sale of power plant equipment, has been appointed its Southern agent Communications should be addressed to Room 702, Candler Bldg. Atlanta, Ga.

THE KEWANEE BOILER CO is now located in its new building at 822 West Washington St, Chicago.

THE NATIONAL ANILINE & CHEMICAL CO., INC, announces that E. L Rimbault, formerly reclamation manager of the company, at the Buffalo plant, has been appointed manager of the intermediates and certified food color divisions. Mr Rimbault will be located at the main office of the company at 40 Rector St, New York City.

THE MONSANTO CHEMICAL WORKS, St. Louis, Mo., announces that at its annual meeting on Jan 15 the stockholders elected the following directors to serve during 1923: John F. Queeny, Gaston Du Bois, Beverly D Harris, Edgar M. Queeny, H O. McDonough, Joseph D. Lumaghi and Theodore Rassieur At the directors' meeting immediately following, the officers were elected as follows: Chairman of the board, John F. Queeny, president, Beverly D. Harris; first vice-president, Gaston Du Bois; second vice-president, Edgar M Queeny; third vice-president, Frank L. McCartney; treasurer, H. G. Gunther; secretary, W. R. Phemister, assistant secretary, C. A. Zacher Frank L. McCartney's title is now vice-president in charge of sales, while Edgar M. Queeny is vice-president and assistant general manager.

DWIGHT P ROBINSON & CO, INC., New York, has added as consulting materials engineer C. L. Chapman. Mr. Chapman, who has been active in the work of the American Society of Testing Materials and the American Concrete Institute, will, in the future, represent Dwight P Robinson & Co. in the committee work of these societies

THE POWER SPECIALTY CO. announces that Paul T. Buckler, for 14 years with the Detroit Stoker Co as manager successively of the Pittsburgh, Cleveland and New York offices, is now in its New York Office, assisting in the sale of Foster superheaters and economizers

THE WESTERN PRECIPITATION CO, Los Angeles, Calif, has moved its Eastern office from Philadelphia to New York City This applies as well to the office of the subsidiary company, the International Precipitation Co The Eastern office is now in the same quarters as those occupied by the company's associate, the Research Corporation, at 25 West 43rd St.

THE CONVEYORS CORP. OF AMERICA, Chicago, Ill., announces the acquisition from the Green Engineering Co, East Chicago, Ind., of all rights to the Green steam jet ash conveyor, the transaction having become effective Feb 1. It acquires all the patterns, patents and manufacturing rights pertaining to the Green conveyor All orders for replacement parts and extensions to the Green conveyor will be filled by the Conveyors Corp of America

THE ELECTRO BLEACHING GAS CO, manufacturer of liquid chlorine, announces the advancement to general sales manager of S W. Jacobs, succeeding D. K. Bartlett, resigned Mr. Jacobs is a chemical engineer and has supervised the installation of a number of chlorine plants His office will continue to be at the main office of the company, 18 East 41st St, New York City.

THE HARRISBURG PIPE & PIPE BENDING CO, Harrisburg, Pa, at a meeting of the board of directors, elected Christian W. Lynch president and director of the company, to fill the vacancy caused by the resignation of Alfred K. Barker Mr. Lynch up to the last year was president and general manager of the Harrisburg Foundry & Machine Co, Harrisburg, Pa., and prior to that was for many years president and general manager of the W. O. Hickok Mfg Co., Harrisburg, Pa

THE MERRIMAC CHEMICAL CO, 148 State St, Boston, Mass, announces that it has added to its list of products the following: Merclor, a bleach and disinfectant to be used in laundries, dairies, freight cars, markets, etc., and acetic acid in strengths from 56 per cent to glacial.

THE NEW YORK TESTING LABORATORIES, New York City, has installed a new automatic 100,000 lb. Tinius Olsen testing machine for handling of tensile tests, compression tests, transverse tests, etc.

THE ALEXANDER MILBURN CO., of Baltimore, Md., manufacturer of oxy-acetylene welding and cutting equipment, has recently placed on the market an addition to its line, viz., a portable acetylene welding generator designed to obviate the use of high-pressure cylinders. The company says: "The generator is of 30 lb. carbide capacity, or equivalent of 150 cu.ft. cylinder gas. It is simple to operate, having few parts, operates automatically with no clock or motors; steel body welded throughout, and all parts easily 'get-at-able'."

Coming Meetings and Events

AMERICAN ASSOCIATION OF CEREAL CHEMISTS will hold its ninth annual convention at Hotel Sherman, Chicago, June 4 to 9.

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual convention in Norfolk, Va., May 7 to 9.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York.

AMERICAN FOUNDRYMEN'S ASSOCIATION will hold a meeting in Cleveland, O., April 28 to May 4.

AMERICAN GAS ASSOCIATION will hold its annual convention the week of Oct. 15 at Atlantic City. An elaborate exhibition of gas-making and gas-utilization equipment is planned.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its summer meeting June 20-23 at Wilmington, Del

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W. Va., June 7, 8 and 9.

AMERICAN OIL CHEMISTS' SOCIETY will hold its annual meeting at the Eastman Hotel, Hot Springs, Ark., April 30 and May 1.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

IRON AND STEEL INSTITUTE (London) will hold its annual meeting May 10 and 11 at the House of the Institution of Civil Engineers, London, S. W. 1.

NATIONAL ASSOCIATION OF MANUFACTURERS OF THE UNITED STATES OF AMERICA will meet in annual conference May 14 to 16, inclusive, at the Waldorf-Astoria, New York City.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (NINTH) will be held in New York Sept. 17-22.

NATIONAL FOREIGN TRADE COUNCIL has postponed its annual conference from April 25, 26 and 27, to May 2, 3 and 4. It will be held in New Orleans, La.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

FIFTH PAN-AMERICAN CONFERENCE will be held at Santiago, Chile, March 25, 1923.

SOCIETY FOR STEEL TREATING—Eastern sectional meeting will be held June 14 and 15, in Bethlehem, Pa.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

A PAPER INDUSTRIES EXPOSITION will be held in Grand Central Palace, New York City, during the week of April 9, 1923, by the International Exposition Co.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City; March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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Salaries for Public Servants

BRIGHTENING the closing days of Congress, Representative UPSHAW of Georgia introduced a bill to increase Congressional salaries from $7,500 to $10,000 a year. In support of his measure he quoted no less an advocate than the late FRANKLIN K. LANE, to the effect that men in government service should be better paid. From the flowers of Mr. UPSHAW'S rhetoric we glean information to the effect that conditions have so changed since the present rate of compensation was fixed that it is now impossible for Congressmen to live properly and in a seemly fashion on less than $10,000 a year. He painted a pitiful picture of Congressmen borrowing money with which to take themselves and families back home.

We should be the last to gainsay the assertion that the cost of living has gone up; and we know from experience that Washington is an expensive city. But our meditations follow those of the late Secretary LANE even more closely than do those of Congressman UPSHAW, for the latter is thinking of Congressional salaries only, while the former was known to have had the deepest concern for the welfare of scientific and technical employees of the government, most of whom are notoriously underpaid. Our thought goes out to examiners in the Patent Office, whose lot was recently improved in some degree, and to chemists, physicists, geologists and other scientists, engineers and men of learning who worry along in the various government scientific bureaus on $1,800, $2,500 and $3,600 a year. Years of service and unusual ability may eventually carry them to the dizzy summits of affluence in civil service with a reward of $4,000 or $5,000 per annum.

It is neither unfair nor intended to be unkind to compare the qualifications and pay of these scientific servants of the government with those of its political representatives. We admit the comparison is odious, but we cannot help remembering that scientists in the government service are required to show special and extraordinary qualifications for the work they desire to do. They are tested and examined to determine their eligibility. Rules and regulations are laid down, and only through their strict observance do we permit these men of knowledge and scholarship to work for the people. And for all these requirements the remuneration is about 60 per cent honor and 40 per cent coin of the realm. Against this picture paint the corresponding qualifications and pay of Congressmen: local popularity, persuasive oratory, political regularity, a campaign fund, and a salary disproportionate to the intrinsic value of the service rendered.

All this, however, is far from proving that the pay of Congressmen should not be increased. But we should like to see it done on the basis of special qualifications for the job. Perhaps our point would be driven home with greater effect if Congressmen were engaged on a civil service basis—required to prove by test and examination that they are specially qualified for their work. Without boasting, we think we could organize an examination that would result in a marked improvement in the competence of our great law-making body. We should be inclined to ascertain the measure of intelligence of each candidate and his knowledge of public affairs, economics, finance and business. Oratory, on the other hand, we should rate very low; indeed the addiction to impassioned oratory would be regarded as a disqualification. Then when we had thus selected our Congressmen we should pay them such salaries as are now given to other civil service employees of exceptional and proved qualifications—and await the result. It is not at all certain that even under these conditions we could keep Congressional salaries from running away from those of government scientists, but we feel quite sure that in the first shock of realization there would be a tendency to increase salaries all around. If Mr. UPSHAW would give due consideration to the technical employees of the government we should have more sympathy for his proposal.

Another Boost For Lignite

RESULTS obtained during the past year by the United States Bureau of Mines in carbonization of lignite have attracted a great deal of favorable notice. Indeed, they indicate more promising opportunities for lignite briquets than have ever been prophesied before. As a natural consequence of this important development the Canadian authorities, who also have been studying this subject, are now concerning themselves directly with the methods used by the bureau.

This work now takes very definite form in an arrangement whereby the Bureau of Mines will act as consulting engineer for the Lignite Utilization Board of Canada. Under this arrangement the bureau will design an oven to be built by the Canadian investigators in connection with their plant at Bienfait, Sask. This new installation will follow closely the lines of the simple internally heated retort which was operated so successfully at Grand Forks last summer. Thus we have further evidence of the success of the co-operative agreement under which the bureau and Professor BABCOCK, of the University of North Dakota, have been working.

The new type of oven does not provide for gas or byproduct recovery. By some this may be regarded as a return to the old beehive oven principles; as a matter of fact, it is substantially that. But the oven gives results that promise to be commercially as well as

technically successful, and that is the true measure of industrial achievement. It would have been more satisfying to our technical sense of conservation of all products from raw materials if the tar, ammonia and gas, which theoretically might be evolved from lignite, could also be saved. But equipment that would recover these byproducts is far too costly both to build and to operate for greatest present-day success in lignite processing. The bureau very wisely, therefore, chooses a method that has commercial prospect of success in furnishing a smokeless domestic fuel for states otherwise far from sources of such material. It will be time enough later to add the refinements of design and operation when the basic work of the industry, manufacture of lignite briquets, can stand on its own feet financially.

Making a Fetish Of Secrecy

TOM MIDGLEY said not long ago: "When you bolt the door of your research laboratory, you're locking out more information than you're locking in." He was enunciating a principle of open-mindedness that has characterized the automobile industry and has been responsible for much of its progress. In this principle there is a lesson for many of our chemical manufacturers, particularly those affected by the German blight that surrounds a part of our industry with an air of mystery and secrecy. The war did much to improve this condition, but it did not eliminate it. Many chemical plants, making standard products by well-known processes, have closed their doors to the outside world in order to guard more carefully their precious manufacturing "secrets."

It has been our experience that it is in those plants where the German influence is most pronounced that the greatest reserve is maintained. Sometimes this is carried to a degree that is ridiculous. We recall the case of a fine chemical factory established here many years ago by some German chemists and engineers. The plant burned down recently and has just been reconstructed under the direction of the original superintendent, Herr Doktor B. When the architects drew up the plans for the new building, the superintendent insisted that all dimensions and proportions be given incorrectly in the specifications in order to make it more difficult for anyone to copy or duplicate the installation. When the equipment was ordered special scales were provided for reading all thermometers and gages, and only the superintendent had record of their real calibration. Another interesting precaution was the insistence that the aluminum kettles used in the process be painted black, so that if any of the competitors observed them during shipment, there would still be a mystery about their construction. These are but a few unimportant observations, but they are prime examples of suspicious and self-centered policies maintained by a few of our chemical manufacturers. It is perhaps significant to point out that after the chemical plant we have just mentioned was completed, serious difficulties were encountered in one of the distillation operations. Rather than call in a recognized consultant who was expert in such matters, the superintendent made an expensive trip to Germany and at a high cost purchased the information he needed from an employee of one of his foreign competitors.

But the German chemist is not the only one to worship at the shrine of secrecy. JOHN P. HARRIS makes the statement in an article in *The Cotton Oil Press* (extracts from which appear elsewhere in this issue), "that the art of edible oil refining has progressed less since its inception than any other branch of applied chemistry . . . because practically all of the manufacturers have made a great fetish of secrecy, even introducing it into their own organizations so that only the chosen few shall know of the 'wonderful secrets' by which their efficiency is obtained." He shows very clearly the industry's need for real co-operation in the free exchange of technical information and in the common effort to advance the industry by improving the quality of its products.

There is sound logic in this doctrine and the chemical engineering industries will find that removing the millstone of secrecy from about their necks is one of the surest and quickest steps toward technical and scientific progress.

How They Do It In England

PLENTY of criticism has been directed at the National Research Council. Many times we have been tempted to join the chorus of disapproval. An organization that is all overhead, that has funds with which to "start" and "co-ordinate" researches (some derivative of the word *liaison* should be used here, despite early acquaintance with the nasty word in the novels of DAUDET and BALZAC), but which has no money to prosecute investigations—such an organization is sure to be an easy butt of ridicule.

Undoubtedly it would be more desirable to describe a better method. So at the risk of being suspected by the Hearst publications of being pro-British, we should like to call attention to the activities of their Government Department for Scientific and Industrial Research. This was formed to organize and foster industrial research. As a matter of fact, this department controls the activities of the National Physical Laboratory—corresponding somewhat to our Bureau of Standards—but in addition it has done one thing since the great war. During those red years, science was found to be of value not only to the government but to industry as well. Particularly has the awakening occurred in the metallurgical industry in its many branches—steel making, iron founding, non-ferrous alloying, rolling mills and heat-treating shops. So this national organization has brought together the firms in various branches of industry into several research associations, which are charged with the duty of fostering, organizing and *paying for* researches into practical matters affecting the industry. For instance, nearly all the big and little firms making brass and bronze have joined the Non-Ferrous Metals Research Association. Financial support is apportioned according to the size or output of the member, and the government matches the expenditures for research, pound for pound, for 5 years. Ten different investigations into common troubles are now under way. Each of the studies is costing up to £2,000 per year and they are prosecuted at various laboratories fitted to carry them on. Others of them, such as the cause of red stains in brass, are being done at the National Physical Laboratory.

Another active organization in the metallurgical trades is the British Cast Iron Research Association.

It has a membership of 202 foundries and has the good fortune of obtaining PERCY LONGMUIR as director of research. It has eight investigations actively under way, on such things as the grading of pig iron, molding sand, cylinder casting, corrosion-resisting irons, ladle linings, "draws and shrinks" in castings, and sulphur holes and hard spots.

Publication of the results of these investigations will eventually be made, although they will be divulged only to the members of the association for a specified time. However, the members are kept in touch with the progress in a unique and intimate manner: Lectures are arranged at various centers by the research staff and to which only members of the association are admitted. A full account of the investigation is then given, and demonstrations are made of recommended practice as developed by the research. Two objects are served in this manner: First, early confidential communication of the results of the research is assured to those who have given it financial support; and second, the investigator gets into close and immediate contact with that section of the industry chiefly interested in his work.

Joint activities of this sort are particularly fine because of the support by industry. Since the industries are helping to pay for the work, they are much more anxious to see the results and to make an attempt to profit thereby. Researches done by outsiders, and published, may be read, but inertia is so great that obvious applications toward individual works-practice may be, and too often are, long delayed.

Such accomplishments by our English cousins appear to be a particularly fine example of how to get a thing done. While the work is sponsored by a governmental department, there is no more compulsion on the part of industry to co-operate than there is in this country. The essential difference is that over there a fund is available to match, pound for pound, the contributions of industry, and the National Research Council would undoubtedly do well to compare the net results.

The Mystic Quest In Science

ON THE 19th of February it was 450 years since NICHOLAS KOPPERNIGK, known as COPERNICUS, was born at Thorn, in Poland of those days and later of Prussia. His uncle was a bishop. He studied law at the University of Cracow, astronomy (and canon law) at Bologna, and medicine at Ferrara. He was his uncle's private physician until the bishop's death in 1512, and then became canon of Frauenberg, after which (according to Dr. C. G. ABBOT in *Science* of Feb. 16) he exerted himself for many years as physician to the poor. His great work "De revolutionibus orbium cœlestium" was completed in 1530, but was not published until 1543, when the first printed copy was brought to the author on his death bed. The year 1543 was only 360 years ago. Let us bear this fact in mind for a few minutes.

The work to which we have referred contained the amazing, surprising, absurd and preposterous proposal that the earth is round like a ball and revolves about the sun! Now everybody knew that the earth was flat like a cake, that it was stationary, and that while a complex system of epicycles had been spun out by the learned to account for the peculiar motions of the planets, all the stars were in fact "lesser lights" and of little more importance than so many tallow dips. There was a plane above the earth and the stars—which was heaven—and another plane below the earth—which was hell. The sun was a big lantern which was raised every morning in the East, and in the evening was let down in the West. Anybody who wasn't insane and possessed of devils or in league with SATAN from choice (or by foreordination) could recognize these facts as facts. So this last and great work which followed a previous extensive treatise on monetary reform by the same author was kindly provided with a preface by his friend OSIANDER, who explained that the whole notion—observations, computations and all—was purely speculative. And it was probably well for COPERNICUS that he passed away in 1543 and not later. He had a proper funeral at all events.

His conclusions were supported by GALILEO, who was not born until 21 years after the death of COPERNICUS, and GALILEO, as we know, had his troubles for his thoughts. He was forced to deny any such foolishness on pain of torture. Not long before he died, in 1642, it is said that he ventured to say that the earth does move after all. But it was heretical to do so, and everybody knew he was wrong. That was 281 years ago.

Only 281 years ago, and this country was already beginning to be settled. Our Fourth of July dates from less than a century later. Now ideas have inertia, and continue to endure even when the reason for them is removed, just as we learn in our books on physics of the movement of material bodies. In economics they call such persistence the "drag." Nearly all our philosophy of life and our dogmas of ethics and religion and our institution of common law date much farther back than 1642. The Holy Inquisition has passed out, but its principles and habits of thought remain. The earnest pleading of ex-Secretary BRYAN against the theory of evolution is an instance of this drag of ideas.

Many persons acknowledge the vastness and immensities of space, but they continue to order their thoughts according to the Ptolemaic system, which we have theoretically abandoned, with its conclusions that spring from a belief in a little, measurable, domestic universe of which the earth is at once the nucleus and the principal substance. It is confusing to think of hundreds of thousands of light-years in connection with space while remaining sound in traditional doctrine. In fact, the world is very much bewildered in these days. Many of us don't know what to believe, and finally we settle the matter by believing in nothing but what we can see or hear. But we can see and hear so very little that it is not enough to give us a grip on life; to give us faith. Then from many of us comes a general denial and we let things go at that. This is the philosophy that GOETHE attributed to *Mephistopheles*, and he pointed to it as the road to destruction.

So the question arises whether the time is not approaching to order our thinking according to the newer and greater light of science and to venture into the field of metaphysics in the quest of faith and understanding. When ASTON computed the resolution of the fractional mass of the hydrogen atom into energy on the creation or organization of helium, did he not do this very thing? He surely sought the greater understanding. And out of the greater understanding there may emerge the greater faith. Is it not right and proper that men of science should seek it? We are in sore need of it.

Readers' Views and Comments

Marketing Of Ideas

To the Editor of Chemical & Metallurgical Engineering

SIR:—The business executive was speaking and he was talking about a subject you have frequently discussed in your columns. It was of his technical men and of their difficulties in selling themselves and their ideas that he was speaking. But, you ask, who is this executive? All that I can tell you is that he is vice-president and general manager of a large organization operating a string of plants extending from Chicago west to San Francisco. He is what is termed a self-made man; his formal education had been completed in the elementary grade school. Initiative, hard work and persistence had brought him to the top. The rungs on the ladder had not been forgotten. His old associates pointed with pride to his accomplishments and respected and admired him.

"Frequently," said he, "the technical man wonders why he does not attract a larger salary. He wonders why, when so many plans and products are brought to him for an opinion, and often this is the determining opinion of their worth or feasibility—why, when he seems such an important cog in the machinery of his organization, he should draw a salary of such modest proportions. It so happens that business pays its greatest dividends to him who risks the most, and since these dividends are in the medium of exchange, this means who risks the most money. To the initiator of an idea goes the long reward, provided he knows how to carry it to a successful conclusion, or, as is more often the case, knows how to attract men to him who know the details upon which the success of the enterprise is dependent. Speaking for our own organization and from my experience with other similar organizations I should say that the technical man is seldom the initiator of the type of idea which is possible of successful commercial application. Usually our technical men act in the capacity of consultants to whom a proposition is submitted after it seems commercially feasible. The scope of their work is necessarily limited as compared with that of some of our executives.

"Compare for a moment my work with that of Dr. ——, head of our technical department. As in any organization, the worth of a man to us can be determined by a glance at his salary check. Why is mine greater than his? Simply because I am worth more; I can bring to this organization business on which we show a profit and because all of his duties are only one part of mine. To me is assigned the task of initiating projects and pushing them to a point where they become financially profitable; to him falls the duty of helping me with the technical details of these projects. I am not the only source of energy or ideas in this organization; if I were, it would not deserve that name.

"Sometimes ideas come from the technical department which are possible of profitable application, but, and note this, our technical men, who, by the way, are as able and wide awake as any, can carry these ideas only through the laboratory and to the plant. They can bring them to the point where large-scale production is possible, but there they stop. To someone else then must go the finishing of the job. Developing a process is an important thing, but so managing production and sales of the article produced that it will return a profit to those who have risked money in its manufacture is vastly more important, and incidentally more profitable.

"Take this message back to your technical friends who are dissatisfied with their money-earning capacity. Until they are able to plan a venture, supervise its details and bring it to a point where its returns will more than earn the rental of money invested in it—until that time must they remain relatively unimportant cogs in the machine, responsible for only a part of its operation."

And thinking about this on the way home, what "Sid" said in the *American Magazine* some time ago came back to me with a new force. "How many payrolls are you on?" he asked. "How much did you draw in your *pay* envelope last month, and how much in your *satisfaction* envelope?" I wonder how many of us have answered these questions before we voiced our complaints about the meagerness of our pay envelope and the lack of appreciation of our efforts by business?

ADOLPHUS.

Production of Sodium Sulphide

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have read with interest the articles on Sodium Sulphide which you have published in three recent issues of your journal and note the difficulties encountered by some.

For the manufacture of fused product I have never found any better installation that the reverberatory furnace, and even here the upkeep is very high on account of the action on the lining. However, where one wishes the 30 per cent crystals, I have had excellent results on a manufacturing scale from the batch rotary and the continuous rotary.

Some years ago I carried out experiments on a batch rotary for a chemical company in the South and obtained a reduction of 96 per cent of the theory using a charge of 1,600 lb. of coal to 2,000 lb. of salt cake and maintained my temperature between 750 and 850 deg. C. Much better and more economical results were obtained from a continuous rotary furnace using a charge of 2,000 lb. salt cake, 600 lb. of coal and 1,000 lb. of coke or residue from the leaching vats, maintaining same temperature as stated above. This gave 96 per cent of the theory, and one remarkable thing about it was it required no outside heat after it was once started. Due to the coke in the smelt it also obviates the filtration troubles. The sodium sulphide crystallized from the leachings of this material and dried and slightly washed in a centrifugal is practically chemically pure.

H. P. BASSETT.

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How Does Idleness Affect Profits And Selling Prices?

The Executive's Problem of So Adjusting Prices as to Increase Sales and Total Profits When a Plant Is Not Operating at Capacity Involves Considerable Computation—A Simple Method of Solving the Problem Is Described in This Article

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IN normal times many articles are written telling how to increase profits. In dull times the question of how to reduce losses is given considerable attention. At present business has reached the point where it cannot be considered either normal or dull. While all indications point to a slow but consistent increase in the demand for manufactured products rather than a tendency to revert to a demand so small that business is considered "dull," still very few industries are running full capacity. This means that there is a certain amount of idle equipment in nearly every line of industry, which, of course, results in a loss of money.

The problem confronting the business executive today is how to increase the demand for his product so that the factory can be run at a greater capacity. While the demand for a product of a factory can usually be stimulated by a reduction in selling price, an executive cannot consider taking this step unless he has a very complete picture of the effect that a reduced selling price will have on the final profit of the business. The first question he must decide is, "Will a reduction in selling price increase the demand for the product?" The next question is of the following nature: "How much can the selling price be reduced, if doing so will increase the demand for the product and still enable the company to make the same net profit?" A selling price slightly greater than this will result in an increase to profits, although the price finally set may still be considerably lower than the present selling price. All of this assumes that the reduction in price will actually increase the volume of sales.

It is the purpose of this article to discuss, first, the relation which plant capacity has on final profits, and then present a chart for the convenient ready solution of the problems involving this relationship.

Every manufacturing plant has a certain definite expense which is incurred regardless of the amount produced. This expense consists of rent of buildings, interest, taxes, insurance, maintenance, depreciation and other fixed charges, and is generally known as "Constant Expense." If the factory is running at its full, or normal, capacity, the constant expense per unit produced is relatively small. However, if the factory is running at only a fraction of its capacity, say one-half, and turning out only one-half of its normal production, the amount of constant expense incurred per unit produced is twice as great as the desired minimum.

Some accounting systems charge the constant expense, no matter how large, against the amount produced, no matter how small. Under such a system the loss incurred shows up as an increase in the cost of production. It is becoming generally recognized that the cost of each unit of product should include only those expenses which contributed to its production and that, therefore, the constant expense should be spread over the normal capacity of the shop. Under this method, the amount of constant expense charged against the output of the factory bears the same ratio to the total constant expense as the amount produced bears to the normal capacity of the factory. Any portion of the constant expense which is not charged to the product, due to the fact that the factory has not been run at full capacity, is charged as a loss against the business. Thus, in a plant running one-half capacity and turning out one-half of its normal production, one-half of the constant expense represents the loss incurred—in other words, the cost of idleness. Of course, the cost of idleness decreases as the used capacity of the shop increases.

Entirely regardless of the accounting method used, the fact remains that, all other factors remaining the same, an increase in the volume produced and sold will not only increase the total income of the business, but will at the same time increase the profit per unit produced. This is because the fixed charges, or "Constant Expense," are less per unit produced. To indicate the similarity between both methods of charging constant expense, let us take a plant the full normal capacity of which is 200 units, but which is using only 50 per cent of its capacity and turning out 100 units. At full capacity the cost is, say, $100, of which $15 represents the fixed charges or constant expense. The accounting methods compare as follows:

	Constant Expense Distributed Over—	
	Amount Produced	Normal Capacity
Quantity produced	100	100
Per cent of capacity used	50	50
Unit cost	$115	$100
Unit selling price (est.)	$150	$150
Unit profit	$35	$50
Total profit	$3,500	$5,000
Loss due to idleness	...	$1,500
Profit after idleness	$3,500	$3,500

In order to study the relation among capacity, selling price and profit, it is only necessary to determine the loss incurred as a result of running the plant at the various rates of capacity less than normal. It is not necessary to change the accounting method, providing the present method indicates the amount of this loss.

Let us take as an example a factory running at 40 per cent capacity. In this case 60 per cent of the constant expense is the cost of idleness. If enough work can be secured to run at 70 per cent capacity, this loss

will be reduced to 30 per cent of the constant expense. Therefore, because of the reduction in the cost of idleness, the selling price can be reduced an amount equal to 30 per cent of the constant expense and the business will still make as much profit as was made previously.

THE PROFIT COMPARISON CHART

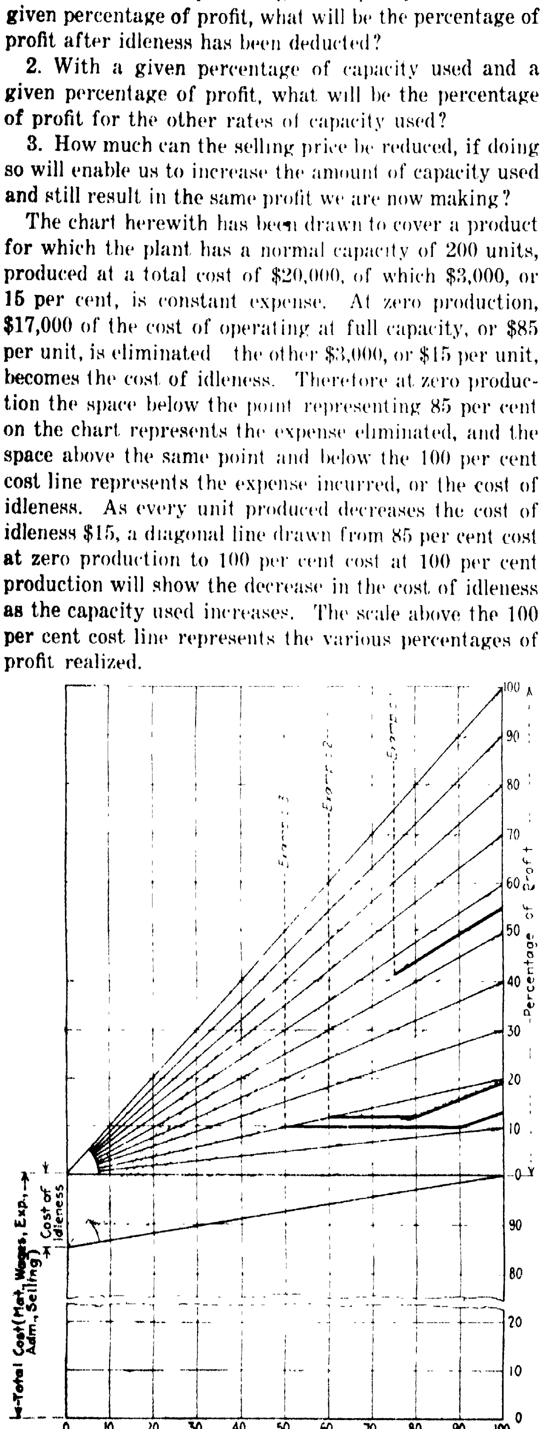
The "Profit Comparison Chart" has been devised to answer the following questions:

1. With a given percentage of capacity used, and a given percentage of profit, what will be the percentage of profit after idleness has been deducted?

2. With a given percentage of capacity used and a given percentage of profit, what will be the percentage of profit for the other rates of capacity used?

3. How much can the selling price be reduced, if doing so will enable us to increase the amount of capacity used and still result in the same profit we are now making?

The chart herewith has been drawn to cover a product for which the plant has a normal capacity of 200 units, produced at a total cost of \$20,000, of which \$3,000, or 15 per cent, is constant expense. At zero production, \$17,000 of the cost of operating at full capacity, or \$85 per unit, is eliminated the other \$3,000, or \$15 per unit, becomes the cost of idleness. Therefore at zero production the space below the point representing 85 per cent on the chart represents the expense eliminated, and the space above the same point and below the 100 per cent cost line represents the expense incurred, or the cost of idleness. As every unit produced decreases the cost of idleness \$15, a diagonal line drawn from 85 per cent cost at zero production to 100 per cent cost at 100 per cent production will show the decrease in the cost of idleness as the capacity used increases. The scale above the 100 per cent cost line represents the various percentages of profit realized.



PROFIT COMPARISON CHART

Solid lines: profit after deducting cost of idleness. Dotted lines: profit before cost of idleness is deducted.

Lines drawn from the point representing 85 per cent cost at zero production to the points representing the various percentages of profit will show the percentage of profit before deducting the loss due to idleness. Lines drawn from the point representing 100 per cent cost at zero production to the points representing the various percentages of profit will show the percentage of profit after the cost of idleness has been deducted. On this chart dotted lines denote the profit before deduction is made for the loss due to idleness. The solid lines denote the profit after this deduction has been made.

HOW TO USE THE CHART

Through the use of a "Profit Comparison Chart" the profit before idleness at any capacity can be converted to terms of profit after idleness without the necessity of detailed figuring. Profit after idleness can likewise be converted to terms of profit after idleness. For example: 60 per cent profit before idleness at 75 per cent capacity is equivalent to 55 per cent profit after idleness. (See example 1.) The result, 55 per cent, is obtained by scaling from the zero point of the solid lines, through the point representing 60 per cent profit and 75 per cent capacity on the dotted line, to the "Percentage of Profit" scale at the right of the chart.

Knowing the profit now made at a certain capacity, it is a simple matter to determine the percentage of profit necessary, at any other capacity, to make the same amount of profit. For example: If a factory is running at 60 per cent capacity and making a profit of 30 per cent before idleness, the same amount of money can be made and the product sold at a price equivalent to a 19 per cent profit before idleness, providing enough work is obtained to run at 80 per cent capacity. (See example 2.) This is determined by scaling from the zero point of the dotted lines, through the point representing the same "Percentage of Profit" at 80 per cent capacity as at 60 per cent capacity and 30 per cent profit before idleness, to the "Percentage of Profit" scale at the right of the chart.

Example 3 shows that if we are now running 50 per cent capacity and making a profit of 20 per cent after idleness, we can make as much profit by selling at 12.8 per cent profit before idleness providing we run at 90 per cent capacity. This is determined by scaling from zero point of the dotted lines, through the point representing the same "Percentage of Profit" at 90 per cent capacity as at 50 per cent capacity and 20 per cent profit after idleness, to the "Percentage of Profit" scale at the right of the chart.

CHANGES IN SELLING PRICE IN DIFFERENT TYPES OF ORGANIZATION

Manufacturing plants may be divided into two classes. The first class embraces those turning out a more or less standard product. By this we mean articles which are regularly catalogued and sold through various representatives. The selling price on the products of factories in this class cannot be changed with any great frequency, but the "Profit Comparison Chart" will be of value whenever the question of selling price is brought up. However, it should be borne in mind that the main object of the chart is to enable the executive to tell at a glance what effect increased sales will have on profit; or, in other words, to determine readily how much the selling price of a product can be reduced, without loss of income, by increasing the amount of plant capacity used. If the selling price is reduced and

enough goods are not sold to run the plant at the capacity expected, less profit will be made. Therefore the executive who uses these charts should be reasonably certain that a price reduction will accomplish the desired results before he takes definite action.

The second class embraces plants turning out articles on job or contract work. Factories of this class obtain work on estimates made on the different jobs after taking business conditions, the amount of work ahead of the shop, etc., into consideration. The executives of these plants will find the chart of great value because, knowing the shop capacity they are now using and the gross or net profits now made, they can readily determine how low they can bid on any job and still obtain the same or better results.

Petroleum Refining Gains 335.8 Per Cent in 7 Years

Output of Marketable Products in 1922 Valued at One and Three-Quarter Billions of Dollars

According to reports made to the Bureau of the Census, the value of products of establishments engaged primarily in refining petroleum amounted to $1,727,440,200 in 1921, as compared with $1,632,532,800 in 1919 and $396,361,400 in 1914, an increase of 5.8 per cent from 1919 to 1921, but an increase of 335.8 per cent for the 7-year period 1914 to 1921. The number of refineries has steadily increased from 76 in 1914 to 320 in 1919 and 336 in 1921. Of those reported for 1921, 67 were located in Oklahoma, 64 in Texas, 53 in Pennsylvania, 45 in California, 23 in Kansas, 16 in Louisiana, 13 each in Illinois, Ohio and Wyoming, 9 in New Jersey, 6 each in Kentucky and New York, 5 each in Indiana, Missouri and West Virginia, 4 each in Colorado and Maryland, 3 each in Arkansas and Massachusetts, 2 in Rhode Island and 1 each in Delaware, Georgia, Minnesota, Montana, South Carolina, Utah and Virginia.

Wage Earners and Hours Employed

In January, the month of maximum employment, 72,298 wage earners were reported; and in September, the month of minimum employment, 56,632; the minimum representing 78.3 per cent of the maximum. The average number of wage earners employed during the year was 63,197, as compared with 58,889 in 1919 and 25,366 in 1914. A classification of the wage earners with reference to the prevailing hours of labor in establishments in which employed shows that for 6,186, or 9.8 per cent of the total (average) number, the hours were less than 48 per week; for 27,471, or 43.5 per cent, they were 48; for 3,808, or 6 per cent, the hours were between 48 and 54; for 890, or 1.4 per cent, they were 54; for 23,294, or 36.9 per cent, they were between 54 and 60; and for 1,548, or 2.4 per cent, they were 60 or over.

TABLE I—STATISTICAL SUMMARY OF PETROLEUM REFINING, 1914-1921

	1921*	1919*	1914
Number of establishments	366	320	176
Persons engaged	74,291	73,473	31,077
Proprietors and firm members	55	59	52
Salaried employees†	11,039	14,525	5,659
Wage earners (average number)	63,197	58,889	25,366
Salaries and wages	$129,262,700	$116,368,700	$27,289,900
Salaries	27,940,300	26,619,000	7,892,400
Wages	101,322,400	89,749,700	19,397,500
Contract work	4,832,000	2,352,000	502,700
Cost of materials	1,382,425,000	1,247,908,400	325,264,500
Value of products	1,727,440,200	1,632,532,800	396,361,400
Value added by manufacture‡	345,014,800	384,624,400	71,096,900

* Figures for 1921 do not include establishments reporting products under $5,000 in value, thus excluding 7 establishments which employed 7 wage earners, and in the aggregate reported products to the value of $22,752. The figures for 1919, however, include 4 such establishments, which employed 2 wage earners, and reported products to the value of $10,996.

† Includes to some extent employees of sales and distributing departments.

‡ Value of products less cost of materials.

TABLE II—DETAILED STATISTICS OF PETROLEUM PRODUCTION, 1914-1921

	1921	1919	1914
Total value of products	$1,727,440,200	$1,632,532,800	$396,361,400
Naphthas and lighter products			
Gasoline—			
Gal	5,098,056,700	3,648,590,600	1,195,412,100
Value	$840,672,300	$679,867,100	$106,140,200
Average value, gal.	$0 164	$0 186	$0.088
Naphtha, benzine, etc.—			
Gal	275,176,200	557,036,200	264,626,100
Value	$40,729,400	$86,139,000	$15,779,100
Average value, gal.	$0 148	$0 155	$0.06
Illuminating oils—			
Gal	1,963,826,600	2,305,489,700	1,935,274,800
Value	$152,515,900	$235,663,100	$96,806,500
Average value, gal	$0 078	$0 102	$0 05
Fuel oils—			
Distillates—			
Gal	1,220,247,000	646,652,600	457,491,600
Value	$59,586,100	$36,548,100	$15,999,400
Average value, gal	$0 049	$0 056	$0.035
Gas oils—			
Gal	1,634,342,200	1,393,623,500	755,558,400
Value	$85,322,400	$76,383,400	$22,805,300
Average value, gal	$0 052	$0 054	$0.03
Residual fuel oil—			
Gal	6,894,534,300	5,727,624,500	2,521,042,000
Value	$232,355,700	$205,192,800	$45,213,200
Average value, gal	$0 033	$0 035	$0.087
Lubricating oils—			
Gal	949,246,700	821,580,400	517,838,800
Value	$194,609,300	$196,242,400	$55,812,100
Greases—			
Gal	24,440,000	28,147,500	14,006,400
Value	$9,754,800	$11,896,700	$3,536,500
Liquid asphaltic road oils—			
Gal	168,378,000	98,036,500	(*)
Value	$7,831,200	$4,491,400	(*)
Average value, gal	$0 046	$0 046	
All other products, value	$104,063,100	$100,108,800	$34,269,100

*Figures not available

The statistics for 1921, 1919 and 1914 are summarized in Table I; the figures for 1921 are preliminary and subject to such change and correction as may be found necessary from a further examination of the original reports.

Detailed statistics of production for the years 1921, 1919 and 1914 are given in Table II. While the production in the group "naphthas and lighter products" increased 27.8 per cent in quantity, and 15.1 per cent in value since 1919, the increase in the output of gasoline alone was 39.7 per cent in quantity, and 23.7 per cent in value.

University of Minnesota to Have Experimental Blast Furnace

At the North Central Station of the Bureau of Mines, in Minneapolis, plans for the proposed experimental blast furnace for the University of Minnesota have been made. For the purpose of gaining assistance in the design of this experimental furnace, a careful study has been undertaken of the records obtained in 34 experimental runs on small-scale blast furnaces operated by the Bureau of Mines at Minneapolis since 1919. These records will also be studied in considering changes in the bosh and hearth of the furnace stack, now erected outside the Minnesota School of Mines building, which it is expected will be put into blast about the first of May. Several years ago a method of studying the lines of flow of stock in the blast furnace by the use of cardboard models filled with lead shot was developed. This device has also been used in testing the flow of stock in the experimental blast furnace proposed for the university.

Closure for Acid Carboys

A Review of the Report of the Committee Appointed by the Manufacturing Chemists Association

BEGINNING in May, 1920, shortly after the committee was asked to undertake the work and continuing throughout 30 months of active work, the carboy test sub-committee of the executive committee of the Manufacturing Chemists Association has completed a very valuable piece of work. The need for a study of carboy closure was great. Not only was there great unreliability in the average acid carboy closure but there was considerable danger in the use of cement and plaster of paris and other special closure agents from cracking and breaking the carboy lip. No satisfactory stopper or gasket was at hand, and considering the fact that thousands of carboys are used and shipped daily, the necessity of solving the problem was at once imperative and obvious.

The logical development of the work is intensely interesting and it is a pleasure to follow the systematic, ingenious and painstaking study involved. Starting with the three following statements of which the committee was reasonably sure, an investigation of stoppers, gaskets and stopper fastenings was begun:

1. Ground glass closures were entirely satisfactory if fastened in by any reasonably secure method.
2. Carboys with chipped necks should never be allowed for nitric acid.
3. Carboys with necks chipped as much as ¼ in. deep should be condemned.

The Ideal Closure

It will be impossible to discuss in detail the progress which was made. It is illuminating, however, to record the seven characteristics which the committee felt were desirable for an ultimately satisfactory solution to the closure problem:

(*a*) The closure must be vented in some way to prevent accumulation of pressure.

(*b*) The neck of the carboy must be sufficiently smooth to afford a proper seat for a gasket or else the gasket must be so made that it will fill all cracks and crevices.

(*c*) The stopper must be tough, well formed and uniform and must fit closely in the neck of the carboy.

(*d*) The gasket must be such as to afford a tight closure, must not be subject to disintegration through action of various acids, must not become solid so as to hinder removal, and must not discolor the acid through contact.

(*e*) The fastenings must be strong and secure and only slightly, if at all, affected by acid fumes. It must also be easily applied and removed.

(*f*) The entire closure should, if possible, be arranged so that an examination of it in place will show whether it is in good condition.

(*g*) The cost of the parts of the closure and of the labor of applying it must be reasonable.

Prevalent Type of Closure Prior to the Investigation

There were two closures in very general use before the investigation was undertaken. The committee collected considerable data on the specific criticisms of them.

Class I. The glass or earthenware stopper with a gasket, generally paraffined asbestos, held in place by a wire fastening of the "Brainerd" type or of the lever type such as the well-known "Gem" fastener. In this closure the glass stopper is easily broken; the earthenware stopper is frequently poorly designed and made and is sometimes brittle; no efficient venting is easily and surely obtained without the probability of leakage; the paraffined asbestos gasket or, in fact, any gasket of that type is efficient only when it has a nearly perfect seat; the wires of the fastener are frequently too light; and, if the carboy has a chipped neck, an additional coating of plaster of paris or some cement mixture must be applied, but such a coating has generally been found to be inefficient against handling or storage.

Class II. The earthenware (or occasionally glass) stopper sealed in place by means of plaster of paris or similar cement mixture, or possibly clay, applied between the flange of the stopper and the neck of the carboy and also coated over the entire stopper and top of the neck of the carboy and then inclosed in a burlap covering securely tied around the neck of the carboy; sometimes the burlap is further coated with tar or asphaltum. This closure is reasonably efficient when properly made and applied, but is especially undesirable because of the probability of the use of a poor cement mixture and careless application; it is also very liable to deteriorate in storage due to the cement becoming crumbly; the burlap covering frequently conceals the defects until too late to prevent accident.

Development of Stopper Design

Perhaps the first conspicuous progress was made with a porous earthenware stopper and about the middle of March, 1921, it was judged satisfactory. It had the following qualities in its favor:

1. It was hard and could be well shaped in manufacture.
2. It was tough and would withstand rough treatment without breakage.
3. It could be made as highly porous as necessary.
4. It was non-sulphating.

Later on a gasket was developed which gave great promise of filling the needs. It was made of a ½-in. rope asbestos soaked in a mixture of paraffine and oil. This is 50 per cent machine oil and 50 per cent paraffine and is heated and thoroughly mixed and the asbestos rope soaked therein for about 5 minutes and then run through a grooved wringer to remove surplus material, allowed to solidify and cut into proper lengths for use. This gasket is flexible, compressible and tough. Easy application, low cost, tight closure and no discoloration of acid was claimed.

The Progress Report in August, 1921

Conclusions that had been reached in August, 1921, were:

1. Glass stoppers ground to fit and secured in place by burlap or other suitable fastening allowed for all acids. Note: It was thought unnecessary to forbid the use of chipped necks or cracked necks with this form of closure.
2. Glass stoppers with gasket: Not to be allowed.
3. Porous clay or earthenware stoppers with gaskets and fastenings under the following conditions:

(*a*) Allowed for all acids.

(*b*) Stoppers must be made of material sufficiently porous to prevent accumulation of interior pressure under ordinary conditions of transportation. The M. A.

Knight standard porous stopper is to be considered as a minimum for porosity.

(*c*) Stoppers must fit fairly closely inside the neck of the carboy. Shank of stopper must be at least 1⅛ in. long and taper not more than ⅛ in. on the diameter. Stoppers must have two cross-grooves in the upper surface with minimum depth at top of ¼ in. and maximum width of ⅜ in. Stoppers must be tough and not brittle.

(*d*) Gaskets must be made of asbestos rope (not less than ¼ in. commercial) soaked in a mixture of 50 per cent machine oil and 50 per cent paraffine at a temperature of about 250 deg. F. and subsequently wrung out and allowed to cool; other gaskets of similar physical qualities so that they will remain plastic and not disintegrate during use are also allowed.

(*e*) The "Brainerd" or similar efficient wire fastening or a lever fastening of type similar to the "Gem" must be used. Note: The use of a screw thread on inside of neck of carboy with corresponding thread on the stopper is to be investigated.

(*f*) Chipped lips not allowed unless the package will not leak when gasket and stopper are in place and without using some additional means such as plaster of paris.

The wire must be "Armco" or other acid-resisting iron wire dipped in asphalt paint. The diameter of this wire should not be less than some minimum size which will be investigated and determined later. Possibly 0.1 in. (10 gage B.&S. or 13 gage Birmingham) will be all right for the Brainerd closure, while 0.15 in. will be proper for the lever type closure.

Material Progress in the Development of the Carboy Neck-Grinding Machine

About this time the carboy neck-grinding machine was completed, a description of which was published in *Chem. & Met.* (vol. 27, page 1267, Dec. 27, 1922). This was a condition greatly to be hoped for and was considered of the highest importance on account of the fact that chipped and cracked necks of carboys are among the greatest difficulties to be overcome in securing a tight closure. The work on this machine was pushed to a satisfactory conclusion and a separate report rendered. The special recommendation was summarized as follows:

That glass carboys used for the shipment of corrosive liquids must have an even surface around the mouth in which to seat the gasket; this surface must be at least ¼ in. in width for carboys of 7 to 13 gal. capacity and at least $\frac{3}{16}$ in. in width for carboys of less than 7 gal. capacity.

The development of this machine allows us to consider that all carboys may be prepared, before shipment, with a smooth surface for the gasket seat and thus do away entirely with the use of plaster of paris or other cement or clay mixtures, which have undesirable qualities, for the purpose of sealing.

Type of Wire for Fastening Also Studied

The investigation was continued to determine the amount of corrosion of wire fastenings when used with porous stoppers and also to endeavor to develop a wire-twisting device that would be more powerful and effective than the one ordinarily used for the Brainerd closure. A heavy type wire twisting tool was obtained after a very considerable delay and was tried out with heavy wire in several experiments, but without satisfactory results, as a strong tendency was noted to break the lip of the carboy due to the excessive pressure developed. Otherwise the tool and heavy wire were satisfactory.

Before formulating the final report certain special questions were brought up in a questionnaire, the answers being as follows:

(*a*) The venting of carboys closed by ground glass stoppers should not be recommended or allowed.

(*b*) The size of the inside diameter of the neck of carboy should not be recommended for standardization.

(*c*) The dimensions of cross-grooves in the upper surface of stoppers should be recommended as having a minimum depth of $\frac{5}{32}$ in. and a maximum width of $\frac{5}{16}$ in.

Final Recommendations of the Committee

The following recommendations were made by the committee and are reproduced verbatim from their final report:

General

1. The use of clay, plaster of paris and other similar mixtures for sealing carboys should be discontinued. It is possible to get a good seal in this way, but the high probability of getting a poor seal, the tendency of these mixtures to disintegrate during storage, the fact that a good seal is hard to remove and results in chipped and cracked necks, the fact that such a seal is frequently used to cover up serious chips and cracks in the mouth of the carboy, and the lack of necessity for such a seal when proper gasket, porous stopper and good flat seat on carboy mouth are used, make the use of such seals inadvisable.

2. Glass carboys used for the shipment of corrosive liquids should have an even, unchipped and uncracked surface around the lip on which to seat the gasket; this surface to be at least ¼ in. in width for carboy of 7 to 13 gal. capacity, and at least $\frac{3}{16}$ in. in width for carboys of less than 7 gal. capacity. The "neck-grinding machine" described, illustrated and recommended in our report of April 18, 1922, makes this condition a commercial possibility.

3. The stoppers for carboys should be required to fi fairly closely in the mouth of the carboy and have a taper conforming closely to the taper of the inside o the mouth of the carboy.

4. The size of stoppers should be standardized as nearly as possible at not more than ⅛ in. less diameter (approximately) than the inside of the carboy neck.

Stoppers

5. Glass stoppers, ground to fit, should be authorizec for all corrosive liquids, and should be secured in plac by wire, cloth, burlap or other suitable fastening.

6. Clay or earthenware stoppers, porous, should b authorized for all corrosive liquids; they should b made of a material sufficiently porous to prevent accu mulation of interior pressure under conditions of trans portation or storage; they should be tough and no brittle, and of such material as will not be disinte grated by the corrosive liquid contained in the car boys. These stoppers should be of such size that th shank will fit inside the mouth of the carboy with no over ⅛ in. clearance. The shank of the stopper shoul be at least 1⅛ in. long, and should taper not more tha ⅛ in. on the diameter; the upper surface of the stoppe should have two cross-grooves with minimum depth o $\frac{5}{32}$ in. and maximum of $\frac{5}{16}$ in., measured at the cente of the top; provided, that these stoppers, when mad

with screw thread to engage in corresponding threads on inside of carboy neck, need not have the grooves in their upper surface.

7. Glass stoppers (plain or screw, but not ground to fit), clay and earthenware stoppers (not porous) and other similar stoppers should not be authorized for mineral acids or for other corrosive liquids liable to develop considerable interior pressure; such stoppers may be properly authorized under suitable conditions other than the foregoing, but which should be determined dependent on the particular article being shipped.

8. Asbestos rope, treated, should be authorized for use for any corrosive liquid that will not seriously disintegrate the gasket during use; these gaskets should be made of asbestos rope (not less than ½ in. commercial) soaked in a mixture of 50 per cent machine oil and 50 per cent paraffine at a temperature of 250 deg. F. (approximate) and subsequently wrung out slightly and allowed to cool.

9. Flat asbestos, Rubberoid and other similar gaskets (not thoroughly plastic) should not be authorized for use for mineral acids or for other corrosive liquids liable to develop considerable interior pressure; they may be properly authorized under suitable conditions other than the foregoing, but which should be determined dependent on the particular article being shipped.

10. Other gaskets having physical properties similar to the treated asbestos rope gaskets, described above, so that they will remain plastic and not disintegrate during use, should also be authorized from time to time if found to be properly efficient in transportation and storage.

Stopper Fastenings

11. Wire fastenings of the type in which a wire is passed around the neck of the carboy just below the mouth and thence up over the stopper and twisted fast in a way to securely hold the stopper in place (such as the "Brainard" fastener) sould be authorized for all corrosive liquids; the wire should be required to be made of material as highly acid-resistant as practicable ("Armco iron" is recommended), and should be not less in size than No. 14 B.w.g. They should be coated with acid-resistant paint before using.

12. Wire fasteners of the lever type (such as the 'Gem" fastener) should be authorized for all corrosive liquids; the wire should be made of material as highly acid-resistant as practicable and should not be less in size than No. 9 B.w.g. They should be coated with acid-resistant paint before using.

13. Metal screw cap fasteners, consisting of a cap to screw down over the thread on the outside surface of the mouth of the carboy should be authorized for all corrosive liquids; the thread should be required to be heavy and rounded to prevent chipping and should be made so that, with gasket and stopper in place, at least two full threads will be engaged; these caps should be made of material as highly acid-resistant as practicable and not less than No. 18 gage U. S. Standard in thickness. The cap may be allowed to have a hole in the top.

14. "Screw thread on stopper" fastening in which a thread on the shank of the stopper engages in a corresponding thread on the inside of the mouth of the carboy should be authorized for all corrosive liquids; the thread should be required to be heavy and rounded to prevent chipping, and should be made so that, with gasket in place, at least two full threads will be engaged.

15. Action should be taken to advise all users of carboys in regard to the desirability of instituting and enforcing such of the recommendations mentioned above as are considered acceptable.

16. The Bureau of Explosives should be requested to take appropriate action at some future date such that all concerned will have ample opportunity to prepare themselves for the change, to make obligatory and effective throughout the United States and Canada such of the foregoing recommendations as may be acceptable.

Comparison Made on Prices of Cement

The Cement Information Service has recently issued a statement of the facts concerning cement prices, profits, production and distribution, in reply to charges brought against the cement industry as a whole. It is stated that during the early part of 1915 some companies sold cement at 60 cents a barrel at their mills—a price admittedly below cost. Never before in the history of the industry had cement prices dropped so low. Many manufacturers refused to sell their product at that figure. Being confronted with serious financial difficulties, some plants were obliged to close. In reference to this, the Cement Information Service states that it is not fair to take the price of a commodity at an abnormally low point and during a temporary period as an indication of what a reasonable price should be.

A comparison between the price of cement and that of other building materials indicates that the price of cement did not rise to the high point reached by other building materials. Cement prices are therefore extremely low, considered relatively or absolutely. Let us compare today's price of the essential elements in the cost of cement with the price in 1914: Coal per ton delivered at the cement mill in 1914 cost $2.45. Coal now costs $6 per ton. Labor in cement plants in 1914 received on the average 20.1 cents an hour and now receives an average rate of about 42 cents an hour. Gypsum per ton at plant in 1914 cost $2.75. It now costs $6.20 per ton. Bags per 1,000 in 1914 cost about $82. Now bags cost about $215 per 1,000 due to the rise in the price of cotton from 7 cents a pound in 1914 to about 30 cents a pound today, and it takes four bags to make a barrel of cement.

Selling expense is also an important item in the cost of cement. Nineteen Eastern companies report that selling expenses increased on the average from 6.4 cents per barrel in 1914 to 12.5 cents per barrel in 1921. When existing conditions are taken into consideration, present figures for cement compare very well with those prevailing in 1915.

Resistance of Flow of Ore Through Beds of Solids

A large-scale apparatus has been devised at the Minneapolis Experiment Station of the Bureau of Mines for measuring the pressure encountered by a stream of ore in its passage through beds of lumps of coke and ore. More than 150 tests have been made. Three sizes of coke were employed (pea, nut and stove) and in each case it was found that the pressure drop varies as the square of the weight of air forced through a given bed. As yet the effect of the size of the coke on its specific resistance has not been determined. Experiments for the three cokes individually have been made and the binary system pea coke-stove coke has been completed.

Secondary Structures in Steel

Steel Solidifies in Dendrites of Delta Iron; Transformation Into Gamma Iron Involves Recrystallization Into Independent Granules of Austenite; Further Change Into Alpha Iron Causes Three Varieties of Secondary Structure

BY COLONEL N. T. BELAIEW, C.B.

IN 1913 Prof. Federico Giolitti communicated a paper to the Academy of Science of Turin, giving some observations on a piece of metal "whose structure did not correspond to Belaiew's dicta." I received a copy of that paper from Professor Giolitti on the eve of the great war and was unable then to more than glance at it. So that very interesting paper remained unanswered.

Dr. Giolitti also published a series of articles on the structure of steel in *Chemical & Metallurgical Engineering* during 1920. In the first of these, on "Crystallography of Alpha and Beta Iron," he gives a critical survey of my published views on primary and secondary crystallization and scheme of the three main secondary structures—viz., the network structure, the Widmanstattian structure, and the structure of large crystals. Then Professor Giolitti proceeds to give his observations on a sample of sheet steel having 0.32 per cent carbon, which had been heated about 5 months continuously at from 900 to 1,050 deg. C. and then cooled with the furnace, requiring 4½ days to drop from 1,000 to 150 deg. C. He says: "Belaiew's views would require such a piece to have a reticular structure, yet this metal has very coarse crystals and perfectly developed Widmanstattian structure." Thus his idea that ferrite is ejected to the periphery of homogeneous austenite on very slow cooling is not confirmed by study of a really uniform metal, which then actually gives Widmanstattian structure."

Instead of the author's hypothesis, Dr. Giolitti holds that "hypoeutectoid steels, especially, can therefore be classified and their structure explained by the hypothesis that beta iron assumes a granular and alpha iron a laminar habit." The real point at issue between the two views is, therefore, whether a definite type of structure is more or less linked up with certain allotropic modifications of iron, or whether it is dependent on thermal treatment only. Some of the differences undoubtedly arise from the fact that Dr. Giolitti was consulting an imperfect abstract found in a German journal of my early writings.

THREE TYPES OF SECONDARY STRUCTURES

My views on secondary structures in steel were first presented in various papers read before the Russian Technical Society in 1908 and 1909 and subsequently published in my thesis "On Crystallization of Steel on Slow Cooling" (Petrograd, 1909). In 1912 they were traversed again at some length in French in the *Revue de Métallurgie*[1] and in 1920 in English in a paper read before the Institution of Aëronautical Engineers.[2] They also formed the bulk of my two first lectures on "Crystallization of Metals" delivered in 1922 at the Royal School of Mines (University of London).

In proposing my scheme of three secondary structures, I had in view two main considerations: to bring in evidence first the crystallographic relations, and second the relation between these structures and the various areas of the well-known iron-carbon equilibrium diagram (Fig. 1). One of the most important determining factors is also the influence of previous processes on the condition of the metal immediately before secondary crystallization would start. Therefore, there are two of such processes now to be taken into consideration: the solidification process or "primary crystallization," occurring in the mushy zone between the liquidus and solidus lines and the process of "granulation" taking place in the austenitic zone.

Primary Crystallization results in the formation of dendritic crystals or dendrites in every alloy. After

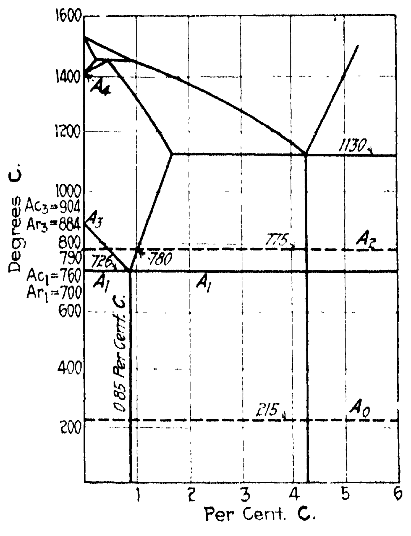


FIG. 1—IRON-CARBON DIAGRAM, AS PROPOSED BY HONDA

having completely solidified the alloy will be constituted of juxtaposed and interlocked dendrites. Every dendrite is a unit both from the crystallographical and chemical point of view. Alloys solidifying over a range of temperature—i.e., forming solid solutions—develop a chemical non-homogeneity in the dendrites which remains during its cooling and may be revealed at ordinary temperatures by proper methods. We say, therefore, that "development of macrostructure reveals dendritic structure."

The importance of primary crystallization has been sufficiently realized these last few years, and advantage taken of it. The same cannot be said about the subse-

[1] "Sur la Cristallisation et Structure des Aciers refroides lentement," *Rev. Mét.*, 1912, p. 321.

[2] "The Structure of Steel," *J. Inst. Aëronautical Engineers*, 1920, vol. 1, No. 3, p. 14.

quent phenomenon of granulation. A considerable amount of confusion appears to exist in the minds of several authorities, and the author feels compelled to re-cover the ground already traversed in his previous papers, some of which are quite inaccessible.

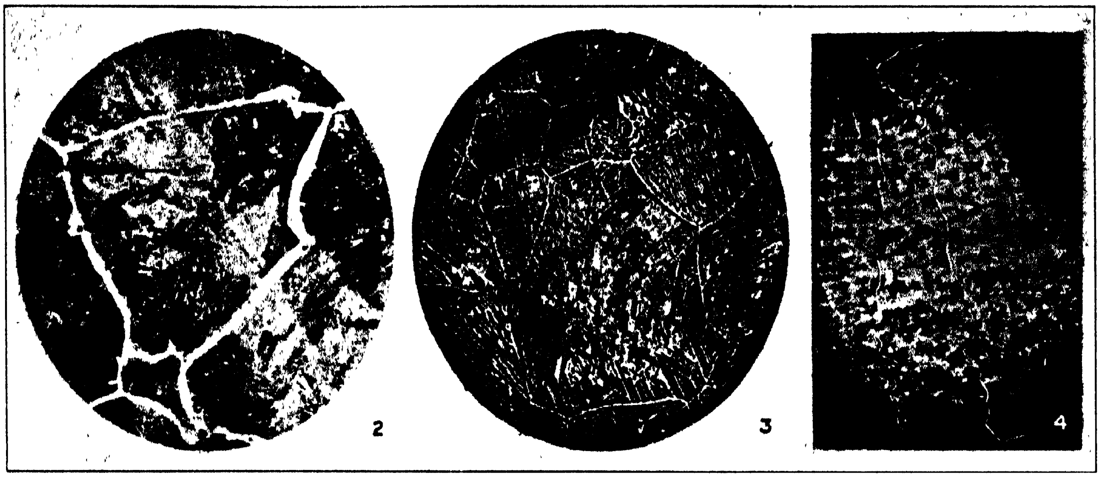
Granulation

On entering the austenitic zone every alloy is built up of dendrites; in leaving that zone, as the direct observations of Osmond and Baykoff show, every alloy is build up of "grains" or "granules."

The structure of dendrites (Fig. 4), as already mentioned, can be revealed by macro-etching - for instance by the method of N. I. Belaiew (diluted picric acid), by the cupric reagent of Stead and Le Chatelier, or by one of the "Damascene etchings." The structure of the granules can be revealed by etching the steel while in sequently of crystalline grains) are also altered. The general character of the process, however, remains the same and the resulting structures remain polyhedral, as appears to be true for all known allotropic transformations.

Therefore the present author has advanced the view that the granulation process is linked up and even caused by an allotropic change in iron. In his view the granulation zone is the one true gamma zone, while in the area of primary crystallization the iron is in another modification (as some authors suggest it exists in the delta state).

The final result of the granulation process is the breaking up of every alloy in a number of crystalline polyhedral grains, every such grain or granule being an allotriomorphic crystal. So it happens that the crystallographic unity of dendrites is destroyed in the



FIGS 2 TO 4 TRIAD OF SECONDARY STRUCTURES

Fig. 2—Network structure × 40. (Steel No. 5, carbon 0.60.)

Fig. 3—Widmanstättian structure. × 4 (Steel No. 8, carbon 0.60.)

Fig. 4—Dendritic structure with ferrite mesh × 1 (Steel No. 6, carbon 0.60.)

the granulation zone by the method of Saniter or Osmond.[3] The same structure is revealed afterward by secondary deposits.

Dendrites have become very familiar to us now and it is well to bear in mind that that structure is a macrostructure—i.e., a structure usually visible by a naked eye, hence the dimensions of dendrites are usually large. The structure of granules or the general picture of granulation is but seldom seen by an unaided eye; larger magnifications are needed and hence the name of microstructure. As a rule a great number of granules arise from one dendrite. The dimensions and distribution of the dendrites of primary crystallization depend on conditions of cooling during solidification. Correspondingly, the dimensions and distribution of the granules depend on the conditions of cooling in the austenitic zone. These processes are different and independent and the resulting structures are also different and independent.

The process of granulation is governed by the same laws as every process of recrystallization in a solid crystalline body—i.e., nuclei are appearing at a certain rate and transformation starts from these with a certain linear velocity. As the conditions of cooling are altered the number and distribution of nuclei (and subsequently of crystalline grains) ...

[3]"Microstructure of Iron and Mild Steel at High Temperatures," by H. S. Rawdon and Howard Scott, A.I.M.E., February, 1920, meeting. Chem. & Met. vol. 22, p. 787 (1920).

granulation zone; every alloy on leaving that area is built up of new crystallographic units. However, the chemical non-homogeneity of austenite (due to the mode of dendritic crystallization) remains, so that both of these structures can be revealed on every such alloy or piece of metal. Proper etching will reveal both the dendritic structure of primary crystals and the boundaries between the granules.

Decomposition of Austenite

It is in such an alloy, built up of a number of allotriomorphic crystals or granules, that the decomposition of austenite into the excess constituent and pearlite occurs. Every granule possesses its own crystallographic orientation and all the elements of such a grain are crystallographically identical; but where different grains meet there must be a kind of neutral zone, or "no man's land," where the crystalline matter cannot assume the orientation of either of the grains. This thin layer, which according to Beilby, Rosenhain and others is in an "amorphous" state, seems predestined to facilitate the ejection of the first particle of the crystallizing pro-eutectoid element, the latter tending to form an envelope about the remaining austenite. Given sufficient time and other suitable conditions the whole of the excess element will be ejected to the periphery of the grain, forming a membrane

of a certain thickness. On a plain section such structure will be seen as a cellular or network structure (Fig. 2). Thus arises one of three secondary structures seen in steel.

Widmanstättian Structure

If the whole of the secondary deposit had time to segregate in this way a pure "network structure" would ensue. The main condition is a correct relation between the size of the grain and the velocity of crystallization. It is easy to see that the larger the size of the grains the more difficult it is to expect that the whole of the secondary deposit would collect at the boundaries. Then, if the process were to continue at a more accelerated pace in a coarse-grained metal, a certain proportion of the excess constituent would be forced to crystallize out "on the spot"—that is, not at the boundary but in the middle of the grain, whereupon the habit and the orientation of the crystalline austenite would be the dominant factors controlling the shape of the deposits. Ordinarily the latter would arrange themselves along the cleavage planes of the mother crystals. Cleavage planes in an octahedral grain are parallel to four faces of the octahedron. Ferrite precipitated along such planes would build up the appearance of Widmanstättian figures on a section. These Widmanstattian figures together with the network form the "Widmanstättian structure." (Fig. 3.)

Structure of Large Crystals

The third possible type of secondary structures would occur if the secondary deposits would lodge themselves parallel to the axes of the dendrites, reminding one of the crystal skeletons of the macrostructure. That will occur in the absence, total or partial, of granulation. Then the crystallographic unity of dendrites remains undestroyed and the elements of secondary crystallization lodge themselves preferentially parallel to the dendritic axes. Such structures may be seen either in hypereutectoid steels, where the granulation zone is nearly absent, or in large steel crystals like the famous Tshernoff crystal, when the granulation zone was apparently passed too rapidly. Such structure the author calls the structure of large crystals. (Fig. 5.) Together with the Widmanstättian and the network structure it forms the triad of secondary structures.

In my opinion the occurrence of various secondary structures is thus explained without assuming with Dr. Giolitti that beta iron assumes a granular and alpha iron a laminar habit. By studying the secondary crystallization and the subsequent formation of pearlite grain I have never been able to find any crystallographic or structural difference between the alpha and beta varieties. Recent X-ray studies seem to confirm this view, while they also confirm the existence of the delta modification.

Genesis of Secondary Structures

A series of steels were made in 1907 and 1908 according to my directions at the Poutilov and Ijewsky Works in Russia. The carbon content was about 0.60 per cent for alloys Nos. 5, 6 and 8 and 1.80 and 2.20 for alloys Nos. 1 and 2 respectively. All these steels were prepared under the conditions indicated by Anossoff and Tshernoff for the manufacture of Damascene steels—i.e., cooled at an extremely slow rate—the area of secondary crystallization was passed very slowly indeed and the deposition of ferrite lasted not less than 2 hours. The process of granulation was also very marked in the hypo-eutectoid alloys, the granules growing sometimes as large as 7 sq.cm. in cross-sectional area. Steels Nos. 5 and 6, prepared at the Poutilov Works, exhibited a pure network structure, but on a very large scale. On the other hand, alloy No. 8, made at the Ijewsky Works, exhibited a splendid Widmanstättian structure. Hypereutectoid steels gave the structure of large crystals.

The conditions of cooling at the Ijewsky Works differed from those at the Poutilov Works in that the steel ingots were stripped earlier, presumably during the process of secondary crystallization. Therefore I arrived at the conclusion that Widmanstättian structure will be favored by a somewhat greater cooling speed in the interval of secondary crystallization. These conditions would be present either when the velocity of cooling through the secondary range is not excessively low, or when a marked undercooling occurs after a very slow cooling. If a steel is undercooled the secondary crystallization—i.e., the throwing out of the free element—proceeds at a considerable velocity in spite of

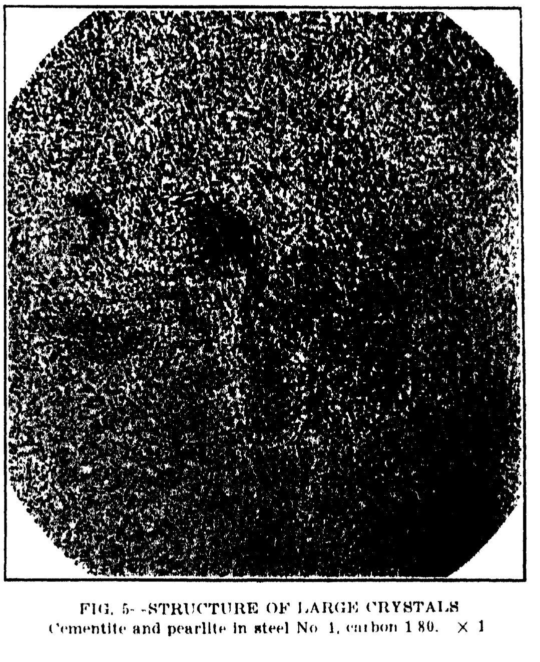


FIG. 5—STRUCTURE OF LARGE CRYSTALS
Cementite and pearlite in steel No. 1, carbon 1.80. × 1

the cooling being extremely slow, or the temperature even nearly stationary. In practice, this usually occurs in muffles, runners and the like; several instances were mentioned by the author in his thesis and have been noted by other writers.

The piece of sheet steel described by Professor Giolitti,[4] which had been heated for about 5 months continuously in the granulation zone and then cooled slowly, also comes under the heading. Its Widmanstättian structure is entirely in accordance with the present author's views. Here I would like to draw attention only to the importance of granulation and the size of the granules, in the production of such structures. The first and paramount condition for obtaining a well-defined Widmanstättian structure is the devel-

[4] "Crystallography of Alpha and Beta Iron," by Federico Giolitti *Chem. & Met.*, March 31, 1920, vol. 22, p. 585. Fig. 5 of this article is incorrectly described. It is a view of steel containing but 0.60 per cent carbon. Fig. 6 should also be called "Structure of Large Crystals."

opment of large grains of austenite while in the granulation zone. Once that is achieved, it will be comparatively easy so to modify the velocity of secondary crystallization as to cause the largest possible amount of the free element to crystallize out along the cleavages of the large granules and produce the Widmanstättian figures.

The smaller the granules the greater must be the speed of secondary crystallization to produce the Widmanstättian structures.

In my 1909 thesis I insisted on the importance of a uniform orientation of the elemental octahedra in the large granules as the most important preliminary condition for the subsequent development of Widmanstättian structure. In other words, each grain must be a true crystal, as far as its internal arrangement is concerned. In my later French paper (1912) I also dwelt on the relation between the size of the granules and the velocity of secondary crystallization, and on the importance of undercooling to produce Widmanstättian structure. It is regrettable that my views were rendered somewhat incorrectly and the illustrations wrongly labeled in the text which was mainly used by Professor Giolitti.

It is very difficult to bring out simultaneously the white ferrite mesh of the network structure and the dendrites of primary crystallization. I attempted to show that the "dendritic" structure as a rule is in no way related to the secondary structure; in some cases one dendrite is cut up in a multitude of granules, in another, one granule or one ferrite mesh contains several dendritic systems. That idea has been considerably developed by the present author in his French paper and in the publications following. I should therefore like to take this opportunity of saying that on this point I am in complete agreement with the views of Professor Giolitti and would like to indorse the conclusions of the latter's paper on the "Relationship Between Dendritic Structure and Ferrite Mesh"[5]; I feel, however, that if rightly interpreted the dendritic structure showing thin ferrite meshes shown in Fig. 4 could find its place in the latter paper, alongside Professor Giolitti's very interesting photos.

SUMMARY

To sum up, the present author believes that by suitably altering the velocity of cooling through the granulation zone and the zone of secondary crystallization any one of the three types of structures can be produced. So, for instance, my alloys Nos. 5 and 6 with 0.60 per cent C exhibit a macroscopic network structure; alloy No. 8 (C = 0.55 per cent) is a typical example of Widmanstättian structure, and my alloy No. 1 shown in Fig. 5 exhibits the structure of large crystals. The famous Tchernoff Crystal (C = 0.60 per cent) is the classic example of the structure of the latter.

This shows that the type of structure "depends in the first instance not on the chemical composition, but on the conditions of cooling, and brings into evidence the importance of crystallographic relation not only in crystals and isolated grains but in ingots and in every article manufactured of iron, steel or any other metal or alloy."[6]

London, England

[5]*Chem. & Met* vol. 22, p 939, May 19, 1920.
[6]"Crystallization of Metals," by Colonel N. T. Belaiew. London. University of London Press 1922, p. 71.

Creating a New Industry

Prodigious Wood Waste Will Be Made Available for Industry by a New Process

AT THE present time, it is safe to say, not much over 40 per cent of the average timber tree gets into the shape of lumber at the mill. The waste of limbs, of unused portions of the trunk, of bark, of sawdust, of slabs and trimmings at the mills make up nearly 60 per cent of the total timber volume. Of course some of this material is burned to fairly good advantage and not infrequently some of it is available for paper making, but from the 30,000 sawmills in the United States the total loss from waste wood must be prodigious, so it is with considerable interest, from both the economic and the technical standpoint, that the recent announcement of the National Lumber Manufacturers Association has been welcomed. Two men on the Pacific coast, W. T. Dumbleton and W. A. Leuenberger, have developed a process for utilizing this wood waste in the form of briquet that will have a thermal value equal to that of the best anthracite coal.

WHAT THE SAVING MAY MEAN

The mill waste which may be used in this new development may amount in value to as much as 50 per cent of that of the large mills. In a fair-sized sawmill, producing 200,000 b.ft. of lumber per day, there will be 200 cords of waste material to dispose of. It is a wicked economic fact that more than half of this material is probably burned in waste burners because there is no market for its utilization. From such a mill the men referred to have produced over 60 tons of charcoal briquet at a manufacturing cost of $8 per ton, nothing being allowed for the cost of the material when the briquetting plant is operated in conjunction with the mill. In addition to this, 15 gal. of tar oil, 30,000 cu.ft. of wood gas and 7 gal. of acetone are recovered for each ton of briquet delivered. With that method of making briquets, it is entirely possible that they will find a use in the metallurgical industries on the Pacific coast, where they would be able to replace high-grade coals at roughly $15 per ton. If such a thing works out economically, it will undoubtedly prove a big boom to the industrial Northwest, where steel and pig iron have not been able to develop because of lack of good coking coal.

POSSIBILITIES OF THE PLAN

From an economic standpoint, the saving is conceivably stupendous. The mills in Washington and Oregon produce 9,000,000,000 ft. of lumber a year. If they were all to introduce this new carbonizing and briquetting process, their waste would make 2,700,000 tons of briquets a year, enough to meet the requirements of the section for high-grade domestic fuel as well as prospective metallurgical requirements on a large scale. Applied to the entire amount of the lumber output of the United States, the potential amount of fuel of equal quality to anthracite realized by this process would be close to 10,000,000 tons. The same land that makes briquets can produce acetone, tar oil and gas with some comparatively inexpensive additional pieces of equipment, and this would net roughly 2,500,000 gal. of tar oil, 5,000,000 cu.ft. of gas and 1,000,000 gal. of acetone each year.

In addition to these figures can be added some considerable savings due to the use of logging wastes, which are about as large as those of the mill waste.

Evaluation of Decolorizing Carbons

It Is Contended That Present Empirical Methods Should Be Replaced by General Adsorption Data

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ALTHOUGH decolorizing carbons have been of commercial importance for a decade or two, there is as yet no standard method for evaluating them. Each manufacturer and each buyer has his own test. One selects bone black or some carbon as a standard, and, more or less arbitrarily, says that his product is, perhaps, thirty times as efficient; another rates his product on its "decolorizing power," a test dependent upon percentage of color removed by a given quantity of carbon from a certain solution. A third tries to measure the amount of dye which he can add to an aqueous suspension of the carbon without coloring the water. In all of these methods lies a common fallacy. A straight line cannot be determined by one point, nor is one equation with two unknowns capable of definite solution. It has been shown that decolorization is an adsorption phenomenon. The empirical adsorption equation most widely used in relation to experimental data dealing with adsorption is that proposed by Freundlich:

$$\frac{X}{M} = kC^{\frac{1}{n}}$$

where X is the amount of solute adsorbed by M grams of the absorbent and C is the concentration of this material remaining in the solution at equilibrium. Both k and n are empirical constants and any method of evaluating decolorizing carbons must take into consideration the fact that there are two of them.

TABLE I—SPECIAL UNITS FOR USE WITH HESS-IVES TINTPHOTOMETER

If X = color units and Y = scale readings

Red, $Y = 100E^{0.05299X}$

Green, $Y = 100E^{-0.01418X}$

Blue Violet, $Y = 100E^{-0.1006X}$

Scale Reading	R	G	BV	Scale Reading	R	G	BV
1	87.1	325.2	45.8	51	12.7	47.6	6.7
2	73.9	276.0	38.9	52	12.4	46.2	6.5
3	66.4	248.0	34.9	53	12.0	44.8	6.3
4	60.8	227.0	32.0	54	11.7	43.5	6.1
5	56.6	211.5	29.8	55	11.3	42.2	5.9
6	53.2	198.7	28.0	56	11.0	41.0	5.8
7	50.2	187.4	26.4	57	10.6	39.7	5.6
8	47.7	178.2	25.1	58	10.3	38.5	5.4
9	45.5	170.0	23.9	59	10.0	37.3	5.3
10	43.5	162.5	22.9	60	9.7	36.1	5.1
11	41.6	155.5	21.9	61	9.4	34.9	4.9
12	40.1	149.7	21.1	62	9.1	33.8	4.8
13	38.6	144.0	20.3	63	8.8	32.7	4.6
14	37.2	138.1	19.6	64	8.5	31.5	4.4
15	35.9	134.1	18.9	65	8.2	30.4	4.3
16	34.6	129.1	18.2	66	7.9	29.3	4.1
17	33.5	124.9	17.6	67	7.6	28.3	4.0
18	32.4	120.7	17.0	68	7.3	27.3	3.8
19	31.4	117.1	16.5	69	7.0	26.3	3.7
20	30.4	113.6	16.0	70	6.8	25.2	3.6
21	29.5	110.0	15.5	71	6.5	24.1	3.4
22	28.6	107.0	15.1	72	6.2	23.1	3.3
23	27.8	103.6	14.6	73	5.9	22.2	3.1
24	27.0	100.7	14.2	74	5.7	21.2	3.0
25	26.2	97.8	13.8	75	5.4	20.3	2.9
26	25.5	95.2	13.4	76	5.2	19.4	2.7
27	24.8	92.4	13.0	77	4.9	18.5	2.6
28	24.1	89.9	12.7	78	4.7	17.5	2.5
29	23.4	87.4	12.3	79	4.5	16.6	2.3
30	22.7	85.0	12.0	80	4.2	15.8	2.2
31	22.1	82.7	11.7	81	4.0	14.9	2.1
32	21.5	80.4	11.3	82	3.8	14.1	2.0
33	21.0	78.3	11.0	83	3.5	13.2	1.9
34	20.4	76.2	10.7	84	3.3	12.4	1.7
35	19.8	74.1	10.4	85	3.1	11.5	1.6
36	19.3	72.2	10.2	86	2.9	10.7	1.5
37	18.8	70.2	9.9	87	2.6	9.8	1.4
38	18.3	68.3	9.6	88	2.4	9.0	1.3
39	17.8	66.5	9.4	89	2.2	8.2	1.2
40	17.3	64.7	9.1	90	2.0	7.5	1.1
41	16.8	63.0	8.9	91	1.8	6.7	0.9
42	16.4	61.2	8.6	92	1.6	5.9	0.8
43	15.9	59.6	8.4	93	1.4	5.1	0.7
44	15.5	57.9	8.2	94	1.2	4.3	0.6
45	15.1	56.4	7.9	95	1.0	3.6	0.5
46	14.7	54.8	7.7	96	0.8	2.8	0.4
47	14.3	53.3	7.5	97	0.6	2.1	0.3
48	13.9	51.8	7.3	98	0.4	1.4	0.2
49	13.5	50.3	7.1	99	0.2	0.7	0.1
50	13.1	48.9	6.9	100		.	.

METHODS OF MEASURING COLOR

The evaluation of decolorizing carbons postulates the measurement of color, so it might be well to consider immediately the commercially used methods for measuring color of liquids.

There are three of these methods:

(1) The use of Nessler tubes or a Duboscq type of colorimeter.

(2) The use of instruments in which the color of the liquid is matched with tinted glasses.

(3) The use of instruments depending on the measurement of the extinction coefficient for certain wave lengths of light.

Nessler tubes or the Duboscq colorimeter are used only when the colors of the unknown and known samples can be perfectly matched by the dilution of one of them. If several coloring matters are present and are not in the same proportions in both samples, the tints will be different, and a match of the colors practically impossible. L. W. Parsons and R. E. Wilson[1] have found that a Duboscq colorimeter may be used for the measuring of the color of certain oils. In our work with sugars, however, we have found that the color of the decolorized solution cannot be matched with any dilution of the original sample. In such a case, either Nessler tubes or Duboscq colorimeter are useless.

The Lovibond tintometer is an example of the second class of instruments. The chief drawbacks of these instruments are the large assortment of colored glasses necessary, the rather long time consumed in taking a reading, the difficulty of checking results and of two operators reading a given solution alike. Parsons and Wilson in the article referred to above also point out that the Lovibond color scale is not directly proportional to the true color scale. This may be due in part to the loss of light by reflection from the many surfaces exposed when a number of colored slides are used.

In the third class fall spectrophotometers, and possibly the Hess-Ives tintphotometer. A spectrophotometer would doubtless be far better than the Hess-Ives tintphotometer, but the original cost and the care needed for its operation disqualify it for ordinary laboratory work. The color screens of the Hess-Ives tintphotometer transmit rather wide regions of spectrum. However, we have found it quite satisfactory in our type of work.

MODIFIED UNITS FOR HESS-IVES INSTRUMENT

Meade and Harris[2] propose a system of units for use with the Hess-Ives tintphotometer. These units are based on the extinction coefficient. Meade and Harris give equal weight to the units representing red, green and blue violet light. The units which we use are those of Meade and Harris, weighted by the luminosity of each color. A system of these units is given in Table I.

The writer believes these modified units more closely represent the color of a solution as it affects the human eye than do those of Meade and Harris. The scale read-

[1] *J. Ind. Eng. Chem.*, vol. 14, p. 269 (1922).

[2] *J. Ind. Eng. Chem.*, vol. 12, p. 687 (1920).

ing of the Hess-Ives tintphotometer for each screen is translated to "units of color" for that screen. The sum of these values for each screen is taken as the color of the solution.

It is the writer's desire to take exception to a recent statement[3] that the color units read by viewing a ½-in. layer of liquid are not twice the value determined by viewing a ¼-in. layer. The law for the absorption of light by a transparent colored liquid is:

$$\frac{I}{I_0} = E^{-kcd}$$

where I is the intensity of the transmitted light

I_0 the intensity of the incident light

E the base of natural logarithms

k a constant

c the concentration of the light-adsorbing substance

d the thickness of the layer of liquid.

It is a well-known fact that if a colored substance suffers change on dilution, this law does not hold rigidly, but there is no evidence to sustain the opinion previously stated. The writer has found in the case of sugar and molasses solutions that when the thickness of the layer of liquid is doubled the "color units" also double.

At the fall meeting of the American Chemical Society in 1921, Dr. F. W. Zerban presented a paper in which he stated that he had found that the removal of color by carbons follows the adsorption equation, and that by using the Meade-Harris color units in place of the concentration terms X and C in the adsorption formula

$$\frac{X}{M} = kC^{\frac{1}{n}}$$

he had obtained straight lines for the plotted relations of the log $\frac{X}{M}$ to log C.

The modified Meade-Harris units, given in Table I, may be used equally as well in place of the concentration terms X and C. When X and C were expressed in these modified Meade-Harris units, the plot of log $\frac{X}{M}$-log C was a straight line in all cases tested by the writer, except for that end of the curve corresponding to very small quantities of carbon and a consequent slight color removal. It is believed that the determination by the Hess-Ives tintphotometer of the color removed and the use of the modified Meade-Harris units will be found a satisfactory method. However, as has been pointed out above, the Duboscq colorimeter may be used with assurance of accurate results in certain special cases.

Conclusions

In view of the fact that the adsorption equation satisfactorily represents the action of a decolorizing carbon in any given case, it seems that the logical way to evaluate decolorizing carbons is by means of the adsorption isotherm. Furthermore, as the constants of the equation (k and n) are for one particular coloring matter and one initial concentration of that coloring matter, the action of the various decolorizing carbons should be determined for the particular solution it is intended to decolorize.

D. C. Henry[4] is of the opinion that the exponent $\frac{1}{n}$ is the ratio of the osmotic work of adsorption to the total work $\frac{RT}{RT + W}$ where W is the non-osmotic work of adsorption. If this is the case $\frac{1}{n}$ will vary with the coloring matter to be removed. There is no apparent reason why the action of the carbon in one case should be of itself any criterion for its action in any other. It is a well-known fact that often a carbon that is more efficient than another in one case is less efficient in another case.[5] Suppose in the decolorization of a given solution by each of two carbons, that the exponents $\frac{1}{n}$ for these carbons are not identical. Then the efficiency of the two carbons will vary with the color of the solution after decolorization.

We are now in a position to see the fallacies of the present methods of comparing decolorizing carbons. To say that one carbon is so many times as efficient as another is valueless. To rate a carbon on its "decolorizing power" or on some arbitrary test with a dye, while it is a step in the right direction, is inconclusive and misleading. The carbon will probably be used on some solution other than the one on which it was standardized. Even if by chance this should not happen, still by these methods only one point on the adsorption isotherm is determined, and the position or direction of the curve remains unknown.

The ultimate method for evaluating decolorizing carbons must take into account two factors. The various carbons do not act similarly on different solutions and the action of decolorizing carbons, being an absorption phenomenon, follows the adsorption equation.

Increase in Copper Metal Exports

According to *Commerce Monthly*, exports of copper from the United States in 1922 showed a gain of 16 per cent over 1921 and were only 11 per cent below the pre-war average. The declines, as compared with 1921, in shipments to Germany and Japan were more than offset by the gains in exports to Italy, France, the United Kingdom and Belgium.

Ninety per cent of the exports in 1922 was in the form of refined copper, in bars and ingots, 7 per cent as copper rods, less than 2 per cent as uninsulated wire and 1 per cent as plates and sheets. Exports of unrefined, old and scrap copper were under 1 per cent.

Copper exported from the United States meets as its chief competitors in the international market the exports from Australia, Japan, Spain and Africa. Chile, Peru, Canada and Mexico likewise export large quantities, but most of their shipments, either because of financial control or for convenience in shipment, are sent to the United States. A large part of this output is refined here. As a refinery requires a large capital investment, the refineries of the United States play a large part in this country's control of the market.

The ease with which copper may be worked led to its use in many household utensils, although in the Western world it has been displaced in this use to some extent by aluminum and enameled steel. In Eastern countries copper and brass are still almost the only materials from which domestic utensils are made, and large quantities of those metals are imported.

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[3] By F. E. Thomas, in the last paragraph of p. 162, *International Sugar Journal*, 1921.

[4] *Phil. Mag.*, vol. 44, pp. 689-705 (1922), through *Chem. Abs.*, vol. 17, p. 11 (1923).

[5] A. B. Bradley, *Int. Sugar Journal*, vol. 23, pp. 25-32 (1921); vol. 23, pp. 455-62 (1921).

Engine Experiments With Oxidized Oils*

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Engine experiments with a fuel made by the catalytic oxidation of kerosene and a fuel of similar character made by the oxidation of gas oil show that the oxidized kerosenes develop approximately the same power as ordinary kerosene, in spite of the fact that their thermal value is one-eighth less. It is believed that there is a better "clean-up" in the combustion of these partly oxidized fuels, which accounts for their efficiency. These oxidized kerosenes show lower detonation tendencies than the straight hydrocarbon fuel. Similar experiments with lower boiling oxidized fuels in an automobile engine gave results which show that the above results hold here as well.

IT WAS pointed out in a previous article[1] that in the catalytic oxidation of petroleum hydrocarbons there is always a portion of the product having a lower boiling range than that of the raw material, and for convenience this was called "oxidized kerosene." As shown by the distillations of the oxidation products used in the experiments described in the present paper, this material always had between 20 and 35 per cent boiling under 200 deg. C., while the upper limit in every case was taken at 300 deg. C.

Further it was noted in the earlier paper that the fuel value of these products was about one-eighth less than that of ordinary petroleum hydrocarbon mixtures boiling within the same range.

Reasoning from the work of other investigators, particularly that which had been done on alcohol, it was believed that these oxidized kerosenes might show desirable properties when used as a fuel in an internal combustion engine. To test out this idea, the experimental runs described here were made, particular attention being paid to the behavior of the engine as to any "knocking" or detonating characteristics of the fuels, as well as to the power developed in each case.

The fuels tested were: (1) Ordinary kerosene (for comparison), (2) oxidized kerosene made by the oxidation treatment of Pennsylvania kerosene and taking the portion boiling up to 300 deg. C., (3) oxidized kerosene made in the same way from high-sulphur Mexican kerosene, (4) oxidized kerosene made by applying the oxidation treatment to Mexican gas oil, and distilling out the portion boiling up to 300 deg. C.

The Engler distillations of the fuels used in the kerosene engine tests and the later automobile tests are given in Table I.

STATIONARY ENGINE AND AUTOMOBILE TESTS

The kerosene engine used in the first set of experiments summarized in Table II was a one-cylinder, 10-hp., 375-r.p.m., Mogul No. H507, made by the International Harvester Co., of Chicago, and kept in somewhat intermittent use for instructional purposes in the Automotive Laboratory of the Carnegie Institute of Technology. This engine is provided with attachments for "warming up" on gasoline. Lubrication is by forced feed. The water injection is provided for lessening the detonation common with kerosene engines and the readings of this adjustment bring out an important characteristic of the oxidized kerosenes.

Table II gives the more important readings taken; in every case the engine was warmed up by running on gasoline.

Additional experiments bearing on the same line were tried as follows on the two oxidized fuels within the gasoline range:

The motor fuel No. 1 was tested in a six-cylinder car (28 hp.) which was run for 90 miles under all sorts of city traffic conditions, yielding 20 miles per gallon, under the same conditions which gave with ordinary "58-60" gasoline 14 to 15 miles per gallon. The most marked feature of the test was the freedom from detonation with spark advanced and on hills, where the "58-60" fuel gave persistent knocking.

DISCUSSION OF RESULTS

The No. 2 fuel was used in a touring test in the same car with the following results:

Lighter gasoline was needed for priming the cold engine. The road-touring test consumed 10.8 gal. of the fuel, giving an average of 16.5 miles per gallon.

TABLE I CHARACTERISTICS OF FUELS USED IN ENGINE TESTS

	Oxidation Products From High-Sulphur Mexican Kerosene	Oxidation Product (up to 300 Deg C) From Mexican Gas Oil (b)	Motor Fuel No I	Motor Fuel No II	Pennsylvania Kerosene	Oxidation Product From Penna. Kerosene (up to 300 Deg C)
Sp gr at 15 6 deg C	0 8515	0 903	0 798	0 798	0 800	0 847
Initial bp, deg C	110	110	72	82	193	112
Up to 105 deg C, per cent			6 5	2		
125 deg C, per cent	2	2	25	8		3
140 deg C, per cent			43	19		
150 deg C, per cent	5	6	54	23		11
175 deg C, per cent	11	10	80	45		21
190 deg C, per cent			91	60		
200 deg C, per cent	23	17	94	70	3	34
225 deg C, per cent	44	20	(c) 98		24	43
250 deg C, per cent	68	28		(d) 99	58	56
275 deg C, per cent	86	40			84	76
300 deg C, per cent	98	60			96	96
350 deg C, per cent		90				
End point, deg C	300		218	253	300	300
Distillation loss, per cent	2	(a) 10			4	4
Organic acids						
Not removed for test, per cent	9 2	20	15	(All removed)		11

(a) Residue plus distillation loss.
(b) A distillation of this product was made cutting out portion below 300 deg C for the engine test.
(c) Up to 218 deg C (d) Up to 210 deg C. = 80 per cent, 220 deg. C = 90 per cent and 99 per cent recovered at end point

*A paper presented at the Richmond meeting of the American Institute of Chemical Engineers, Dec. 8, 1922.
[1] "Some New Petroleum Products" by J. H. James, *Chem. & Met.*, vol. 26, No. 5, pp. 209-12 (1922).

With spark advanced almost no detonation was observed at any stage of the run. Similar tests with "58-60" gasoline gave about the same mileage, but noticeable detonation.

Realizing that part of the foregoing results on the oxidized kerosene were obtained because of the presence of the fraction boiling below 200 deg. C., it should be pointed out that this portion does not have the ordinary gasoline distillation curve by any means; hence, if we call the portion from 200 to 300 deg. C. kerosene, the under 200 deg. portion resembles, as far as its distillation goes, a heavy naphtha. Looked at in this light, these oxidized fuels up to 300 deg. C. might be regarded as mixtures of ordinary kerosene with heavy naphtha, in ratios from 4:1 to 2:1.

As bearing on this point, an engine run was made

TABLE II RESULTS OF ENGINE EXPERIMENTS WITH VARIOUS OXIDIZED FUELS

Reading No.	Time	Rpm.	Brake Hp	Fuel Weight Lb	Fuel Used Between Readings	Fuel Used Per Bhp-Hr	Temperatures (Deg. C.) Cooling Water In	Cooling Water Out	Air Heater	Exhaust	Fuel Adj	Water Adj	Remarks
							Ordinary Commercial Kerosene (Penna Petroleum) — Series 1a						
	P.M.												
1	4:35	394	9.17	17.344			55	64	60	425	4	8	These readings made as a trial in getting all adjustments Preliminary trials without water injection showed extremely bad detonation
2	4:45	392	9.17	15.750	1.594	1.043	58	69	60	423	4	8	
		Av 393											
							Series 1b						
3	4:58	392	..	13.906			65	75	54	480	4	11	This run determined the maximum water injection the engine would stand and carry the load. The detonation was still marked
4	5:08	392	9.14	12.688	1.218	0.799	65	75	55	470	4	11	
5	5:18	391	9.13	11.000	1.688	1.110	65	77	57	490	4	11	
6	5:28	396	9.17	9.375	1.625	1.063	66	79	57	490	4	11	
7	5:38	391	9.17	8.000	1.375	0.900	67	76	57	495	4	11	
	40 min.	Av 392.4	Av. 9.15	Used 5.906	Total 5.906	Av 0.968							
							Oxidation Product From Penna. Kerosene (Up to 300 Deg. C.) — Series 2a						
	A.M.												
8	11:35	397		25.875			57	69	52	460	4	0	Readings 8 and 9, detonation noticeable, but not so pronounced as with "no water" trials with ordinary kerosene
9	11:50		6.33				64	81	60	470	4	0.0	
10	11:53	403	6.38				65	81	63	480	4	4.0	Readings 10 and 11, detonation was practically silenced by this water adjustment
	P.M.												
11	12:01	403	6.39				65	78	64	450	4.3	4.0	
12	12:11	395	6.33				65	79.5	63	470	2.3	0.0	
13	12:21	394	6.26				67	82	66	475	2.4	0.0	
14	12:25			19.938	5.937	1.125							
	50 min	Av 398.4	Av 6.35										
							Oxidation Product From Penna. Kerosene (Up to 300 deg. C.) — Series 2b						
	P.M.												
15	2:45	395	9.25	16.750			49.5	64.0	61		3.5	8	This water adjustment practically eliminated detonation
16	2:55	398	9.25	15.375	1.375	0.892	58.5	68.0	62		3.5	8	
17	3:05	393	9.22	14.063	1.312	0.853	62.0	72.0	63	540	3.5	8	
18	3:15	397	9.21	12.563	1.500	0.977	64.0	74.5	64	530	3.5	8	
19	3:25	390	9.17	11.188	1.375	0.900	65.0	77.0	59	520	3.5	8	
	40 min	Av 394.6	Av 9.21	Used 5.562	Total 5.562	Av 0.916							
							Series 2c						
20	3:44	381		17.750			71.0	90.0	58	520	3.5	0.0	No water injection Some detonation Lower horsepower and higher fuel consumption
21	3:54	379	7.98	16.125	1.625	1.22	73.5	97.0	59	520	3.5	0.0	
22	4:04			14.313	1.812		69.0	91.0	59	495	3.5	0.0	
	20 min.	Av 380		Used 3.437	Total 3.437								
							Oxidation Product From High Sulphur Mexican Kerosene (Up to 300 Deg. C.) — Series 3a						
23	2:00	398	8.68	20.625			54	75	47.5	485	3.3	5.0	Exhaust clear Lean fuel setting. Water injection sufficient to quiet detonation to "bomp, bomp" condition
24	2:10	398	8.68	19.500	1.125	0.778	58	75	52.5	497	3.3	5.0	
25	2:20	398	8.67	18.313	1.187	0.82	61	82	54.0	500	3.3	5.0	
26	2:30	397	8.67	16.718	1.595	1.103	63	84	56.0	505	3.3	5.0	Spark at full advance
27	2:40	398	8.68	15.500	1.228	0.843	64	86	57.0	502	3.3	5.0	Amount of water used for injection 3.35 liters.
28	2:50	398	8.68	14.125	1.375	0.951	64	90	57.5	500	3.3	5.0	
29	3:00			12.813	1.312		64	85	58.0	500	3.3	5.0	
	60 Min	Av 397.3	Av 8.68	Used 7.812	Total 7.812	Av 0.899							
							Series 3b						
30	3:11	388		10.938			64	83	56.0	490	3.5	10.0	Trial for maximum load with this fuel Exhaust had slight blue haze, odor not noticeable. Water injection as set entirely quieted detonation.
31	3:21	386	12.12	9.063	1.875	0.928	63	80	56.0	480	3.5	10.0	
32	3:31	372	11.88	7.250	1.813	0.916	62	80	56.0	480	3.5	10.0	
33	3:41			5.250	2.00		60	77	53.0	450	3.5	10.0	Throttle nearly wide open as set by governor with speed below normal
	30 Min.	Av 382	Av 12.00	Used 5.688	Total 5.688	Av 0.922							
							Series 3c						
34	3:50	398		10.250			59.0	75	56.0	485	3.4	6.5	Half load test on this fuel Water injection was set at quiet running, but some "bomp, bomp" was noticeable Exhaust had slight haze at first, but became clear.
35	4:00	400	6.79	9.25	0.938	0.829	60.5	74	57.0	465	3.5	6.0	
36	4:10	400	6.81	8.125	1.25	1.10	58.0	80	58.0	480	3.5	6.0	
37	4:20				1.00		60.0	83	57.0	480	3.5	6.0	
	30 Min	Av 399	Av 6.80	Used 3.188	Total 3.188	Av 0.965							
							Oxidized Kerosene Made From Mexican Gas Oil — Series 4a						
	A.M.												
38	11:00	394		14.188			60	73	43.0	440	5.0	5.5	Water injection sufficient to bring detonation down to the "bomp, bomp" condition. Would take no more water and hold load. Exhaust showed considerable smoke with a very pungent odor. This is the leanest mixture would run engine for this load.
39	11:10	398	8.64	12.500	1.688		61	76	45.5	445	5.0	5.5	
40	11:20	400	8.71	10.563	1.937	1.172	62	77	44.0	450	4.0	5.5	
41	11:30	398	8.71	9.500	1.063	1.335	62	80	48.0	490	4.0	5.5	
42	11:40	397	8.67	8.063	1.437	0.733	62	78	46.0	440	5.0	5.5	
43	11:50	394	8.63	6.625	1.438	0.995	62	80	47.5	450	5.0	5.5	
44	12:00	..	...	5.000	1.625	1.000	62	83	44.0	...	5.0	5.5	
	60 Min.	Av 396.83	Av 8.67	Used 9.188	Total 9.186	Av. 1.047							
							Series 4b						
45	4:30	400	.	10.250	...		61	85	54.0	480	3.5	5.0	Lighter load than 4a test. Exhaust clear. Engine ran evenly. "Bomping" noticeable but not objectionable. Injection water used 0.73 liter.
46	4:40	402	6.82	9.250	1.000	0.88	62	80	57.5	500	4.0	5.0	
47	4:50	...	.	8.125	1.125		62	84	60.5	500	4.0	5.0	
	20 Min	Av 401	6.82	Used 2.125	Total 2.125	Av. 0.88							

with the oxidized Mexican kerosene in the automotive laboratory of one of the large oil companies. The behavior of this fuel as to detonation was checked against a kerosene-gasoline mixture that would give the same low detonation characteristics. It was found that a mixture of 60 per cent kerosene and 40 per cent gasoline was required to bring ordinary kerosene down to that of the oxidized kerosene in low detonating character.

When we note that all the oxidized fuels tried in the kerosene engine have one-eighth lower thermal values than ordinary hydrocarbons within the same distillation range and still gave as good or better efficiencies than ordinary kerosene, the writers believe that we must look to the chemical character of the mixtures for the explanation. According to this idea the original hydrocarbon molecules are weakened toward the oxidation attack in the internal combustion engine because of their oxidized character, so that a better "clean up" results, and perhaps more of a propulsive effect during the explosion which is evidenced by a diminution of the detonation.

Gum Formation With Oxidized Fuels

In the discussion following the presentation of Professor James' paper at the Richmond meeting, Wilbert J. Huff, of the Koppers Co., asked the author if he has noticed any gum formation in the use of this fuel. It was pointed out by the inquirer that gum formation is a very fundamental question in the use of fuels in internal combustion engines and that an investigation by the Bureau of Mines had shown that oxidized gasoline gives a heavy yield of gums. Professor James declared that most of the gum is in the fraction over 300 deg. C. As bearing on the gum formation problem, the oxidation product fractions over 300 deg. C. were made into a lubricating oil by careful vacuum distillation and were used in the same kerosene engine described in the previous tests. There was no varnish-like formation with this lubricant, and the carbon formed was only about half that formed from the well-known commercial engine oil lubricants. This carbon was of a light, fluffy character. Professor James believes that here again the chemical character of the oil is the determining factor in the cleaner combustion.

What Real Co-operation Can Do for the Edible Oil Industry

Manufacturers' Nearsighted Policy of Secrecy Declared a Serious Obstacle to Technical Progress*

BY JOHN P. HARRIS
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OF COURSE we all hate to admit it, but, if we are honest with ourselves, we must acknowledge that the art of edible oil refining has progressed less since its inception than any other branch of applied chemistry. However, we are not willing to admit that this is due to any inferiority of the technical men engaged in this industry, but rather because practically all of the edible oil manufacturers have made a great fetish of secrecy, even introducing this pernicious practice into their own organizations, so that only the chosen few shall know the "wonderful secrets" by which their efficienecy is obtained, with the idea of keeping their quality high above their competitors'. In view of this selfish and near-sighted policy, it is really rather remarkable that the industry has progressed as far as it has. We can readily understand the manufacturers' viewpoint, their idea being to stifle competition and obtain a virtual monopoly upon that business, or at least secure a preference by the discriminating trade.

EXCHANGING TECHNICAL INFORMATION

A few years of real co-operation would make a tremendous difference in the edible oil industry. A few years of pulling together and "speaking out in meeting" would mean a great deal to everyone. The power of suggestion is a wonderful thing and when Jones of the John Doe Co. suggests to Smith of the Richard Roe Co. that we are doing thus and so in our neutralizing process, Smith tries it out, adds his own individual ideas to it and obtains even better results than Jones. He then tells Jones about it, and Jones tries out Smith's suggestions, which he improves by adding some new ideas of his own, and so on ad infinitum. The entire industry becomes stimulated, and undreamed of improvements and economies result.

Would it not be wonderful if we could attend a convention where no one attempted to secure all the information possible from everyone else, at the same time withholding all of his own information and intentionally deceiving everyone else, with the result that no one profits by attending the convention?

Of course we must realize that no firm is ever going to be broad gage enough to sacrifice profits for the uplifting of the industry, but what we do insist is that the sort of co-operation we have mentioned, which sounds like the coming of the millennium, would be of benefit to everyone in the long run, and that the most efficient concerns and those who do the greatest amount of advertising would be the ones to profit most.

Many employers of laborers condemn labor unions because they do not help raise the standard of labor. And yet those very men belong to trade organizations possessed of wonderful potential possibilities for the advancement of their industries, which have never made one single move for the production of higher quality products by that industry.

And the vegetable oil industry is no exception. There is not one concern in the industry which is producing the very best product of which it is capable, even though a part of its product may be very superior. And many concerns, through ignorance or through a near-sighted policy of "getting by" with the least possible cost, are producing a product which is so poor that it is consumed only by the lowest class of trade and forever prejudices the discriminating trade against vegetable oil products, if they happen to try using it.

This condition of affairs cannot be changed without a stiff battle, but could be overcome by the Interstate Cottonseed Crushers' Association and the American Oil Chemists Society if they would inaugurate a *real* campaign for co-operation with deeds instead of words. Those who err through ignorance should be assisted, and those who err through greed should be enlightened and shown that the best way is always the cheapest way.

*Extracts from an article in *The Cotton Oil Press*, official organ of Interstate Cottonseed Crushers Association and the American Oil Chemists Society.

Loading Limestone

Bureau of Mines Issues Paper of Interest to All Plants Utilizing Limestone

IN PLANTS which utilize limestone the removal of fragments of broken rock from the quarry floor and the placing of these in cars for transportation to the kilns is a very important process. At most plants of this nature, the loading constitutes the largest single item in quarry cost. In view of the great expense involved, the Bureau of Mines has made an investigation of the subject and has published the results of this investigation in a paper entitled (Serial 2446) "Rock Loading at Lime-Plant Quarries."

HAND LOADING

Hand loading is prevalent at most lime quarries today, and this method has numerous advantages. The greatest of these advantages, which applies particularly to the small operator, is the necessity involved with a mechanical-loading system for the investment of a large amount of capital, against which the hand-loading system involves very little outlay. Another advantage of the hand system is that a certain amount of sorting of the material occurs as it is loaded by hand. In addition, by hand loading the fines are sorted out to the maximum amount in the first place, so that only large lumps are shipped to the kiln. A final advantage of the hand-loading system is that it eliminates the possibility of breakdown inherent in all mechanical systems.

This hand-loading method, however, has many disadvantages, two of which only need be mentioned. The first is the fact that with the hand-loading system a much larger gang of laborers is necessary and all the troubles which follow on the employment of a large quantity of unskilled labor will attend the operation. The second disadvantage is the fact that the removal of waste and dirt will lag behind the removal of good stone inevitably where the hand-loading system is used, so that extra labor must be employed to remove this waste in proportion to that used for the limestone, and it will be found that the cost runs 2 or 3 cents per ton greater for handling the waste than for handling the good stone. This is not the case with the mechanical method.

LOADING WITH A STEAM SHOVEL

A steam shovel is used in loading limestone in connection with a crushing and scraping equipment, all of which involves a rather high first cost. The extent of the operation should govern the size of the shovel used —for an output of 150 to 300 tons of rock per day the small tractor shovels with ¾ to 1¼-yd. dippers are suitable. The size of the shovel should be increased from there on in accordance to the size of the operation.

A steam shovel has numerous advantages over the hand method of loading. In the first place, it can handle much larger sizes of material, doing away with a great deal of secondary blasting. Second, a great reduction is made in the size of the labor gang necessary. The Bureau of Mines figures show that one man in a hand shovel gang can load only about one-seventh of the material that a man can load with a steam shovel gang. This is, in fact, the principal advantage of the steam shovel and one that can hardly be overestimated.

The first and main disadvantage of the steam shovel method is the fact that it entails the addition of crushing and sorting material, which is quite expensive. A second disadvantage is the fact that it is hard to make any differentiation in quality of the material loaded, as the steam shovel will load any undesirable material just the same as the good rock. This tends to degrade the final product.

In view of the extra cost involved in the use of a steam shovel, for small plants it is sometimes not well to go into these methods, but it is more economical to retain the hand-loading method.

Mineral Production in Canada in 1922

Canada's mineral production in 1922 was valued at $183,000,000—an increase of $11,106,000 over the value recorded in the preceding year, according to a report issued by the Dominion Bureau of Statistics. This amount was made up as follows: Metallics, $61,000,000; non-metallics, $82,500,000; structural materials and clay products, $39,300,000,

The outstanding feature of the metal production was the large increase in gold in both Ontario and British Columbia, amounting to more than 1,230,985 oz. This represents an increase of 31.0 per cent over 1921. Although nickel and copper were lower last year than in 1921, silver and lead increased appreciably both in quantity and value. The end of the year also saw a marked revival in zinc and cobalt. Metals as a whole advanced 23.9 per cent, to a total value of $61,144,990, as compared with $49,343,232 in 1921.

The slight decline in the production of non-metallics, including coal, amounted to approximately $5,260,343 in value. Since the greater part of this decrease was due to loss of production, caused by labor troubles, it may be regarded as negligible. In the successful marketing of structural materials and clay products, the revival of the building industry has played an important part and during the past year production increased.

The output of natural gas from Canadian fields in 1922 amounted to about 14,954,097,000 cu.ft., valued at $5,468,963. The quantity of gas produced was more than 800,000,000 cu.ft. above the output in the preceding year, and the value in 1922 was about $874,799 more.

The output of asbestos in 1922 reached a total of approximately 136,657 tons of all grades, valued at $4,664,106, as compared with 92,761 tons, valued at $4,906,230 in 1921. The appreciable percentage increase in production was due almost entirely to the activity about the mines during the closing months of the year.

The recovery in mineral production as a whole to a total value of $183,029,595 may be considered most propitious. Comparison with preceding years shows that 1920, 1919 and 1917 were the only years in which this valuation was exceeded.

Factors Affecting Contraction of Alloys

The United States Bureau of Mines lists the following as the most important factors affecting the contraction of a non-ferrous alloy on casting: (1) Chemical composition of the alloy; (2) pouring temperature; (3) cross-section of the bar poured; (4) length of the bar in relation to its cross-section; (5) character of the mold, and the method of molding; (6) gas occlusion, and overheating of the melt. These factors are discussed briefly in Serial 2410, "Contraction and Shrinkage of Non-Ferrous Alloys as Related to Casting Practice," which may be obtained from the Bureau of Mines, Washington, D. C.

The Determination of the Specific Gravity of Coke

Method for Finding Real and Apparent Specific Gravities of Coke and From These Values the Percentage Porosity

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THE percentage by volume of cell-space of lump coke is usually referred to as porosity. In practice, this is calculated from the true specific gravity of the moisture-free pulverized coke and the apparent specific gravity of the moisture-free lump coke, as follows:

Percentage by volume of coke substance

$$= 100 \times \frac{\textit{Apparent specific gravity}}{\textit{True specific gravity}}$$

Percentage by volume of cell-space

$$= 100 - \textit{percentage by volume of coke substance}$$

The experiments here described were undertaken in order to develop a satisfactory method for determining true and apparent specific gravities of metallurgical coke. The methods used by various laboratories for making such determinations differ considerably, and results obtained on the same sample may vary decidedly depending on the methods used.

TRUE SPECIFIC GRAVITY

The true specific gravity is, as a rule, determined by boiling the pulverized coke in a liquid, usually water, in an accurately calibrated pycnometer, so as to wet the coke particles thoroughly and displace included gases.

Experiments were made as to the effects of fineness of grinding, the medium used, and the time and method of boiling. The pycnometer used was the Hogarth specific gravity bottle, which usually has a capacity of 100 to 125 cc. and is convenient to manipulate. Each bottle was accurately calibrated, and a table was constructed giving capacities in grams of water at a range of room temperatures likely to exist in the laboratory. The true specific gravity was calculated by the use of the following formula:

$$\textit{True specific gravity} = \frac{W}{W - (W' - P)}$$

when W = weight in grams of dry coke
W' = weight in grams of pycnometer + coke + water
P = weight in grams of pycnometer + water.

EFFECT OF TIME OF BOILING AND PARTIAL VACUUM

Two samples of metallurgical coke, pulverized in ball mills to pass a 60-mesh sieve, were selected. One was a 72-hour beehive foundry coke, Connellsville, Pa., region; and the other was a byproduct coke from Franklin County, Ill., coal.

Ten grams of moisture-free coke was boiled in water at atmospheric pressure for periods ranging from ½ to 3 hours; other samples were boiled at atmospheric pressure for a half-hour, and the boiling continued for another half-hour under the partial vacuum of a Chapman water filter pump; while samples were also boiled on a water bath under partial vacuum for 3 hours. The results of these tests are given in Table I.

It will be noted from the table that the same results were obtained by boiling at atmospheric pressure for ½- or 1-hour periods as by boiling for 3 hours; also, no noticeable difference resulted when the boiling was performed under a partial vacuum. These results indicate that boiling the pulverized coke for 1 hour at atmospheric pressure is as satisfactory as boiling for longer periods or boiling under a partial vacuum.

EFFECT OF FINENESS OF SAMPLE AND LIQUID MEDIUM

Two samples of byproduct coke, one of beehive coke and one of low-temperature coke made in the laboratory at a temperature of 500 to 600 deg. C., were pulverized in ball mills until one portion passed a 60-mesh sieve and another portion a 200-mesh sieve. Specific gravity determinations were made on the 60- and 200-mesh samples, using both water and benzene as mediums. The specific gravity determinations in water were made by boiling for 1 hour at atmospheric pressure, and

TABLE I—EFFECT OF TIME AND METHOD OF BOILING 60-MESH COKE IN WATER

Time and Method of Boiling	True Specific Gravity	
	72-Hr. Beehive Foundry Coke, Connellsville Region	Byproduct Coke From Illinois Coal
½ hour at atmospheric pressure	1.976 1.969 Average 1.97	1.895 1.893 1.886 1.880 1.891 Average 1.89
1 hour at atmospheric pressure	1.970 1.969 Average 1.97	1.890 1.897 1.893 1.902 1.897 Average 1.90
2 hours at atmospheric pressure	1.976 1.969 Average 1.97	1.903 1.901 1.900 1.903 Average 1.90
3 hours at atmospheric pressure...	1.974 1.967 Average 1.97	1.902 1.904 Average 1.90
½ hour at atmospheric pressure and ½ hour under partial vacuum of Chapman filter pump.	1.962 1.964 1.974 1.965 Average 1.97	1.895 1.894 Average 1.90
Boiling 3 hours under vacuum of Chapman filter pump.........	1.969 Average 1.97	1.899 Average 1.90

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TABLE II—TRUE SPECIFIC GRAVITY TESTS ON 60-MESH AND 200-MESH SAMPLES OF VARIOUS COKES IN WATER AND BENZENE

Origin of Coke	True Specific Gravity				
	60-Mesh			200-Mesh	
		Water	Benzene	Water	Benzene
Connellsville 72-hr beehive foundry coke	(Ash in dry coke, 8.6 per cent) / (Ash in dry coke, 8.8 per cent)	1.933	1.958	1.958	1.964
		1.923	1.958	1.962	1.963
		1.930		1.955	
	Average	1.93	1.96	1.96	1.96
Byproduct coke from Illinois coal	(Ash in dry coke, 14.0 per cent) / (Ash in dry coke, 14.1 per cent)	1.851	1.793	1.920	1.806
		1.845	1.803	1.919	1.803
		1.845		1.919	
	Average	1.85	1.80	1.92	1.80
Byproduct coke from Pittsburgh bed coal	(Ash in dry coke, 10.6 per cent) / (Ash in dry coke, 10.7 per cent)	1.860	1.832	1.882	1.842
		1.864	1.838	1.890	1.842
		1.86[illegible]		1.885	
	Average	1.86	1.84	1.89	1.84
Low-temperature coke (500-600°C.) from Pittsburgh bed coal	(Ash in dry coke, 4.0 per cent) / (Ash in dry coke, 4.1 per cent)	1.517	1.469	1.525	1.550
		1.524	1.468	1.528	1.554
		1.520		1.526	
	Average	1.52	1.47	1.53	1.55

those in benzene by boiling a half-hour at atmospheric pressure. Ash was determined on the 60- and 200-mesh portions in order to ascertain whether any increase of ash resulted from the longer grinding required to pass the coke through 200-mesh sieves. The results of these tests are given in Table II. Sizing tests made on the through 60-mesh samples of the four cokes to determine the approximate fineness of the samples showed:

Mesh	Connellsville 72-Hr Beehive Foundry Coke, Per Cent	Byproduct Coke From Illinois Coal, Per Cent	Byproduct Coke From Pittsburgh Bed Coal, Per Cent	Low-Temperature Coke From Pittsburgh Bed Coal, Per Cent
On 100	34.9	1.6	23.7	24.2
Through 100, on 200	36.3	50.2	41.8	44.0
Through 200	28.8	48.2	34.5	31.8

It is noted from Table II that there is considerable difference between the results obtained with water and those with benzene. In most determinations benzene gave lower values than water, but in some the reverse was true. With benzene all of the metallurgical cokes gave the same results on 60- or 200-mesh samples; however, for the low-temperature laboratory coke, the 200-mesh sample gave the higher specific gravity. With water, all of the cokes gave a higher specific gravity on the 200-mesh samples, the greatest difference being for the byproduct coke from Illinois coal, where it was higher by 0.07 than for the 60-mesh material. The slight increase in ash content of the 200-mesh material, due to longer grinding, was so small that it did not affect the specific gravity of the samples.

Rose[1] made similar true specific gravity tests on a number of cokes, using water and benzene as mediums, and found in each test that the results obtained with benzene were lower than those with water, these differences ranging from 0.025 to 0.150. He also determined the specific gravities in benzene of portions of a byproduct coke, the one portion being pulverized to pass 60 mesh and the other to pass 200 mesh, and obtained a value higher by 0.06 on the 200-mesh material.

[1]Rose, Harold. J., "The Determination of the True Specific Gravity of Coke," *J. Ind. Eng. Chem.*, vol. 14, No. 11, 1922, pp. 1047-1049

There is no apparent reason why water should not be used as the medium in determining true specific gravity of pulverized coke. Other mediums may or may not give results comparable to those obtained with water, and benzene evidently will give results differing from those obtained with water.

The higher results obtained with water on the 200-mesh material, as compared with those obtained on the 60-mesh material indicate that it is desirable to pulverize the coke to pass a 200-mesh sieve for true specific gravity determinations. The greatest difference observed was in the byproduct coke from Illinois coal, where a value of 1.85 was obtained on the 60-mesh material, compared to 1.92 on the 200-mesh material. Assuming an apparent specific gravity of 0.90, this difference would amount to 2 per cent in calculating the percentage by volume of cell-space in the lump coke.

Method for True Specific Gravity

Hogarth's specific gravity bottle with a side tubulure is a convenient type of pycnometer for the determination. This bottle as furnished usually has a capacity of about 125 cc. The bottle should be accurately calibrated, and a table constructed giving its contents in grams of water at room temperature likely to occur in the laboratory. This is readily done from tables prepared by the Bureau of Standards[2] giving corrections for determining the true capacities of glass vessels from the weight of water in air.

A 10-gram portion (W) of 200-mesh coke, which has previously been dried for an hour at 105 deg. C., is carefully introduced into the weighed specific gravity bottle with enough distilled water to fill it about half full. It is then placed on a hot plate, and kept boiling for an hour, with frequent shakings to wash down any coke adhering to the sides. It is then removed from the hot plate, filled to the tubulure with recently boiled and cooled distilled water, the stopper inserted, and permitted to cool to room temperature. (Cooling may be hastened by placing the bottle in water.) Next, the bottle is filled to slightly above the mark on the capillary of the stopper. This is conveniently done by inserting the end of the tubulure in a small beaker of previously boiled distilled water, which has been cooled to room temperature, and applying a slight suction on the stopper. The water level is adjusted to the mark on the capillary by touching a piece of filter paper to the end of the tubulure. The bottle is then wiped dry and weighed (W'). Immediately after weighing, the stopper is removed, and the temperature of the contents taken. The capacity of the bottle in grams of water at the temperature recorded is obtained by reference to the calibration table of the bottle (P).

The true specific gravity is conveniently calculated by the following formula:

$$\textit{True specific gravity} = \frac{W}{W - (W' - P)}$$

in which

W = Weight in grams of dry coke.

W' = Weight in grams of bottle + dry coke + water to fill.

P = Weight in grams of bottle + water to fill.

Apparent Specific Gravity of Lump Coke

The apparent specific gravity of lump coke is determined in practice by immersing the coke pieces in water, and determining the amount of water displaced.

[2]"Standard Density and Volumetric Tables," Bureau of Standards Circular 19, 1916, pp. 52-56.

As lump coke is a cellular substance, considerable water may penetrate into the coke pieces, so some experiments were made as to the amount of this, and attempts were made to determine the apparent specific gravity by preventing any water from entering during the determination.

The apparent specific gravity tests were made with a Nicholson hydrometer, which instrument permits weighing the sample in air and also when totally immersed in water. The capacity of the hydrometer used was approximately 500 grams of coke. Pieces of coke about 1½ to 2 in. in size were used.

Three byproduct cokes were available for the tests. The samples were dried to constant weight at a temperature of approximately 150 deg. C. previous to making the determinations. About 500-gram samples were taken and weighed in air, after which they were immersed in water for about 3 minutes, and the weight of the sample in water determined. The coke pieces were then removed from the water and allowed to drain for about 1 minute, and then were weighed in air again to determine the weight of water absorbed. The same pieces of coke were then re-dried to constant weight at 150 deg. C., and coated by painting with melted paraffine. Apparent specific gravity determinations were made on the paraffined coke pieces, and a correction was made for the coating of paraffine—the results thus obtained were regarded as the correct apparent specific gravity of the coke.

After immersion of the paraffined pieces, all surface water adhering to the paraffine was removed by absorbent paper, and the pieces were weighed in air to determine the amount, if any, of water that might have penetrated into the coke. The apparent specific gravities of the cokes as determined (1) without correcting for absorbed water, (2) correcting for absorbed water, and (3) as determined on the paraffined pieces, are given in Table III.

TABLE III—APPARENT SPECIFIC GRAVITY OF COKES
(1) Not corrected for absorbed water (2) Corrected for absorbed water, and (3) As determined on paraffined coke

Condition	Apparent Specific Gravity		
	Coke No. 1 Weight of sample 413 grams	Coke No. 2 Weight of sample 407.5 grams	Coke No. 3 Weight of sample 488 grams
No correction for absorbed water	1.16	0.98	1.09
Correcting for absorbed water	1.03 44 grams water absorbed	0.91 30 grams water absorbed	1.00 39.6 grams water absorbed
Determined on paraffined coke and correction made for paraffine	1.05	0.94	1.02
Correcting for water absorbed by paraffined coke	1.04 5.5 grams water absorbed	0.93 4 grams water absorbed	1.00 10.8 grams water absorbed

The tests show that considerable water was absorbed by the coke during the 3-minute immersion in water, the amount varying from 7 to 10 per cent of the weight of coke. It is evident that unless a correction is made for the water absorbed, a considerable error will be introduced. The absorption of water by the dry coke proceeds rapidly after immersion. Coke No. 3, after immersion for 3 minutes, was weighed in air and re-immersed for 30 minutes. It was found that 39.6 grams of water was absorbed in 3 minutes and 46.5 grams in 30 minutes; however, when a correction was applied for the water absorbed, the apparent specific gravity was the same (within experimental error), being 1.00 after the 3-minute period and 1.01 after the 30-minute period.

The paraffined pieces of coke absorbed a small amount of water during the 3-minute period of immersion, the amount ranging from 5 to 10 grams. As the paraffined coke pieces were dried with absorbent paper after immersion, this small gain in weight may be accounted for by imperfections in the paraffine coating on the coke pieces, which probably allowed some water to get into them. Assuming that this small amount of water was absorbed, and making the slight corrections for it, the values obtained for apparent specific gravity are in close agreement with those obtained in the usual manner when a correction is made for absorbed water. The maximum difference between the values obtained for the paraffined coke and those for unparaffined coke after correction for absorbed water amounted to only 0.02. It will be noted that if a correction is not made for the large amount of absorbed water when determining apparent specific gravity in the usual manner, the values obtained will be considerably higher than if the correction is applied—the differences in the three cokes listed in the table ranging from 0.07 to 0.13. It is evident that such a correction should be made in any method for apparent specific gravity which permits water to be absorbed by the sample during immersion.

METHOD FOR LARGE PIECES OF COKE

The cell structure of coke pieces from the same oven or retort usually shows noticeable variation, and the cell structure of the same piece of coke may vary at different points of the piece. If a small sample of coke is used for apparent specific gravity determinations, it is essential to select the sample carefully so as to be representative of the coke. The Nicholson hydrometer used in the tests described had a capacity of about 500 grams. By careful selection of the portions for duplicate tests, good checks on duplicate determinations can be obtained with the Nicholson hydrometer method. The sample should be in the form of pieces about 1½ to 2 in. in size, and the pieces used for the tests must be systematically selected. Of 170 different cokes on which duplicate apparent specific gravity determinations were made, the average difference between duplicate determinations was 0.03.

A method by which a large sample of large pieces could be used would be desirable, as it would be easier to select a representative sample. Such a method has been used by the Koppers Co., and the method is one of those for the apparent specific gravity of coke adopted by the American Gas Association.[4] The method is as follows: Select 25 to 30 lb. of coke, which should be as nearly representative as possible of the entire quantity under consideration with regard to size, shape and general appearance. Dry the coke thoroughly at 105 to 200 deg. C., and weigh when cool after shaking and brushing off any adhering dust (*A*).

Provide a wash-boiler or other suitable container with a spout, which may be conveniently formed by soldering in horizontally a short ½-in. nipple about 2½ in. below the top of boiler. The boiler should be placed on a level and rigid base or floor. A wire cage or basket provided with a cover and a long wire handle suitable for holding the entire sample of coke should also be provided and placed in the boiler.

Place a tightly fitting cork in the ½-in. nipple and fill boiler with water until the water level is above the nipple. Allow the water to come to rest, remove cork,

[4] "Gas Chemists' Hand Book," American Gas Assn., 1922 edition, pp. 58-59.

permit all excess water to drain, and replace cork. Remove cage, shaking all adhering water back into the boiler and place the dried coke sample in the cage. Lower the cage and coke into the water and let stand for 30 minutes, with occasional stirring of coke to detach any air bubbles adhering to the surface of the coke, but without disturbing the position of the boiler. The coke must be completely submerged at all times. At the end of the 30 minutes, after the water has come to rest, remove cork and allow the displaced water to drain into a weighed container. Weigh the displaced water (B). Quickly remove the cage and coke from the water, allow to drain for 1 minute and weigh wet coke without cage (C).

A = Weight of dry coke.
B = Weight of water displaced by wet coke.
C = Weight of wet coke.
$C—A$ = Weight of water absorbed by coke.
$B + (C—A)$ = Weight of total water displaced and absorbed.

$$\frac{A}{B + (C - A)} = \text{Apparent specific gravity.}$$

(Note: The water should be near room temperature so as not to vary appreciably.)

Results of This Method

As will be noted, the above method uses a large sample of coke, and makes a correction for water absorbed by the coke during immersion, which, according to the experiments previously described in this paper, should give fairly correct values for the apparent specific gravity of coke.

In order to test the accuracy of the method, tests were made on two different byproduct cokes which were available in sufficient quantity to obtain approximately 18 lb. of large-size pieces. A wash-boiler was used as the water container. The coke pieces were dried to constant weight at about 150 deg. C. before the determinations. The same pieces of coke were used throughout the tests, all water being removed before each determination by drying to constant weight. The results of these check determinations are given below:

Apparent Specific Gravity Check Results as Determined on Same Pieces of Coke by Method Using Large Sample

	Coke No. 1 (8400-gram sample)	Coke No. 2 (8050-gram sample)
	0 91	1 05
	0 90	1 04
	0 90	
Average	0 90	1 05

The results show that the method itself is accurate inasmuch as, obtaining close checks, the greatest difference shown was only 0.01.

It was found, when the cork was removed from the overflow spout in order to allow the water in the wash-boiler to come to a constant level, that water would drip from the spout for a long time. Satisfactory results were obtained by allowing the water to drip for 1 minute after the overflow stream started to discharge drop by drop.

Conclusions

For calculating the percentage by volume of cell-space of metallurgical coke, the following conclusions are drawn from the tests on methods of determining true and apparent specific gravities:

1. True specific gravity may be satisfactorily determined by boiling the pulverized coke in water at atmospheric pressure for 1 hour in a convenient calibrated pycnometer such as the Hogarth specific gravity bottle.

2. The experiments indicate that it is not necessary to boil the sample under reduced pressure, or to boil at atmospheric pressure for periods longer than 1 hour.

3. Somewhat higher results were obtained for true specific gravity on coke samples pulverized to pass a 200-mesh sieve as compared to the same samples pulverized to pass a 60-mesh, so it appears to be desirable to pulverize the coke to pass a 200-mesh sieve.

4. It is not advisable to use other mediums besides water for determining true specific gravity of coke, as the results may not be comparable. In the case of benzene, the results obtained did not check those obtained with water, and benzene appears to have a tendency to give lower values than those obtained with water as a medium.

5. In determining the apparent specific gravity of lump coke, a correction should be applied for water absorbed, as metallurgical coke is a cellular substance which absorbs considerable water rapidly after immersion.

6. The method for determining apparent specific gravity, using a sample of 20 to 30 lb. of large pieces of coke, and correcting for the water absorbed, is recommended.

The writers are indebted to A. C. Fieldner, supervising chemist, Pittsburgh Experiment Station, U. S. Bureau of Mines, for helpful suggestions.

Investigation of Mineral Fillers

At the Southern experiment station of the Bureau of Mines, Tuscaloosa, Ala., a special study is being made of the determination of the grain size and character of grains of representative fillers produced in the district. This investigation of non-metallic minerals is for the purpose of determining their use as mineral fillers. It includes a study of the various methods of calculation of average grain size applicable to fillers which vary greatly in size—from diameters of 100 microns or more to zero—and the determination of average grain size of representative samples of commercial fillers, including clay, barite, fullers earth, whiting, mica, ocher, slate, silica and talc. The character and size of particle of fillers is a basic property which has an important effect on the other physical properties and characteristics.

A study of the effect of grain size of fillers in compounding is also being undertaken and will be conducted along the line of determining the difference in actual use between a filler made up of mixed sized grains as usually employed, and the same material classified within as close limits as possible regarding variation in grain size and having the same average diameters as the mixed product. It will also include the determination of the difference in effect between two products of the same material but classified between different limits of grain size.

The effect of heat-treatment on the properties of non-metallic minerals other than clays with respect to their use as fillers is also being studied by the Bureau of Mines. This will involve a determination of the effect of heating at different temperatures on the specific gravity, loss in weight, color, grain size, oil absorption, covering power or spread and ease of grinding. Previous work on clays along the same line has shown an improvement of certain samples for filler use.

The relationship among grain size, oil absorption and covering power of fillers and pigments is also being investigated. The general direction of this relationship is known, but no exact data are available on the subject.

Effect of Ammonia on Steel

In co-operation with the Fixed Nitrogen Research Laboratory, the Bureau of Standards has made a microscopic examination of specimens representing a series of steels varying in carbon content from 0.02 to 0.98 per cent exposed to a current of ammonia at temperatures in the range of 100 to 700 deg. C. The purpose of this test was to determine the effect of change in carbon content upon the method of attack of heated ammonia. No change was observed on the specimens up to 400 deg. C.; at 500 deg. a film of white nitride was followed by the layer of nitride needles. At 600 deg. C. this effect increased, while at 700 deg. a new compound of nitrogen was formed following directly the film of white nitride layer. At 700 deg. C. the nitride needles in low-carbon steels removed further from the edge to the center. They are absent at that temperature in high-carbon steels of 0.49 to 0.98 per cent C.

Testing a Cost System

The rules to apply in analyzing the soundness of a cost system are:

Does your cost system give you up-to-date costs, not merely history?
Does it aid in stablizing your wages and piece work rates?
Does it point out defects in your routing system?
Does it help you maintain a perpetual inventory?
Does it increase your production?
Does it measure your overhead?
Does it detect new overhead expense?
Does it point out leaks in expense?
Does it encourage your employees?
Does it promote intelligent competition?
Does it point to non-profit paying lines?
Does it permit you to bid safely?

Twelve suggestions for testing the value of a cost accounting system are given in a pamphlet issued recently by the fabricated production department of the Chamber of Commerce of the United States.

A cost accounting system is very much like the engine of an automobile, only there are more various kinds of cost systems and their idiosyncracies are legion. If a cost system fails to show what it should, it consumes profits. It pays to check your system; you ought to determine the upkeep and make sure it pays.

Wear Tests on Steels

Some investigations on the wear of steel have been under way at the Bureau of Standards, in connection with the work sponsored by the Gage Steel Committee. Especial effort has recently been made to keep the surfaces of the specimens clean and free from all adhering abraded particles while under test. A cloth buffing wheel, rotated at high speed by electric motor, has been used successfully for this purpose. It has been found that when the wearing surfaces are thus kept free of abraded metallic dust, the rate of wear drops to a comparatively almost negligible quantity.

Record Sugar Crop in Hawaii

Hawaii's sugar cane harvest during the year ended last Sept. 30 was the largest in 8 years, according to an estimate by the Department of Agriculture. Production for the year was placed at 1,184,000,000 lb., or 13 per cent more than that for the previous year

A New Instrument for Testing Glue and Gelatin Jellies

Description of Bloom Gelometer Developed for Factory Control Work, but Useful for Other Jelly Strength Investigations

BY WILLIAM D. RICHARDSON
Chief Chemist, Swift & Co., Chicago

THE jelly strength of glue and gelatin may be considered the most important single determination which it is customary to make on these important substances. Following the old finger test method, which is still in use in many factories in this country and abroad, numerous mechanical devices have been developed for the purpose, all of more or less merit. A description of these is scattered through the literature, and a summary of a number of types, including those of Peter Cooper, Lipowitz, Valenta, Scott, Alexander, E. S. Smith, Forest Products Laboratory, Hulbert, C. R. Smith, Sheppard and Schweitzer, are included in Bogue's[1] recent work on gelatin and glue. In addition to these a number of other types are in use in the laboratories of different glue factories.

The outstanding feature of all previous testing machines for jelly strength is that they have not been standardized and reproducible. Each has been a law unto itself capable of developing comparable results, which were intelligible to the user in terms of certain glue and gelatin standards, the standards being carefuly preserved from month to month and year to year for making comparisons with factory runs and shipments of product. Standards of this sort, however, ultimately became exhausted and when new standards were selected they were probably not identical with the old.

The fundamental idea underlying the development of the Bloom Gelometer, named after O. T. Bloom, its inventor, was that of a machine so constructed that it could be reproduced by measurement and, given precisely regulated conditions, would yield identical results at any time and place on the same sample. It should be understood, however, that due caution be observed in applying the term "precisely regulated conditions," particularly as regards the temperature of the jelly, which must be most carefully controlled and regulated for a definite period of time prior to the test by means of a thermostat bath.

GENERAL DESCRIPTION

This instrument is so designed that the two factors, diameter of plunger and depth of plunge, are maintained constant, and the third factor, time of application of the pressure, which is applied by means of flowing shot, is kept within a reasonably close time limit. While the depth of plunge can be varied, it is kept precisely at 4 mm. for the purpose of testing glue and gelatin jellies, while the time of introduction of the shot is maintained between 2 and 5 seconds. The diameter of the plunger is exactly 12.7 mm. (½ in.) and is constructed of aluminum or hard rubber, the sharp lower edge being rounded to the slightest possible degree to prevent cutting.

The instrument is automatic in its action. Once started by hand, the flow of shot is rapid and continuous between the two contact points, and the cut-off is sharp

[1]"The Chemistry and Technology of Gelatin and Glue," by Robert H. Bogue, Mellon Institute Technochemical Series, McGraw-Hill Book Co., Inc., pp. 369 to 380 (1922).

when the silver disk working between the two contact points reaches the lower point. It has been found in the comparatively brief time that the instrument has been operated that it yields excellent results, accurate beyond the requirements of factory or trade.

In reading the following description and working directions for the instrument, reference should be had to Fig. 1.

The instrument is mounted on the base R_1 and the pillar R_2. The adjustment stand N resting on the base R_1 is provided with a platform N_1 capable of being raised and lowered by the rack and pinion mechanism N_2. Affixed to the upper end of the pillar R_2 by the bracket J_1, the spring adjusting mechanism G holds the spring F and the plunger L, hanger and pan H_1 and H_2 respectively. At the upper part of the plunger hanger, the silver contact disk B is set to operate between the contact points A_1 and A_2. The rod H_3 of the plunger hanger works through the adjustable guide J_{2a} which is affixed to the bracket J_2.

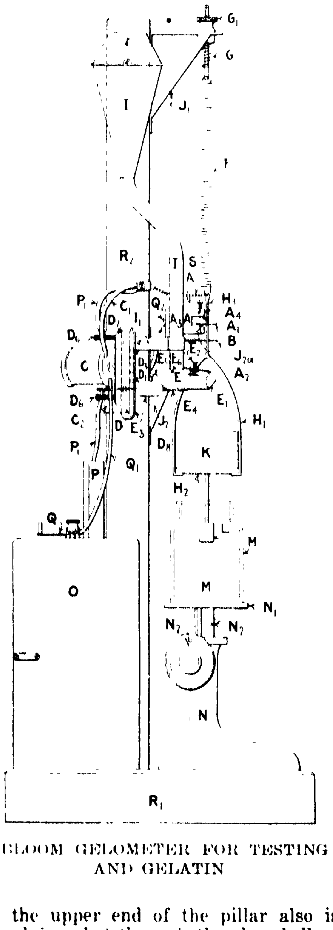


FIG. 1—BLOOM GELOMETER FOR TESTING GLUE AND GELATIN

Affixed to the upper end of the pillar also is the shot hopper I, supplying shot through the clamshell cut-off E-E_1 to the shot receiver K, which rests on the pan H_2. The automatic shot control mechanism D-D_5, working on the clamshell cut-off E-E_1 consists of the electromagnet C, the soft iron bar D_7 carrying the brass dogs D_1 to D_5 and the brass guide bar D.

The cut-off mechanism consists of the clamshell cut-off E-E_1, the control rod E_4, working on the dogs D_1-D_5 and the counterbalance weight E_3. E_2 is the bearing on which the cut-off mechanism turns. The entire cut-off mechanism is adjustable vertically on the pillar R_2 by means of the screws C_2, this adjustment setting and adjusting the pitch of the clamshell cut-off E-E_1. This adjustment is made when the machine is assembled and is permanent.

Electric current is supplied to the electromagnet C through the contact points A_1-A_2 from the 3-volt dry battery O through the connections Q_1, C_1, S and Q_2. P is a small telephone condenser arranged in shunt circuit by means of the connections P_1 and P_2.

The test bottle M containing the jelly to be tested rests on the platform N_1.

The space between contact points A_1 and A_2 is adjusted as follows: With the current cut off by means of switch Q and with the silver disk B resting on contact point A_1, adjustment is made by means of the adjustment screw A_4 so that the distance between the upper face of the silver disk B and the contact point A_1 is exactly determined. This determines the depth of plunge. In the case of glue and gelatin jellies, the depth of plunge is exactly 4 mm. as determined by the standard Brown & Sharpe 4-mm. gage furnished with the instrument.

Adjustment is now made of the silver disk B against contact point A_2 by turning the adjustment screw G_1 (which acts on the spring F) until the silver disk B is in lightest possible contact with contact point A_2. When this point is reached, sparking will be noticed between the point A_2 and the disk B and a make-and-break vibration is set up between the soft iron bar D_7 and the core of the electromagnet C. When this adjustment is once carefully made the machine stays in adjustment for some time, although readjustment should be made occasionally.

The glue or gelatin jelly (or the like), prepared in the usual way or according to standard directions, is placed in the test bottle M and chilled to the test temperature for the desired length of time. The bottle is placed on platform N_1 and raised by means of the rack and pinion mechanism N_2 until the jelly is in contact with the plunger L and the latter is raised until the silver disk B is brought into light electrical contact with contact point A_1. This point is indicated by sparking and make-and-break vibration between the soft iron bar D_7 and the core of the electromagnet C. The shot receiver K is quickly placed on pan H_2 and immediately the lever E_4 is raised to the predetermined position on one of the dogs D_1-D_5. The height to which lever E_4 is raised regulates the velocity of the flow of shot. For weak jellies one of the lower dogs is used, for strong jellies one of the upper dogs. The dog selected should be such as to keep the flow of shot within the prescribed limit of 2 to 5 seconds. The finest chilled shot obtainable is used, No. 12 or finer. The raising of the lever E_4 immediately starts the flow of shot, depressing the plunger L into the jelly until contact is made between the silver disk B and contact point A_2. This closes the circuit which acts on the electromagnet C, moving the soft iron bar D_7 and withdrawing the support of the dog from the lever arm E_4, which immediately falls, thus cutting off the flow of shot by closing the clamshell cut-off E-E_1.

The weight of shot delivered into the shot receiver K plus the weight of the shot receiver itself is the weight required to move the plunger L through the prescribed distance against the resistance of the jelly, and measures the jelly strength. For glues and gelatins this distance is exactly 4 mm. as determined by a Brown & Sharpe gage.

After the combined weight is determined, the shot is emptied back into hopper I and the machine is ready for another test.

The Bloom Gelometer is sufficiently accurate for all control work in glue and gelatin factories and is, in fact, rather more sensitive than previous devices for the same purpose. It can also be applied to the investigation of jellies for scientific purposes and for the determination of the influence of various factors on the strength of jellies, such as concentration, p_H value, time of setting, time of pressure application, etc. It should be used in conjunction with a thermostat bath capable of being regulated to within 1/10 of 1 deg. C. at 10 deg. C., and by preference test should be made in a chill room the temperature of which is carefully controlled at 10 deg. C.

Columnar Crystallization in Ingots of Invar

The Bureau of Standards has studied the ingot structure of ingots of invar (Fe:Ni 65:35) and the relation of the structure to the forgeability of the alloy. It has been found that ingots cast in chilled molds cool too slowly and form excessively large columnar crystals, producing a very brittle ingot which breaks readily on forging. To correct this difficulty a specially designed and refrigerated mold must probably be used.

Synopsis of Recent Chemical & Metallurgical Literature

Ingot Practice for Chromium Steels

In order to find the effect of the rate of solidification on the eutectic network, P. Oberhoffer[1] made six series of chromium steels with carbon varying from 0.65 to 1.50 per cent and chromium from 1.8 to 13.5 per cent. In every series, consisting of two charges each, one was chill cast and the other allowed to cool down with the ladle. On macro-etching, the latter showed a dendritic structure and the former a fine globular structure. On "secondary" etching with a concentrated solution of picric acid in alcohol containing a few drops of nitric acid, the slowly cooled steels showed a large network and chill-cast steels a fine network. Test pieces were then forged down from 45 mm. square to 15 mm. square. On microscopic examination the slowly cooled steels showed long drawn out accumulations of carbide particles, while in the quickly cooled steels the carbides were distributed quite evenly throughout the sections. Mechanical tests indicated that the notch toughness was higher in chill-cast specimens—otherwise the results were quite similar.

Composition of Blast-Furnace Gases

The composition of blast-furnace gas is definite enough to be expressed by a linear formula, as pointed out by M. J. Seigle in *Revue de Métallurgie*, 1922, vol. 19, pp. 11-36. If the respective percentages of nitrogen, oxygen, carbon dioxide, carbon monoxide, hydrogen, water (vapor) and methane are a, b, c, d, e, f and g, so that $a + b + c + d + e + f + g = 100$, then $4.76b + (4.76 - N)c + (2.88 - N)d + 0.88e + f + g = 100$. If the amounts of oxygen (b), of hydrogen (e) and of methane (g) can be left out, then for a dry blast

$$(4.76 - N)c + (2.88 - N)d = 100.$$

In this formula N is a function of the volume of carbon dioxide introduced by the carbonates from the flux (λ), of the volume of oxygen from the oxides in the ore (μ) and of the percentage a of carbon contained in the pig iron, whose total weight is F.

$$N = \frac{\lambda + \mu}{0.495\left(1 - \frac{aF}{100}\right) + 0.54\lambda}$$

It follows from these formulas that the possible values for the volumes c and d of carbon dioxide and carbon monoxide will lie on certain straight lines. These lines are not parallel and the points where they intersect the axes c and d are easily calculated.

Applying these formulas to the extreme case of that of a gas producer, we have $4.76c + 2.88d = 100$.

On the other side, for an electric blast furnace we have the simple equation $a + b = 100$.

This latter line shows the limit for the possible numerical values of CO. and CO. Thus a graphical representation of the composition of blast-furnace gases is conveniently drawn and various theoretical and practical conclusions easily arrived at. Most important is the possibility of predicting the various occurrences which would happen when any changes are introduced in the conditions existing in the blast furnace

[1]*Stahl und Eisen*, 1922, vol. 42, pp. 1240-1242.

Fuel Oils in Internal Combustion Engines

There are three distinct types of difficulties encountered in the burning of heavy oils—namely, ignition, burning after ignition, and impurities. Even an oil that meets two of these requirements is often found unfit for use on account of the third effect. Harold Moore, in a paper which is presented in abstract form in the *Journal of the Franklin Institute* for February, 1923, classifies heavy oil engines in the three groups: Diesel engines using compressed air for firing; cold starting engines which fire by spontaneous combustion, the fuel being pulverized without air blasts; and hot bulb engines in which the fuel is injected mechanically, external heat being applied to insure ignition. The capacity of an engine for burning heavy fuels is not merely dependent upon the cycle and the method of fuel injection; it is also determined to a very marked degree upon the size, speed, compression, fuel-valve tuning and other factors.

Fatigue of Metals

To find out (1) whether a safe "endurance limit" does really exist and (2), what is happening to a metal subjected to alternating stresses, investigations were undertaken by Professor Ludwick[1] at the Technical College in Vienna. Specimens of aluminum, copper and iron were subjected to series of stresses and the results were plotted as curves, having for co-ordinates the unit stress and the number of cycles. The results indicate that even when the number of repetitions becomes infinite, the unit stress necessary for fracture does not approach zero. This means that an endurance limit is passed by metal and that lesser stresses can be applied to the specimen indefinitely.

It has been further found out that the resistance to alternating impact stresses depends not on the ductility or malleability of the metal, but on its elastic limit, its yield point and hardness—in other words, this resistance is not a function of the faculty of the material to endure deformation, but to withstand deformation. For instance, a quenched specimen, in spite of its brittleness, would show a better resistance under these tests than an annealed one

Microscopical investigations show how stresses produce slipping along crystal planes inside the crystallites. If stresses are small such slipping usually

[1]Paper read June 29, 1922, before the German Association for the Study of Metals, and abstracted in *V. D. I. Nachrichten*, 1922, No 28/29a, July 19, pp 310-311

Important Articles in Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem. & Met.* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature and consequently should be of considerable interest to our readers Those that are of unusual interest will be published later in abstract in this department; but since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage. The magazines reviewed have all been received within a fortnight of our publication date

BUILDINGS FROM THE MANAGER'S VIEWPOINT—TYPES OF INDUSTRIAL CONSTRUCTION. G L. H. Arnold *Management Engineering*, March, 1923, pp 177-182.

MANUFACTURE OF SULPHURIC ACID BY THE CONTACT PROCESS. III, Processes and Apparatus for Purifying Gases. H. Braidy *L'Industrie Chimique*, February, 1923, pp. 54-57.

VERTICAL ACID PUMPS. C. Millberg. *L'Industrie Chimique*, February, 1923, pp. 61-63.

EXTRACTION OF VEGETABLE OILS WITH ACETONE. Louis Périn. *L'Industrie Chimique*. February, 1923, pp. 63-64

SPECIFIC HEATS OF NITROUS AND NITRIC OXIDES. J. R. Partington and W. G. Shilling. *Phil. Magazine*, March, 1923, pp. 416-480.

PREFERENTIAL OXIDATION IN THE PRESENCE OF CATALYSTS. Rex Furness. *Chemistry and Industry*, March 1923, pp. 196-199.

GASOLINE TEN YEARS HENCE. Ralph H. McKee. *Chemistry and Industry*, March 2, 1923, pp 193-196.

THE BRITISH INDUSTRIES FAIR *Chemical Age* (London), Feb. 24, 1923, pp. 195-204.

THE FUTURE OF THE BRITISH COLOR INDUSTRY. Dr. H. H. Hodgson, *Chemical Age* (London), March 3, 1923, pp. 231-232.

THE RATE OF REACTION BETWEEN GASES AND LIQUIDS H. G. Becker. *Phil. Mag.*, March, 1923, pp. 581-592.

SOME MECHANICAL FEATURES OF THE RUBBER INDUSTRY (First Part). H. C. Young. *The Engineer*, Feb. 23, 1923, pp. 196-197.

STATISTICAL COMPILATION. H. B. Horwitz, H. A. Wembridge and H. J. Hutkin. *Bulletin* of the Taylor Society, February, 1923, pp. 3-11.

THE ORGANIZATION AND MANAGEMENT OF A MEDIUM-SIZED PLANT. Percy S. Brown. *Bulletin* of the Taylor Society, February, 1923, pp. 12-30.

occurs where the metal is less homogeneous—i. e., in the neighborhood of slag enclosures, porosities and impurities. At such places even a certain rise of temperature can be detected, showing that it is there that the metal actually "works"; on the other hand the sound metal would be still subjected to elastic deformations only.

Gas Producers

At a meeting of the Manchester Section of the Society of Chemical Industry, held on Feb. 2, T. R. Wollaston read a paper on "Some Developments in Gas Producers," which was reported in the *Iron and Coal Trades Review* for Feb. 9, 1923.

The results obtained from gas producers of the recovery and non-recovery type are compared with those from an improved plant which has been devised with a view to eliminating as far as possible the faults of the older systems.

Performance

The paper set forth a statement of the average performances of gas producers at the time (10 years ago) when the author began his investigation, and indicated the causes of loss and inefficiency which appeared preventable. These, expressed in B.t.u. and money value and compared with the new plant—the R-G. plant so called—are shown diagrammatically in Fig. 1 and Fig. 2. In Fig. 2 an assumption is made that an ammonia sulphate yield of a gross value of 7s. involves a production cost of 4s.

The R-G Producer

The R-G. experimental plant which gave the records from which these diagrams were made has a 9-ft. diameter producer of 1,300 lb. hourly capacity. The fuel is introduced through a retort in contact with hot exit gases and is thus partly coked, while the gases are enriched. The steam for the process is raised by means of an annular boiler, surrounding the unlined producer body. Blast saturation and superheat are derived from a central cone-shaped boiler within the producer which acts as a flash-boiler.

The author pointed out that the precoking leads to a wide extension of the range of common fuels available, to practical elimination of clinkering, to great ease and economy of working, and to the production of a gas of unusually high value, as for example, CO_2, 10.6 per cent; CO, 18.8 per cent; H_2, 24.4 per cent; CH_4, 3.9 per cent; total combustible, 45.1 per cent; higher heating value, 182.5; lower heating value, 164.5 B.t.u. per cu.ft.

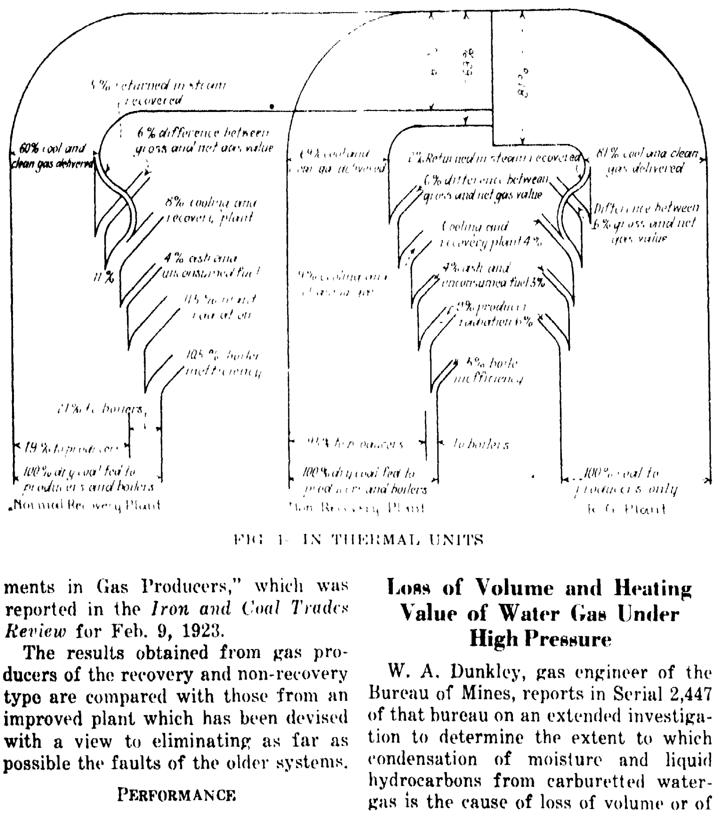


FIG. 1—IN THERMAL UNITS

Loss of Volume and Heating Value of Water Gas Under High Pressure

W. A. Dunkley, gas engineer of the Bureau of Mines, reports in Serial 2,447 of that bureau on an extended investigation to determine the extent to which condensation of moisture and liquid hydrocarbons from carburetted water-gas is the cause of loss of volume or of heating value of the gas. The work was done in connection with the distribution system of the Western United Gas & Electric Co., of Aurora, Ill. That system includes supply of gas over a territory 85 miles long by 35 miles wide at pressure ranging up to 90 lb. per square inch.

This work shows that the condensation of water vapor and of oil vapors in the distribution system does not ordinarily contribute materially to the loss in volume during distribution. Only when the inlet gas is metered at considerably higher temperature and then subsequently compressed and cooled is the volume decreased by as much as 5 per cent due to condensation. The effect on heating value under the conditions of test was a loss of approximately 9 B.t.u. per cubic foot, or 1.6 per cent, but it is believed that this might increase during extreme winter weather to 35 B.t.u., or 6 per cent of the initial heat value under extreme conditions. The full report can be obtained on application to the Bureau of Mines, Washington, D. C.

Silico-thermy and Its Practical Application

The reaction between iron and silicon is one producing a considerable evolution of heat. Therefore when soft iron and metallic silicon are heated together in a crucible to a temperature of about 1,250 deg. C., which is still considerably below the fusing temperature of either of them, a vigorous reaction ensues, the temperature rises rapidly to above 1,800 deg. C., the mass melts, and the whole contents of the crucible become an overheated liquid. If the charge was of about 80 per cent iron and 20 per cent silicon the product would have the composition of the silicide Fe_2Si, if 67 per cent and 33 per cent of FeSi. At intermediate percentages a more or less saturated solution of these silicides in iron is apparently obtained. As alloys so obtained are too brittle for practical use, a certain amount of carbon must be alloyed, whereupon alloys very suitable for making acid-resisting wares are obtained. In describing the process, R. Walter[1] suggests for these alloys the name of "Thermisilid." The valuable properties of "Thermisilid" are obtained because of its homogeneity, which is not attained in other high

[1]A paper read before the German Society of Metals, *Metallkunde*, 1921, pp. 225-233

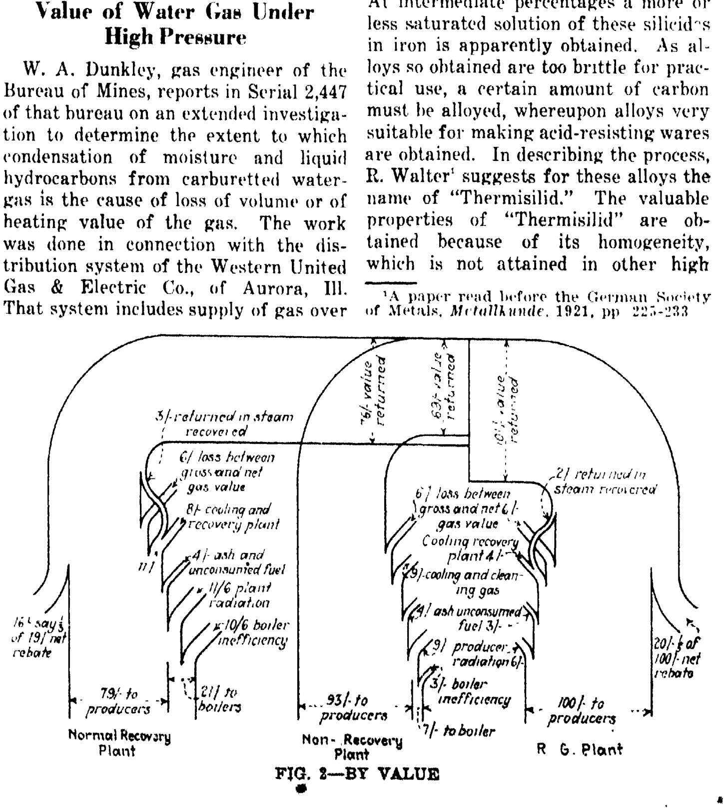


FIG. 2—BY VALUE

silicon irons. Numerous sections are described and the structure of the finished article given as that of polygonal crystals of Fe_3Si imbedded in the matrix of a solid solution of silicon in iron. Carbon is present in the ground mass as evenly distributed fine flakes of graphite.

During the verbal discussions in which, among others, Professors Arndt and Guertler took part, the suggestion was put forward by the latter that a low-melting eutectic might be formed at or about the temperature of 1,250 deg. The formation of the first liquid drop would thus liberate a certain amount of heat and facilitate the liquefaction of further quantities of the charge.

The analogy that exists between alumino-thermy and silico-thermy was also discussed, as well as the possibilities of numerous practical applications for industry.

Buildings From the Manager's Viewpoint

The manager of an industrial organization which is about to construct new buildings has many problems to solve quite outside the usual routine of manufacture. As a guide in the solution of these problems, G. L. H. Arnold has written an interesting article in the March, 1923, issue of *Management Engineering*. This article points out that the questions which arise are inevitable and depend entirely upon the industry for which the buildings are to be erected. Once a decision is reached on any of these problems and the building is erected, it is a fixture. Therefore thought must be taken before any building is started, so that nothing shall be erected which is a hindrance to future operations.

The principal concern of the manager in deciding the type of buildings to erect is with the effect of the new building on his output. In considering this phase of the matter, the following points must be taken account of:

1. Duration of occupancy.
2. Character of occupancy.
3. Extent and character of probable future growth.
4. Advisability of providing space to be rented.
5. Nature of materials used in manufacture.
6. Fire and explosion hazards.
7. Size and weight of units to be handled.
8. Methods of transportation within the building.
9. Class of machinery or equipment to be installed.
10. Receiving, shipping, and storage requirements.
11. Amount and character of departmental intercommunication necessary.
12. Type of labor employed.
13. Density and distribution of population in the neighborhood.
14. Economic arrangement of equipment.

The author goes on to enlarge on these various factors and points out particularly the responsibility of the management in deciding the story height, building width and column spacing carefully with relation to the industrial operations that are to be carried on in the building. In conclusion the paper states that the new building is a machine, each detail of which must be considered with relation to its effect upon the quality, quantity and cost of the product. The governing question as to size and type of industrial building in the last analysis is whether the benefit to the product is sufficient to justify the expense incurred.

Recent Chemical & Metallurgical Patents

Manufacture of Phenyl Glycine—There are several well-known methods for making synthetic indigo which start with aniline as a base, the principal intermediate product being phenyl glycine ($C_6H_5.NHCH_2.CO_2H$). One of the earliest methods developed for making phenyl glycine from aniline was by reaction with chloracetic acid in the proportion of three molecules of aniline to one of the acid. This process has, however, presented considerable difficulties, principally due to the formation of certain undesirable intermediates, such as anilide. These products, of course, affect the yield of phenyl glycine. In a process patented by Charles J. Strosacker, of Midland, Mich., and assigned to the Dow Chemical Co. of that city, the aniline and chloracetic acid are mixed in the presence of water, the water being approximately one part in four by weight of the combined mixture. The mixture is

American Patents Issued March 6, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem & Met* readers. They will be studied later by *Chem & Met.'s* staff and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,447,203—Process of Making Arsenicals. Carleton Ellis and Vernon T. Stewart, Montclair, N. J.

1,447,208—Composition of Matter for Use as a Roof Paint. Joe Power and Henry Wolfe, Sparta, Ill.

1,447,248—Smokeless-Powder Dynamite. Linwood H. Jones, Kenvil, N. J., assignor to Hercules Powder Co., Wilmington, Del.

1,447,296—Apparatus for the Combined Solvent and Destructive Distillation Treatment of Shale. David T. Day, Washington, D. C.

1,447,297—Process for the Combined Solvent and Destructive Distillation Treatment of Oil Containing Earthy Material. David T. Day, Washington, D. C.

1,447,344—Pulp Washing and Condensing Apparatus. Ira Thomas Fisk, North Hoosick, N. Y., assignor to Stevens & Thompson, Inc., North Hoosick, N. Y.

1,447,400—Process for the Manufacture of Alkaloids. Arthur Stall, Basel, Switzerland, assignor to Chemical Works, formerly Sandoz, Basel, Switzerland.

1,447,401—Apparatus for Producing Smoke. James N. Alsop, Owensboro Ky., assignor to Packer's Meat Smoking Corporation, Chicago, Ill.

1,447,452—Colloidal Decolorizing Material and Process of Producing the Same. Leonard Wilkenden, Flushing, N. Y.

1,447,461—Method for Employing Decolorizing Carbons and Other Absorbing Materials. Joseph Fergus Brewster, Clarendon, Va., and William G. Raines, Jr., Jackson, Miss., assignors by direct and mesne assignments to the Government of the United States and to the people of the United States.

1,447,485—Coloring Matters Derived From Pyrazolone. Emil Reber, Basel Switzerland, assignor to Society of Chemical Industry in Basel, Basel, Switzerland.

1,447,501—Process for the Preparation of Basic Salicylate of Aluminum. Jean Altwegg, Lyon, France, assignor to Société Chimique des Usines du Rhone, Paris, France.

1,447,544—Manufacture of Sodium Phosphate. Walter Glaeser, Brooklyn, N. Y.

1,447,557—Reduction of Nitrocompounds. David Alliston Legg, London, England, assignor to Matthews Atkinson Adam, London, England.

1,447,568—Process of Treating Lime-Containing Materials. Joseph Pelt, Cicero, Ill.

1,447,581—Apparatus for the Combustion of Poisonous Gases in Blast Furnaces. Johann Voegeli, Zurich, Switzerland.

1,447,645—Roasting Sulphur-Bearing Materials, etc. March F. Chase, Cleveland, Ohio, and Frederic E. Pierce and John Skogmark, New York, N. Y., assignors to the Cos Process Co., Inc., New York.

1,447,654—Method of and Apparatus for Drawing Sheet Glass. Arthur E. Fowle, Toledo, Ohio, assignor to the Libbey-Owens Sheet Glass Co., Toledo, Ohio.

1,447,661—Method and Apparatus for Flattening Sheet Glass. Seth B. Henshaw, Charleston, W. Va., assignor to the Libbey-Owens Sheet Glass Co., Toledo, Ohio.

1,447,689—Process of Reactivating Spent Catalyzers. William D. Richardson, Chicago, Ill., assignor to Swift & Co., Chicago.

1,447,930—Preparation of Preservative Substances for Rubber Latex. Samuel Cleland Davidson, deceased, late of Belfast, Ireland, by Frederick George McGuire, Bangor, Ireland, Alfred Agar, Holywood, Ireland, and Hugh Taylor Coulter, Belfast, Ireland, executors.

1,447,937—Process of Making Hydrochloric and Arsenic Acids. Carleton Ellis and Vernon T. Stewart, Montclair, N. J.

1,447,938—Process of Making Arsenate of Lime. Carleton Ellis and Vernon T. Stewart, Montclair, N. J.

1,447,954—Oxidizable Oil. Paul Wentworth Webster, Pelham Manor, N. Y., assignor to Perry & Webster, Inc., Elizabeth, N. J.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

then heated to a temperature at which the reaction starts, whereupon the heat is withdrawn and the action is allowed to proceed to completion. The aniline salt of phenylglycine and aniline hydrochloride are formed. Then a suitable neutralizing agent, such as sodium carbonate, is added in amount sufficient to react with the hydrochloride, with the result that it is decomposed into aniline oil and sodium chloride. After the products are allowed to settle and become stratified, the mixture of the aniline salt of phenylglycine and aniline oil is drawn off and treated with a solution of sodium carbonate to yield the sodium salt of phenylglycine and additional aniline oil. The latter is easily separated and returned to the process. (1,442,732. Jan. 16, 1923.)

Method of Making Phthalic Anhydride—Hidematsu Sasa, of Tokyo, Japan, has been granted a patent for the manufacture of phthalic anhydride from nitro-naphthalene. He claims that his product can be manufactured economically with sulphuric acid of ordinary strength and with a cheap metal such as iron or zinc as a catalyst. Other processes based on the oxidation of naphthalene often require the use of fuming acid and mercuric or other expensive salts as catalysts. In the process here described, 450 kg. of sulphuric acid, 65 deg. Bé., is heated to 150-160 deg. C., and then 35 kg. of nitro-naphthalene is added. After the latter has fused into the sulphuric acid, 80-90 kg. of iron borings or zinc dust is added during agitation. A temperature of 200 deg. C. is maintained until all the gases are driven off; then the temperature is raised about 300 deg. C. and phthalic anhydride is driven off and recovered by condensation at the proper subatmospheric pressure. (1,443,094. Jan. 23, 1923.)

Phosphate Fertilizers — Hermann Plauson, of Hamburg, Germany, has patented a process for preparing a satisfactory phosphate manure by simply grinding the insoluble crude phosphate with six times its own weight in water to which a little acid or alkali has been added. The beater mill employed in the process reduces the phosphate to practically a colloidal condition and in this form, after drying, it is claimed to be an excellent fertilizer in spite of the fact that it is regarded as an insoluble form under normal conditions. (1,445,167. Feb. 13, 1923.)

Production of Zinc Oxide—E. P. Stevenson has assigned to Arthur D. Little, Inc., of Cambridge, Mass., a process for making pure zinc oxide. Normally the color of zinc oxide is not absolutely white and is due to minute traces of other metals, such as copper, iron and cadmium. By digesting a roasted zinc ore with ammonium sulphate a precipitate of basic zinc sulphate is obtained, which is then washed and dried to decompose the ammonium salt. It is then digested further with soluble alkali, which converts the zinc into a mixture of zinc hydroxide and zinc carbonate. This mixture is finally dried and calcined at a low heat to produce commercial zinc oxide, which, however, has an extremely high purity due to the preliminary treatment. (1,445,366. Feb. 13, 1923.)

Agitator—The object of this invention is the construction of an agitator which automatically produces an influx of air into the agitated mass during operation. In order to accomplish this the rotating stirring device is provided with an air passage having an outlet so placed that it discharges the air directly into the agitated mass. The inlet of this air passage connects with a scoop for the entrance of air, which is drawn in by compression within the scoop and by the displacement of liquid produced during the rotary movement of the agitator. In operation air is forcibly ejected through the arms of the stirring device into the agitated material in such a way that a complete mixture of air and material is obtained. While this apparatus is particularly designed for the process of concentration by flotation in handling ores, it will have numerous other applications where agitation and separation or concentration are to be effected at the same time. (1,445,935. Arthur C Daman and Thomas J. Pennington. Feb. 20, 1923.)

Selenium Oxychloride as a Solvent—Victor Lenher, of Madison, Wis., has suggested the use of selenium oxychloride for dissolving unsaturated hydrocarbon compounds of various kinds. This includes rubber, both pure and vulcanized, Redmanol, Bakelite and Condensite, resins, glues, gelatin, celluloid, varnish, lacquer and paints. The solvent action may be increased by adding 20 per cent sulphur trioxide and diminished by diluting with carbon tetrachloride, 2.75 per cent by weight. (1,445,329. Feb. 13, 1923.)

Process for Making Plastic Compositions—A. A. Backhaus, of Baltimore, Md., has assigned to the U. S. Industrial Alcohol Co. a mixture from which a plastic composition may be made. The patent covers the use of ethyl aceto acetate as a camphor substitute in such compositions—for example, 10 oz. by weight of cellulose nitrate, together with a gallon of suitable solvent, such as acetone, amyl acetate, etc., and anywhere from 1 to 4 oz. of ethyl aceto acetate. After this material is hardened it behaves very similarly to the camphor-made product and it is claimed that ethyl aceto acetate provides flexibility and pliability, which obviates brittleness, opacity and blushing. (1,437,952. Dec. 5, 1922.)

Recovery of Waste Potash Liquor—C. T. Whittier has assigned to the Royal Baking Powder Co. of New Jersey a patent whereby the waste potash containing liquor from a tartaric acid manufacture may be recovered. Always in the past this material has been thrown to waste because, in evaporating, calcium sulphate separates out and the organic matter coagulates. This leaves a viscous mass very difficult to handle. By utilizing a spray drier it is possible to obtain this material in an available form. (1,442,317. Jan. 16, 1923.)

Production of Soluble Resins From Furfural—G. H. Mains and Max Phillips of the Department of Agriculture have developed nine soluble resins by heating furfural with the following substances: Meta-nitraniline, alpha-naphthylamine, para-toluidine, beta-naphthylamine, meta-toluylenediamine, methyl ethyl ketone ortho-toluidine, cymidine and xylidine. The process in general is to heat furfural with two parts of the other material (in some cases this is varied) for several hours under a temperature which varies from 150 to 200 deg. The various conditions are for the purposes of abstracts unimportant. (1,441,598. Jan. 9, 1923.)

Manufacture of Orthosulphonic Acids of Aromatic Amines—J. Baddiley, Joseph B. Payman and Harry Wignall, of Blackley, Manchester, England, have assigned to the British Dyestuffs Corporation, Ltd., the following process for the preparation of orthosulphonic acids of aromatic amines. The chlorsulphonic acid of the amines is dissolved in a suitable solvent which will be unattacked by chlorsulphonic acid (tetrachlorethane is used frequently in this work). This process gives often a chlorsulphate addition product which sometimes separates out as a precipitate and may be filtered from the solvent. The material is then transformed into the sulpho acid with the elimination of hydrochloric acid. (1,441,655. Jan. 9, 1923.)

Two-Stage Process for Coke Manufacture—The method for coking proposed by James G. West is a two-stage process intended to produce high-grade metallurgical coke from high-volatile coal which is claimed to be otherwise not suitable for this purpose. In the first stage some coal is carbonized for reduction of the percentage of volatile matter, preferably to about 17 to 20 per cent, but in no event less than 6 to 10 per cent volatile. This semi-coke is ground and mixed with more of the original coal and the mixture carbonized as usual. (1,445,735. Feb. 20, 1923.)

Use of Lepidolite in Vitreous Enamels—Alexander L. Duval d'Adrian, of Washington, Pa., has assigned to B. F. Drakenfeld & Co., of New York, a patent covering the use of lepidolite in vitreous enamels. Used either in the frit or in the ground mass, or in both, it is claimed that a higher grade stronger enamel is produced which is more serviceable and which does not crack or craze. Where tin oxide is used, it is claimed that this may be replaced in part by lepidolite, producing a higher grade product at lower cost. (1,443,813. Jan. 30, 1923.)

British Patents

For complete specifications of any British patent apply to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Explosives—Salts of azidothiocarbonic acid, which may be obtained from sodium azide and carbon bisulphide, are used in priming compositions - for example, with phlegmatizing agents such as resin or paraffine solution. The lead salt is of special importance and can be obtained from the sodium salt by treatment with lead nitrate. (Br. Pat. 188,302; not yet accepted. H. Rathsburg, Fürth, Germany. Dec. 29, 1922.)

Absolute Alcohol—A continuous process for the production of absolute alcohol consists in mixing alcohol of 95 to 96 deg. Gay-Lussac with powdered quicklime or other suitable dehydrating agent and distilling the greater part in a continuous still, collecting the alcohol, and continuously withdrawing the remaining liquid mixture, diluting it with water and delivering it to a rectifier, where it is exhausted of its alcohol which is concentrated to 96 deg. and again subjected to dehydration. In the apparatus shown in Fig. 1 lime and alcohol are mixed in a large stirrer A and delivered by a valve B and pump C to a heater worm D and thence to a continuous still E with steam jacket F and stirrers. The alcohol is condensed in the heater D and cooler G and flows out through a testing device H. Only about three-quarters of the alcohol is thus distilled, the remaining liquor being continuously tapped off by a pipe e, diluted with water by a cock S and funnel T and delivered to a continuous exhauster KL, the lower part of which is provided with bubbling plates constructed so as to prevent incrustation with lime. The base M is heated by a steam bubbler which drives the alcohol into the upper part L of the column, where by means of a reflux N it is rectified to 96 deg. and may be withdrawn through a testing-device N^1, and returned to the apparatus for further dehydration. The calcic mud collecting at the base M is passed into an extractor Q with float q operating an exit valve R, whereby a constant level is maintained in M. In the simpler form of the apparatus shown in Fig. 2 the preliminary reaction between the alcohol and quicklime is dispensed with, the crude alcohol being delivered direct to the upper plate of the column K through a heater X heated by waste steam from the exhauster K. Pasteurized alcohol is drawn off from the column L by the pipe u to a measuring device U and thence to the still E, E^1 which carries a partition E^1 dividing the unheated portion E from the portion E^2 which is heated by the steam-jacket F. Quicklime is dropped into E in measured quantities by a rotating recessed plug tap P. It is stated that the testing device W also serves to separate any aldehyde products. If incomplete dehydration is required the pasteurized alcohol may be drawn off at U. Instead of quicklime, fused calcium chloride, anhydrous potassium carbonate, anhydrous sodium or copper sulphate or anhydrous sodium acetate may be employed (Br. Pat. 189,136; not yet accepted. Barbet et Fils et Cie., Paris. Jan. 17, 1923.)

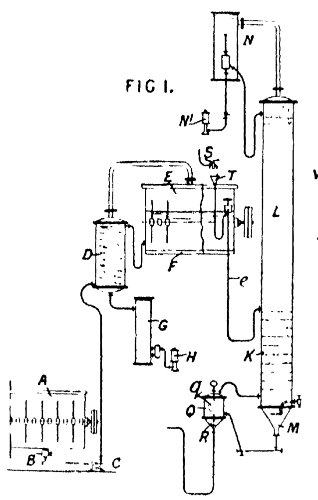


FIG. 1.

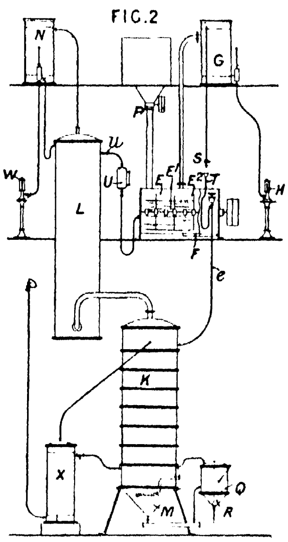


FIG. 2

Dyeing Cellulose Acetate—In the production of azo dyes on the fiber or material of cellulose acetate silk, films, etc., soluble salts are added to the baths containing the parent amines or the developers or to both; suitable salts are the chlorides of ammonium, sodium, potassium, barium, calcium, magnesium, zinc or tin, or sulphates of sodium, potassium or magnesium. Protective colloids, such as gelatine, boiled-off liquor, soaps, turkey red oils, etc., may also be added when the bases or developers are used in neutral or alkaline baths. In an example, acetate silk is first treated in a bath containing dianisidine hydrochloride, magnesium chloride and sodium bicarbonate, then passed to a diazotizing bath, followed by a developing bath containing alpha-naphthylamine hydrochloride and sodium bicarbonate, after which it passes to a second diazotizing bath and a second developing bath containing alpha-aminonaphthol, boiled-off liquor, and magnesium chloride; a black shade is obtained. Specification 176,535 is referred to. (Br. Pat. 187,964; not yet accepted. R. Clavel, Basel, Switzerland. Dec. 20, 1922.)

Dyeing—The waste liquor from aniline black dyeing in which ferrocyanide is used is treated with ferrous sulphate so that the liquor is acid or neutral, and the precipitated blue is separated. The precipitate, which is of no value as a pigment, is dissolved by treatment with an alkali, alkaline earth or ammonia a hydrate of iron being also produced. To the liquor is then added an excess of an organic or inorganic acid, or first a ferrous or ferric salt and then excess of the acid, when a blue precipitate is obtained which is a good pigment. (Br. Pat. 188,208. Bleaching and Dyeing Co., Ltd., and A. J. Hall, Congleton, Cheshire. Dec. 29, 1922.)

Carbon and Briquet Fuels—Peat, lignite, sawdust, or other carbonaceous material is preliminarily treated with a potassium or sodium salt such as carbonate, chloride, sulphate, acetate or phosphate, either by wetting the material with a solution of the salt or, if already wet, by intimately mixing with the salt dissolved in the least possible amount of water, and is then carbonized by roasting the mass on a hot plate while freely exposed to the air. According to an example, sodium carbonate or soda crystals are employed. To obtain a pure carbon the product is boiled with dilute hydrochloric acid and dried. The carbon produced may be worked up into briquets for fuel by use of a binder such as gluten, molasses or casein treated with formaldehyde. (Br. Pat. 188,807. A. M. Hart, London. Jan. 10, 1923.)

Extracting Copper, Lead and Silver Ores—Ores are treated with nitric acid of at least 40 per cent in the presence of iron or acid-soluble iron compounds equivalent to the metals other than iron in the ore, the iron nitrate produced being the effective attacking agent. After the separation of the iron hydrate, the nitrate solution may be treated with sulphuric acid to precipitate the lead and then by cementation to obtain first the silver and then the copper; or the solution after the removal of the lead and silver may be treated with sulphuric acid to obtain crystallizable sulphates which owing to their water of crystallization leave the liberated nitric acid in a concentrated state. Alternatively instead of cementation as above described the metals may be obtained by fractional electrolysis. (Br. Pat. 188,865. J. S. Wetzlar, London. Jan. 10, 1923.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Industrial Alcohol Interests Get Into Action on Drastic Restrictions

Sugar Men Turning Blackstrap Into Methanol—Senator Broussard Urges Utilization of All Available Waste

EVIDENCE is plentiful that the industrial alcohol situation rapidly is reaching a climactic stage. Prohibition enforcement officials propose more drastic regulations than those now in force. On the other hand, the chemical interests, including the sugar producers and those concerned with the expanded use of alcohol as a stove fuel and for internal combustion engine fuel, are ready to combat any more stringent regulations which tend to discourage the manufacture of industrial alcohol. More and more these interests are insisting on being relieved of the provisions of existing regulations which are throttling an industry of increasing importance.

Senator Broussard's Speech

It is understood that wide distribution is to be made of a recent speech made on the floor of the Senate by E. S. Broussard of Louisiana. Senator Broussard's principal interest in industrial alcohol springs from the sugar industry, with which he has been intimately associated all of his life. In the course of that speech, he said:

"While Australia recommends a bonus and many nations are appointing commissions to encourage the manufacture of industrial alcohol, we persist in this foolish course of prohibiting the manufacture of a commodity on the assumption that the manufacturer is a criminal and a crook and may interfere with some sumptuary measure. If we persist, we will find, within 20 years, when gasoline will be scarce, that the advances made in the internal combustion alcohol engines will have been made by foreigners, thoroughly safeguarded by patent rights."

A Crime to Discard Waste

In his address Senator Broussard contended that farm wastes should be made into alcohol. Such use should be made of surplus crops. He cited years in which farmers burned their corn as fuel because it was cheaper than coal and when millions of bushels of potatoes were allowed to rot in the field for lack of market. He pointed out a statement from the Bureau of Chemistry showing that alcohol could be made in 1922 at a cost of 6 cents a gallon from blackstrap molasses, and 7 cents a gallon from corn. "However," he said, "the hand of death was effectively laid upon such use of surplus materials by regulation No. 30, issued on Sept. 29, 1916, by the Commissioner of Internal Revenue. Although the statutes in the original form gave the right to the farmer to convert his waste products into industrial alcohol, these regulations absolutely defeat the law and make it impossible for him to do so."

In Hawaii the sugar producers long have made their own alcohol for use as motor fuel and for stove fuel. Just at this time the domestic sugar producers are taking up actively the use of their low-grade molasses in the manufacture of alcohol, due to the recent rise in the price of gasoline.

Calendar

The following important technical meetings are scheduled for the immediate future:

AMERICAN CHEMICAL SOCIETY
New Haven, Conn., April 3-7

AMERICAN ELECTROCHEMICAL SOCIETY
New York City, May 3-5

AMER SOCIETY MECHANICAL ENGRS
Montreal, May 28-31

AMERICAN FOUNDRYMEN'S ASSOCIATION
Cleveland, O., April 28-May 4

AMERICAN OIL CHEMISTS' SOCIETY
Hot Springs, Ark., April 30-May 1

SOCIETY OF INDUSTRIAL ENGINEERS
Cincinnati, O. April 18-20

SOCIETY OF CHEMICAL INDUSTRY
New York, regular meeting, March 23

SOCIETY OF CHEMICAL INDUSTRY
New York, joint meeting with other societies, April 20

Botanist Finds New Use for Aluminum Sulphate

Experiments conducted by Dr. Frederick C. Coville, a botanist of the Department of Agriculture, have developed the fact that aluminum sulphate when applied to ordinary soil is an effective and inexpensive method of changing the soil reaction from neutral or alkaline to acid. Where soils have been treated with crude aluminum sulphate marked stimulation of growth of certain plants has been noted.

To Study Chemical Tariff

Several Chemicals on List to Be Investigated in This Country and Abroad by Experts

The Tariff Commission, after reference to the President regarding its authority to proceed, has announced field investigations into seventeen commodities regarding which applications for changes in duties under the flexible tariff section of the new act have been received. Included are seven items in the chemical schedule: oxalic acid, paragraph 1, in which an increase is sought; diethyl barbituric acid and derivatives thereof, paragraph 5, increases sought; barium dioxide, paragraph 12, applications for both increase and decrease; casein, paragraph 19, increase sought; potassium chlorate, paragraph 80, applications for both increase and decrease; sodium nitrite, paragraph 83, increase sought; and logwood extract.

Investigations Abroad

Decision whether public hearings shall be held will be determined by the results of the field investigations. In any event several months must elapse before any definite results may be obtained. These investigations are to be carried on abroad as well as in this country.

Three representatives of the chemical section of the United States Tariff Commission will embark for Europe within a month to conduct investigations in connection with relative costs of production here and abroad of these chemicals. Germany, France, Switzerland and England will be visited in carrying out the study.

Personnel of Investigators

Dexter North and M. G. Donk will leave first and will remain as long as is required to complete the investigations. They will be followed by C. R. DeLong, chief of the section, who probably will remain abroad 2 months to supervise the work in Europe. On his return he will present a report to the commission regarding the changes that will be necessary. Much interest is aroused as to the outcome of the application of this flexible provision of the tariff.

Some difficulty is expected by the commission in obtaining foreign production costs in certain instances, but it has been suggested that the price level at which an imported article sold in this country over a given period could be used as a basis for comparison.

Comment on the Chemical Equipment Association

Notable Scientific, Commercial and Government Representatives See Benefit to Business

Many notable figures in chemical industry and the general world of chemical activity have recently commented approvingly on the activities of the Chemical Equipment Association. The association was formed a few months ago by leaders in equipment manufacture and now embraces a national membership of companies manufacturing essential equipment for the chemical, metallurgical and technical process industries.

Brigadier-General Amos A. Fries, chief of the Chemical Warfare Service, recently wrote to the association: "The activities of your organization, I believe, will be of great benefit to the general field of chemical industry." Charles L. Reese, chemical director of E. I. du Pont de Nemours & Co., expressed himself to the association recently as follows:

"I have no doubt that the Chemical Equipment Association can be of great value not only to the chemical equipment manufacturers but also to the chemical manufacturers. As an illustration of the co-operation between chemical manufacturers and the Chemical Equipment Association I might mention a recently appointed committee of the Manufacturing Chemists' Association for the standardization of the chemical ware forms which is to co-operate with a similar committee of the Chemical Equipment Association to bring about these standards, which will make it unnecessary for chemical manufacturers to maintain such large stocks of earthenware, glass, etc., for repairs when a great number of the equipment manufacturers hold in stock standard equipment."

A.C.S. Approves

"One of the most striking letters we have had," according to Pierce D. Schenck, president of the association, "is from the secretary of the American Chemical Society, Charles L. Parsons. Mr. Parsons has written us: 'I have watched with real interest the foundation of the Chemical Equipment Association. I believe it has a decided field for usefulness, and I am confident from the strong names that appear on your letterhead and from others whom I know to be members of your association, that it will do great good toward increasing the quantity and standardizing the design and use of chemical equipment and will be very helpful in the development of American chemical industry.' "

E. W. Washburn, chairman of the division of chemistry and chemical technology of the National Research Council, has also expressed his belief in the advantages to the chemical field as a whole that will accrue from the association, in a letter saying:

"In my opinion trade associations which cover both the producers and the consumers are in the long run likely to prove of the greatest advantage to both parties concerned. . . . The formation of these associations is an indication of great advances which the future will bring forth in the direction of co-operation between manufacturers and users and the increase of scientific knowledge which will result from the research work initiated and supported by such associations."

Malay Rubber Exports Grow Despite Drawbacks

Despite the restricting legislation of the British, rubber exports from Malay continue to grow. During January, 1923, 22,871 long tons of rubber was exported from British Malayan ports, as compared with 18,427 long tons in December, 1922, and 21,642 tons in November, the first month during which the restriction scheme was in effect, according to reports received by the Department of Commerce. The total of 62,940 tons during the 3 months may be compared with 55,257 tons during the corresponding period of 1921-1922.

Texas Engineers Stage Trip

Thirty-five junior and senior chemical engineering students of the Texas Agricultural and Mechanical College, accompanied by the head of the department, Dr. C. C. Hedges, made an interesting field trip on March 7 and 8 through Dallas plants. They inspected the Oak Cliff paper mill, the works of the East Texas Chemical Co., the Dallas sewerage disposal plant and the White Rock filtration plant. While in Dallas, the delegation attended a session of the local branch of the American Chemical Society, and later was present at a barbecue given by the Texas Portland Cement Co.

Yale to Do Silk Research

A fellowship has been established at Yale in silk research by Cheney Bros., silk manufacturers of South Manchester, Conn. This will be awarded to a graduate student who has shown special proficiency in chemistry and biochemistry and demonstrated his ability to pursue research work leading to the degree of Doctor of Philosophy. The recipient of this fellowship is to conduct research on some fundamental problem the solution of which will advance the knowledge of the chemistry of silk and substances and processes used in the silk industry.

Bauxite Again Mined in British Guiana

A considerable force of laborers has been placed at work at the mines and plant of the Demerara Bauxite Co., and it seems probable that a resumption of shipping of this material will begin shortly, according to a report to the Department of Commerce from Consul Chester W. Davis, Georgetown, British Guiana.

Olive Oil Foots Ruling Is Made Public by Treasury

Decision Makes Sulphur Olive Oil, Sulphured Olive Oil and Olive Oil Foots Duty Free

The contention between soap and oil importing interests is settled. No duty is to be levied on olive oil foots, according to the official ruling recently made public by the Treasury Department: The text of the ruling as made in the form of a letter from Assistant Secretary Moss to the Collector of the Port of New York is as follows:

The department refers to your communication of the 3d ultimo, in which you state that it is the practice at your port to pass ol've oil foots free of duty under paragraph 1632 of the tariff act as unfit for use as food or for any but mechanical or manufacturing purposes.

In view of the information supplied relating to sulphur olive oil, sulphured olive oil and olive oil foots, the department is of the opinion that the three names as used in the United States relate to one and the same article, it being an olive oil obtained by the use of a solvent known as carbon bisulphide or carbon disulphide.

Provision for Free Entry

The provision in paragraph 1632 for the free entry of olive oil rendered unfit for use as food or for any but mechanical or manufacturing purposes by such means as shall be satisfactory to the Secretary of the Treasury and under regulations to be prescribed by him, is a re-enactment of a previous provision which appeared in paragraph 639 of the tariff act of Aug. 5, 1909, and paragraph 561 of the tariff act of Oct. 3, 1913.

The department in T.D 29957 promulgated regulations in regard to the denaturing of olive oil under paragraph 639 of the tariff act of 1909, and in these regulations provided that "sulphured olive oil obtained by the extraction of olive oil from press cake by means of carbon bisulphide need not be further denatured."

In a later decision, T D. 34215, collectors were authorized to sample only 10 per cent of importations of oil invoiced as sulphured olive oil or olive oil foots or olive oil which had been rendered inedible abroad.

Provisions of Tariff

Under the provisions of the tariff acts of 1909 and 1913, above cited, merchandise known as sulphured olive oil or sulphur olive oil and olive oil foots was admitted free of duty and it must be presumed that the Congress had knowledge of the department's regulations authorizing the free entry of the merchandise under consideration, and the department is of the opinion, therefore, that its re-enactment of the provision in paragraph 1632 must be regarded as legislative sanction of the department's regulations and the practice of admitting this merchandise free of duty

In view of the foregoing, the department approves your practice of admitting free of duty sulphured or sulphur olive oil or olive oil foots under paragraph 1632 of the tariff act.

U. S. Wants Dust Engineers

Competitive civil service examinations are to be held on April 24 for assistant and associate dust explosion engineers, and on April 25 for junior dust explosion engineer. Entrance salaries will range from a minimum of $1,440 for junior engineer to a maximum of $3,000 for associate engineer. The duties of these engineers are to be in connection with investigations relative to the cause and prevention of dust explosions and resulting fires.

Full information and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or secretary of the board of U. S. civil service examiners at the post office or custom house in any city.

Government Standardizes Metal Specifications

Organized Committee Now at Work Methods Being Employed Recognize Interests of Government and Industry

The Federal Specifications Board has appointed a technical sub-committee to which is assigned the task of coordinating all existing metal specifications of the several government departments and recommending such new specifications for metals as may be required. The personnel of the committee includes representatives of various technical and supply bureaus of the Navy, War, Commerce and Interior Departments.

Existing navy, army or other government specifications when available are used as a basis for the writing of all specifications. If no existing government specifications are available, commercial specifications such as those of the American Society for Testing Materials or Society of Automotive Engineers are made use of. When possible specifications from several sources are utilized.

How Specifications Are Drawn

Umpire methods of chemical analysis are being incorporated as a part of all specifications. The standard methods of chemical analysis adopted by the American Society for Testing Materials are being used where they apply. When the latter are not available, methods are being developed by the Chemistry Division of the Bureau of Standards. Preliminary specifications are submitted to authorities in the metal industries before adoption. The interests of both the industry and the government are considered in arriving at a satisfactory specification.

Work So Far Accomplished

The specifications before the federal board at present are: Pig lead; phosphor tin; silicon copper; ingot copper; ingot tin; slab zinc; phosphor copper; steel castings; foundry pig iron; high-test gray iron castings; gray iron castings; malleable iron castings; washed metal; silver solder; spelter solder; tin lead solder; manganese bronze castings; aluminum bronze castings; welding wire, iron and steel; copper-nickel alloy castings (Monel metal).

Huston Resigns to Head Huge Oil Corporation

Assistant Secretary of Commerce C. H. Huston has resigned to accept the presidency of the World Commerce Corporation, which has applied for a federal charter.

According to Mr. Huston, the World Commerce Corporation has been organized by substantial New York and Pittsburgh business men for the purpose of exploiting both foreign and domestic oil properties. The claim is made that "half of the oil-producing lands in the world" are controlled by this corporation.

Wainwright Urges Readiness

"Organization for rapid industrial mobilization is necessary," declared retiring Assistant Secretary of War Wainwright, "if we are to be prepared for another war." He also pointed out our specific deficiencies at the present time. His idea of the problem is that of insuring, "so far as foresight may provide, that our industrial establishment and factories be prepared upon outbreak of war to turn rapidly from their peace-time tasks to the production and creation of those things that shall have the primary preference."

The Three Essentials

Roughly, there are three great elements of supply to be provided:

"1. Those things which the ordinary or current productive capacity of the country can be relied upon to furnish.

"2. Technical supplies, such as munitions and aircraft.

"3. The strategic materials—namely, those not produced in sufficient quantity within the continental limits of the United States, such as nitrate, metal alloy, tin, rubber, platinum, tungsten and the like.

"This will show that unless we actually construct in time of peace sufficient reserves of certain vital equipment and accumulate working reserves of strategic raw materials we cannot produce within the continental United States we would not be able to hold our lines during the early period of the war."

Pulped Currency Used for Paper Making

The Forest Products Laboratory at Madison, Wis., has received from the Treasury Department 150 lb of currency cut up and pulped to be deinked and made into paper. It is estimated that the sheets of pulp represented approximately $2,500,000. The first run of paper made in the laboratory resulted in a poor quality because of a high percentage of foreign particles in the bills. Later runs indicate better success in making a clean product. As 2 to 3 tons of bills per day is macerated at the Treasury Department at Washington, the reclamation of the pulp is of importance even if the product can be used only for wrapping paper.

To Take German Nitrates on Reparation Account

Official announcement has been made that Germany has begun direct negotiations with Italy regarding deliveries of nitrates on the reparation account. A statement to this effect has been sent to the Reparations Commission in reply to an invitation that Germany enter into conference relative to such deliveries to France, Belgium and Italy. Owing to the Ruhr occupation, the German Government is not in a position to make deliveries to France and Belgium, and therefore has announced that it will not send representatives to the contemplated conference.

Founders Program Announced

Aluminum Alloys, Sand Investigations and Modern Developments in Foundry Practice to Be Discussed

Arrangements for the Cleveland meeting of the American Founders Association, April 28 to May 3, are nearly complete. The sessions and talks as planned cover a wide range of subjects. Probably of most general interest to all foundrymen will be the two sessions on foundry sand investigations. The joint sand investigation committee of the A.F.A. and the National Research Council will present progress reports of investigations of methods of testing sand, reclamation investigations and of progress in securing geological surveys of the foundry sand resources of the country. A great amount of work has been done by this committee since the Rochester meeting and much information of value to the foundrymen will be presented at these sessions.

Aluminum Alloy Session a Feature

The subject of aluminum and aluminum alloys will be considered at a joint session of the A.F.A. and the A.I.M.E. The developments in this branch of the industry have been so great that the papers committee decided to continue the practice inaugurated at Rochester of devoting at least one session to papers and discussion on this subject. In addition to the usual sessions on steel and cast iron there will be a session for the discussion of the new developments in the foundry world. The electric furnace and centrifugal casting will feature in this session.

The Institution of British Foundrymen will be represented on the program by an address by Dr. Percy Longmuir, one of the world's most foremost metallurgists, who has devoted his life to improving foundry practice.

National Safety Council To Hold Winter Meeting

Handling material, dust and fume hazards and traffic safety are the three main topics on the program of the meeting of the midyear conference of the National Safety Council to be held April 17 at Chicago, Ill.

The morning session will deal with causes of accidents in handling materials, and use of conveyors and trucks in eliminating material handling accidents, followed by a general discussion of specific safety problems in material handling. George T. Fonda, chairman of the Engineering Section of the Council, will preside at the morning meeting.

Preventing dust fires and explosions, health protection against dust, and a discussion of practical methods of dust and fume removal will follow in the afternoon. Homer E. Niesz, treasurer of the National Safety Council, will preside at the banquet in the evening, at which traffic problems will be discussed.

Eyesight Council Elects Officers for Coming Year

Important Work of Conservation Being Carried On in Schools and Factories —Officers Are Announced

A campaign to eliminate economic and physical losses due to poor eyesight in schools and factories is being carried on by the Eyesight Conservation Council of America. L. W. Wallace, executive secretary of the Federated American Engineering Societies, has been re-elected president of this association. Defective vision as a source of industrial waste was revealed by the Hoover Committee on Elimination of Waste in Industry, of which Mr. Wallace was vice-chairman.

Prominent Men Directing

Associated with Mr. Wallace as members of the board of directors and of the board of councilors of the Eyesight Conservation Council, according to the announcement of the election of officers for the coming year, are several prominent engineers, including Prof. Joseph W. Roe of New York University, president of the Society of Industrial Engineers; Dr. Morton G. Lloyd, chief of the Safety Section of the U. S. Bureau of Standards and vice-president of the American Society of Safety Engineers; G. E. Sanford of West Lynn, Mass., past-president of the American Society of Safety Engineers.

Recently Elected Members

Prof. F. C. Caldwell, of the department of electrical engineering, Ohio State University, and Secretary of Labor James J. Davis are recent additions to the governing bodies of the Eyesight Conservation Council. Engineering methods will be employed by the Council in surveys which are to be conducted in schools and workshops. Guy A. Henry of New York has been re-elected general director of the Council and will actively direct the eye campaign from the Council's national headquarters in New York City.

Wisconsin Metal Men Convene

At the request of the Wisconsin Foundrymen's Association, a statewide "Metals Convention" will be held at the University of Wisconsin under the auspices of the department of mining and metallurgy of the College of Engineering. There are 320 foundry groups with 700 different foundries in the state. During the convention a large exhibit of foundry machinery and equipment will be held in the University Stock Pavilion. The Society for Steel Treating will hold a meeting at the university at the same time and will have a separate exhibit of steel-treating methods, appliances and results.

The foundrymen are planning to organize at the convention a statewide association to further co-operation among themselves and with the university for the study of their technical problems.

Boll Weevil Fight Is On

Disagreement Between Active Agencies Does Not Interfere With Progress —Purchasing Bureau Projected

Although there is continued disagreement between the two great agencies aiming at extermination of the boll weevil—namely, the American Cotton Association and the National Campaign for Boll Weevil Control—still it appears that progress is being made.

Dr. Miller Reese Hutchinson has announced the co-operation of Luther Burbank in the N.C.B.W.C. From several statements made during the past week, it appears that Dr. Hutchison is to obtain much support in his campaign. The U. S. Department of Agriculture has signified its willingness to co-operate in every possible way.

Arsenate Agency to Be Formed

M. L. Tilton is in charge of an agency designed to stabilize the market for calcium arsenate. According to the plan a central purchasing bureau is to be established in New York which will contract with various manufacturers over varying periods. This agency will in turn distribute the material so purchased to state agencies, which will be placed in operation in each of the cotton states. The central agency will be placed upon a business basis and do business at sufficient profit to cover the expense of handling the work. Any surplus remaining after the expenses have been paid will revert to the National Campaign, to be used in still further pushing the work of eradicating the boll weevil.

Estimate of Available Arsenate

The amount of arsenate available for combating the weevil this year is far in excess of last fall's estimates. It is stated by R. N. Chipman, insecticide manufacturer, that 22,500,000 lb. of calcium arsenate is in sight. He adds, however, that because of an inactive market, exhaustion of this supply is not unlikely, because manufacturers are unwilling to put difficultly available white arsenic into a form which may not sell.

Government to Use Airplanes

Besides the use of arsenic in the usual manner several other ideas have recently been advanced. One of the most interesting is that of using army planes in spraying, an idea which has met with the approval of the Secretary of Agriculture, who has stated that planes will be used in Louisiana to spray calcium arsenate over experimental fields to determine just how efficacious the treatment from the air will be.

The Department of Agriculture believes that spraying the cotton plants twice daily with calcium arsenate broken into fine particles by the force of the propellers may control the activities of the boll weevil in such a way as to make cotton raising profitable, even in infested areas.

Makes Survey of Scientific Activities in United States

National Research Council Receives Report Concerning Details of Investigations

The co-operative scientific work carried on by the Federal Government and outside agencies is the subject of a report recently submitted to the National Research Council. According to this, there are 553 agencies engaged in research work in the United States, under which more than 1,100 co-operative undertakings are involved. Of these projects approximately 66 per cent can be described as engaged in the acquisition of new knowledge through scientific investigation. The remaining projects have directed their attention to technical service, the gathering of statistics and the enforcement of regulatory measures.

Agencies at Work

In the federal agencies engaged in co-operative work are included twenty-three bureaus and independent establishments maintained by the government. The outside co-operating agencies include various branches of the state governments, municipalities and Chambers of Commerce, endowed universities, etc.

According to the available data, more than $41,000,000 has been expended during the past year in the interests of federal and outside co-operators in definitely organized scientific work for the government. Of this amount, over $14,000,000 was supplied by the federal government, the balance being given by outside agencies.

In making this investigation, the central government had as its object the provision for more adequate scientific investigation of matters of general interest from a national or a regional viewpoint, and the promotion of nation-wide movements of various kinds. In general the forms of agreement or understanding entered into among these co-operating parties are for the purpose of avoiding misunderstanding and of fostering the spirit of co-operation.

Cleveland A.C.S. Hears Slosson

The March meeting of the Cleveland Section of the American Chemical Society was held in co-operation with the Cleveland Engineering Society, Tuesday, March 20, 1923. Dr. Edwin E. Slosson addressed the meeting, to which the Cleveland Chamber of Commerce was invited, on "Chemistry Applied to Industry."

Molybdenum Source Found

A deposit of blue molybdenum ore, rare in the United States, has been discovered near Ouray, Utah. This is the largest known source in the country. A report on this ore is to be issued in the near future by Dr. F. G. Hess of the Geological Survey.

A.C.S. Spring Meeting Plans Near Completion

New Haven Accommodation Problem Being Worked Out—Details of Social Affairs Arranged

In spite of the fact that practically all available hotel rooms in New Haven have been already reserved for the week of April 2 to 7, the executive committee of the American Chemical Society has arranged through the kindness of the people of New Haven to take care of everybody who comes. The Y.M.C.A., Y.W.C.A. and Chamber of Commerce of New Haven have furnished the hotels committee a large list of private homes where rooms may be obtained for the week. To give the local committee ample time, everyone who plans to attend is requested to write as soon as possible to Dr. Ralph Langley, 84 McKinley Ave., New Haven, regarding room reservations. The committee gives assurance, however, that last-minute reservations will be provided.

Council and Reunion Dinners

The councilors' dinner on Monday night is also open to all members of the A.C.S. who purchase tickets obtainable at Byers Hall. An attractive program has been arranged including brief addresses by noted and able speakers.

The time between the close of the section meetings and the polo game on Thursday will be devoted to fraternity and alumni dinners. These "reunion" dinners should prove a very attractive feature of the meeting. All organizations or groups wishing to get together for a dinner should communicate at once with Dr. Arthur H. Smith, 84 Woodlawn St., Hamden, Conn.

As a matter of convenience it will not be necessary to arrange Pullman reservations for the return trip at the railroad station, facilities for this being provided at headquarters at Byers Hall. This service will be in charge of N. C. Magnus, whose office is located at 219 Elm St.

Metal Inquiry Proceeds

Delayed organization of the commission to investigate the gold and silver situation has resulted from the absence and illness of several of its members, including that of the proposed chairman, Senator Nicholson of Colorado.

This time will not be lost, however, as literature on the subject is being assembled and abstracted. Abstracts also are being made of the experiences of commissions and committees which have investigated monetary or precious metal questions in the past. An analysis is being made of freight rates on gold and silver ore as compared with the rates on other commodities. Other basic information is being gathered so that the commission when it meets in April will have before it in concise form the results of similar inquiries in the past and certain other data which will make possible a more intelligent determination of the scope of this investigation.

Paper Exhibition Progress Indicates Success

The list of exhibitors at the Paper Industries Exposition, which is to open at Grand Central Palace, New York, on April 9, indicates that the story of paper is to be well told. Final plans are being formed for the conventions of the T.A.P.P.I. of the A.P.P.A. and of the National Paper Trade Association, all of which fall during the week of the exposition. Government films dealing with the forestry end of pulp are to be shown, and special programs have been arranged on different days. The exhibits are to cover practically every phase of paper making from preparation of raw material to the testing of the finished products. At present the number of exhibits arranged for is approximately sixty. Of especial interest to students of the industry will be the government and Forest Products Laboratory booths.

Montana Arsenic Source To Be Developed

A development of interest has recently taken place in the production of arsenic. The district about Jardine, Mont., has long been the scene of gold mining; but the operations there have been greatly hampered by the arsenical character of the pyrites in which most of the gold values are found. It is now proposed to develop the recovery of arsenic to as large an extent as the market will warrant.

The Jardine Mining Co. has erected a reverberatory furnace with arsenic kitchens, for the purpose of roasting its concentrates and extracting arsenic. The production is 100 tons of white arsenic per month on the present scale of operations. The ores appear to be entirely free of antimony, bismuth or any other element which would interfere with the production of high-grade arsenious oxide.

The present production of this new plant will make no increase in the country's supply of arsenic, as the same amount was formerly removed at the A.S.&R. smelter in Tacoma, Wash., where the Jardine concentrates were shipped. The deposits at Jardine, however, cover a large area, most of which is yet undeveloped; and, when the investment is warranted by the demand, it is expected that the output of the Jardine property will be greatly increased.

Seeks Graduate Assistants

Dean Ketchum, of the College of Engineering, University of Illinois, announces that fellowships are available at that institution for work in engineering research. This may be undertaken in architecture, architectural engineering, ceramic engineering, chemistry, civil engineering, electrical engineering, mechanical engineering, mining engineering, municipal and sanitary engineering, physics, railway engineering and theoretical and applied mechanics.

New Jersey Chemists Hear Prominent Speakers

Brigadier-General A. A. Fries and Dr. Hugo Schlatter Address March Meeting

Growing enthusiasm was evidenced in the March 12 meeting of the New Jersey Chemical Society by the fact that the largest crowd ever turned out was on hand to hear the two speakers of the evening, Brigadier-General A. A. Fries, chief of the Chemical Warfare Service, and Dr. Hugo Schlatter, of Philadelphia.

The Artificial Silk Industry

Dr. Schlatter in his talk brought out many interesting points in regard to the artificial silk industry. He outlined its development from early days, the mechanics of the four usual methods involved in its fabrication, the chemistry of these methods and the general economics applying. He made the point that cuprammonia silk is most largely manufactured in Germany, where it was discovered; nitrocellulose silk in France, where Count de Chardonnet first made it; while viscose silk, of Anglo-English origin, is the major industry in England and the United States. In 30 years the annual consumption of artificial silk of domestic manufacture has grown to 30,000,000 lb. in the U. S.

General Fries on War Gas

Unusual moving pictures and photographs of maneuvers with gas on land, on sea and in air attended General Fries' talk on "War Gas, Past, Present and Future." The fact that the press has vastly exaggerated the deadliness and misrepresented the effects of war gases was emphasized by General Fries, who also spoke of the research now being carried on at Edgewood, where the toxic effect of various gases is being studied and new methods of manufacture are being evolved.

Demonstrates Improved Naval Stores Production

Practical, profitable methods of producing rosin, turpentine and similar naval stores are to be demonstrated by G. P. Shingler, government expert, to interested parties in the South during the next 6 weeks. Mr. Shingler will confer with individual producers who may need and desire his advice, assistance and suggestions regarding improvements in operation.

Headquarters at Savannah and New Orleans

Mr. Shingler will have his headquarters during the remainder of March in the U. S. Custom House, New Orleans, La., and during the month of April in the U. S. Custom House at Savannah, Ga. It is suggested that producers desiring to confer with Mr. Shingler write to him in order that arrangements can be made for a conference either at his headquarters in one of those cities or at the place of the producer.

Salesmen Hold Alkali Dinner

Caustic Remarks Not in Evidence at Regular Monthly Program—Roth and French Give Talks

The New York Section of the National Association of Chemical Salesmen held a most successful dinner at the Chemists' Club on March 14. There was plenty of enthusiasm and at the same time an increased evidence of seriousness of purpose and constructive thought. On behalf of the members of the association who attended the lectures given by Dr. F. E. Breithut on chemistry, Mr. Ashbridge presented him with $70 in gold. Dr. Breithut replied felicitously and announced that if the members of the association were interested in pursuing the work next year, he would be glad to arrange it.

With Mr. Dorland as master of ceremonies, Mr. Boyer, the national association president, and Edward Signor were introduced. Both of these men discussed the problems that confront the association and offered suggestions as to the necessary work.

Charles Roth, of the International Exposition Co., spoke on the policy of his company with reference to the Chemical Exposition. He earnestly requested the members to make definite criticisms. The exposition could be successful only if it was representative of all phases of chemical industry and supported by everyone.

E. P. Finch, of the Alkali Export Association, reported a very interesting change in the attitude of the South American countries toward American heavy chemicals. From suspicion and even hostility, they have changed to a receptiveness and even an eagerness to deal with us.

France Lifts Double Duty

More than $30,000,000 worth of goods purchased by the Allies in the Ruhr previous to French occupation are released from the additional duty of 10 per cent which has been imposed. Chemicals, textiles, dyestuffs, steel and machinery which have been held because of the exporters' refusal to pay the double duty imposed will begin to move again if the French official action of release takes its expected effect. Traffic conditions in the Ruhr for these goods are reported by the French as being favorable. Contracts involving unfinished goods, however, are not subject to this tax-exempt ruling, it is understood.

Dust Hazards Report Coming

A report covering the work of the dust explosion hazards committee of the National Fire Protection Association is about to be issued. This will cover tentative regulations for the installation and use of grinding and pulverizing systems for sugar; for the installation and use of pulverizing fuel systems, and for the prevention of dust explosions in terminal grain elevators.

Export Association to Handle Rubber Commodities

Papers have been filed with the Federal Trade Commission for the formation of a rubber export association. This organization, which will include the United States Rubber Export Co., the Goodyear Tire & Rubber Export Co., and the Miller Rubber Export Co., will not be incorporated, however, but will operate along mutual lines in exporting manufactures of rubber and commodities of the rubber industry.

The three companies, it was stated, will use their own individuality and trademarks, but will probably maintain joint offices abroad, with a single sales force. J. B. Tower, of New York, has been named secretary.

Rubber Trouble Continues

Varying Viewpoints Advanced by American and British Interests Concerning Solution

The controversy over the rubber situation grows. Despite unofficial American protest, the British viewpoint, as voiced by such men as Winston Churchill, defends the Stevenson plan. This plan, providing for reduced production of raw rubber in Malay, is aimed to bring up the selling price of rubber to cover production costs. Consumers in the United States believe, however, that Britain is taking unnecessary means of bringing about this end.

The directors of the Rubber Association of America have made the following recommendations to the Rubber Growers Association of London:

"1. That the Stevenson plan for the restriction of crude rubber exports from British Dominions be abolished in its entirety, this recommendation being predicated upon the firm belief that the natural conditions of supply and demand now existing will fully protect the plantation industry.

"2. A request for immediate consideration by the Colonial Government's advisory committee, of which Sir J. Stevenson is the head, of the announcement by the British colonial or the local colonial governments that it use its discretionary powers with respect to the application of this scheme and release rubber without regard to quarterly periods or prices if necessary to prevent wild fluctuations as part of a speculative movement."

Government Action Advocated by Firestone

The group of American rubber men led by Harvey Firestone believes that government action in the matter is desirable. It is now certain that a survey of possible new sources of rubber for United States consumption is to be made. Secretary Hoover has invited the various rubber interests to co-operate with the government in organizing this work. The Philippines and Amazon Valley are considered to be the best fields for investigation.

Paint Men Make Known Activities of Association

G. B. Heckel, Secretary, Shows Facts of Case and Claims No Need of Vindication

From a recent statement of G. B. Heckel, secretary, the public obtains a clear-cut outline of the activities of the Paint Manufacturers Association, which for the past 2 years has undergone investigation by the government and against which, as was stated in *Chem. & Met.* last week, no charges have been sustained.

The statement says in part:

The last thing our organization has ever contemplated was control of prices. Our organization devotes itself to the improvement of the paint industry and the correction of evil practices, such as misbranding, mislabeling, unfair competition and bribery. Among our activities we conduct a research laboratory at Washington, at the cost of $50,000 a year; an unfair competition bureau at Washington, at a cost of $15,000 a year, and a "Save the Surface" campaign, with headquarters in Philadelphia, which is for the creation of greater demand for paint and kindred products, and which costs $200,000 annually All of these agencies for the benefit of the paint business are open to paint manufacturers of the country whether they are members of the association or not

In view of these activities for the general good of the business it is hard to understand how there can be any machinery for price fixing. The Sherman act is a very ill-defined law which may be unknowingly violated by the most innocent. However, it would not require an indictment to induce an association like that of the paint manufacturers to correct any tendencies which might have existed toward its violation. As a matter of fact, the association has carefully followed the interpretations of the Sherman law with a view to avoiding any possible infraction. It will continue this policy in the future.

Food Standards Discussed

The Joint Committee on Definitions and Standards held its twenty-fourth meeting in the Bureau of Chemistry, March 12 to 16. Consideration was given to definitions and standards for a number of food products. The committee is composed of Dr. W. W. Skinner, chairman; Dr. F. C. Blanck, and R. E. Doolittle, representing the United States Department of Agriculture; Dr. J. Hortvet, of Minnesota, Dr. C. D. Howard, of New Hampshire, and Dr. E. M. Bailey, of Connecticut, representing the Association of Official Agricultural Chemists; Dr. L. E. Sayre, of Kansas, Dr. W. W. Randall, of Maryland, and Dr. R. E. Rose, of Florida, representing the Association of American Dairy, Food and Drug Officials.

Sulphur Agreement Framed

According to dispatches from Rome the Sulphur Export Association has signed an agreement with representatives of the Italian Government, regarding the control of sulphur sales in Europe. Under it the Italian Government will control the output of the Sicilian beds and will co-operate with the three leading American producers, the Union Sulphur Company, the Texas Gulf Sulphur Company and the Freeport Texas Company in meeting European demands.

Personal

H. E. BARNARD, director of the American Institute of Baking, was in New York, March 10 and 11, to attend the formal opening of the laboratory of the Fleischmann Co.

Colonel LEWIS T. BRYANT has been reappointed State Commissioner of Labor, New Jersey, by Governor Silzer, for a new term of 5 years.

E. J. CUTHBERT, formerly vice-president of the Solar Refining Co., Lima, Ohio, manufacturer of refined oils, has been elected president of the company to succeed J. G. NUBAUER, resigned. N. D. KEYS, heretofore general superintendent, has been appointed secretary and treasurer, succeeding F. G. BORGES, who has been elected vice-president.

P. M. DINKINS, formerly of the Dorr Co., has been made sales manager of the division of heavy chemicals with the Kalbfleisch Corporation, New York City.

General AMOS A. FRIES, head of the Chemical Welfare Service, has discussed the work of this bureau in two recent addresses, one before the New Jersey Chemical Society and the other before the Phi Lambda Epsilon fraternity, Columbia University.

W. S. FRISBIE, Office of Co-operation, Bureau of Chemistry, is conferring with the New Jersey and Delaware state and city officials on the co-operative enforcement of state and federal food and drug laws.

HERBERT S. HARNED, assistant professor of physical chemistry, University of Pennsylvania, Philadelphia, spoke before the Franklin Institute, March 15, on "Radiation and Chemical Reaction."

B. OLNEY HOUGH, for many years editor of the *American Exporter*, has resigned that position to establish himself as an expert counselor, consultant and adviser to banks, exporters and manufacturers. His office is at 17 Battery Place, New York City. He will continue his relations with the *American Exporter*, with the title of contributing editor.

Dr. SABASTIAN KARRER, of the Fixed Nitrogen Research Laboratory, addressed the meeting of the American Physical Society recently on subjects of thermal and electrical ionization as related to problems of nitrogen fixation.

WALLACE MONTGOMERY has been made superintendent of the Central Moron of the Eastern Cuba Sugar Corporation. For some time past he has been assistant superintendent.

A. H. NICKERSON, who since 1904 has been with the American Agricultural Chemical Co., has resigned to accept a position with Stone & Webster, Inc., in the mechanical division. Mr. Nickerson started with the former company as chief engineer, holding that position until 1921, when he was made manager of the manufacturing department.

R. B. MOORE, chief chemist of the Bureau of Mines, has accepted an invitation to deliver an address before the New York Section of the Société de Chimie Industrielle of France, on the occasion of the meeting to be held on May 11.

R. J. QUINN has been transferred to New York City as assistant sales manager of the Mathieson Alkali Works, Inc. JOHN W. BOYER, formerly assistant sales manager, becomes sales manager, and J. A. KIENLE, former sales manager, is now vice-president in charge of sales.

PAUL C. SCHRAPS, of the South American Development Co., sailed March 5 from San Francisco for Ecuador, South America.

A. D. SHAMEL, Bureau of Plant Industry, sailed from San Francisco, Feb. 17, for Honolulu, where for several months, while on furlough, he will continue the work begun in 1920 under the auspices of the experiment station of the Hawaiian Sugar Planters' Association in the application of the principles of the improvement of plants through bud selection to the propagation of sugar cane. Mr. Shamel has spent several months each winter since this work was begun in Hawaii developing it. Through the selection of propogating material a large increase in the yield of sugar has been obtained. While absent in Hawaii Mr. Shamel will further develop the selection work with sugar cane and will endeavor to perfect the methods and to extend their application to the entire sugar industry of the islands.

J. THOMPSON SMITH, at the annual meeting of the stockholders of E. I. du Pont de Nemours & Co., was made general manager of the company's explosives department to succeed the late Charles A. Patterson.

Dr. F. P. VEITCH, chemist in charge of the leather and paper laboratory, Bureau of Chemistry, has been appointed a member of the paper specifications committee of the joint committee on printing, which will prepare standard specifications and samples of paper suitable for the government printing and binding.

JAMES A. WATSON, assistant in the experimental work incidental to the introduction of the Allen process at the du Pont Nitrate Co.'s oficina, in Taltal, Chile, in 1920, and since in charge of the plant, has been appointed assistant manager.

Dr. E. R. WEIDLEIN, director of Mellon Institute, Pittsburgh, Pa., spoke before the members of the Hercules Powder Co., Wilmington, Del., March 5, on the subject "Value of Industrial Scientific Research." The meeting was held at the Trinity Parish House and members of the Delaware Section of the American Chemical Society were invited to attend.

Obituary

Prof. EDWARD WILLIAMS MORLEY died at Hartford, Conn., on Feb. 24. He was probably most widely known for his association with Prof. A. A. Michaelson in the far-famed Michaelson-Morley experiment in relation to the velocity of light. For this work he received the Sir Humphry Davy medal in Great Britain in 1907, while Professor Michaelson received the Nobel prize the same year. There are, however, many other records of major research which stand to Professor Morley's credit. His work on the densities of oxygen and hydrogen in the ratio of their atomic weights was a classic contribution to scientific knowledge, and about forty more papers of profound scholarship and of leading importance were published by him. These included repetition of the Michaelson-Morley experiment in view of the Lorentz-Fitzgerald suggestion that the form of bodies may depend on translation through space or through luminiferous ether. Other contributions were on the atomic weight of oxygen, on variations of the amount of oxygen in the air, the vapor density of mercury from 0 to 100 deg., etc.

He was president of the American Association for the Advancement of Science in 1895, and of the American Chemical Society in 1899. He was honorary chairman of the Eighth International Congress of Applied Chemistry at New York in 1912, and had been made honorary chairman of the spring meeting of the American Chemical Society that convenes at New Haven next month. In 1912 he received the Elliot Cressom medal, and in 1917 the Willard Gibbs medal was awarded to him.

Professor Morley was the son of a clergyman, and was born at Newark, N. J., Jan. 21, 1838. He was graduated at Williams College and later received honorary degrees from Yale, Lafayette and the University of Pittsburgh. In 1868 he was appointed professor of chemistry at the Western Reserve University at Cleveland, and held the post for 38 years, until his retirement in 1906. He then took up his residence at West Hartford, Conn., where he had lived with his parents as a boy.

He was married to Isabella Ashley Birdsall in 1868, whose demise preceded his by only 3 months. Immediately after her death he made a gift of $5,000 to the First Church of Christ of West Hartford in her memory, and, later he underwent a major operation at the Hartford Hospital from which he did not recover.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

Problem of Maintaining Standard Prices

New Legislation Needed to Clear Up Uncertainties in Important Business Practice

One of the weighty problems facing the manufacturer is the policy of maintaining standard prices for the retail sale of his products. Can he refuse to sell to a retailer or jobber who markets his products at prices lower than the standard schedules set by the producer? Can a manufacturer decide to market his products solely through wholesale channels and then in order to maintain this policy, refuse to sell to a retailer at the jobber's price no matter what the quantity of merchandise involved? These are the questions that have been involved recently in some very important litigation - the Colgate and Beech-Nut cases before the Supreme Court and the Mennen case just decided by the United States Court of Appeals for the Second District.

These decisions, however, do not eliminate the element of uncertainty, for they do not tell the manufacturer just how far he can go in naming his own prices and thus protecting his own property. It is believed by many that the situation will not be cleared until there is definite legislation recognizing the principle of price standardization.

Proposed Legislation

When the last Congress adjourned two bills were pending that were designed to meet this situation. One of them is the Kelly-Stephens bill, originally drawn by Justice Brandeis before he became a member of the Supreme Court, and the other is the Merritt bill, introduced by Representative Merritt of Connecticut, which contains suggestions from Secretary of Commerce Hoover.

The Kelly-Stephens bill would set up machinery for price standardization to permit any independent manufacturer of a standard, identified article to file a schedule of his prices with the Federal Trade Commission. He would have authority to maintain the retail prices of his article or articles, but under section 3 of the bill the Federal Trade Commission may, on complaint of any person, investigate the standard prices so fixed to determine if they are fair. Under another section of the bill a retailer handling the standard price articles would be required to offer them for sale to the manufacturer at the price he paid for them before he would be permitted to offer them for sale to the public at prices lower than the standard fixed prices.

The Merritt bill is more simple and is confined largely to legalizing the principle of price standardization. It would permit the producer or manufacturer to fix his price and to refuse to sell to any dealer who cuts the fixed price. It provides no machinery, but if enacted into law would be rather an expression by Congress of recognition of the principle of price standardization and maintenance.

No Evidence of Price Fixing on Calcium Arsenate

Report of Federal Trade Commission Shows No Cases of Unfair Trade Practices

In its preliminary report on the calcium arsenate industry, made in pursuance to Senate Resolution 417, the Federal Trade Commission reaches the conclusion that "the evidence thus far obtained does not show that the prices (of calcium arsenate) were fixed by agreement." In the commission's detailed report a great deal of correspondence among the different manufacturers is cited and competitive conditions have been carefully analyzed. Although the producers have made a close co-operative study of prices and have discussed them at various meetings of their trade associations, there was no evidence of unfair practices such as price fixing and open-price activities.

From the facts assembled in this preliminary report, the commission submits the following conclusions:

1. That the great increase in the Southern demand for calcium arsenate and the inadequacy of the available supply of white arsenic prevented the insecticide manufacturers from producing sufficient quantities of calcium arsenate to meet this demand, the result being a marked increase in the price of white arsenic and of calcium arsenate during the seasons of 1922 and 1923.

2 The low price paid in the State of Georgia during the term of the Sherwin-Williams contract with that state was in part, at least, responsible for the opinion that an injustice was being done by the insecticide manufacturers to those customers outside the state who were paying a price as high in some cases as 100 per cent greater than that named in the above-mentioned contract, an opinion which was shared by the Georgia consumers after the expiration of this contract, when they likewise had to pay similarly high prices for calcium arsenate.

3 While efforts were made by the insecticide manufacturers to establish an association one of the objects of which seems to have been adjusting or at least discussion of price discrepancies, it does not appear that these efforts resulted in price fixing or open-price activities

4. No widespread or important specific cases of unfair practices in the trade have been found down to the present stage of the inquiry.

Fixing Standards for Naval Stores

Details of Harrison Bill to Establish Grades and Prevent Unfair Practices

During the session of Congress that ended on March 4 there was considerable discussion of naval stores, both as regards co-operative marketing and in the standardization of the many grades and varieties of these products. The Harrison bill, which passed the Senate but was not acted upon by the House, provided the establishment of standard grades of naval stores and also would make unlawful any untruthful representations in the sale or advertising of rosin and turpentine.

The various grades of rosin, from highest to lowest, are to be designated by the letters X, WW, WG, N, M, K, I, H, G F, E, D and B, together with the designation "gum rosin" or "wood rosin."

Turpentines were defined thus:

"(B) Spirits of turpentine" includes gum spirits of turpentine and wood turpentine.

"(C) Gum spirits of turpentine" means spirits of turpentine made from gum (oleoresin) from a living tree

"(D) Wood turpentine" includes steam-distilled wood turpentine and destructively distilled wood turpentine

"(E) Steam-distilled wood turpentine" means wood turpentine distilled with steam from the oleoresin within or extracted from the wood

"(F) Destructively distilled wood turpentine" means wood turpentine obtained in the destructive distillation of the wood.

Fines not exceeding $5,000 and 1 year imprisonment are provided for the "use in commerce of any false, misleading, or deceitful means or practice in the sale of naval stores or anything offered as such."

Upon application, the Secretary of Agriculture would be required to make an analysis of any naval stores and certify as to their classification.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	179.51
Last week	176.76
March, 1922	156.00
March, 1921	157 00
March, 1920	252.00
April 1918 (high)	286 00
April, 1921 (low)	140.00

A marked increase in the index number this week can be traced to the stronger markets for ammonium sulphate, cottonseed and linseed oils. Ammonium sulphate advanced to $4.15 per 100 lb., cottonseed oil to 10.5c. per lb. and linseed oil to 99c. per gal.

A. S. & R. Wipes Out Deficit

The annual report of the American Smelting & Refining Co. shows that the company's net income in 1922 after providing for general expenses, depreciation, etc., taxes and interest amounted to $5,918,142.94, an increase of $4,207,201.83 over the preceding year. After payments of dividends on preferred stock, there was a surplus of income of $2,003,112.94 at the end of 1922, compared to a deficit of $2,457,102.64 at the close of 1921. The surplus disclosed by the report is equal to earnings of approximately $3.28 on the common stock.

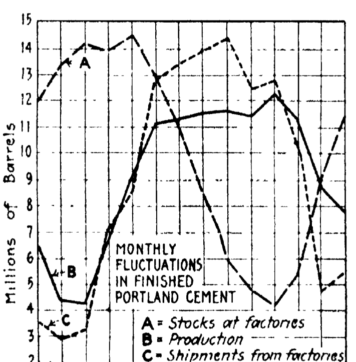
As an incident in the letter of the president of the company it is reported that the production of various important metals and the output of byproducts also showed marked improvement in 1922 over 1921 as follows:

	1922	1921
Copper (lb.)	433,548,000	348,888,000
Silver (oz.)	84,793,931	75,354,443
Lead (ton)	252,898	207,612
Spelter (lb.)	35,140,000	14,628,614
Sulphuric acid (lb.)	28,494,000	9,952,000
Arsenic (lb.)	11,203,052	5,155,522
Byproduct metals (lb.)	12,710,577	5,232,48

The report also shows that the production of some of the above, notably spelter, sulphuric acid and arsenic and the output of byproduct metals, last year greatly exceeded their production in 1913.

Cement Production Twice That of Year Ago

Preliminary figures just announced by the Bureau of the Census indicate that the output of portland cement during February, 1923, was almost double that of February a year ago. The total of 8,085,000 bbl. is an increase of 381,000 bbl. over the preceding month.



CEMENT OUTPUT, SHIPMENTS AND STOCKS

Shipments in February totaled 5,963,000 bbl. and stocks on hand at the end of the month were 13,592,000 bbl. These may be compared with the corresponding figures for last year by means of the accompanying chart showing the monthly fluctuations in production, shipments and mill stocks throughout the country, Dec. 1, 1921, to Jan. 31, 1923.

Ammonium Sulphate Advanced by Producers in a Moderately Active Market

Difficulty in Locating Imported Goods Is Still Evident—Alkali Sales Show Improvement—Vegetable Oils Are Advanced

NEW YORK, March 19, 1923.

THE chemical market during the past week continued along moderately active lines. Sales were in most instances for small orders for immediate requirements and buyers seemed quite cautious about purchasing any surplus stocks. Existing conditions in the Ruhr district have caused a noticeable shortage of importations and several items have already been advanced by second hands. Producers of ammonium sulphate advanced prices for bulk goods at the works. Spot goods for export were also sharply advanced due to the acute scarcity of any large supplies. The alkali market showed a slight improvement and several fair-sized contracts were placed for Japan and Italy. Soda ash also recorded a fractional gain. Permanganate of potash was sharply advanced during the early part of the week, but reacted later and quotations were at the same level as previously reported.

Barium carbonate and chloride were advanced by importers, due to the shortage of shipments. Arsenic continued without any special feature and prices were unchanged. Bleaching powder producers reported a favorable market, with demand up to all expectations. Carbonate of potash was much firmer, although prices remained quotably unchanged. Caustic potash was rather unsteady and dealers were quite anxious to shade on actual business. Copper sulphate was in fair demand and producers reported an active call from the agricultural districts. Yellow prussiate of soda, formaldehyde, oxalic acid, cyanide of soda and bichromate of soda and potash continued without any notable changes.

Principal Price Changes

Alcohol—Producers reported a fair business for denatured alcohol and methanol. Second hands quoted rather low on several odd lots, but the general range for methanol 95 per cent in barrels was around $1.23 per gal. Denatured No. 1 was quoted at 38c. per gal.

Ammonium Sulphate—Leading dealers announced an advance on spot material for export. Quotations ranged around $4.15@$4.25 per 100 lb. f.a.s. for prompt shipment. Bulk material at the works was also advanced, with prices around $3.30@$3.40 per 100 lb.

Arsenic—Importers were rather unsteady and quoted fractionally lower prices on actual business. Buyers were not anxious to purchase in quantity lots at present levels and the general tone was only moderate. Quotations ranged around 15@15½c. per lb.

Barium Chloride—Importers advanced spot prices, due to the unsettled conditions abroad and the scarcity of importations. Quotations ranged around $90@$95 per ton.

Copper Sulphate — Producers reported a moderate business to the insecticide industries, with quotations at former levels. Prices range around $6.40 for 100 lb. for regular crystals.

Formaldehyde—Dealers quoted much under producers' prices, due to the unsteady consuming demand. Resale lots were around the market at 15c. per lb. Manufacturers quoted 16@16½c. per lb.

Caustic Potash—Imported material was somewhat lower on spot. Quotations were heard around 8c. per lb. on spot, with shipments at 8½c. c.i.f. N. Y., duty paid. Demand has fallen off considerably.

Carbonate of Potash — Importers were quite firm on spot material and although prices showed no material advances, round lots were very difficult to purchase at the regular quotations. The 80-85 per cent calcined held at 5¾@6c. per lb., with 96-98 per cent at 7½@8c. per lb.

Caustic Soda—The general demand continued quite steady among exporters and quotations for standard goods held around $3.45@$3.50 per 100 lb. f.a.s. Domestic traders reported a very steady market at $3.75 per 100 lb. ex-store. Contracts remained quotably unchanged.

Prussiate of Soda—Dealers were somewhat higher in their views, although actual business was not of any large dimensions. Spot stocks have been diminishing and prices ranged around 19@19½c. per lb. Shipments were around 18@18½c. per lb.

Sodium Sulphide—Spot quotations have been fractionally advanced by leading dealers. Imports have not been coming in at the rate previously noted and surplus stocks are gradually diminishing. Spot prices range around 4¼@4½c. per lb.

Phenol—Producers continued to report a well sold up condition at the works and second hands were not eager to quote any round lots. Some quotations were heard during the week at 50c. per lb. in drums.

Vegetable Oils Advanced

Linseed Oil—Several crushers announced an advance of 3c. per gal. on spot and nearby oil. There were some dealers, however, that continued to quote former levels. Quotations ranged around $1.01 per gal. in barrels for nearby shipments; 98c. per gal. for May shipments and 95@96c. per gal. for June.

Cottonseed Oil—Crude oil at the mills recorded a new advance, with quotations heard at 10¾c. per lb., tank cars, f.o.b. mill. The demand has only been moderate at the present high levels.

Improved Demand Noted in Chicago Market

Firmer Prices Generally Reported—Heavy Buying Would Cause Shortage

CHICAGO, ILL., Mar. 17, 1923.

The demand for heavy chemicals has improved considerably during the past few days and it is reported that while business was not up to desired levels it was far from dull. In regard to prices, practically all items were firm. Potash compounds in particular were exceptionally firm and nearly the entire list showed advances. So far only a few items are really scarce on spot, but even a short period of heavy buying would without a doubt create a shortage in the local market that would force prices to higher levels.

There was a better demand for alkalis during the past week and the market was firm. *Caustic soda* was quoted from spot stock at $3.50 per 100 lb. for the solid 76 per cent material and $4.15 for the ground or flake. *Caustic potash* was very firm, with the general asking price for small or moderate lots 8½@9c. per lb. basis 88-92 per cent. *Soda ash* was in good demand and the 58 per cent light was quoted at $2.25@$2.30 per 100 lb. in barrels.

Alum Demand Satisfactory

Potash alum was in moderate supply and the demand was satisfactory, according to the principal dealers. The iron-free lump was quoted at 4½@5c. per lb. and the powder of a similar grade at 7½@8c. A much better price on the powdered grade could have been had for prompt shipment from the East. *Ammonium chloride*, white granular, was in fair demand and domestic material was available at 8c. per lb. and foreign at 7¾c. *Ammonium carbonate* was quiet, with only small lots available for immediate delivery. The general quoted price was 10½c. per lb., although it was possible to shade this fractionally in some directions. *Barium carbonate* was easy and it was possible to secure supplies at $85 per ton. *Barium chloride* was unchanged in price, with small quantities held for 5½c. per lb. *Carbon tetrachloride* was quiet, with nearly all dealers quoting 9½c. per lb. for large drums. *Carbon bisulphide* was in a similar position and supplies were available at 7@7½c. per lb. *Copper sulphate* was firm with an advance expected. The spot price for small or moderate lots was 6½@6¾c. per lb. *Furfural* was unchanged at 25c. per lb. *Formaldehyde* was quiet, with only small lots moving, and the price was unchanged at 16@16½c. per lb. *Glycerine* was unchanged at 18½c. per lb. for c.p. material in drums.

Phosphoric anhydride was weaker and it was possible to secure supplies at 33c. per lb. in case lots of 1-lb. tins. *Potassium bichromate* was quite firm with most factors holding the price at 13c. per lb. *Soda bichromate* was not so firm and it was possible to do 8½@9c. per lb. for moderate lots. *Potassium chlorate* was firm with only very small lots available on spot at 9½@10c. per lb. *Yellow prussiate of potash* was scarce and spot supplies were held at 41@42c. per lb. The *red prussiate* was not so firm and several factors were willing to take 85c. per lb. for a moderate lot. *Potassium permanganate* was scarce and 22@23c. per lb. for U.S.P. crystals was the best price noted. *Potassium nitrate* was slow, although the spot price was firm at 7½c. per lb. for the imported granular.

Linseed Oil and Turpentine Sluggish

Turpentine was still in poor demand and the price was somewhat lower than that of a week ago. At the close of today's market it was possible to get single drums at $1.47 per gal.

Linseed oil was in a position similar to that of turpentine and the market was a quiet affair. Single drums of the boiled oil were quoted today at $1.05 per gal. and the raw in like quantities at $1.03.

Labor Shortage Limits Steel Industry

Record Production Is Being Adequately Handled by Improved Transportation Facilities

PITTSBURGH, March 16, 1923.

The steel industry is functioning very well as to production. There are no strikes and no disability from transportation. Operation of some units is prevented by labor scarcity, but there is more employment than at any previous time in this movement.

The Steel Corporation's unfilled obligations stood at 7,283,989 tons at the end of February, indicating an increase of 373,213 tons during the month, the largest monthly increase since last September. The February increase represented about 29 per cent of the month's capacity, and taking shipments at 88 per cent, the bookings appear to have been 117 per cent, against 97 per cent in January and 73 per cent in December. The figures are not indicative of the trade current as a whole. In December the independents had relatively lean order books, and inquiry was chiefly for early delivery, the independents accordingly booking the larger part of the business going.

Generally speaking, independents are not booking business for shipment beyond July 1, for a variety of reasons. They are uncertain as to costs and market prices that may rule later, and they are doubtful whether buyers really know at this time what they will need in third quarter. The Steel Corporation's far forward bookings are chiefly in steel for construction jobs, involving little if any uncertainty as to the steel being required.

The turnover in the steel market, on the whole, is lighter. There is much inquiry, but a great deal of the inquiry is not considered by mills. There are now some developments along the line of work being postponed on account of prices, with particular reference to some tentative car buying by Western roads and a building here and there. The tonnage involved is not large, but the trend is significant. There have been practically no developments in the past week indicating that actual consumption will be heavier in the spring and summer than was to be estimated on the basis of conditions as previously known.

Premiums and Prices

Basis prices for finished steel products have not advanced in the past 2 or 3 weeks, and further general advances are improbable. Premiums for delivery may develop, but there is distinct doubt whether the premium market will be large in point of tonnage. There is premium business being done now, but it covers only an almost insignificant tonnage. Bars, shapes and plates remain at 2.25c. as the general basis, with $2 a ton more paid sometimes, and occasionally as much as $7 on plates.

Steel mills having regular customers in sheet bars will make a price of $42.50 for the second quarter, involving a large tonnage. A few consumers have no regular source of supply, and some with regular sources of supply may require extra tonnages. On such business $45 or more will probably have to be paid, there having already been $45 business done on both sheet bars and slabs. Sheet bars are thus quotable at $42.50@$45 and slabs and billets at $45.

Pig Iron and Coke

The buying movement in Connellsville furnace coke for second quarter is now practically ended, with the larger operators well sold up and with substantially all the operating furnaces, such as use purchased Connellsville coke, well covered, together with most of the idle furnaces that are at all likely to get into blast. The business totaled a trifle over 300,000 tons a month. Most of the buying was at $7, with $7.25 done on much of the later business, making an average for the whole tonnage of nearly $7.10.

Basic iron at valley furnaces has followed the advance in foundry iron reported a week ago, from $28.50 to $30, and as was the case with foundry it appears there were no sales at intermediate prices. Bessemer has advanced $1, to $30, so that the three prominent grades are all quotable at the moment at $30 valley. Furnaces are looking for higher prices, however, and some producers are out of the market. Within a week prices may be $1 or $2 higher. The furnaces seem to be comfortably sold for second quarter and it remains to be seen how well consumption is covered. There is no interest thus far in third quarter.

In all probability Lake Superior iron ore prices will be 50c. higher for the coming season, making Mesabi non-bessemer $5.55 f.o.b. dock. Such an advance, moreover, would restore the 1921 schedule and leave prices $1 below those of 1920, the modern high record.

Current Prices in the New York Market

FOR CHEMICALS, OILS AND ALLIED PRODUCTS

Although these prices are for the spot market in New York City, a special effort has been made to report the American manufacturer's quotations whenever available. In many instances these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported and resale stocks are reported when of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb.	$0 36 –	$0 38
Acetone, drums	lb.	22	23
Acid, acetic, 28%, bbl	100 lb.	3 15 –	3 40
Acetic, 56%, bbl	100 lb	6 25 –	6 50
Glacial, 99½%, carboys.	100 lb.	12 00 –	12 50
Boric, crystals, bbl	lb.	.11½	11¾
Boric, powder, bbl	lb.	.11 –	11½
Citric, kegs	lb.	.49 –	.50
Formic, 85%	lb.	.15 –	17
Gallic, tech	lb.	.45 –	50
Hydrochloric, 18° tanks, 100	lb.	.90 –	1 00
Hydrofluoric, 52%, carboys	lb.	.12 –	.12½
Lactic, 44%, tech., light, bbl	lb.	.11½–	12
22% tech, light, bbl	lb	05½–	06
Muriatic, 20°, tanks, 100	lb.	1 00 –	1 10
Nitric, 36°, carboys	lb	.04½–	05
Nitric, 42°, carboys	lb.	06 –	06½
Oleum, 20%, tanks	ton	17.00 –	18 00
Oxalic, crystals, bbl	lb.	.12½	13
Phosphoric, 50% carboys	lb.	08	09
Pyrogallic, resublimed	lb.	1 50 –	1 60
Sulphuric, 60°, tanks	ton	9 00 –	10 00
Sulphuric, 60°, drums.	ton	12 00 –	14 00
Sulphuric, 66°, tanks	ton	14 50 –	15 00
Sulphuric, 66° drums	ton	19 00 –	20 00
Tannic, U S P, bbl	lb	65 –	70
Tannic, tech, bbl.	lb.	.40 –	45
Tartaric, imp. crys, bbl	lb.	.30½–	31
Tartaric, imp, powd, bbl.	lb	31 –	32
Tartaric, domestic, bbl	lb.	–	32
Tungstic, per lb	lb.	1 00 –	1 20
Alcohol, butyl, drums, f o b Terre Haute.	lb.	.27 –	29
Alcohol ethyl (Cologne spirit), bbl	gal.	4.75 –	4.95
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 188 proof No. 1	gal.	38 –	40
Alum, ammonia, lump, bbl	lb.	03½–	03¾
Potash, lump, bbl	lb	03 –	03½
Chrome, lump, potash, bbl	lb	05¼ –	05½
Aluminum sulphate, com, bags	100 lb.	1 50 –	1 65
Iron free bags	lb	02¼–	.02½
Aqua ammonia, 26°, drums	lb.	06½–	07¼
Ammonia, anhydrous, cyl	lb.	.30 –	.30½
Ammonium carbonate, powd casks, imported	lb.	09½–	10
Ammonium carbonate, powd domestic, bbl	lb.	.13 –	.14
Ammonium nitrate, tech, casks	lb	10	11
Amyl acetate tech, drums	gal	2 80 –	3 05
Arsenic, white, powd, bbl	lb.	15 –	15½
Arsenic, red, powd, kegs	lb	12½–	13
Barium carbonate, bbl	ton	78 00 –	80 00
Barium chloride, bbl	ton	90 00 –	95 00
Barium dioxide, drums	lb.	18 –	18½
Barium nitrate, casks		08 –	08½
Barium sulphate, bbl	lb	04 –	04¼
Blanc fixe, dry, bbl	lb	04 –	04½
Blanc fixe, pulp, bbl	ton	45.00 –	55 00
Bleaching powder, f o.b. wks, drums	100 lb.	2 20 –	2 50
Resale drums	100 lb	2 50 –	2 75
Borax, bbl	lb	05½–	05¾
Bromine, cases	lb	28 –	30
Calcium acetate, bags	100 lb	3 50 –	3 60
Calcium carbide, drums	lb.	04½	04¾
Calcium chloride, fused, drums	ton	22 00 –	23 00
Gran. drums	lb	01½–	01¾
Calcium phosphate, mono, bbl	lb	06½–	07
Camphor, cases	lb.	.91 –	93
Carbon bisulphide, drums	lb	07 –	07¼
Carbon tetrachloride, drums	lb.	09½–	.10
Chalk, precip -domestic, light, bbl	lb	04¼ –	04½
Domestic, heavy, bbl	lb.	03½–	03¾
Imported, light, bbl	lb.	04½–	05
Chlorine, liquid, cylinders	lb.	06 –	06½
Chloroform, tech, drums	lb.	35 –	38
Cobalt oxide, bbl	lb	2 10 –	2 25
Copperas, bulk, f o b wks	ton	16 50 –	20 00
Copper carbonate, bbl	lb	19 –	20
Copper cyanide, drums	lb	47 –	50
Copper sulphate, crys, bbl	100 lb.	6 40	6 50
Cream of tartar, bbl	lb	24 –	25
Dextrine, corn, bags	100 lb.	3 25	3 50
Epsom salt, dom, tech, bbl.	100 lb	2 00 –	2 25
Epsom salt, imp, tech, bags.	100 lb.	1 10 –	1 25
Epsom salt, U.S P, dom, bbl.	100 lb.	2.50 –	2 75
Ether, U S P. drums.	lb.	13 –	.15
Ethyl acetate, com, 85%, drums	gal.	.80 –	.85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 –	1.00
Formaldehyde, 40%, bbl	lb	$0 15 –	$0.16½
Fullers earth, f o b mines	net ton	16 00 –	17 00
Fullers earth - imp, powd	net ton	30 00 –	32 00
Fusel oil, ref, drums	gal	3 55 –	4 05
Fusel oil, crude, drums	gal	2.30 –	2 40
Glaubers salt, wks, bags	100 lb	1 20 –	1 40
Glaubers salt, imp, bags	100 lb.	1.00 –	1.25
Glycerine, c p, drums extra	lb	18½–	.19
Glycerine, dynamite, drums	lb.	.17 –	.17½
Iodine, resublimed	lb.	4.55 –	4.65
Iron oxide, red, casks	lb.	.12 –	.18
Lead			
White, basic cabonate, dry, casks	lb.	.10 –	.10½
White, in oil, kegs	lb.	.12½–	.14
Red, dry, casks	lb.	.11½–	.12
Red, in oil, kegs	lb	.13½–	.15
Lead acetate, white crys, bbl	lb	13½–	14
Lead arsenate, powd., bbl	lb	23 –	24
Lime-Hydrated, bbl	per ton	16 80 –	17 00
Lime, Lump, bbl	280 lb	3 63 –	3 65
Litharge, comm, casks.	lb	10½–	11
Lithophone, bbl	lb	06½–	07
Magnesium carb, tech, bags	lb.	08 –	08½
Methanol, 95%, bbl	gal	1 23 –	1 25
Methanol, 97%, bbl	gal	1 25 –	1 27
Nickel salt, double, bbl.	lb.	10 –	10½
Nickel salts, single, bbl.	lb.	11 –	.11½
Phosgene		.60 –	.75
Phosphorus, red, cases	lb.	.35 –	.40
Phosphorus, yellow, cases	lb.	.30 –	35
Potassium bichromate, casks	lb.	.10 –	.10½
Potassium bromide, gran., bbl	lb.	.16 –	.23
Potassium carbonate, 80-85%, calcined, casks	lb.	.05½–	.06
Potassium chlorate powd.	lb.	.07 –	08
Potassium cyanide, drums	lb.	.45 –	50
Potassium hydroxide (caustic potash) drums	100 lb	8 00 –	8.50
Potassium iodide, cases	lb	3 65 –	3 75
Potassium nitrate, bbl	lb	06¼–	.07½
Potassium permanganate, drums	lb	.20 –	.21
Potassium prussiate, red, casks	lb.	.80 –	.85
Potassium prussiate, yellow, casks	lb.	.37½–	.38
Salammoniac, white, gran., casks, imported	lb	.06¼–	.06½
Salammoniac, white, gran, bbl, domestic	lb	.08 –	.08½
Gray, gran, casks	lb	.08½–	.08¾
Salsoda, bbl	100 lb	1 20 –	1.40
Salt cake (bulk)	ton	26 00 –	28 00
Soda ash, light, 58% flat, bags, contract	100 lb	1.60 –	1 67
Soda ash, light, basis, 48%, bags, contract, f o.b wks	100 lb	1.20 –	1 30
Soda ash, light, 58%, flat, bags, resale	100 lb.	1.75 –	1.80
Soda ash, dense, bags, contract, basis 48%	100 lb.	1.17½–	1 20
Soda ash, dense, in bags, resale	100 lb.	1.85 –	1 90
Soda, caustic, 76%, solid, drums, f a s	100 lb.	3.45 –	3 70
Soda, caustic, 76%, solid, drums, contract	100 lb.	3.35	3 40
Soda, caustic, basis 60%, wks, contract	100 lb.	2.50 –	2 60
Soda, caustic, ground and flake, contracts	100 lb.	3.80 –	3 90
Soda, caustic, ground and flake, resale	100 lb	4 00 –	4 15
Sodium acetate, works, bags	lb.	06 –	06½
Sodium bicarbonate, bbl	100 lb	2 00 –	2 50
Sodium bichromate, casks	lb	07½–	08
Sodium bisulphate (niter cake)	ton	6 00 –	7 00
Sodium bisulphite, powd., U S P, bbl	lb	.04½–	04½
Sodium chlorate, kegs	lb	.06½	07
Sodium chloride	long ton	12 00 –	13 00
Sodium cyanide, cases	lb	20 –	23
Sodium fluoride, bbl	lb.	09 –	10
Sodium hyposulphite, bbl	lb	03 –	03½
Sodium nitrite, casks	lb	08½–	09
Sodium peroxide, powd, cases	lb	.28 –	30
Sodium phosphate, dibasic, bbl	lb.	.03½–	04
Sodium prussiate, yel. drums	lb.	.19 –	19½
Sodium silicate (40°, drums)	100 lb.	.80 –	1 15
Sodium silicate (60°, drums)	100 lb.	2.00 –	2 25
Sodium sulphide, fused, 60-62%, drums	lb.	.04½–	.04½
Sodium sulphite, crys, bbl.	lb.	.03½–	03¾
Strontium nitrate, powd., bbl.	lb.	.09½–	10
Sulphur chloride, yel drums.	lb.	.04½–	.05
Sulphur, crude	ton	18.00 –	20.00
Sulphur dioxide, liquid, cyl.	lb.	08 –	1 08½
Sulphur, flour, bbl.	100 lb.	2.35 –	3 15
Sulphur, roll, bbl	100 lb.	$2.00 –	$2 50
Talc imported, bags	ton	30 00 –	40 00
Talc domestic powd., bags.	ton	18 00 –	25.00
Tin bichloride, bbl	lb.	13½–	.14
Tin oxide, bbl	lb.	52 –	54
Zinc carbonate, bags	lb.	14 –	.14½
Zinc chloride, gran, bbl.	lb	.06 –	07
Zinc cyanide, drums.	lb.	37 –	.38
Zinc oxide, XX, bbl	lb.	.07½–	08
Zinc sulphate, bbl	100 lb	2.75 –	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl	lb	$0 80 –	$0 85
Alpha-naphthol, ref, bbl	lb	1 05 –	1 10
Alpha-naphthylamine, bbl.	lb	38 –	40
Aniline oil, drums	lb	.16½–	.17
Aniline salts, bbl	lb	24 –	.25
Anthracene, 80%, drums	lb.	.75 –	1.00
Anthracene, 80%, imp., drums, duty paid.	lb.	.65 –	.70
Anthraquinone, 25%, paste, drums	lb.	.70 –	75
Benzaldehyde U.S P, carboys	lb	1 40 –	1 45
Benzene, pure, water-white, tanks and drums	gal.	30 –	.35
Benzene, 90%, tanks & drums	gal.	26 –	.32
Benzene, 90%, drums, resale	gal.	.33 –	.35
Benzidine base, bbl	lb	85 –	.90
Benzidine sulphate, bbl	lb	.75 –	.80
Benzoic acid, U S P, kegs	lb.	72 –	.75
Benzoate of soda, U S P, bbl.	lb.	.57 –	.65
Benzyl chloride, 95-97%, ref, drums	lb	.25 –	27
Benzyl chloride, tech, drums	lb.	.20 –	.23
Beta-naphthol, subl, bbl	lb.	.55 –	.60
Beta-naphthol, tech, bbl	lb.	.24 –	.25
Beta-naphthylamine, tech.	lb.	.80 –	.90
Carbazol, bbl	lb.	.75 –	.90
Cresol, U S P., drums.	lb.	.25 –	29
Ortho-cresol, drums	lb.	.24 –	.26
Cresylic acid, 97%, resale, drums	gal.	1 40 –	1.50
95-97%, drums, resale	gal.	1.40 –	1.50
Dichlorbenzene, drums	lb.	.07 –	.09
Diethylaniline, drums	lb.	50 –	60
Dimethylaniline, drums	lb.	.41 –	.42
Dinitrobenzene, bbl	lb.	19 –	.20
Dinitroclorbenzene, bbl	lb.	.22 –	.23
Dinitronaphthalene, bbl.	lb.	.30 –	.32
Dinitrophenol, bbl	lb.	.35 –	.40
Dinitrotoluene, bbl	lb.	.20 –	.22
Dip oil, 25%, drums	gal.	.25 –	.30
Diphenylamine, bbl	lb.	.50 –	.52
H-acid, bbl	lb.	.80 –	.85
Meta-phenylenediamine, bbl.	lb	.95 –	1.00
Michlers ketone, bbl	lb	3.00 –	3.50
Monochlorbenzene, drums	lb.	.08 –	10
Monoethylaniline, drums	lb.	.95 –	1.10
Naphthalene, crushed, bbl.	lb.	.06 –	.06½
Naphthalene, flake, bbl	lb.	.07½–	.08
Naphthalene, balls, bbl	lb.	.08½–	.09
Naphthionate of soda, bbl	lb.	.58 –	.65
Naphthionic acid, crude, bbl.	lb.	.60 –	.65
Nitrobenzene, drums	lb.	.10 –	.12
Nitro-naphthalene, bbl.	lb.	.30 –	.35
Nitro-toluene, drums.	lb.	.15 –	.17
N-W acid, bbl.	lb.	1 15 –	1.20
Ortho-amidophenol, kegs	lb.	2 30 –	2 35
Ortho-dichlorbenzene, drums	lb.	17 –	.20
Ortho-nitrophenol, bbl	lb.	.90 –	.92
Ortho-nitrotoluene, drums	lb.	.10 –	.12
Ortho-toluidine, bbl	lb.	13 –	.15
Para-amidophenol, base, kegs	lb.	1 15 –	1.20
Para-amidophenol, HCl, kegs	lb.	1.20 –	1.25
Para-dichlorbenzene, bbl	lb.	.17 –	.20
Paranitraniline, bbl	lb.	.74 –	.75
Para-nitrotoluene, bbl	lb.	55 –	.65
Para-phenylenediamine, bbl.	lb	1.45 –	1.50
Para-toluidine, bbl	lb.	.90 –	.95
Phthalic anhydride, bbl	lb.	.35 –	.38
Phenol, U S P, drums.	lb.	50 –	.55
Picric acid, bbl.	lb.	.20 –	.22
Pyridine, dom, drums	gal.	nominal	
Pyridine, imp, drums	gal.	2 30 –	2 50
Resorcinol, tech, kegs	lb	1 50 –	1.55
Resorcinol, pure, kegs	lb.	2 00 –	2.10
R-salt, bbl	lb.	.60 –	.65
Salicylic acid, tech, bbl	lb.	.40 –	.42
Salicylic acid, U.S P, bbl.	lb.	.45 –	.47
Solvent naphtha, water-white, drums	gal.	.37 –	.40
Crude, drums	gal.	.22 –	.24
Sulphanilic acid, crude, bbl.	lb.	.18 –	.20
Thiocarbanilide, kegs	lb.	.35 –	.38
Toluidine, kegs	lb.	1 20 –	1.30
Toluidine, mixed, kegs	lb.	.30 –	.35
Toluene, tank cars	gal.	.35 –	.37
Toluene, drums	gal.	.40 –	.43
Xylidines drums	lb.	.40 –	.45
Xylene, pure, drums	gal.	.45 –	.50
Xylene, com., drums	gal.	.40 –	.42
Xylene, com., tanks	gal.	.30 –	....

Naval Stores

Rosin B-D, bbl.	280 lb.	$6 15 –	
Rosin E-I, bbl.	280 lb.	6.25 –	$6 40
Rosin K-N, bbl	280 lb.	6 55 –	6 95
Rosin W.G.-W.W., bbl	280 lb	7 35 –	8 05
Wood rosin, bbl.	280 lb	6 25 –	
Turpentine, spirits of, bbl.	gal.	1 52 –	1 53
Wood, steam dist., bbl.	gal.	1 35 –	
Wood, dest dist., bbl.	gal.	1 25 –	
Pine tar pitch, bbl.	200 lb.	–	6 00
Tar, kiln burned, bbl	500 lb	–	12 00
Retort tar, bbl.	500 lb.	–	11 00
Rosin oil, first run, bbl.	gal.	.43 –	
Rosin oil, second run, bbl.	gal	47 –	
Rosin oil, third run, bbl	gal.	.53 –	
Pine oil, steam dist.	gal.	–	90
Pine oil, pure, dest. dist.	gal.	–	.85
Pine tar oil, ref	gal.	–	.46
Pine tar oil, crude, tanks f o b Jacksonville, Fla.	gal.	–	.35
Pine tar oil, double ref, bbl	gal.	–	.75
Pine tar, ref, thin, bbl	gal.	–	25
Pinewood creosote, ref, bbl	gal.	–	.52

Vegetable Oils

Castor oil, No 3, bbl	lb	$ 13½ –	$ 13¾
Castor oil, AA, bbl.	lb	14 –	14¼
Chinawood oil, bbl	lb	22½ –	23
Coconut oil, Ceylon, bbl	lb	10½ –	10¾
Coconut oil, Cochin, bbl.	lb	10¾ –	
Corn oil, crude, bbl	lb	.12¼ –	
Cottonseed oil, crude (f o.b. mill), tanks	lb.	.10¼ –	
Summer yellow, bbl.	lb.	.12¼ –	12½
Winter yellow, bbl	lb	13 –	13¼
Linseed oil, raw, car lots, bbl	gal.	1 01 –	
Raw, tank cars (dom)	gal.	96 –	
Boiled, 5 bbl lots (dom)	gal	1 05	
Olive oil, denatured, bbl	gal	1 10 –	1 15
Palm, Lagos, casks	lb	08¼ –	08½
Palm kernel, bbl	lb	.09½ –	
Peanut oil, crude, tanks (mill)	lb.	13½ –	13¾
Peanut oil, refined, bbl	lb	.17 –	
Rapeseed oil, refined, bbl	gal	85 –	86
Rapeseed oil, blown, bbl	gal.	90 –	91
Soya bean (Manchurian), bbl	lb.	.12¼ –	
Tank, f.o b Pacific coast.	lb	.10½ –	

Fish Oils

Menhaden, light pressed, bbl.	gal	$0 70 –	
White bleached, bbl.	gal.	72 –	74
Blown, bbl	gal.	.76 –	78
Whale No 1 crude, tanks, coast	lb	06½ –	

Dye & Tanning Materials

Divi-divi, bags	ton	$38 00	$39 00
Fustic, sticks	ton	30 00 –	35 00
Fustic, chips, bags	lb	04 –	05
Logwood, sticks	ton	28 00 –	30 00
Logwood, chips, bags	lb	02½ –	03½
Sumac, leaves, Sicily, bags	ton	65 00 –	
Sumac, ground, bags	ton	55 00 –	60 00
Sumac, domestic, bags	ton	35 00 –	
Tapioca flour, bags	lb	03¼ –	05

EXTRACTS

Archil, conc, bbl	lb	$0 17 –	$0 18
Chestnut, 25%, tannin, tanks	lb	02 –	03
Divi-divi, 25%, tannin, bbl	lb	04 –	05
Fustic, crystals, bbl	lb	.20 –	22
Fustic, liquid, 42°, bbl	lb	.08 –	09
Gambier, liq, 25%, tannin, bbl.	lb	08 –	.09
Hematine crys, bbl	lb	.14 –	18
Hemlock, 25%, tannin, bbl	lb	.04 –	05
Hypernic, solid, drums	lb	24 –	.26
Hypernic, liquid, 51°, bbl	lb	14 –	.17
Logwood, crys, bbl	lb	.19 –	.20
Logwood, liq, 51°, bbl.	lb.	.09 –	10
Quebracho, solid, 65% tannin, bbl	lb.	.04¾ –	.05
Sumac, dom, 51°, bbl.	lb.	.06½ –	.07

Waxes

Bayberry, bbl.	lb	$0 28 –	$0 30
Beeswax, refined, dark, bags	lb	30 –	32
Beeswax, refined, light, bags.	lb	34 –	35
Beeswax, pure white, cases.	lb	40	41
Candelilla, bags.	lb.	.25 –	27
Carnauba, No 1, bags	lb.	.40 –	41
No 2, North Country, bags	lb.	.23½ –	24
No. 3, North Country, bags	lb.	.19 –	.19½
Japan, cases	lb.	.15 –	.15½
Montan, crude, bags.	lb.	04 –	.04¼
Paraffine, crude, match, 105-110 m.p	lb.	.04 –	.04½
Crude, scale 124-126 m.p, bags	lb.	.02¾ –	03
Ref., 118-120 m p., bags	lb	.03½ –	.03¾
Ref, 125 m p., bags	lb	.03½ –	.03¾
Ref. 128-130 m.p, bags	lb	.04 –	.04¼
Ref, 133-135 m p, bags	lb.	04½ –	.04¾
Ref, 135-137 m p, bags	lb	05 –	.05¼
Stearic acid, sgle pressed, bags	lb.	.14 –	
Double pressed, bags	lb.	.14½ –	
Triple pressed, bags	lb.	.16 –	

Fertilizers

Ammonium sulphate, bulk, f o b. works	100 lb.	$3 30 –	$3.40
F a.s. double bags	100 lb.	4.15 –	4 25
Blood, dried, bulk	unit	4 60 –	
Bone, raw, 3 and 50, ground	ton	30.00 –	35 00
Fish scrap, dom., dried, wks	unit	5.00 –	5.10
Nitrate of soda, bags	100 lb.	2.62½ –	2.65
Tankage, high grade, f.o.b. Chicago	unit	4.70 –	4 80

Phosphate rock, f o.b. mines, Florida pebble, 68-72%	ton	$4 00 –	$4 50
Tennessee, 78-80%	ton	8 00 –	8 25
Potassium muriate, 80%, bags	ton	35 00 –	36 00
Potassium sulphate, bags	unit	1 00 –	

Crude Rubber

Para—Upriver fine	lb	$0 33 –	$0 33½
Upriver coarse	lb	27½ –	28
Upriver caucho ball	lb	29½ –	30
Plantation—First latex crepe	lb	34½ –	.35
Ribbed smoked sheets	lb.	34½ –	.35
Brown crepe, thin, clean	lb	31 –	32
Amber crepe No 1	lb	31 –	32

Miscellaneous Materials

Asbestos, crude No 1, f o b., Quebec	sh ton	$450 00	$550 00
Asbestos, shingle, f o b, Quebec	sh. ton	60 00 –	80 00
Asbestos, cement, f.o.b., Quebec	sh. ton	15 00 –	17 00
Barytes, grd, white, f o b mills, bbl	net ton	16 00 –	20 00
Barytes, grd, off-color, f o b mills bulk	net ton	13 00 –	15 00
Barytes, floated, f o b. St Louis, bbl	net ton	24 00 –	28 00
Barytes, crude f o b. mines, bulk	net ton	9 00 –	9 25
Casein, bbl, tech	lb.	11 –	12
China clay (kaolin) crude, f o b Ga	net ton	7 00 –	9 00
Washed, f o b Ga	net ton	8 00 –	9 00
Powd, f o b Ga	net ton	13 00 –	20 00
Crude f o b Va	net ton	8 00 –	12 00
Ground, f o b Va	net ton	13 00 –	20 00
Imp, lump, bulk	net ton	15 00 –	20 00
Imp, powd	net ton	45 00 –	50 00
Feldspar, No 1 pottery	long ton	6 00 –	7 00
No 2 pottery	long ton	5 00 –	5 50
No 1 soap	long ton	7 00 –	7 50
No 1 Canadian, f.o b mill	long ton	25 00 –	27 00
Graphite, Ceylon, lump, first quality, bbl	lb	.06 –	.06½
Ceylon, chip, bbl	lb.	.05 –	.05½
High grade amorphous crude	ton	35 00 –	50.00
Gum arabic, amber, sorts, bags	lb	.15 –	16
Gum tragacanth, sorts, bags	lb.	.50 –	60
No 1, bags	lb	1.75 –	1 80
Kieselguhr, f o b Cal	ton	40 00 –	42 00
F o b N Y	ton	50 00 –	55 00
Magnesite, crude, f o b Cal	ton	14 00 –	15 00
Pumice stone, imp, casks	lb	03 –	05½
Dom, lump, bbl	lb	05 –	05½
Dom, ground, bbl	lb	06 –	07
Shellac, orange fine, bags	lb	82 –	83
Orange superfine, bags	lb	84 –	85
A C garnet, bags.	lb	79 –	80
T N, bags	lb.	80 –	81
Silica, glass sand, f o b Ind	ton	2 00 –	2 50
Silica, sand blast, f o b Ind	ton	2 50	5 00
Silica, amorphous, 250-mesh, f o b Ill.	ton	17 00 –	17 50
Silica, bldg sand, f o.b Pa.	ton	2 00	2 75
Soapstone, coarse, f o.b. Vt, bags	ton	7 00 –	8 00
Talc, 200 mesh, f o b, Vt., bags	ton	6 50 –	9 00
Talc, 200 mesh, f o b Ga, bags	ton	7 00 –	9 00
Talc, 200 mesh, f o b. Los Angeles, bags.	ton	16 00 –	20 00

Refractories

Bauxite brick, 56% Al_2O_3, f o b. Pittsburgh	ton	$45–50
Chrome brick, f o b Eastern shipping points	ton	50–52
Chrome cement, 40-50% Cr_2O_3	ton	23–27
40-45% Cr_2O_3, sacks, f o b Eastern shipping points	ton	23 00
Fireclay brick, 1st quality, 9-in shapes, f o b Ky wks	1,000	40–46
2nd. quality, 9-in shapes, f.o b wks.	1,000	36–41
Magnesite brick, 9-in straight (f.o.b wks)	ton	65 68
9-in arches, wedges and keys	ton	80–85
Scraps and splits	ton	85
Silica brick, 9-in sizes, f.o b. Chicago district	1,000	48–50
Silica brick, 9-in sizes, f o b Birmingham district.	1,000	48 50
F o b Mt Union, Pa	1,000	42–44
Silicon carbide refract. brick, 9-in	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18% f o b. Niagara Falls, N Y.	ton	$200.00 –	$225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11½	.11¾
4-6% C	lb.	.12 –	.13
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	110.00 –	112 00
Spiegeleisen, 19-21% Mn	gr. ton	35.00 –	37.00
Ferromolybdenum, 50-60% Mo, per lb Mo	lb.	1.90 –	2.15
Ferrosilicon, 10-15%	gr. ton	38.00 –	40 00
50%	gr. ton	86.00 –	89.00
75%	gr. ton	150 00 –	160.00
Ferrotungsten, 70-80%, per lb. of W	lb.	$0.85 –	$0.90
Ferro-uranium, 35-50% of U per lb of U	lb	6 00 –	
Ferrovanadium, 30-40%, per lb. of V	lb	3 75 –	4.00

Ores and Semi-finished Products

Bauxite, dom crushed, dried, f o b shipping points	ton	$6 50 –	$8 75
Chrome ore, Calif concentrates, 50% min Cr_2O_3.	ton	22 00 –	23 00
C i f Atlantic seaboard	ton	18 50 –	19 00
Coke, fdry, f o b ovens	ton	8 25 –	8 50
Coke, furnace, f o b ovens	ton	7 00 –	7.25
Fluorspar, gravel, f.o b. mines Illinois	ton	21 50 –	
Ilmenite, 52% TiO_2	lb.	.01½ –	.01¾
Manganese ore, 50% Mn, c i f Atlantic seaport	unit	.33 –	
Manganese ore, chemical (MnO_2)	ton	75.00 –	80.00
Molybdenite, 85% MoS_2, per lb MoS_2, N Y	lb.	.65 –	.70
Monazite, per unit of ThO_2, c i f, Atl seaport	lb	.06 –	08
Pyrites, Span, fines, c i f Atl seaport	unit	11½ –	.12
Pyrites, Span, furnace size, c i f Atl seaport.	unit	.11½ –	.12
Pyrites, dom fines, f o b mines, Ga	unit	.12	
Rutile, 95% TiO_2	lb.	.12 –	
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.50 –	8.75
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	8.00 –	8.25
Uranium ore (carnotite) per lb of U_3O_8	lb.	3.50 –	3.75
Uranium oxide, 96% per lb U_3O_8	lb	2 25 –	2.50
Vanadium pentoxide, 99%	lb.	12 00 –	14.00
Vanadium ore, per lb V_2O_5	lb.	1 00 –	
Zircon, washed, iron free, f o b. Pablo, Fla	lb	04½ –	.13

Non-Ferrous Materials

	Cents per Lb
Copper, electrolytic	16 75-17 00
Aluminum, 98 to 99%	25 00-25 50
Antimony, wholesale, Chinese and Japanese	8 75-9.00
Nickel, virgin metal	25 00-27.00
Nickel, ingot and shot	29 00
Monel metal, shot and blocks	32.00
Monel metal, ingots	38 00
Monel metal, sheet bars	45.00
Tin, 5-ton lots, Straits	50 00
Lead, New York, spot	8.25
Lead, E St Louis, spot	8 25
Zinc, spot, New York	8 00-8.10
Zinc, spot, E St Louis	7.70-7.85

OTHER METALS

Silver (commercial)	oz.	$0.67
Cadmium	lb	1.10
Bismuth (500 lb lots)	lb.	2 55
Cobalt	lb	2 65@2.85
Magnesium, ingots, 99%	lb	1 00@1.05
Platinum	oz	110 00
Iridium	oz	260 00@275.00
Palladium	oz	79 00
Mercury	75 lb.	69 00@70.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.75
Copper bottoms	30.75
Copper rods	20.50
High brass wire	19 50
High brass rods	17 00
Low brass wire	21 10
Low brass rods	22 00
Brazed brass tubing	24 25
Brazed bronze tubing	29.00
Seamless copper tubing	25 25
Seamless high brass tubing	23.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.30@11.50
Copper, heavy and wire	11 25@11 50
Copper, light and bottoms	9.25@ 9.50
Lead, heavy	5.75@ 6.00
Lead, tea	3.50@ 3.75
Brass, heavy	6.25@ 6.40
Brass, light	5.35@ 5 75
No. 1 yellow brass turnings	6.30@ 6.50
Zinc	3.50@ 4.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.29	$3 14
Soft steel bars	3.19	3 04
Soft steel bar shapes	3.19	3 04
Soft steel bands	3.29	3 19
Plates, ¼ to 1 in. thick	3.29	3.14

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

HOLT—The Central Foundry Co will immediately commence erection of a new 1-story foundry, 140x365 ft., for the manufacture of cast-iron pipe for heavy pressure service, 2 to 18 in. in diameter Headquarters are at 41 East 42nd St., New York

BIRMINGHAM—A 1-story foundry will be erected at the plant of the Birmingham Machine & Foundry Co., 11th Ave, to be used for the production of iron castings. It will cost about $12,000, exclusive of equipment

California

BAY POINT—The West Coast Chemical Co., 77 O'Farrell St., San Francisco, has leased a portion of the local plant of the Pacific Coast Shipbuilding Co for the establishment of a temporary factory for the manufacture of sulphur specialties as used in the rubber industry, and chemical byproducts A 5-acre tract of land has been secured in this same section, and at an early date it is purposed to commence the erection of a large plant, at which time the temporary works will be abandoned F A. Somers and H. R. Bostwick head the company

FULLERTON—The Orange County Brick & Tile Co., recently organized, has acquired property from the Moore Brothers Sand Co as a site for a new plant for the manufacture of brick, tile and affiliated burned clay products The works will be equipped for an initial production of about 40,000 bricks per day, and are estimated to cost approximately $50,000, with machinery The company is headed by F C Krause, J W. Carmichael and J. J Lilley

SAN DIEGO—The Union Oil Co, Union Oil Bldg., Los Angeles, has acquired property at San Diego, and plans for the erection of a new storage and distributing plant, with initial capacity of about 80,000 gal

REDLANDS The Jones Vinegar Co has tentative plans under consideration for extensions in its plant to double approximately the present capacity. The company is a recent industry, having been operating since last fall.

SAN FRANCISCO—The Banner Refining Co., Kohl Bldg, is arranging for the immediate erection of a new plant in the vicinity of Seattle, Wash., to cost about $175,000. Plans are also being considered for an oil refinery in southern California or Arizona, to cost approximately a like amount.

RICHMOND—The Pacific Sanitary Mfg Co, manufacturer of sanitary fixtures, has commenced the erection of an addition to its plant at California, 5th and Hensley Sts., estimated to cost approximately $150,000, with equipment

Connecticut

BRIDGEPORT—The Contract Plating Co, 725 North Washington Ave., is planning for the installation of laboratory equipment for chemical and other service R J O'Connor is in charge.

WINDSOR LOCKS C H Dexter & Sons, manufacturers of paper products, have taken bids on a general contract and plan for the early erection of a 4-story and basement addition, 54x100 ft., to be used for the most part as a beater department Greenwood & Noerr 847 Main St, Hartford, Conn., are consulting engineers

Illinois

CHICAGO—The Plunkett Chemical Co., 2940 South Park Ave., has purchased property at 35th and Morgan Sts., 116x160 ft, improved with a 4-story and basement building totaling about 60,000 sq.ft., for a consideration of about $100,000, and plans for the immediate establishment of a new plant. It is purposed to remove the present works to the new location, following repairs and improvements in the structure.

CHICAGO—Gutmann & Co, 1511 Webster St, leather tanners, will soon take bids on a general contract for the erection of a 4-story addition to their tannery, estimated to cost $50,000. I. S. Stein, 35 South Dearborn St., is architect.

CHICAGO—The Asbestos Products Co, 220 South La Salle St., has purchased the factory of the General Combustion Co., at 2100 Fullerton St, from L L Mullins, receiver, for a new plant The site aggregates 150x170 ft., with 1-story and basement building, 50x100 ft. The property was secured for a consideration of $41,000. Machinery will be installed at an early date.

Iowa

SIOUX CITY—The Sioux City Brick & Tile Co, 9 West 3rd St, has awarded a general contract to William Klinger, Warnock Bldg, for the erection of a new plant consisting of seven buildings, estimated to cost about $100,000. The main structure, to be used for operating machinery, will be 5-story, 60x80 ft.; the other buildings, all 1-story, will be 44x136 ft., 45x126 ft., 60x60 ft., 38x60 ft., 38x44 ft., and 24x52 ft. Work will be commenced at once D P. Mahoney is president and general manager

Kentucky

CARTER—The Ashland Limestone Co has plans under consideration for the installation of additional equipment at its plant, including power house. The company has a tract of 100 acres of land, and plans for extensive output M. E S Poseg, P. O. Box 668, Ashland, Ky., is manager and engineer

LEXINGTON—The board of directors, State University of Kentucky, has commissioned Coolidge & Shattuck, Ames Bldg., Boston, Mass, architects, to prepare plans for a 2-story and basement addition, 56x110 ft., to the chemistry building at the institution, estimated to cost approximately $80,000. Frank McVey is president.

OWENSBORO—Bolger & Medley have plans in preparation for the construction of a new local plant for the manufacture of brick and tile products, estimated to cost $60,000

Maryland

BALTIMORE—The Maryland Glass Corp., Linden and Ontario Sts, will immediately commence the erection of a 1-story addition to its plant, 40x120 ft, estimated to cost $25,000. A general building contract has been let to the Austin Co., Bulletin Bldg., Philadelphia, Pa.

ELKTON—The Beacon Hill Brick Co, recently organized with a capital of $80,000, is perfecting plans for the operation of a new plant in the Beacon Hill section for the manufacture of brick and tile products Equipment will be provided for an initial working force of about 35 men John Mattiuse and James F. Evans, Elkton, head the company

HANCOCK—The Maryland Glass Sand Co. has plans under way for extensions and improvements in its plant for considerable increase in capacity. It is purposed to electrify the complete works, and equipment for this purpose will be installed. The company has recently arranged for an increase in capital from $150,000 to $250,000 for expansion.

BALTIMORE The Prudential Oil Corp, Fairfield, has taken title to a tract of land, 161x945 ft, heretofore held by the United States Industrial Alcohol Co., for a consideration of $23 500, and will use the site for the construction of a new oil storage and distributing plant.

Massachusetts

HOLYOKE—The Judd Paper Co., 166 Race St, is considering plans for the erection of a new building at its plant to cost about $75,000 George P. B. Alderman & Co., 316 High St., Holyoke, is architect

Michigan

LANSING—The Briggs Co., manufacturer of brick and other burned clay products, with plants at Grand Rapids and Grand Ledge, Mich., has acquired the local works of the Clippert & Spaulding Co., with rated capacity of about 70,000 face brick per day. Immediate possession will be taken and plans developed for increased output. It is purposed to install additional machinery to double, approximately, the present capacity.

DETROIT—Contract has been awarded to the Austin Co., Penobscot Bldg, for the erection of a 1- and 2-story foundry at the plant of the United States Radiator Co., Campbell Ave., estimated to cost $104,000, with equipment. It will be devoted to the production of iron castings.

MUSKEGON—The Central Paper Co. has work under way on two additional buildings at its plant, to be used for general manufacturing. The structures will cost in excess of $50,000.

Minnesota

MINNEAPOLIS—The Diamond Steel Products Co, 1414 Marshall St, is perfecting plans for the erection of a new 2-story plant addition George C Bouthinon is one of the heads of the company in charge

New Hampshire

EAST JAFFREY—The New Hampshire Match Co, Keene, N. H., is arranging for the early installation of machinery at its new local plant now in course of completion It will be 1-story, 50x148 ft and estimated to cost approximately $25,000, exclusive of equipment. L F Dickenson heads the company.

New Jersey

NEWARK—The Eastern Steel Castings Co., a subsidiary of the American Brake Shoe & Foundry Co., 30 Church St., New York, has taken over the plant of the parent company at Ave. L and Edwards St., Newark, comprising three main buildings, 230x480 ft, 60x230 ft. and 60x200 ft, on large tract of land. The plant will be used for the production of steel castings, and will be equipped to develop a total output of 1,000 tons per month The Eastern company recently acquired the plant and business of the Bayonne Steel Casting Co., Oak St, Bayonne, N. J, and will remove this works to the new location. William D. Sargent, formerly head of the Bayonne company, will be president of the Eastern organization

BLOOMSBURY—The Bloomsbury Graphite Co. has authorized the immediate rebuilding of its local plant devoted to the manufacture of graphite products, foundry facings, etc, recently destroyed by fire with loss of about $10,000 New grinding and other machinery will be installed to double the former capacity.

NEWARK—H. F. Sommer & Co, 219 Wilson Ave, operating a leather tannery, will build a 1-story addition to their plant at 12-16 Paris St, including improvements in the present structure, estimated to cost $15,000

BAYONNE—The Tide Water Oil Co., 11 Broadway, New York, has filed plans for the erection of a new building at its local refinery and additional tanks, estimated to cost $25,000.

New York

BROOKLYN—Plans are being completed and bids will soon be asked for the erection of a 2-story addition, 54x100 ft, to the plant of Abraham Werbelovsky, 83 Meserole St., manufacturer of glass products to be located at 57-59 Scholl St.. estimated to cost close to $40,000. Harry J Nurick, 44 Court St., is architect.

BUFFALO—Spencer Kellogg & Sons, Delaware St, manufacturers of linseed, core and other oils, will build a new addition to their plant at Michigan and Ganson Sts, to cost about $12,000. It will be used for general operating service.

NORTH TONAWANDA The Herschell-Spillman Motor Co., Sweeney St, is planning for the immediate rebuilding of the portion of its heat-treating department, damaged by fire March 4. An official estimate of loss has not been made.

North Carolina

FOUR OAKS—The Meadow Brick Co., recently organized with a capital of $25,000, has tentative plans under consideration for the installation of additional equipment of develop a maximum output in excess of 75,000 bricks per day New clay loading machinery will be purchased. J. W. Sanders is president, and W. H. Smith, secretary and treasurer.

Ohio

EAST PALESTINE—The W. S. George Pottery Co. manufacturer of general ware, has completed plans and will break ground at

once for the erection of a 2-story addition, 156x400 ft., on site of the old East Palestine pottery, destroyed by fire some time ago A tunnel kiln will be installed in the new plant, which is estimated to cost close to $300,000, with equipment Facilities will be provided for the employment of about 400 operatives. W. S. George heads the company.

COLUMBUS—H. C. Godman, 35th St, has plans nearing completion for the erection of a new plant at West State and Lucas Sts, to be equipped for the manufacture of leatherboard products. Richards, McCarty & Bulford, 584 East Broad St., are architects.

Pennsylvania

MARTIN'S CREEK — The Alpha Portland Cement Co., Easton, Pa., will make extensions and improvements in its local mill including the installation of a new power plant and waste heat equipment, the latter to provide for more economical operation Other apparatus will also be purchased The company has arranged an appropriation in excess of $1,000,000 for extensions and betterments in its other mills in different parts of the country.

HAZLETON—The Hazleton Iron Works Co has tentative plans under consideration for the rebuilding of the portion of its iron foundry, recently destroyed by fire with loss approximating $50.000, including equipment

YORK The Emigsville Lime & Shale Co, Emigsville, near York, has preliminary plans in progress for the rebuilding of the portion of its plant destroyed by fire March 8. An official estimate of loss of buildings and machinery has not been announced

HILLSVILLE—Fire, March 2, caused by an explosion, destroyed a portion of the Quaker Falls plant of the Grasselli Powder Co, near Hillsville, with loss estimated at $14,000 It is planned to rebuild.

Texas

LUBBOCK—The Lubbock Cotton Oil Co, recently organized with a capital of $150,000, has plans nearing completion for the erection of a new local plant to cost about $100,000, including machinery. Bids will soon be asked. G. A. Simmons is general manager.

SMITH'S BLUFF—The Pure Oil Co., Pure Oil Bldg., Columbus, O. is perfecting plans for the erection of a new refining plant on local site, recently acquired. It will have a capacity of 10,000 bbl per day, and will include a gasoline refinery, with 26 "cracking" process units. It is estimated to cost in excess of $300,000, including machinery.

PORT ARTHUR — The Gulf Refining Co, Frick Annex, Pittsburgh, Pa., has arranged an appropriation of more than $10,000,000 for extensions and improvements in its local oil refinery. The work will include an addition to the main plant, with 94 oil stills; extension to the chloride process department used for gasoline production; addition to the sulphuric acid works to provide a total capacity of about 100 tons per day; new grease and compounding plant, with total floor area of about 100,000 sq.ft.; new power and pumping machinery for different operating departments; new electric power plant of 10,000 kw. capacity and steam power house of 6,000-hp. rating; can manufacturing works and additions to tankage department, the latter including 66 new steel tanks and auxiliary equipment with capacity of 500 000 bbl. The company will also build an addition to concrete wharf. George V. Taber is vice-president in charge.

BRECKENRIDGE—The Acme Brick Co., Fort Worth, Tex., has tentative plans under consideration for the construction of a new plant at Breckenridge. A site is being selected. W. R. Brennt is president.

WACO—The Waco Lime & Products Co., formerly known as the Koury Calcium Co., McGregor, Tex., has work under way on a new local lime plant with capacity of about 100 tons a day. A hydrator and other equipment will be provided for larger output in the near future. John L. Spurlin, Jr., Waco, is secretary.

Virginia

ROANOKE—The Roanoke Tire & Rubber Co, Terry Bldg., has commissioned B F. Mitchell, Seaboard Bank Bldg., architect, to prepare plans for its proposed new 3-story plant in the West End section, 50x130 ft., for the manufacture of tires and other rubber products. Alfred Buck is head of the company, in charge.

West Virginia

NEWELL—The Homer Laughlin China Co. is completing plans for the erection of a new plant unit on the old golf links, Ohio River, to consist of a main 1-story structure, 220x800 ft., estimated to cost in excess of $600,000, with machinery. Three tunnel kilns, Harrop type, will be constructed, one to be used for bisque ware, another for glost material and the third for decorating service Work will be commenced at an early date. Marcus Aaron is president.

PARKERSBURG—The plant of the Parkersburg Brick Co. has been acquired by the Citizens' Lumber Co, consisting of about 10 acres of land in the Lee's Hill section. The new owner will continue the operation of the plant and has plans in progress for the erection of a new works on adjoining site, with daily capacity of about 75,000 bricks, estimated to cost $100,000, with machinery.

Wisconsin

STEVENS POINT—The Consolidated Water Power & Paper Co. has completed plans and will soon break ground for the construction of a 2-story addition to its local mill, estimated to cost approximately $150,000, with machinery. L. A. De Guers, Wood Block, Wisconsin Rapids, is engineer. George W Mead heads the company.

Industrial Developments

LEATHER — The Endicott - Johnson Co., Endicott and Johnson City, N Y., is maintaining capacity production at practically all of its tanneries giving employment to full working forces. The sole leather tannery has a production of over 6,000 sides of leather per day, with employment of 450 operatives; the chrome leather tannery at Endicott has a daily output of 1,500 sides, giving work to 100 persons; the chrome sole tannery at this same place is also giving employment to about 100 workers, under a capacity schedule of 2,000 sides of leather daily; the new upper leather tanning plant at Endicott is employing 200 operatives, with a rated output of 1,800 sides per day, while the other tannery of this same character here is running on a basis of 3,800 sides daily, with employment of 400 workers; the calfskin tannery of the company produces about 5,000 sides of leather per day, with employment of 650 operatives.

Dungan, Hood & Co, Philadelphia, Pa., specializing in the production of glazed kid leathers, are operating at about 75 per cent of capacity.

Tolman, Dow & Co, Inc., Woburn, Mass., is operating at regular capacity at its local tannery, with bulk of output devoted to brown leathers.

GLASS — The Owens Bottle Co., South Glassboro, N. J., is running at the highest capacity possible with existing working force, and is said to be seeking additional operatives. The plant has orders on hand for some time to come.

The Carr-Lowrey Glass Co., Westport, Md, is maintaining production at its local plant, devoted to hollow ware specialties, with full working force, and a recent fire at the works, caused by the bursting of a 20-ton mixing vat of molten glass, will not cause any suspension in operations

The Illinois Glass Co, Bridgeton, N. J., is operating at its new local machine-blowing plant and adding additional workers to the force. It is expected to develop capacity production at an early date.

The majority of the glass plants in the vicinity of Millville, Salem and Vineland, N. J., are operating at capacity, with full working forces, and expect to continue on this basis throughout the spring and well into the summer.

CERAMIC—The Gem Clay Works, Sebring, O, are running at maximum capacity with full working force. Plans are being developed to double the present output and a number of additions will be constructed.

The Elk Fire Brick Co., Renovo, Pa., is operating under heavy production and will maintain this schedule for an indefinite period. Plans are in progress for the establishment of a housing development for employees.

The Wellsville Fire Brick Co., Wellsville, Mo., is maintaining capacity operations and heavy shipments are leaving the plant. A full working force is being employed. It is expected to advance production with the installation of additional equipment, giving employment to an increased number of workers.

The Pennsylvania Clay Co. is arranging for the immediate resumption of operations at its Conway, Pa., plant, devoted to the production of paving brick. It is expected to develop an output of about 60,000 bricks per day. The plant has been closed recently for repairs and improvements.

IRON AND STEEL - The Joseph E. Thropp Co., Inc, Cumberland, Md., recently succeeding to the blast furnace and iron properties of Joseph E. Thropp, has improvement and repair work in progress at the stack, and plans to blow in at an early date. The furnace has been idle for some months past. Operations are also being resumed at the coke ovens and limestone quarries of the company

The Eastern Steel Co, Pottsville, Pa., is advancing operations at its local plant and additional open-hearth furnaces will soon be lighted. Part of the works will be placed on a double turn at once, giving employment to an increased operating force

The McKinney Steel Co., Cleveland, O., has resumed operations at its two furnaces at Josephine, near Blairsville, Pa., following a suspension for about 24 months. It is expected to maintain production for an indefinite period, giving employment to a large working quota The company is planning to blow in its furnace on the Genesee River near Rochester, N Y, early in April, and the stack is being made ready.

E. J Lavino & Co., Philadelphia, Pa, has blown in its blast furnace at Lebanon, Pa., after a suspension for nearly 2 years. This makes the second stack of the company in Bethlhem County in service All five stacks of the Bethlehem Steel Co, in this same county, are still inactive.

The Carnegie Steel Co, Sharon, Pa., is making ready to apply the torch to its No. 4 blast furnace here, after an idleness of about 36 months. With this stack in service, all furnaces of the company will be producing for the first time since April, 1920. Throughout the Pittsburgh district, 49 of the 59 furnaces of the company are now on the active list

Steel mills in the vicinity of Birmingham, Ala., are running at capacity, with full working forces The Gulf States Steel Co., is at maximum output at its Gadsden, Ala., works and has recently advanced the wages of common labor at this plant The American Steel & Wire Co, at Fairfield, is running full.

MISCELLANEOUS - The Hinckley Corp. is arranging for the resumption of operations at its sulphite mill at Hinckley, N Y. The plant has been closed for about 2 years past, and a number of improvements will be made, including repairs to machinery.

The Standard Oil Co is breaking all production records at its refining plant at Whiting, Ind, refinery, and on an average of 40,000 bbl., or 2,000,000 gal., of crude oil, are being handled daily, or about 3,000 bbl. more a day than during the pre-war period of 1917-18.

New Companies

THE SURFIX CHEMICAL Co, Detroit, Mich., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts The incorporators are George W. Stallings, A. F and W. H. Knobloch, 3217 Clairmount Ave., Detroit. The last noted represents the company.

THE LEONARD PAPER GOODS Co, Boston, Mass, has been incorporated with a capital of $100,000, to manufacture paper products, Elbert O. Leonard is president; and Andrew J. Wright, 500 Park Ave., Worcester, Mass., treasurer.

THE PLASTIC PRODUCTS Co, Detroit, Mich., has been incorporated with a capital of $25,000, to manufacture paints and kindred products. The incorporators are Russell S. Collins, E F. and Alfred D. Covert, 1940 Highland Ave., Detroit.

THE CYACO CHEMICAL Co., New York, N. Y., care of Jenks & Rogers, 67 Wall St., representatives, has been incorporated with a capital of $20,000, to manufacture chemicals and chemical byproducts. The incorporators are C., I. and A. Juster.

THE DALTON MALLEABLE CASTING Co., Warsaw, Ind., has been incorporated with a capital of $350,000, to manufacture iron and other metal castings. The incorporators are Donald J. and J. S. Dalton, and T. C. and W. D. Frazer, all of Dalton.

THE NATIONAL ART POTTERY Co., Camden, N. J., care of S. Stanger Iszard, 314 Market St., Camden, representative, has been incorporated with a capital of $125,000, to manufacture pottery products. The incorporators are Howard W. Willett, Curtis J. Rothermel and Frederic W. Lineaweaver.

THE MISSOURI GLUE Co., St. Louis, Mo., has been incorporated with a capital of $70,000, to manufacture glue, paste and other adhesive products. The incorporators are Albert Goetz, McCune Gill and T. J Sheridan, all of St. Louis.

Manufacturers' Catalogs

THE WESTINGHOUSE ELECTRIC & MFG CO., East Pittsburgh, Pa., has issued a 20 page booklet, Folder 4506, entitled "Salient Facts on Silent Gears." The booklet describes the advantages of the use of micarta gears and pinions and gives photographs and data describing some of their applications, tables of gear data, etc. This company has also issued Leaflet 1867, which describes electrical equipment for coke plant machinery. Illustrations of the uses of electricity in by-product plants are shown, with recommendations as to the various types to be used.

THE REFRACTORIES MANUFACTURERS ASSN. calls attention to a booklet entitled "Brands Used in the Refractories Industry." It lists the brands used by practically all of the manufacturers of refractory brick and is useful to a man who knows the brand he wants to use, but who doesn't know who makes it. A copy will be sent gratis on receipt of a written request to the association, 810 Oliver Bldg., Pittsburgh, Pa.

THE CHASE METAL WORKS, Waterbury, Conn., has published a very interesting catalog on Chase Condenser Tubes, which describes the technical manufacture and control exercised in making high grade tubing. It illustrates and describes the manufacture of condenser tubes, the steps in manufacture, the properties and specifications, condenser tube service and a list of those who use the tubes.

THE LINK-BELT CO., Nicetown, Philadelphia, Pa., has published a Portable Loader catalog embracing its entire line of portable equipment. Copies can be obtained by addressing the manufacturers. It contains complete specifications of all of the standard machines, which include the one man power swiveling loader, the portable belt conveyor, the standard type "A" machine for anthracite coal, and "CS" loader for handling sand and gravel.

CHALMERS & WILLIAMS, Chicago Heights, Ill., have issued a unique pamphlet in the form of a book, entitled "The 100 a Year Club." It describes and illustrates the Symons disk crushers.

EMIL E. LUNGWITZ, New York, is distributing a booklet on Hanbold Self-Unloading Centrifuge. This centrifuge is built in two styles, either half automatic or absolutely automatic. This booklet concerns itself with the half-automatic centrifuge solely. The absolutely automatic centrifuge is the subject matter of another booklet which will be sent to those desiring it. The half automatic centrifuge will handle such materials as calcium carbonate, calcium sulphate, magnesia carbonate, barium sulphate, barium carbonate, alumina, cyanide slimes, flotation concentrates, starch, short fibers, etc., which at present are handled by the various makes of leaf and rotary suction filters. In addition it is claimed that it will filter fine to coarse crystals of any chemical composition.

F. J. RYAN & CO., Philadelphia, Pa., have issued a bulletin on oil burners for all industrial heating operations. It contains information on the way of determining the amount of air necessary for proper combustion and the correct proportions of air with oil.

SPRAGUE SMITH CO., 162 West Randolph St., Chicago, is issuing a booklet on "Glass and Glazing" which is being distributed by the National Glass Distributors Assn. The object of the booklet is to present to the users of glass a standard or guide for the architect, owner or contractor, by which the material may be better known and more readily understood. It briefly describes the more important and different kinds of glass for building purposes, with regard to adaptability for certain definite uses, and gives printed illustrations. The booklet does not cover every department of structural glass or go exhaustively into the details of the artistic but is confined to the everyday materials which are often thought so simple as to need no consideration.

THE BEACH-RUSS CO., New York, has issued five new pamphlets. No. 20 is on vacuum pumps for vacuum heating systems; No. 25 is on patented gas and oil-burning rivet heating furnaces; No. 26 on high-vacuum finishing pumps. No. 30 is on rotary pumps, and No. 29 is on gas boosters.

THE ESTERLINE-ANGUS CO., Indianapolis, Ind., has issued two bulletins, No. 1122, entitled "How to Make a Plant Survey," and Bulletin No. 1222, on "Instruments for Recording Condenser Leakage."

W. A. JONES FOUNDRY & MACHINE CO., Chicago, Ill., announces catalog 26, on speed reduction drives, which is very elaborate. The information should be of value to consulting engineers, superintendents, chief engineers, master mechanics, etc. It embodies technical and practical information, complete descriptive matter and illustrations of typical drives. The installation section presents pictorially reducer drives in many large industrial plants, and dimensions, weights and horsepower ratings for complete speed reduction sets are shown.

THE ROTO CO., Hartford, Conn., in a new 32-page booklet illustrates and describes Roto tube cleaners, air, steam or water driven, for fire tube and water tube boilers, fuel economizers, condensers, evaporators, feed water heaters, locomotive arch tubes, oil stills, etc.

Industrial Notes

THE OILGEAR CO., Milwaukee, Wis., has opened an office in Detroit, at 115 East Jefferson Ave. Donald Clute, who formerly handled the sale of Oilgear products for the Cadillac Machinery Co., has been placed in charge of this office.

THE COLUMBIA STEEL CORP., San Francisco, Calif., has engaged Freyn, Brassert & Co. as consulting engineers for the construction of its new blast-furnace plant at Provo, Utah.

THE STANDARD CONVEYOR CO., North St. Paul, Minn., announces that it has acquired by purchase all the rights, titles and patents pertaining to the "Brown Portable" line of portable and sectional piling, elevating, conveying, loading and unloading machinery for the handling of packed and loose materials. This line of machinery has been manufactured by the Brown Portable Conveying Machinery Co. at North Chicago for 10 years. Until further notice the plant will be continued in operation by the Standard Conveyor Co., to which all inquiries and correspondence should be addressed. The organization which has developed the portable conveying machinery will continue with the Standard Conveyor Co.

THE MINE & SMELTER SUPPLY CO., with branches in Denver, Salt Lake City and El Paso, has taken over the exclusive representation for Colorado, Utah, Nevada, Wyoming, New Mexico and western Texas for Wilson plastic-arc welders and Wilson color tipt welding metals, for the Wilson Welder & Metals Co., New York City. The Wilson machine and metals were used during the world war in repairing the damage done to a large number of the interned German vessels. Electric arc welding was the method chosen by which the damaged machinery parts of this fleet of vessels were put in operating and seagoing condition and the work was completed within 6 months' time. This machine is also used in railroad shops in the United States and in foreign countries and also by large industrial plants in the United States. The Mine & Smelter Supply Co. will carry in stock at each of its branches a supply of all grades of Wilson color-tipt metals and plastic-arc machines for distribution throughout its territory.

THE CENTRAL STEEL CO., Massilon, O., manufacturer of alloy steel products, has decided to enlarge its field of activities by the addition of special alloy steels for railroad service. This department is under the direction of Irving H. Jones, formerly of Joseph T. Ryerson & Son, Chicago. Mr. Jones will maintain offices in the Peoples Gas Bldg., Chicago, which is the Western headquarters of the Central Steel Co.

The board of directors of the BUFFALO FOUNDRY & MACHINE CO., Buffalo, N. Y., at a recent meeting announced the election of two new officers: C. W. Pearson, who has been associated with the company in various managerial positions for a number of years and for the past year in charge of sales, becomes vice-president and treasurer. In addition to the new duties his promotion will bring, Mr. Pearson will continue as director of sales. P. J. Krentz, who for a number of years past has been works manager, has also been elected as vice-president. As in the past, he will continue actively in charge of manufacture and production. Both Mr. Pearson and Mr. Krentz have been with the company almost from its organization. Their promotions come as no surprise to those familiar with their activities.

THE TH. GOLDSCHMIDT CORP., 15 William St., New York City, has just been founded by the Th. Goldschmidt A. G., in Essen, which years ago also founded the Goldschmidt Detinning Co. and the Goldschmidt Thermit Corp., now united in the Metal & Thermit Corp. The Th. Goldschmidt Corp. represents the Th. Goldschmidt A. G. and its affiliated firms, the Chemische Fabrik Buckau A. G. of Magdeburg, Neufeldt & Kuhnke of Kiel and several other European concerns, for the sale of their products and for the exploitation of new processes and apparatus in the United States and Canada. The president of the corporation is Dr. Franz Meyer, manager of the Th. Goldschmidt A. G., formerly director and officer of the Metallurgical Co. of America, a subsidiary of the American Metal Co., Ltd., and consulting engineer of the General Chemical Co.

Coming Meetings and Events

AMERICAN ASSOCIATION OF CEREAL CHEMISTS will hold its ninth annual convention at Hotel Sherman, Chicago, June 4 to 9.

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual convention in Norfolk, Va., May 7 to 9.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York.

AMERICAN FOUNDRYMEN'S ASSOCIATION will hold a meeting in Cleveland, O., April 28 to May 4.

AMERICAN GAS ASSOCIATION will hold its annual convention the week of Oct. 15 at Atlantic City. An elaborate exhibition of gas making and gas-utilization equipment is planned.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its summer meeting June 20-23 at Wilmington, Del.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W. Va., June 7, 8 and 9.

AMERICAN OIL CHEMISTS' SOCIETY will hold its annual meeting at the Eastman Hotel, Hot Springs, Ark., April 30 and May 1.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold its spring meeting May 28 to 31 in Montreal, Canada.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

ENGINEERING SECTION of the National Safety Council will hold a mid-year safety conference April 17 in the auditorium of the Western Society of Engineers.

IRON AND STEEL INSTITUTE (London) will hold its annual meeting May 10 and 11 at the House of the Institution of Civil Engineers, London, S. W. 1.

NATIONAL ASSOCIATION OF MANUFACTURERS OF THE UNITED STATES OF AMERICA will meet in annual conference May 14 to 16, inclusive, at the Waldorf-Astoria, New York City.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (NINTH) will be held in New York Sept. 17-22.

NATIONAL FOREIGN TRADE COUNCIL has postponed its annual conference from April 25, 26 and 27, to May 2, 3 and 4. It will be held in New Orleans, La.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

FIFTH PAN-AMERICAN CONFERENCE will be held at Santiago, Chile, March 25, 1923.

SOCIETY FOR STEEL TREATING — Eastern sectional meeting will be held June 14 and 15, in Bethlehem, Pa.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

A PAPER INDUSTRIES EXPOSITION will be held in Grand Central Palace, New York City, during the week of April 9, 1923, by the International Exposition Co.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City; March 23—Society of Chemical Industry, regular meeting. April 20 — Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8 — American Chemical Society, regular meeting.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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The Top Of the Hill

ANY one who has driven an automobile knows that an approach to the top of a hill at high speed on the wrong side of the road is dangerous. In the business world the same thing applies, and several traffic officers have stationed themselves on the business hill which has been climbed so rapidly and successfully during the past 18 months, warning traffic to keep to the right and to travel at a reasonable speed. These three officers are no less important persons than the Secretary of Commerce, the vice-president of the National City Bank, and the Federal Reserve Board.

Business always drives a strange road. No one can foresee, especially when on the upgrade, what will be over the top of the hill. In fact, long-time business forecasts are always impossible because the fog on the road conceals everything over a few weeks, or at most a few months, ahead. When we are going down hill we always know that there will be an upgrade when the bottom is reached. On the downgrade the brake pedal and the brake lever are vigorously used, especially if the grade be steep; but on the climb, business is inclined to "step on the gas" and go as fast as possible in the hope that higher levels of business may produce wide and pleasing views, green with the currency of large profit.

Right now clear-thinking business men who view the national situation broadly see that the high speed in increase of business forecasts an arrival at the top under conditions that may not be altogether safe. The top will be reached inevitably with a limit of the buying and consuming power of the public, supplemented by such exports as disturbed foreign conditions may permit. Careful appraisal of the situation indicates that the top of business activity is not very far ahead. The sign "Go Slow" is, therefore, a very important warning.

In two cases the warnings referred to above have been against excessive building activity. The Secretary of Commerce urges that the federal, state and municipal construction work now going forward actively be postponed somewhat in order that it may be used to fill in the hollows that inevitably will come later. This sort of leveling up of the business highway is an untried method of road grading, but it may prove to be a highly satisfactory one. The Federal Reserve Board evidently thinks well of the Secretary's proposal, for it too is contributing to the same end by delaying construction work under its control. Inevitably this will react upon banking agencies of all sorts, who will hesitate to finance additional construction unless it is very clear that it is imperative and that it can be done without unduly high costs.

The third traffic officer who has just placed himself on the business highway speaks from a prominent position as a representative of the Chamber of Commerce of the United States. This eminent banker would extend the warning against excessive construction work to include caution against excessive business inflation and undue expansion of credits in all lines.

When business comes with comparative ease, there is a great temptation to work one's credit facilities to the limit. However, the lesson of the disastrous consequences of that policy, as practiced in 1919 and early 1920, are still too clear in the minds of business to be forgotten. Business confidently expects that as the top of the grade is reached, it will be found that it is a plateau of successful and stable business which has been reached, not simply another sharp peak in the up and down of the business cycle.

If all branches of business will travel on their own side of the road and keep the pace of the crowd, there is no reason to believe that they will not arrive safely at the crest. But spurting ahead, especially attempting to pass just before reaching the top of the grade, will be bad practice.

The Power Outlook And Chemical Industry

THE power supply situation is certain to undergo great changes during the next decade. These changes, foreshadowed last year in the Superpower Survey, are well evidenced by the fact that the largest electric service corporations are studying all the available sources of hydro-electric generation, with a view to supplementing the output of their steam-electric generating plants with power made from "white coal."

The underlying reasons for this tendency are several. Outstanding is the well-recognized difficulty of providing transportation facilities for moving much more coal than the amount now consumed. Then again, the recent difficulties with labor in the coal fields make every coal consumer doubtful of the future continuity of fuel supply. Finally, the recent survey of the Bureau of Mines predicts the exhaustion within the next 50 years of all the good grades of steam coal mined in the eastern United States. This last is of great importance to all, for to raise steam with low-grade coal greatly increases the cost, and it is seldom economical to transport such coal any appreciable distance.

The recent widespread agitation for the development of the power of the St. Lawrence and the interest that New England manufacturers are taking in the development at La Grand Décharge at Lake St. John show where the public and most manufacturing interests look for relief from this coal situation. As predicted in the Superpower Survey, most electric power in the not distant future will be taken from long-distance high-tension transmission lines, fed from hydro-electric

plants, from the most favorably situated of the present existing steam-electric plants and from new steam-electric plants located at the mine-head.

The manufacturer in the chemical line may not see at first glance how these facts will affect him. The large needs of some chemical plants for process steam will undoubtedly make it economical for them to burn coal long after all other manufacturers have found it wise to resort to central station service. In fact, with the recent development of bleeder turbines, it may never be of financial advantage for such a plant to cease the use of coal to generate steam.

However, in many localities in Canada, such as Montreal, Three Rivers and St. Johns, and also in France, Italy, Switzerland, Norway and Sweden, it has been found worth while to generate steam by the use of electric-steam boilers. This because coal is difficult to get and is expensive, and there is a ready supply of high-tension current which can be cheaply had, especially at off-peak load periods.

It would be advisable for users of process steam in this country to investigate the methods used and the results obtained in Canada. For with the prospective development of high-tension distribution in this country, they may find it advantageous to follow the foreign example and place their full dependence on central station power.

A Wake Or Awake?

WHEN a gathering of technical men holds several simultaneous sessions, as is the habit of the American Institute of Mining and Metallurgical Engineers, it is obviously impossible for one person to attend all of them and appraise the relative interest manifest in the various subjects. However, the writer of these lines did sit through the recent sessions of the Institute of Metals Division (devoted to non-ferrous alloys) and those of the Iron and Steel Section. At the end of the meeting he could not help wondering, "What is the matter with the steel men?"

Looking back through the old volumes of *Transactions* you can find metallurgical classics from the pens of FRITZ, HOLLEY, HUNT and GAYLEY. Then after the mechanical revolution of 30 years ago came the interest in quality metals, exemplified by the new science of physical metallurgy. The keenest students turned their attention to this and during the decade from 1910 the *Transactions* bristled with micrographs and expositions of principles of heat-treatment by HOWE, SAUVEUR, JEFFRIES and BURGESS. Now the leader of these men has passed from us, the others have enlisted their interest in other societies or are publishing through more congenial channels. At any rate, any one having a lively remembrance of the discussions on "flakes" 5 or 6 years ago, a discussion which lasted all morning and broke out afresh and usurped a whole afternoon's program, views with sinking heart a meeting before which was dragged a specification for pig iron—already considered at length by other more interested organizations—and a resurrected paper on merchant bars, written from the 1900 viewpoint.

Of course it is unfair to expect an industry continually to put forth epoch-making ideas and improvements. Perhaps the steel industry has shot its bolt. But the American Society for Steel Treating continues to grow vigorously and hold monthly meetings in thirty different places. And in the Institute itself a smaller group of men, representatives of the poorly organized industry made up of hundreds of little brass and bronze foundries overloaded with hoary traditions and archaic methods, is able to maintain interest and even prepare a feature program.

The life seems to have gone out of the steel men. To see them sit around, after the best fashions among manufacturing chemists, with trumpets to their ears and padlocks on their lips, one would think that they have either reached the summit of absolute perfection or that they have no ideas whatever. Even when an excellent and suggestive paper on dirty steel is read, their silence is intense. One might imagine they had never seen such an animal, or if they had, had promptly nailed its skin on their barn door.

"We protest," say the steel men, "that our silence should be so interpreted. We are experimenting continually, and considering ways and means to improve our product. We have conference after conference for just that thing." But isn't it about time you were getting together in some sort of organization, somewhat extraterritorial? where the men from the big plants can rub elbows with those from the little independents —swap ideas and devise ways and means of warding off the demands of these pestiferous steel treaters, even if it is necessary to find out how to give them what they want. "Why, you know that 6 months ago a man in New England started to investigate his tool failures with hot acid, and today a fellow as far away as St. Louis is demanding 'hot etch' in his specifications! This thing has got to stop!"

Well, get together and stop it. But between you and me, it will not be stopped by a conference in the Carnegie Building, one of those meetings at the Commodore Hotel where Judge GARY rises and says "Gentlemen, I see no reason to doubt the future," or such a wake as the recent A.I.M.E. steel session.

Have You Obtained Your Engineer's License?

NO MATTER what one may think of the policy of licensing professional engineers, the fact remains that over half of the states have laws now on their books requiring that such licenses be obtained. In some states these laws are already in operation. In others the date on which they become operative is not far off. In New York State, for instance, the law takes effect May 5, 1923; and after that date no engineer may engage in the active practice of his profession unless he is licensed.

In view of the almost universal lack of knowledge of license laws among engineers we are printing elsewhere in this issue a résumé of license conditions in twenty-five states, together with the sections of the New York State laws that are of greatest interest to those about to apply for license. In this connection, the New York State law is among the most severe in requirements. Many other states accept the same or lesser qualifications as evidence of fitness to practice. Between many states there is reciprocity so that engineers licensed in one state may practice in another without obtaining a new license.

We advise those of our readers who are soon to be affected by these laws to read over the requirements of New York State carefully and then take care of this new obligation lest neglect should interfere with the conduct of their work.

Co-operation on Industrial Alcohol

A GROUP of representatives of the chemical, drug and related industries interviewed the Commissioner of Internal Revenue recently regarding industrial alcohol. The serious problem imposed upon industry by the restriction of this much maligned industrial chemical was clearly set forth, and the Commissioner was asked to establish a separate industrial alcohol unit in his bureau or, as an alternative, to appoint an advisory committee to assist in formulating rules and solving problems.

A very happy solution is now in sight. Commissioner BLAIR tentatively accepts the idea of a committee of ten members to work with his bureau. It will include wholesale and retail druggists, manufacturers of flavors, extracts, toilet goods and pharmaceuticals, chemists and business men acquainted with the problem from the point of view of both producer and user.

The appointment of such committee in the very near future seems assured. It is to be hoped that nothing will delay its appointment and its aggressive effort to straighten out the present snarl. A mutual understanding certainly could clear the atmosphere of much of the sulphurous language which has been incited by past proceedings.

The Civic Aspect Of Chemical Industries

CITIES in this country have been growing like weeds for the past 10 years. Most, if not all, have grown faster than is good for them; too fast to allow for the proper planning for beauty, for wholesome and economical living, and for the general welfare of their citizens.

Of the hundred cities that have grown most rapidly during the decade from 1910 to 1920 it is reported that increase in population has been principally due to the following causes: 13 on account of the automobile industry, 8 to the discovery of oil or gas in the neighborhood, 10 are suburban towns drawing their people from the overflow of larger cities near by, 18 to iron and steel, 7 to climate, hotels, boarding houses and facilities for health recovery and for amusement, 10 to cotton and cotton manufactures, 9 to the production of foods, 8 to lumber, and 17 attribute their rapid growth to reasons that are indicated as "scattering."

Although the production of iron and steel and the preparation of foods are essentially chemical industries, they are not generally so classified, and for the purpose of our thesis we shall confine ourselves to those industries generally recognized as chemical. What is it, then, that chemical industry does for the community in which it establishes itself? Of all the cities mentioned in the census report Wilmington, Del., is probably the only leading chemical producer among those recorded as "scattering," and we must bear in mind that during the war Wilmington was also very active in shipbuilding.

Chemical industries do not employ a large number of laborers in proportion to the capital invested or the value of the output. It is rare indeed that as such they add largely to the population of a town. And yet, of all the larger producing organizations, the manufacture of chemical products calls for the greatest proportion of technically trained men; of professional men as distinguished from business men and laborers. Aside from a few rustlers in the yard group, most of its laborers also need skill and intelligence. In other words, chemical industry does not often bring to town a vast number of hungry mouths to be fed. But it may, it often can and frequently does, bring *quality*. It brings a considerable influx of professional men, and these, with their scholarly training, are peculiarly desirable as citizens. Skilled workmen are also far more desired as citizens than so-called ordinary laborers.

So much for the advantages. The drawback is that too many chemical concerns maintain dirty backyards; some are offensive in general appearance, and not a few produce noxious fumes and odors as well as unsightly and often destructive wastes. Whenever it is possible to avoid these defects, chemical industry, properly administered, assumes a new civic rôle. With a clean, pleasant-appearing establishment that does not offend, with its large staff of professional men in control and research, who constitute a rare social asset, and its reliable and skilled workingmen, who contribute to the solidity of its people, a city is singularly fortunate in being the home of such an industrial organization. It gives it unusual attraction as a dwelling place. It does far more, in the long run, than the discovery of gushing oil wells in the neighborhood with the sudden millions, the inevitable gamblers, the cheap and short sports, and the collapse that is sure to follow the boom.

Chemical industry sometimes is and oftener may be the contributor of quality, of distinction, of straight thinking and of intellectual life to the city of its domicile.

More Complete Census Information

IN THE past the Census Bureau has reported its statistics on wood distillation in such form that one could not distinguish between the yields from hard and from soft wood. Recently a vigorous objection to this was voiced by one member of the industry and the matter was brought to the attention of the bureau by the editors of *Chem. & Met.* It proved to be a very simple matter to make an arrangement whereby these statistics can be divided to show the two branches of the industry separately.

There are doubtless other interests having similar difficulty with official reports. It is not always easy to use published data, valuable as they are. On the other hand, it is not always easy for the government statistician to understand the needs of industry. At all events, it is highly desirable for the industry and the investigators of such bureaus to understand each other most fully.

In discussing this particular detail with the Census it was found, as might well be expected, that the officials are very anxious to give the maximum possible service to the industries. The bureau obtains inadequate appropriations for some of its work, especially in the Census of Manufactures. But despite this condition, which is chronic with most government offices, the bureau reflects admirably the desire of Secretary HOOVER to make his department a real servant of business. *Chem. & Met.* has frequent occasion to confer with government officers and we find them almost invariably entirely reasonable and approachable. They cannot accomplish the impossible, although they are often in a position to do far more for an industry than is being done if they only know what is wanted.

Readers' Views and Comments

Magnesia as a Polishing Agent

To the Editor of Chemical & Metallurgical Engineering

SIR:—I should like to correct the misleading impression that one is likely to get from reading your article on "Magnesia as a Polishing Agent," page 441, March 7, 1923, which states that Dr. Rosenhain originated its use.

In my article on "Polishing Aluminum and Its Alloys for Metallographic Study," I gave credit to Hanson and Archbutt for introducing its use for polishing aluminum, because they made the first mention of it that I found in the literature. However, anyone reading the reference that I gave (*Inst. of Metals*, vol. 21, No. 1, 1919) would find in the discussion that Dr. Rosenhain stated that he had used the powder about 15 years previous, and would thus readily concede the distinction to him.

McCook Field,
Dayton, Ohio.
E. H. DIX, JR.

The Nature Of Solid Solutions

To the Editor of Chemical & Metallurgical Engineering

SIR:—In the article entitled "The Nature of Solid Solutions" which appeared in the Jan. 3 number of *Chem. & Met.*, a discussion of the crystal structure of the gold-copper solid solutions was introduced. Due to an error in computing atomic per cent from composition by weight, the inference was drawn that the alloys were more dense than their weighted atomic volumes would indicate. It was suggested that some extra attraction existed between unlike atoms which caused the

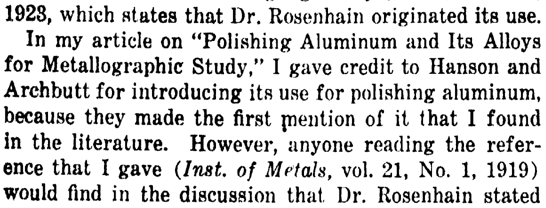

FIG. 1—SIZE OF FUNDAMENTAL CUBE IN THE COPPER-GOLD SOLID SOLUTION SERIES

dimensions of the unit cube of the atomic structure to be less than the atomic proportion would demand if no inordinate compression took place.

Recalculation of the atomic composition for the several lattice measurements produces the straight line function in the plot shown herewith which replaces Fig. 4 of the article. Copper-gold alloys therefore are like the copper-nickel, gold-silver, tungsten-molybdenum and other continuous solid solution series, and do not exhibit the overcompression of the solid solutions of pairs of metals which show limited solubility with formation of intermetallic compounds such as copper-zinc, copper-tin, copper-aluminum, silver-zinc and silver-cadmium.

It appears that the properties of the atoms which enable them to form intermetallic compounds also cause this attractive force when they are organized in the space-lattice of the solvent metal as well as in the compound lattice. And those pairs whose members are chemically similar and without what is sometimes called "chemical affinity" form the continuous solid solutions with no unexpected lattice shrinkage.

Cleveland, Ohio.
EDGAR C. BAIN.

Intelligence Tests For Intelligence Testers

To the Editor of Chemical & Metallurgical Engineering

SIR:—You have recently devoted a little space to the consideration of educational matters, particularly the education of engineers, a subject naturally leading to the question, "What is an engineer?" You have also attacked that problem, at least to the extent of deposing and saying that to the best of your knowledge and belief the man who drives the boss to his work in the morning is not an engineer.

Perhaps, therefore, you will permit the observation that a neat definition of "engineer" and the widespread misuse of the word will neither be found nor prevented (respectively) until the officers of our technical schools, where "engineers are made," as it is said, make up their own minds on what is an engineer and what constitutes engineering. I have documentary evidence indicating this state of affairs, taken from the January number of the *Bulletin* of the Society for the Promotion of Engineering Education. Their committee No. 22, on intelligence tests, commenting on "the fact that the engineering profession is losing its identity," writes as follows:

"If a boy fails in machine design and in mathematics he may still become an engineer. It is only necessary for him to declare that he is a commercial engineer, a human engineer, that he can 'engineer' something that is non-technical. Suppose that a boy is considering engineering as his life work and that he has never had any interest in mathematics, physics, mechanics, machines, electrical devices, and tools. Should we advise him to stay out of engineering? That is a very real question. The boy might succeed in engineering anyway by choosing a course in administrative engineering. He does not need to worry about machine design and mathematics, because he is going to train himself to be a leader, the chief who *merely dictates to the ordinary engineer* what is to be done. [The italics are mine.] He wants to be the kind of engineer who is a leader in industry, not the ordinary kind of engineer who invents and designs and who solves problems that are scientifically intricate. He also has the option of becoming a sales engineer, with emphasis on sales. What can the vocational counselor do with such wonderful possibilities?"

What, indeed? I am dumb in the face of these overpowering thoughts!

Suppose a boy—your boy—on reaching college age was color blind, was a crack rifle shot, would go to sleep at a concert, was nauseated by interpretive dancing, could ski like a Norwegian, abominated Ben Hecht

and spent his spare time making puppets and breeding puppies. Should we advise him to stay out of art? That is a very real question, Mr. Editor!

If you were to ask my opinion, I should say that he certainly should by all means be an artist! One of that kind who spend from 10:30 to 1 o'clock in the Seventy-fifth National Bank behind the desk labeled "Chairman of the Board." A sort of sales artist, if I may coin the word, with emphasis on the sales. Let him be a leader, the chief who merely dictates to the ordinary artist what is to be done. Let him be *the leader*, not the ordinary kind of artist who communes secretly with the wise and beautiful and good, absorbs them into his soul and pours forth a vision of loveliness unthinkable, spreading its effulgence on this sordid world throughout the ages, and enrapturing all beholders with its majesty and godliness!

What can the vocational counselor do with such wonderful possibilities? My suggestion, Mr. Editor, is that they try to invent some intelligence tests for intelligence testers! MARTIN SEYT.

The Purposes Of a Standard

To the Editor of Chemical & Metallurgical Engineering

Sir:—Apropos of your editorial "The Purposes of a Standard" it occurs to me that as far as heavy chemicals are concerned the following points are worthy of consideration:

(1) Fixed standards will enable the buyer and seller to know they are talking about the same thing.

(2) Such standards should be an evolution inasmuch as they should arise from existing practices.

(3) In so far as the standards themselves are concerned they should not do more than record a specification. The improvement of specifications should arise from normal business. Enthusiastic people often write ideal specifications which unduly raise the prices of commodities. We have an example of this in the high candlepower standard of gas in the city of New York.

(4) Many individual specifications at the present time are somewhat, but not very far, different from a number of others. These differences might be brought together and such a movement would result in simplicity.

New York City. WALLACE P. COHOE.

Brittle Steel Evaporating Pans

Dr. T. Swinden read a paper before the Birmingham Metallurgical Society recently on "The Embrittling Action of Sodium Salt Solution on Mild Steel." As reported in *Engineering*, he stated that this type of failure was quite distinct from ordinary rupture arising from stressing beyond the normal static strength, or the fatigue type of fracture due to repeated or alternating stresses causing slip within the crystals. The embrittling action of certain salt solutions on mild steel was similar to the action of mercury and ammonium salts on stressed brass causing what was now generally known under the term "season cracking." The particular problem under discussion was the failure of mild steel plates forming the base of large evaporating pans operating upon mixtures of sodium and potassium nitrates. Whereas these pans lasted for many years without any abnormal failure when evaporating brine, trouble was immediately experienced when the nitrate solution was substituted for brine, and the failures were a matter of vital importance during the war period. Experiments showed that a steel plate laid loosely on the bottom of the pan was not deteriorated, while similar plates riveted in the pan in the ordinary way cracked. It was obvious, therefore, that stress was a necessary factor. However, since the action of nitrates was so distinctly different from that of chlorides, it was suggested that selective chemical action was the fundamental factor in producing "season cracking" in mild steel. The analogous case of the action of sodium nitrate was already well known. The speaker suggested that the embrittling action was due to an absorption in a state of solid solution of nitrogen or oxides of nitrogen from the nitrate solution by the material forming the intercrystalline boundaries.

Tin Ore Deposits

Tin is a difficult metal to mine and the known supplies in the world are limited. According to a report made to the Board of Trade, the output from the large alluvial fields of the Federated Malay States, which amounts to 30 per cent of the world production, has already begun to decline. In the Dutch East Indies and in Nigeria, supplying respectively 15 and 4 per cent of the total output, no expansion of the alluvial deposits is considered probable. Siam and China produce about 8 per cent respectively of the world output, but no large increase is looked for in either country.

Bolivia is the only tin-producing area besides Britain where a large output is obtained from lode mining and increased output there is dependent upon the price obtained for the product. Bolivia produces approximately 20 per cent of the total output of tin. Britain's contribution of metallic tin to the world's supply is under 5 per cent and is smelted from ore found in Cornwall and the adjoining part of Devonshire. Most of the mines, however, are faced with a decreasing yield from the ore mined and the position can be retrieved only by the discovery of new bodies of ore, which is possible but likely to be expensive.

El Dorado Oil Field in Arkansas

In a report recently issued by the United States Geological Survey, the results are given of an examination of drill cuttings from one of the wells in the El Dorado oil field. The examination enabled the geologists engaged in the work to subdivide the formations above the producing sand into ten zones, which can be distinguished by carefully watching the drill cuttings as the drilling progresses, so that the approximate position of the bottom of the hole with respect to the oil sand can at all times be known.

The lines of separation between certain of the zones are sharply marked. When the drill passes from the bottom of the Wilcox into the top of the Midway formation it goes from very sandy beds into beds that are only slightly sandy. The point of contact between the Midway and the Arkadelphia formation is also sharp and is easily detected, for at this point the drill passes from beds containing much sand and some limestone into beds that consist dominantly of shale or gumbo. The contact between the Wilcox and the Midway must be carefully noted, for oil or gas may be encountered anywhere below it, and a constant lookout for showings should be maintained after the Midway has been reached.

Casehardening Plant Timken Roller Bearing Co.

Timken Hardens Over Two Million Roller-Bearing Parts Daily —Special Furnaces and Quenching Machines—Slow, Mild Carburizer Used Exclusively—All Pyrometers of Platinum Wire—100 Per Cent Hardness Inspection on Cups and Cones

By E. W. Ehn
Metallurgist, Timken Roller Bearing Co., Canton, Ohio

IN THESE days when everybody owns an automobile of some breed or color—or cherishes a fond hope to buy one as soon as he can obtain the necessary credit —it is perhaps unnecessary to say very much about the way a roller bearing works. Bearings of this kind are found in every part of a modern automobile, front and rear wheels, differential, transmission, pinions, steering pivots, etc. It is not the intention here to enter into a discussion of the relative merit of the different types of roller bearings, or compare them to ball bearings, but in order to describe the metallurgical problems encountered in the manufacture of bearings it might be well to give a short description of the bearings. A typical Timken bearing is constructed as shown in Fig. 1. It consists essentially of an inner race or "cone" *A*, which slips tightly over the shaft, also an outer raceway, or "cup" *B*, that fits tightly into the wheel or bearing box. Placed between these two are a group of tapered rollers, *CC*, varying in number with the size of the bearing, properly spaced in a loose-fitting cage, *D*. By designing the cups, cone and rollers so that the apexes for the different surfaces coincide and fall on the center of the shaft, a true rolling contact is obtained without any sliding motion between the different members of the bearing. Ordinary tapered bearings will, therefore, carry a load on a line contact and will be able to take up a considerable thrust-load in addition to the normal load. By varying the angles the capacity for taking thrust-load and normal load can be regulated at will and suited for different applications.

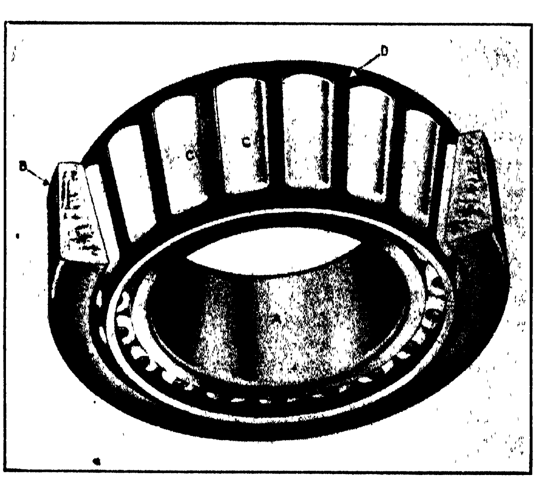

FIG. 1—ASSEMBLY OF TIMKEN ROLLER BEARING

Disregarding the cage, which will not be considered in this outline, all the cups, cones and rolls are made of casehardened low-carbon chromium steel of the following analysis:

	Cups and Cones Per Cent	Rolls Per Cent
Carbon	0.15 to 0.20	0.15 to 0.20
Manganese	0.45 to 0.60	0.45 to 0.60
Sulphur	Below 0.040	Below 0.040
Phosphorus	Below 0.040	Below 0.040
Silicon	0.15 to 0.20	0.15 to 0.20
[illegible]	0.40 to 0.60	1.00 to 1.20

The superiority of the steel is not wholly due to the analysis of the steel used, but is also due to the electric furnace process employed for its making. The Timken plant includes a complete steel mill for making all tubes, bars and rods necessary for the production of the bearings. Steel is made in four 6-ton Heroult furnaces, and the fact that day in and day out the same steel is manufactured permits the workmen to become thoroughly proficient and to have a thorough knowledge of the requirements that must be met.

Laboratory tests, coupled with experience with more than 70,000,000 Timken bearings in service on all types of automotive apparatus and in mechanical and industrial machinery, prove that a bearing made from open-hearth steel will not give the performance and satisfaction of one made from a steel produced by the electric furnace. To prevent misunderstanding it must be mentioned that no claim is made that all open-hearth steel is bad. From time to time when making open-hearth steel, some heats will be as good as electric furnace steel, but for consistently good quality no steel can beat properly made and thoroughly deoxidized electric furnace steel.

Steel is made in the Canton plant from specially selected and analyzed scrap—50 per cent heavy scrap and 50 per cent turnings. After melting down, a test for carbon is made, and if too high some mill scale is added. The first, or dephosphorizing slag, is then rabbled off, the bath recarburized if necessary by coke, and the finishing carbide slag made up. Final adjustments of carbon and manganese are made by adding pig iron after the laboratory analysis has been received. Silicon additions are then made as indicated by forge tests, the furnace is tilted and the steel cast in molds about 5 ft. long and 16¾ in. square, set big end up and having a hot top. Special care is taken to insure a good surface on the ingot—the mold is washed with a solution of molasses and aluminum powder, the ingot remains undisturbed for 1 hour and is then [illegible]

alongside the soaking pits, kept upright, and stripped only when ready to charge.

Ingots are forged into 8-in. blooms in a 625-ton press, cropped, cut in two and cooled. After chipping surface defects they are heated and rolled into useful sizes in a three-high 22-in. bar mill having tables which not only tilt but act as transfer tables as well. Bars from this plant are stock for automatic machine tools and forging machines. Some of the round bars are reheated and pierced in a Mannesman mill, and drawn to size for the caps and cones.

It will be noted that rolls contain a higher chromium content than the cups and cones. It will also be shown that the rolls are double treated after carburizing, as compared with a single quench for the cups and cones. This difference in practice is due to the fact that the rolls in a roller bearing, as well as balls in a ball bearing, must be the strongest part in the bearing. The experience with bearings on the road for more than 20 years, and with tests that have been conducted over a period of 10 years, show that if a bearing is overloaded, failure in service or in test will always be by failure of the rolls. If it were possible to make a better roll, it would consequently be possible to make a better bearing. Some years ago, when nickel steel was being used for rolls with more or less indifferent results, experiments were conducted by the Timken Roller Bearing Co. extending over 3 years and including thousands of bearings, both in the laboratory and on the road, in order to determine definitely the best steel for this part. A large number of steels were tested—chromium-nickel steels and nickel steels of varying percentages of chromium and nickel, tungsten, molybdenum and vanadium steels. Results clearly indicated that the high-chromium steel (1.0 to 1.2 per cent), such as used today in our bearings, was to be preferred to the chromium-nickel steels sometimes suggested for roller bearings. It also confirmed the standard practice in making ball bearings. High-chromium rolls showed the best resistance to wear, fatigue and shock of all the steels that were tried.

Test for Quality

It is outside the scope of this article to discuss the metallurgical details underlying the production of steel, interesting though such an account would be. Every 6-ton heat from our electric furnaces is checked for chemical analysis. In addition, tests are made on the suitability of the steel for casehardening purposes. This method has been developed at the Timken plant and has been the subject of several recent publications.[1] By means of tests of this kind it is possible unerringly to pick out a heat of steel which, while fulfilling all physical and chemical specifications, will possess a tendency to form "soft spots" in hardening. The tests are based on microscopical examination of carburized specimens and a special laboratory outfit working as part of the regular inspection is supplied for this work. Its success has been complete and similar tests are now used at a great many other factories doing considerable carburizing.

The different operations for conversion of the ingot in the steel mill into the proper sizes of forgings, tubes, hars and rods will not be described further. It is sufficient to state that the finished pieces, after proper inspection for size and physical defects (such as seams or laps), are moved to storage racks and from these delivered to the bearing factory according to requirements. By having the steel mill close at hand and subject to orders from the bearing factory, intimate contact and co-operation is maintained—a factor of extreme importance, as it facilitates not only a close control of the raw material for the bearings, but also makes it possible to produce on short notice any tube or bar required for special rush orders.

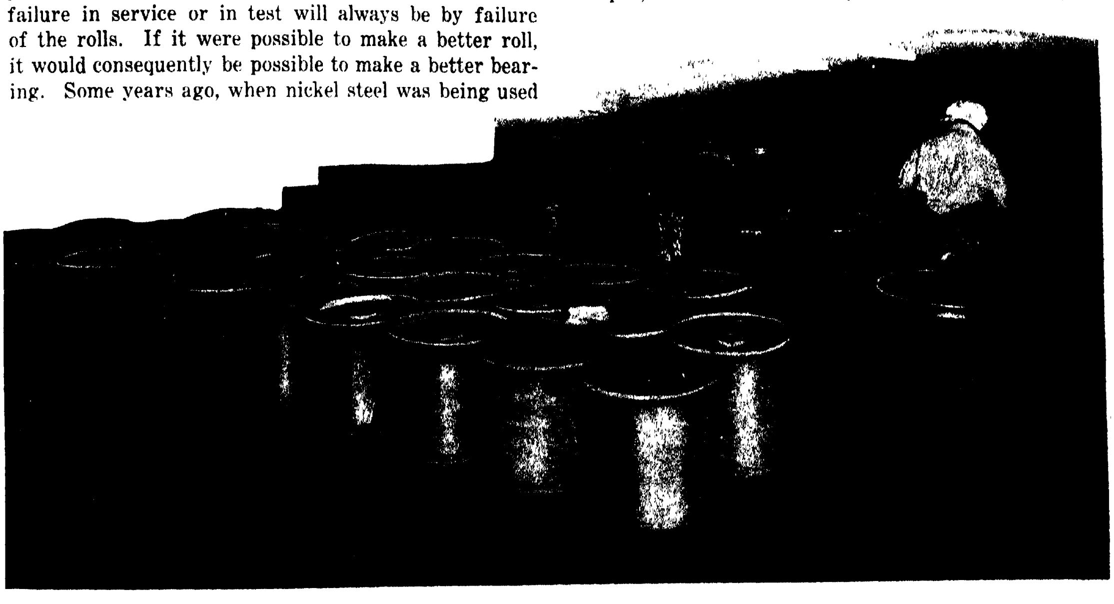

FIG. 2—A CORNER OF THE PACKING ROOM

After the various machining operations in the bearing factory, the "green" cups, cones and rolls are inspected for size, taper and finish, and flow in a steady stream to the carburizing department. The work arrives in properly tagged baskets and pans, and are trucked directly to the packing floor (Fig. 2).

Parts are packed in Nichrome containers with E. F.

[1]"Effect of Quality of Steel on Case-Carburizing Results," by H. W. McQuaid and E. W. Ehn, *Trans.* A.M.E., vol. 67, p. 341 (1922), abstracted in *Chem. & Met.*, vol. 28, p. 656; "Influence of Dissolved Oxides on Carburizing and Hardening Qualities of Steel," by E. W. Ehn, British Iron and Steel Institute, May, 1922, meeting; "Irregularities in Case-Hardened Work Caused by Improperly Made Steel," by E. W. Ehn, American Society for Heat-Treating, 1922, p. 1177 (September issue).

Houghton & Co.'s hydrocarbonated bone black, a compound composed of charred animal bones, charged with a hydrocarbon oil. Every carload of meal is checked before being released for production by special tests under operating conditions and the results must conform to rigid specifications. This compound is a carburizer of the slow type, nearly free from energizing chemicals and with a rather small grain size as compared to most other carburizing compounds. When dry or mixed one part new to three parts old, it flows very freely, which facilitates the packing and dumping of the pots to a considerable extent. The compound is rather heavy as compared with most other compounds, weighing 40 to 45 lb. per cubic foot, and has a comparatively slow heat penetration, but has, on the other hand, several advantages that offset these undesirable features. Shrinkage, even after 50 to 60 hours at heat,

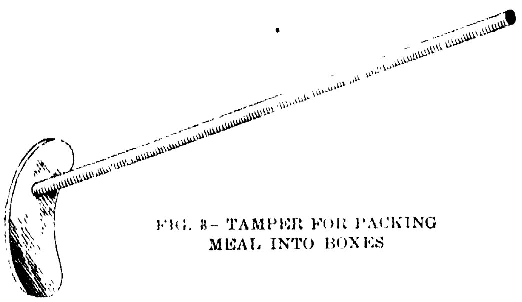

FIG. 3—TAMPER FOR PACKING MEAL INTO BOXES

is negligible and the compound retains its carburizing power practically indefinitely. On account of the slow penetration of carbon into the steel the danger of obtaining hyper-eutectoid cases is eliminated, a matter of extreme importance in the manufacture of roller-bearing parts, where an excessive amount of carbon in the surface would result in its chipping or flaking away and failure of the bearings would quickly result.

Most carburizers are of the rapid type, highly energized and having charcoal or coke as the base. Such compounds have a high shrinkage and lose their carburizing power after 10 to 15 hours at heat, when the energizing chemicals are exhausted. A compound of this type will give a heavy case in a comparatively short time, which of course is desirable from a dollars and cents standpoint, but on account of the almost inevitable variation in furnace temperature during the heating period, there will also be a very distinct tendency toward unevenness in carbon content and depth of case between the work in different parts of a single pot and the work contained in different pots. This may be all right for certain classes of work, but is distinctly not satisfactory when making roller-bearing parts where absolute control and evenness in the case is essential. With the slow carburizer and long time at heat, which features Timken practice, it will make no discernible difference if one pot should reach carburizing temperature slightly ahead of other pots in the furnace. The firing is, moreover, so regulated that there is a minimum danger in this respect.

The work is packed with bone meal into pots made of Nichrome, which alloy has been found to give very satisfactory service. This packing is done by hand by operators sitting in front of the pots with a pan of work on one side and a can of meal on the other. After spreading about 1 in. of meal in the bottom, a row of rings is laid in; this is barely covered with meal and smoothed down and patted in place with a little tamper such as is shown in Fig. 3. The usual practice is to pack the cones inside the cups of the same bearing and reasonable care is taken that the different parts do not touch one another. Two inches of carburizer is always provided at the top of the pot. Rollers are simply scooped into the pots in layers, and contrary to the usual experience in carburizing—that soft spots will be obtained in hardening if the parts touch one another—it has been found that no trouble is experienced in this respect. The reason for this doubtless is that with the long time at heat required by the Timken practice, the carbon has an opportunity to equalize by diffusion, which is not possible when, as in most places, a total time of only 4 to 10 hours is allowed in the furnaces.

ALLOY POTS

Various shapes and types of pots have been used, but best results are obtained with round pots, such as shown in Fig. 4. The pots are considerably larger than the pots used in most other plants, and on account of the size and the slowness of heat penetration with bone meal, the pots are made with a 4-in. chimney in the middle. To facilitate the handling and to allow for heat penetration also from the bottom, the pots are made with stout legs 2½ in. high, and lately legs have been placed also toward the middle of the pots to prevent the bottom sagging. Covers are made with flanges fitting around the chimney and against the wall of the pot. After the pot is filled the cover is rammed down and the fit is close enough to eliminate the use of luting clay. This is one great advantage over steel pots, as when clay is used it is difficult to prevent dirt from getting mixed into the meal and afterward cause soft spots in the hardening operation. Eliminating the clay sealing also facilitates handling the pots and taking out the control samples. It can be mentioned that on the scale on which carburizing is carried out in the Timken plant a saving of two to three men's labor is obtained simply by eliminating this luting operation. Covers are made with flanges on both sides and are used indiscriminately with one or the other side up—this in order to avoid sagging and cracking around the flanges. We have tried other types of pots, of square or rectangular shape,

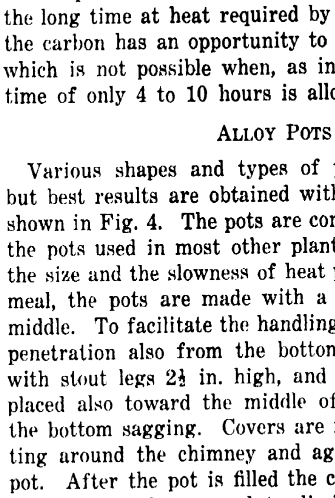

FIG. 4—NICHROME POT

but the sides of these containers warped and cracked badly, and with the exception of a few old pots, the use of this type has been discontinued. Steel pots have also been employed to some extent, but are no longer used. Besides having a short life they scale and warp badly, are very heavy, and heat penetrates slowly through the scaled surfaces. In spite of the lower price per pound, steel pots are in the long run more expensive per heat-hour, and require much more work for handling and sealing. Pots of other heat-resisting alloys than Nichrome have been tried, some with fairly good results, and some with results not

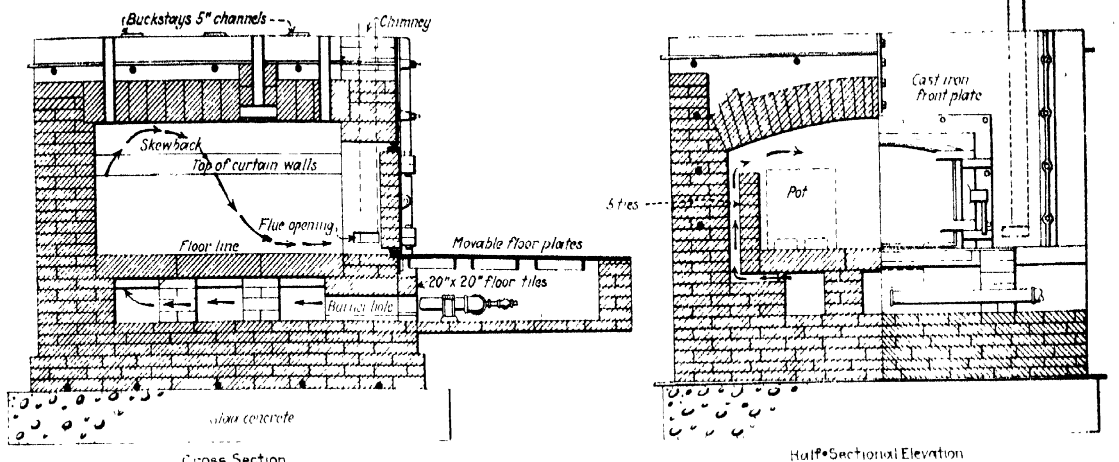

FIG. 5—CARBURIZING FURNACE UNIT

so good. As far as resistance to heat is concerned, several have been satisfactory, the trouble usually being that the legs break off due to a brittle metal and the rather rough handling to which the pots are exposed.

All Nichrome pots are guaranteed for a certain minimum time in service, and in order to keep track of the different pots large identification numbers are cast on the outside of each pot. The furnace hours for each pot are recorded on special sheets, and the time is computed for each pot four times annually. With about 1,500 pots in service, this is quite a job, but it is necessary and in fact pays for itself. The majority of the pots give much more than the guaranteed life, some still being in good condition after more than 10,000 heat-hours, but others, especially those of square design, have not given such good account of themselves. Most of the failures have been due to weak legs, which, however, has now been entirely overcome by an increase in section. Occasionally a pot must be discarded because it cracked around the chimney or developed holes in the sides or in the bottom, these latter defects probably being caused by segregations. However, the latter types of failures have been scarce. In this connection it might be mentioned that Timken practice presents exceptionally favorable conditions for alloy pots, what with slow heating, long heats and a compound containing no energizing chemicals. Rapid and repeated heating or cooling is naturally very damaging to pots of any kind, and it is well known that energized compounds containing cyanogen salts (and to a certain extent sodium carbonate) have a deteriorating influence on nickel-chromium alloys.

Carburizing Furnaces

The packed containers are heated in special furnaces to a temperature of 1,680 to 1,700 deg. F. and kept at this temperature for various lengths of time, depending on the depth of case required. Seventy furnaces, each with a floor space of 5x5 ft., are available, grouped in three blocks and built side by side and back to back, strongly bound together with rods and buckstays (Fig. 5). Such a construction obviously conserves the heat very well, since the individual furnaces radiate heat only through top, bottom and front. The door is a large iron casting hinged on one side and lined inside with a cement-Silocel mixture. It swings open quite easily, but can be held tightly shut by wedging against a cross-bar. When heat is on, all edges are carefully luted with clay. The furnaces are of the underfired type, with a hearth of flat tiles. These are supported by firebrick walls running from front to back, forming a labyrinth through which the flame and hot gases must pass, backward and forward, until they find their way out up the slots formed by the side walls and the vertical tiling set at the side of the hearth. In the furnace chamber the moving gases strike the arched roof, are deflected back down upon the pots, work their way forward and pass through low openings near the door into

FIG. 6—REMOVING A HOT BOX

small exhaust chimneys built in both door jambs. With this method of heating and the construction of twenty to thirty furnaces in one block of brickwork, the temperature distribution in a furnace is extremely uniform, and it is very rare to note any material difference in the quality and depth of case in the different pots that constitute one furnace load. If such a difference is observed, it indicates that the furnace is burned out and should be rebricked.

Heat is supplied by one centrally located burner in front of each furnace. This principle of using one single burner for each furnace is, by the way, a distinct feature in all furnaces used in the Timken plant and it is obvious that firing is thus simplified to a large degree. *Natural gas is used when this is available*—i.e., during summer—and oil during the remainder of the year. Gas firing allows slightly better control and with the burners with dirt and coke. Burners are so made that they can be used for either gas or oil and connected up in such a way that a change from one fuel to another can be made on a minute's notice. The consumption of oil per furnace when up to heat is about 3 gal. per hour and somewhat higher during the heating period.

The loaded carburizing pots are charged into the furnaces by means of special trucks, such as shown by the foreground of Fig. 6. It is usually possible to arrange the schedule so that one full furnace load of nine pots, containing work that requires the same depth of case, can be charged in the same furnace. If this is not possible, the pots with work where a thinner case is desired are charged in front and later withdrawn ahead of the rest of the pots. In moving the pots forked tongs on the front of the truck are slipped under the bottom

FIG. 7—BATTERY OF LEEDS & NORTHRUP RECORDERS

prevailing prices is cheaper, but is harder on the furnaces. A furnace on gas has to be rebuilt about twice as often as when using oil as fuel. In order to obtain proper results it is necessary that a high grade of light oil be employed, and every carload is therefore submitted to laboratory tests for residual carbon, fluidity and to other routine tests before it is pumped into the storage tanks. Oil is supplied to the furnaces through a circulating oil system—i.e., the oil pumps are so dimensioned that they will supply an amount of oil many times in excess of the consumption and the excess oil is carried back to the storage tanks. Pressure is kept constant by pressure regulators on the feed and return lines, the former adjusted to 60 to 70 lb. immediately beyond the oil pumps, and the latter to give 35 to 40 lb. immediately ahead of the discharge to the storage tanks. This system is much to be preferred to a dead-end system, as it facilitates an even adjustment of the oil pressure and has much less tendency to clog up of the pot, between the short legs, and the leverage provided by a long handle is great enough so that the operator can balance the 300 to 400 lb. weight of the loaded pots and move them around rapidly and with great ease. He can also reach into the far corner of the furnace without coming too close to the hot door. All the furnaces are built with their floors level with the aisles, which in turn are paved with cast-iron plates, and the charging or discharging of a furnace can, by means of these trucks, be done in from 5 to 10 minutes. When a charge has been drawn the hot furnaces are reloaded and sealed as quickly as possible. Some of the floor plates in front of the furnace are removed, opening the pipe trench and exposing the burner and its port hole. Control valves for fuel and air are located at handy places in front of the door jambs. Firing at the start is relatively brisk, so that the cold pots may not draw heat from the surrounding brickwork too rapidly and disturb the temperature in adjoining ovens. It is

desired that all charges be brought to heat in 10 hours, a time sufficient to insure that no great difference in temperature exists between the different pots and from center to outside of the individual pots. As previously noted, further assurance regarding the uniformity of the case is obtained by the use of a slow carburizer, and even if the work in one pot should be at effective carburizing temperature 30 minutes longer than the work in another pot, the variation in case cannot be measured.

It might be thought that fuel economy would demand quicker heats, but the construction of the furnaces is such that only 3 gal. of oil, costing about 6 cents a gallon, is required per hour for one furnace, and the extra cost for several hours' heat is compensated by the saving in labor from packing and handling the work in large pots and the greater regularity of the results obtained. It is quite true that more equipment and furnaces are necessary, but careful calculations in regard to the saving of labor cost show that the actual cost of carburizing by the Timken practice is not higher than though a faster carburizing process were used. Even if the cost should be higher, it would be many times repaid by the high and uniform quality of the casehardened work, which is absolutely essential for the parts in a bearing. Moreover, a few rejections at this stage in the operation would amount to more than the cost of the entire carburizing operation. It is not the intention to criticise in any way the practice for carburizing used at other plants, as it is realized that for many purposes faster methods and compounds can be used, but for the very accurate work necessary in making roller bearing parts, only a method such as outlined above will give satisfactory results.

Platinum Couples Used

Temperature in each furnace is measured by platinum thermocouples used in conjunction with indicating and recording potentiometers. The thermocouple is protected by a short quartz tube, extending through the arch at about the middle, and projecting down 3 in. into the furnace. The other (cold) end is surrounded by water jackets and with open discharge overflowing in front of the furnaces so that it can be instantly seen whether all cooling jackets are working properly. Thermocouples are welded to extensions of copper wire that are connected in the usual way by a double-wire system to mercury selective switches in the furnaceman's office and extend to the main pyrometer room. (Some years ago the usual system with a common return line to all thermocouples was used, but it did not prove satisfactory.) In the furnaceman's office individual readings by a potentiometer indicator are made and recorded for each furnace at 30-minute intervals. This record guides the fireman, and he constantly refers to it and adjusts each burner valve accordingly. The main pyrometer room holds the recorders (one battery is shown in Fig. 7) so that heating curves can be obtained on every heat, if a furnace load for one reason or another should not give the desired results.

It has been said that this installation of platinum couples with water-cooled cold ends is unnecessarily expensive, but careful calculations have shown that in the long run, in spite of the high cost of installation, this system does not cost more than the usual installation of base-metal couples. Our pyrometers last indefinitely; one man has no trouble in taking care of about 150 couples, checking them for accuracy once a month. The cost of maintenance is therefore very low as compared with other systems. Moreover, in this line of work, there is only one thing that counts—accuracy—and a few spoiled heats due to defective couples would pay for a very large part of the installation.

After reaching temperature, the furnace is held within 10 deg. F. plus or minus for a length of time, varying from 4 to 50 hours, depending upon the required depth of case. The shorter time will produce a case $\frac{1}{64}$ to $\frac{1}{32}$ in. deep, while the latter will give $\frac{3}{32}$ to $\frac{7}{64}$ in. penetration. The depth of case that can be expected after various lengths of time at heat has been carefully determined by experiments. In addition test specimens are packed in each pot, strung on a loop of wire, one end of which is hooked over the edge of the pot. When the time is judged right, the furnace is opened long enough to withdraw one pot, the samples are quickly extracted without disturbing the contents materially, water quenched and broken with a sledge. Visual examination after dipping in 10 per cent nitric acid indicates to the inspectors whether the desired depth of case has been obtained. If not, the pot is replaced, the furnace sealed and firing recommenced. After an appropriate time, a second pot is withdrawn and test specimens again quenched, broken and examined.

When a furnace load is approved by the inspectors, the pots are removed from the furnace and trucked to a cooling alley, where they stand in open air, requiring about 6 hours to reach 150 deg. F. From each pot is taken a sample of the work, which is reheated to 1,420 to 1,440 deg. F. in a small furnace, quenched in water and broken. After etching the fracture in 10 per cent nitric acid the depth of case may easily be estimated by the dark ring produced. Each individual pot is thus tested and the release is indicated by insertion of rods with attached tags of various colors, showing the nature of the work in the pot and giving instructions for further handling.

When the pots are thus released they are trucked over to a metal screen, No. 4 mesh, set flush with the floor, and dumped upside down. The meal sifts through the screen like dry sand, drops into a hopper, and leaves behind the various carburized parts on the screen. They can then be shoveled into pans and barrels for transfer to the hardening room. Meal is taken from the underground hopper by a screw conveyor and belt elevator to a closed storage bin. All these housings are connected to a suction exhaust and cyclone collector system, which is quite effective in keeping any dust from flying in the air. From the storage bin it is passed through a pug mill, fed automatically with three parts old and one part new meal. This drops into large containers, and these cans of carburizer are returned to the packing floor.

Hardening the Carburized Work

Hardening practice for cups and cones is different from that for rollers, and will therefore be dealt with separately.

Cups and cones are heated in specially designed rotary hearth furnaces, the general arrangement of which is shown in Fig. 8. It is 7 ft. in diameter, built like a turret with stationary side walls and roof, bound together with sheet steel. The moving hearth is annular and is covered with close-fitting segments of Thermalloy, a heat-resisting metal, resting on firebrick, which in turn is supported by a steel ring.

This flat ring rests on rollers, and has an annular rack attached to its lower surface, meshing with a bevel pinion, motor driven through a reducing gear and double speed changer. The speed of rotation can, through this arrangement and a system of double cones, be easily changed through a wide range, and the time for one revolution is so regulated that the parts will reach proper hardening temperature immediately ahead of the discharge door. For small work this time is 20 to 30 minutes and is increased to more than 1 hour for cups and cones of very large sections. The furnaces are heated by a single burner, centrally located, on top of the furnace.

The axis of the furnace—its "core," so to speak—forms a short combustion chamber from which the combustion gases, through slots, pass out radially into a second combustion chamber formed by the roof of the furnace and a false arch set about 5 in. lower. This lower arch has a series of fifteen long slots 3 in. wide equally spaced around the false arch except above the doors. The hot gases travel through the working chambers as indicated by arrows in Fig. 8, and escape through the front doors of the furnace. Of these there are two, the one to the left for charging and the other for removing heated rings after they have traveled around the furnace. By tilting the burner slightly it is possible to divert most of the hot gases to the side where the cold work enters the furnace, and this tends to equalize the temperature above the hearth.

A pyrometer is inserted through the roof immediately ahead of the discharge door. Couples are made of platinum, as in the carburizing department, and are protected by short quartz tubes. The cold end temperature is kept constant by a cold water jacket on top of each furnace. Couples are connected through copper wires leading to a selective mercury switch with an indicating potentiometer and in addition to this the temperature of the furnace is checked on recording instruments in the departmental office. One fireman looks after the temperature control for twenty-one of these furnaces, and he is solely responsible for the heat. Fuel and air valves are located at the back of the furnaces where they can be easily reached from a handy walkway. Oil consumption per furnace is between 2 and 3 gal. per hour. Hardening temperature is 1,420 to 1,430 deg. F. for the small sizes of cups and cones, and up to 1,470 for parts of larger section.

The latest development in regard to temperature control is the installation of automatic temperature regulators which are able to keep the temperature within ±5 deg. F. These controllers, which have been developed at the Timken plant, are extremely simple and much cheaper than any of the various devices now on the market. The principle is to divide the original oil line to the burner into two feed lines, each with a needle valve. One of these valves is adjusted so that if the oil was flowing permanently through this line the furnace temperature would be considerably above that desired, and the other valve adjusted so as to give a temperature somewhat below that desired. Oil is caused to flow alternately through one or the other of these valves by means of a small tapered valve with two orifices, from which pipes lead to the two needle valves. This valve is mounted on a shaft and can be brought to revolve about 90 deg. by means of arms with attached pins acting through two solenoids. Holes in the tapered valve are so arranged that when one is open the other one is closed, and vice versa.

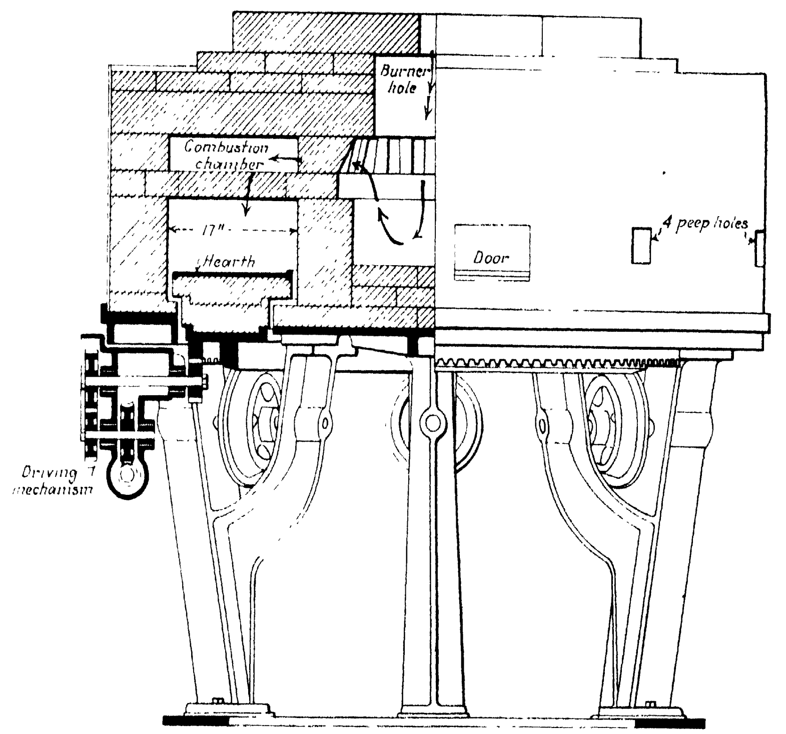

FIG. 8—SECTIONAL ELEVATION OF ROTARY HEARTH FURNACE

This apparatus works in conjunction with a Leeds & Northrup recording and controlling potentiometer and when the temperature becomes, say, 5 deg. higher than desired, a relay is closed, sending a current through one of the solenoids and causing an electromagnetic force to pull the pin in the core of the solenoid downward and through the arm attached to the shaft. The tapered oil valve is simultaneously caused to turn about 90 deg., thus shutting off the oil to the needle valve regulated for the higher temperature and opening the hole leading to the needle valve regulated to give the lower temperature. The action of the instrument when the temperature becomes too low is just the reverse. Thus the oil is caused to flow alternately through one or the other of the needle valves. The controller is so set that this change is effected as soon as the temperature on the thermocouple differs more than 5 deg. F. from that desired.

If only one furnace is controlled from each recording instrument the usual standard Leeds & Northrup in-

strument with signal lights can be used unaltered (or with a slight change in the circuit breakers to prevent arcing), with the wires to the red and blue lights reconnected to the two solenoids respectively. In order to reduce the cost of the instruments, however, it has been found desirable to connect more than one furnace to each recorder, and it is possible to run up to five furnaces from each controlling instrument. This necessitates rather elaborate switches and a very close setting of the oil valves. It has therefore been finally decided to control two furnaces from each instrument, which has proved very satisfactory, and it is now planned to extend the use of these automatic controllers all through the heat-treating department.

Quenching cups and cones is done in specially designed hardening machines, one placed in front of each furnace. Figs. 9 and 10 show these in outline and perspective. The main advantages of these machines are that they closely control the size of the hardened work. Quenching is also effected by means of a strong water spray instead of by mere immersion. A far more effective quench is therefore given than by the old methods and will give a more uniformly hard product. This is especially important for roller bearings, where soft spots would invariably mean failure in service.

The machine is equipped with two plungers that are moved up and down by the action of levers connected to an air cylinder as clearly shown in the drawing. Special fixtures are used for the hardening cups and cones in these machines. When a cup approaches the discharge door of the furnace, the operator lifts it out with a small hook, places it against the locating pins in the bowl, and turns the operating lever. This brings down the plunger, with the fixture attached to its lower end, into the cup at great speed. The spiral fluted fixture is larger than the hot cup and expands it a tiny bit. The bowl is depressed into the water basin, and at the same time water rushes up through the hole in the center of the bowl and out through the flutes in the fixture. Water from several jets also strikes the cups from the outside simultaneously and in this way the heated metal is rapidly chilled from both the inside and outside in such a way that there is a minimum chance for formation of gas bubbles or dead volumes in the quenching bath, and the ring is also rigidly held to shape during cooling. It has recently been found safer and more desirable to operate the water valves by a lever motion controlled from the upper toggles than by the valve pin arrangement shown in Fig. 9.

As the one side is operating in this manner, exactly the opposite sequence of events automatically takes place on the other side. The water jets close, the bowl and grill rise above the water surface, water is drained out of the bowl, the interior fixture rises clear of the hardened cup, which is hooked out and replaced by another hot one.

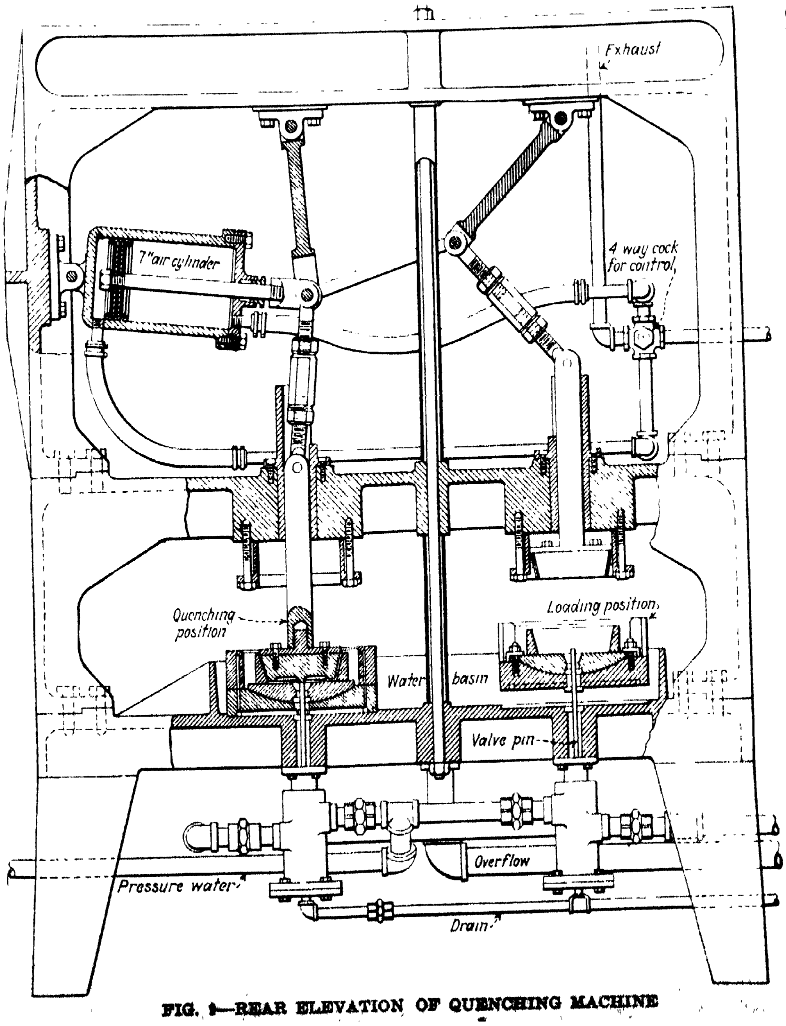

FIG. 9—REAR ELEVATION OF QUENCHING MACHINE

Cones are quenched in the same machine, but different fixtures are used. At times another type of machine is used, where the cones are simply submerged into water with a solid plunger inserted into the heated cones. Most cones, however, are hardened in the same machines as are the cups. The fixture used is a cylindrical plunger drilled centrally and split into six fingers. The lower end of the central hole is ground to a taper which, on the downward stroke, hits a pin of slightly larger size but of the same taper. This forces the fingers out, and the fixture is expanded tightly against the cylindrical bore of the cones.

These quenching machines are extremely speedy and one skillful operator, if he does not have to feed the furnaces, can harden 500 pieces per hour. In order to see that everything is working properly, inspectors check the product for size from the various machines three to four times an hour. In addition to this, all raceways are afterward subjected to a 100 per cent file inspection for hardness. Cones are tested by trying to touch them with new files around the circumference. For cups, which must be hard on the in-

FIG. 10—PERSPECTIVE OF QUENCHING MACHINE

side, a special method has been devised that in all its simplicity works very efficiently. By breaking a file a sharp edge is formed, which is poked against the inside of the cups in such a way that the cups roll slowly forward. If there are any soft spots the sharp point of the file will dig into the metal; the cups refuse to roll and then slide forward. A few scleroscopes are also used, but these are better adapted for checking the hardness of ground and finished work. Our experience is that a better hardness inspection is obtained by a file in the hand of a reasonably good man than by any other method. The main reason for this is that defects in casehardened work are mostly in the form of soft spots. Testing with a scleroscope would require a large number of readings on each part to find one soft spot, while a file test will cover a large area of the surface at one time.

HARDENING ROLLERS

There now remains to be told how the rollers are heat-treated. As noted before, the rollers are the parts in the bearings subjected to the most severe service and every effort is made to give them a correspondingly high strength. They contain 1 per cent chromium, and the hardening temperature is thus raised to about 1,500 deg. F. As a matter of fact, each roller is given a double quench, the first in oil from a temperature slightly above 1,500 deg. F. and the second in water from a temperature slightly below 1,500 deg. F. The intention of this double quench is to refine the case as much as possible and at the same time to obtain a fine-grained center. Experience has shown that better results are obtained by this method than by the usually employed method of a double quench from 1,550 and 1,450 deg. F. respectively. Our practice not only refines the outside layers of the case, but the refinement is driven the full depth of case in the carburized rolls.

Seventeen furnaces with rotary retorts shown in Fig. 11 are provided for this work. The furnaces were originally bought from an outside concern, but have been completely re-designed. The rolls are heated while passing through a Nichrome retort about 2 ft. in diameter and about 7 ft. long. This retort turns on three pairs of power-driven steel rolls, one of them engaging a double-flanged track to prevent endwise creep. By a similar arrangement to that used on the hearth furnaces, the speed can be regulated to suit the size of the work, the time for passing through the furnace varying from 10 to 25 minutes.

Work is moved forward by an inside spiral rib, about 3 in. high. Feed is regulated by an adjustable scoop attached to the cold end of the retort and dipping into a hopper filled with the little rollers. When the rollers have passed the full length of the retort they fall out

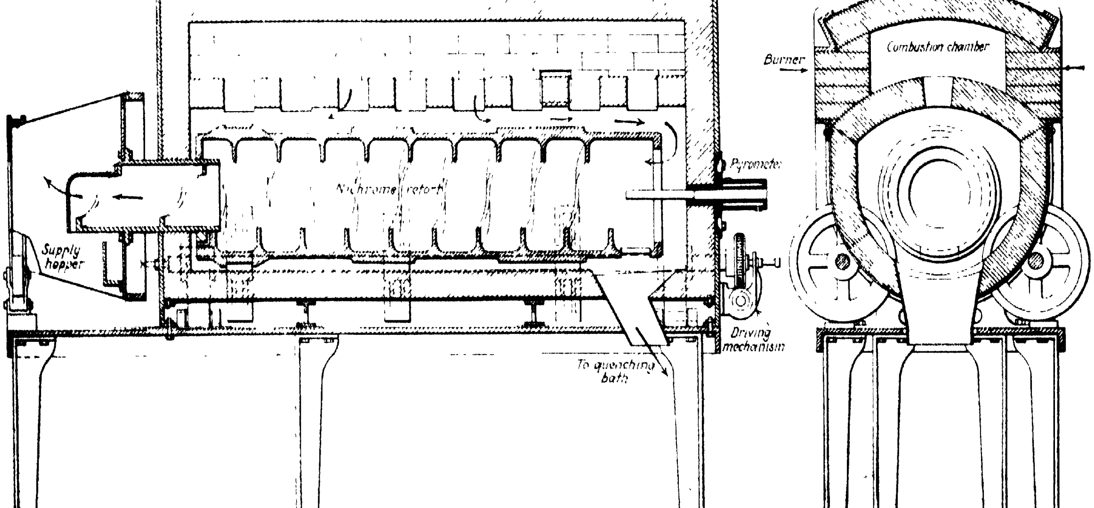

FIG. 11—ROTARY RETORT FOR HARDENING ROLLERS

through a slot in the wall and by means of a guiding chute into the quenching liquid.

The retort is contained in a brick chamber with double arches. The combustion chamber consists of the space between these arches; two oil burners project into this chamber in opposite directions, one near the front and the other near the back of the furnace. Hot gases are conducted through slots in the lower arch into the main furnace chamber, where they play around the retort and escape at the various joints. The burners are so adjusted that the heat gradient rises as the work progresses through the furnace, until proper hardening temperature is reached a little ahead of the discharge end.

As the rolls are discharged from the furnace, they are guided by a small chute, leading to the quenching bath immediately in front and below the furnace. Oil is used for the first quench and water for the second. The oil used is Houghton's No. 2 quenching oil, pumped from a large supply tank holding about 80,000 gal. As this tank is located at a considerable distance from the hardening room, radiation from the long pipe lines makes a special cooling plant superfluous. The oil for the first quench, as well as the water for the second, enters the cooling bath through several jets, set in various directions and so arranged that an effective and reliable quench of the rolls is obtained.

After having passed the quenching bath the rolls land on the inside of a partly submerged cylinder made of wire screen. Interior vanes are so arranged that as the cylinder slowly rotates the quenched rolls are elevated out of the bath and discharged over the edge of the tank into draining boxes set alongside.

Rolls are checked for hardness by file test and for fracture by splitting sample rolls at regular intervals in a small hydraulic press. In this way a very close control of the hardening of the rolls is maintained. After several cleaning operations done in rotary drums holding various substances, the rolls are ready for grinding and leave the hardening department.

In conclusion it can be said that no effort or cost has been spared in the development of the Timken heat-treating departments. Practically all of the equipment has been specially designed and a large number of patents have been granted on the various machinery that is used. The Timken company thus owns patents covering the rotary hearth furnaces, the quenching machines, the special fixtures used for hardening cups and cones, the temperature controllers, the roll-hardening furnaces and the quenching apparatus for the rolls, to mention only some of the more important. The high quality of the Timken bearings depends on these departments as much as on any other branch in the plant and they are equipped and conducted accordingly.

Composition of Beet Sugar Press Cake

The dry material of the filter press cake produced in the process of manufacturing beet sugar consists largely of calcium carbonate, according to the findings of the United States Department of Agriculture, and undoubtedly affords a satisfactory material for liming soils. It also contains comparatively small quantities of nitrogen, phosphoric acid, potash and organic material.

The results of the analysis of a number of representative samples of filter press cake are set forth in Department Circular 257, "Composition of Filter Press (Lime) Cake," by Sidney F. Sherwood, chemist in the Bureau of Plant Industry.

Coatings That Prevent End Checks in Wood

Wood dries more rapidly from the end grain than from the side grain, and is apt to check and split during seasoning unless end drying is retarded by some means. For this reason it is advisable to use a water-resistant end coating on wood during air seasoning or kiln drying, especially on woods which are difficult to dry and on short kiln samples.

Two Classes of Coatings

The coatings ordinarily used can be divided into two classes. The first are liquid at ordinary temperatures and can be applied cold. The second are solid at ordinary temperatures and must be applied hot. Cold coatings have the advantage that they may be used as easily on logs and lumber as on kiln samples and dimension stock; hot coatings, because of the method of application (end dipping), are not easy to use on large stock.

Either the cold or the hot coatings can be used effectively for drying temperatures up to 140 deg. F. Temperatures much above this cause blistering in the cold coatings, but make the hot coatings plastic enough to form new surfaces as fast as the old ones break. For this reason the hot coatings are apt to be more effective than the cold coatings for temperatures from 140 up to 170 deg. F., where they liquefy to such an extent that they run off. No coating has been found which is entirely satisfactory for temperatures above 170 deg. F. Cold coatings are perhaps somewhat better than hot coatings for temperatures above 170 deg. F. and for use on kiln samples when the temperatures are high enough to cause the loss of part of a hot coating.

Effectiveness of Cold Coatings

Cold coatings to be effective should have about the consistency of heavy sirup. The amount of filler required ranges from two to four parts by weight to one of the vehicle. Cold coatings used at the Forest Products Laboratory, Madison, Wis., have been found effective about in the following order, the most effective being placed first:

Hardened gloss oil and air-slaked lime (oil evaporated to consistency of thin sirup before adding the lime)	Very cheap
Chinawood oil and barytes	Cheap
Linseed oil and white lead (very heavy)	Moderate cost
Linseed oil and red lead (very heavy)	Moderate cost
High grade spar varnish and barytes	Expensive

Effectiveness of Hot Dips

The hot dips were effective in the following order:

213 deg. coal-tar pitch	Cheap
254 deg. coal-tar pitch	Cheap
Rosin and lampblack —(100 parts of rosin to 7 parts of lampblack)	Moderate cost

Some asphalts are highly moisture-resistant, but they are difficult to apply because of the high temperatures required to make them plastic.

Paraffine has proved very satisfactory as an end coating for stock during air seasoning, but cannot be used in the kiln because of its low melting point. Excessive shrinkage of the wood and rough handling often cause the end coatings to chip or shear off, and a fresh application of the coating must be made. To reduce end-drying sufficiently there must be a thick coating over the entire end surface. When hot dips are used, the wood should be dipped half an inch into the liquid.

This work has been carried out by the Forest Products Laboratory at Madison, Wis.

Licensing Laws for Engineers

A Survey of Licensing Conditions as Affecting Professional Engineers in Various States

THE situation regarding license laws for engineers is one that deserves the serious attention of chemical engineers everywhere. Already the movement has resulted in the passage in twenty-five states of laws which affect engineers in some way. In most of these states anyone engaged in work that is defined as "professional engineering" is required to obtain a license The New York State definition of "professional engineering" is the usual definition employed, and we quote:

Sect. 39-*n*. *Professional Engineering* A person practices professional engineering within the meaning and intent of this article, except as hereinafter stated, who holds himself out as able to do, or, who does, the work that an engineer does in the planning, designing, constructing, inspecting and supervising of engineering work, or appliances involved in public or private projects, or in making investigations for proposed engineering projects.

The New York law contains the following exemptions, usual but not contained in all state laws:

Nothing herein shall apply to a corporation, partnership or joint-stock association, provided the person or persons carrying on the actual practice of engineering on behalf of such corporations, partnerships or joint-stock associations shall be licensed engineers, and nothing in this article shall be construed to apply to the preparation or execution of designs, drawings, plans or specifications for the construction or installation of machinery or apparatus constructed or installed by the corporation, partnership or joint-stock association preparing such designs, drawings, plans or specifications if the supervision of the preparation of any such designs, drawings, plans or specifications, construction or installation shall be under the general direction of a licensed engineer.

QUALIFICATIONS FOR LICENSE

The qualifications for license are of particular interest to prospective applicants. Again the New York State law gives the average qualifications, and we quote an excerpt from this law which contains information on requirements and issuance of certificates and seals which will serve to illustrate to the reader what the majority of such laws cover:

EXTRACT FROM LAWS OF NEW YORK STATE

Chapter 775 as amended by Laws of 1921
Taking effect May 5, 1923

Sect. 39-*e* *Applications for and Issuance of Certificates.* The Regents, on application therefor, on prescribed forms and the payment of a fee of $25, except in cases where the applicant applies for license to practice professional engineering and land surveying, when the fee shall be $35; and except as hereinafter provided, shall on the recommendation of the board issue a certificate of license:

1. To any person who submits evidence satisfactory to the board that he or she is fully qualified to practice professional engineering or land surveying.

Provided, however, that no person shall be eligible for license as a professional engineer who is under 21 years of age, who is not of good character and repute and who has not been actively engaged for 4 or more years in the practice of professional engineering of a character satisfactory to the board.

Provided, however, that no person shall be eligible for license as a land surveyor who is under 21 years of age, who is not a citizen of the United States or who has not made declaration of his or her intention to become a citizen of the United States, who does not speak and write the English language, who is not of good character and repute and who has not been actively engaged for 3 or more years in the practice of land surveying of a character satisfactory to the board.

However, each 2 years of study, satisfactorily completed, of engineering in a school of engineering of standing satisfactory to the Regents shall be considered as equivalent to 1 year of such active practice

Unless disqualifying evidence be before the board, the following facts established in the application shall be regarded as prima facie "evidence, satisfactory to the board," that the applicant is fully qualified to practice professional engineering or land surveying.

(*a*) Six or more years of active engagement in professional engineering work, one of which shall have been in responsible charge of work, or in the case of applicants for license as a land surveyor, 4 or more years of active engagement in land surveying work of a character satisfactory to the board.

(*b*) Graduation, after a course of not less than 4 years in engineering, from a school or college approved by the Regents as of satisfactory standing, and an additional 4 years of active engagement in professional engineering, 1 of which shall have been in responsible charge of work, or 2 years of active engagement in professional land surveying of a character satisfactory to the board.

Applicants for license, in cases where the evidence originally presented in the application does not appear to the board conclusive or warranting the issuance of a certificate, may present further evidence, which may include the results of a required examination, for the consideration of the board.

In determining the qualifications of applicants for license as professional engineers or land surveyors a majority vote of the members of the board shall be required to pass the candidate.

In case the board denies the issuance of a certificate to an applicant, the license fee deposited shall be returned by the Regents to the applicant.

2. To any person who holds an unexpired certificate of license issued to him or her by a legally constituted board of examiners in the District of Columbia or in any state or territory of the United States in which the requirements for the license or registration of professional engineers or land surveyors are of a standard not lower than those prescribed in this state, provided that an agreement of reciprocity in the matter of indorsement of such certificates of license shall have been entered into between the Regents of the University of the State of New York, the board of examiners of this state and the like duly constituted authorities in the District of Columbia or in any other state or territory of the United States.

Sect. 39-*f*. *Certificates.* The result of every examination or other evidence of qualifications, as provided by this article, shall be reported to the Board of Regents by the board of license, and a record of the same shall be kept by the Board of Regents; and the Board of Regents shall,

SURVEY OF STATES HAVING LICENSE LAWS

Name of State	Affects Ch. Eng'r.	Where to Apply for Complete Information
Alabama	Yes	Judge of Probate in each county
Arizona	Yes	State Board of Registration of Architects and Professional Engineers, Phoenix
California	No	Surveyor-General, State Capitol, Sacramento
Colorado	Yes	State Board of Examiners for Engineers and Land Surveyors, Denver
Florida	Yes	State Board of Engineering Examiners, G K. Armes, Sec, Tallahassee
Idaho	Yes	Department of Law Enforcement, Paul Davis, Boise
Illinois	No	Department of Registration and Education, Springfield
Indiana	Yes	State Board of Registration for Professional Engineers, DeW D Moore, Indianapolis
Iowa	Yes	State Board of Engineering Examiners, K. C. Kastberg, Sec, Des Moines
Louisiana	No	State Board of Engineering Examiners, Baton Rouge
Michigan	Yes	State Board of Examiners of Engineers, George Jerome, Sec, Detroit
Minnesota	Yes	State Board of Registration of Architects, Engineers and Land Surveyors, St Paul
Nevada	Yes	State Board of Registered Professional Engineers, Carson City
New Jersey	Yes	State Board of Professional Engineers and Land Surveyors, Trenton
New Mexico	No	Board of Examining Surveyors, Santa Fe
New York	Yes	State Board of Licensing for Professional Engineers, Albany
North Carolina	Yes	State Board of Registration for Engineers and Land Surveyors, Raleigh
Oregon	Yes	State Board of Engineering Examiners, A. B Carter, Sec, Portland
Pennsylvania	Yes	State Board of Registration of Professional Engineers and Land Surveyors, Harrisburg
South Dakota	No	State Engineer, Pierre
Tennessee	Yes	State Board of Examiners for Architects and Engineers Nashville
Texas	No	Board of Examiners of Land Surveyors, Austin
Virginia	Yes	Board for Examination and Certification of Professional Engineers, Richmond
W Virginia	Yes	State Board of Registration of Engineers, George F Taylor, Sec, West Union
Wyoming	Yes	Board of Examining Engineers, Fremont Morrison, Sec Cheyenne

unless deemed otherwise advisable, issue a certificate of license to every person certified by the board of license as having passed such examination or as being otherwise qualified to be entitled to receive the same.

Sec. 39-i. *Significance of Certificate—Seals.* The issuance of a certificate of license by the Regents shall be evidence that the person named therein is entitled to all the rights and privileges of a licensed professional engineer or land surveyor, while the said certificate remains unrevoked or unexpired.

Each licensee hereunder may upon being licensed obtain a seal of the design authorized by the board, bearing the licensee's name and the legend "licensed professional engineer or licensed land surveyor." Plans, specifications, plats and reports issued by a licensee may be stamped with said seal during the life of licensee's certificate, but it shall be unlawful for anyone to stamp or seal any documents with said seal after the certificate of the licensee named thereon has expired or has been revoked unless said certificate has been renewed or reissued.

Extract From Rules of the Board of Licensing

Responsible charge of work, as referred to in the act, shall be understood to mean the control and direction of the investigation, design and construction of work requiring initiative, skill and independent judgment in meeting unforeseen conditions. The board, in passing on this requirement, will carefully weigh the evidence of experience submitted by the applicant.

The term "principal" as used in the act will be understood to mean an engineer in charge of work who is directly responsible to his client, employer or superior officer for results in connection therewith, even though he may have under his supervision and direction on such work assistants who have responsible charge of certain features thereof.

Conditions in Various States

While the conditions for licensing vary somewhat among states, most states have requirements equal to or less than those of New York. Those states having more severe requirements are Colorado, Illinois, Indiana, Pennsylvania, Tennessee and West Virginia.

In some states the provisions apply only to special classes of engineers and do not apply to chemical engineers. We give herewith, in table form, the states requiring license; those in which chemical engineers are affected; and the address to which to write for complete information.

Moisture-Resistant Coatings for Wood

Shrinking and swelling and internal stresses causing warping and checking are brought about in wood by changes in the moisture content. Such changes are occurring continually when wood is exposed to changing atmospheric conditions, and the only way to prevent or retard them is to protect the wood from the air with some moisture-resistant finish or coating.

In order to determine the protection against moisture afforded by various coatings, a series of tests is being conducted by the U. S. Forest Service, at the Forest Products Laboratory, Madison, Wis. No coating or finish which is entirely moisture-proof has yet been discovered, but several have been found which are very effective.

Linseed oil, although it is probably recommended more frequently than most of the other materials for moisture-proofing wood, was found in the absorption tests to be quite ineffective. Five coats of hot oil followed by two coats of floor wax failed to give any great protection.

Oil paints form a film over wood which is very durable even in exterior locations. Laboratory tests show, however, that such a film, although it may be continuous, does not prevent moisture changes in wood. Graphite paints and spar varnish are about as effective as the ordinary oil paints with the heavier pigments.

RELATIVE EFFICIENCY OF WATER-RESISTANT COATINGS FOR WOOD

	Percentage Efficiency
Aluminum-leaf process—asphalt paint base	98
Three coats spar varnish coated with vaseline	98
Three coats of asphalt paint	96
Aluminum-leaf process—spar varnish base	95
Aluminum-leaf process—cellulose lacquer base	94
Aluminum-leaf process—oil paint base	93
Three coats of aluminum bronze (quick drying)	92
A heavy coating of paraffine	91
Three coats of rubbing varnish	89
Three coats of enamel	88
Three coats of orange shellac	87
Three coats of cellulose lacquer	73
Sheet pyralin 0.005 in. thick glued to wood	68
Three coats of graphite paint	61
Three coats of spar varnish	60
Three coats of whitelead oil	54
Five coats of linseed oil applied hot and two coats of wax	38
No coating	00

Cellulose lacquers rank somewhat higher than the foregoing in moisture resistance. Considerable improvements can probably be effected in them by the addition of solids. They have the advantages that they are fast drying and that the films they form over the wood are very elastic.

Rubbing varnishes afford considerably more protection against moisture than do spar or long oil varnishes. The larger amounts of gum solids present in rubbing varnish probably account for their greater moisture resistance.

Enamel coatings made by the addition of pigments, such as barytes, to ordinary varnish are about as effective as rubbing varnish.

A bronze coating composed of a cheap gloss oil and aluminum powder proved in tests to be superior in moisture resistance to any of the coatings mentioned above. This mixture is very fast drying; three coats can be applied in the course of half an hour.

The aluminum-leaf coating developed at the Forest Products Laboratory particularly for the protection of airplane propellers is highly efficient in preventing moisture changes in wood. Such a coating can best be applied to large unbroken surfaces.

For temporary protection against moisture changes, vaseline smeared over varnish is one of the most moisture-resistant coatings yet tested.

The accompanying table gives the results of moisture absorption tests on panels coated with the different preparations. The percentages are based on average amounts of moisture absorbed per unit surface area by coated and uncoated panels subjected to a humidity of 95-100 per cent for 14 days.

Increase in British Exports of Tin

During the months of December and January the quantity of tin plates exported to the United States from Great Britain totaled more than the amount sent in the whole of the preceding 36 months. From other parts of the world as well there has also been a noticeable revival in the demand for tin. As a result Britain's exports are now between 42,000 and 43,000 tons per month. As will be seen from the following statistics, Britain's tinplate industry centering in South Wales has practically regained its pre-war position as an exporter.

Year	Gross Tons	Value, f.o.b.
1913	494,497	£7,214,938
1920	353,058	18,954,053
1921	226,440	9,077,[illegible]
1922	448,907	9,695,936

How Do You Operate A Column Still?

By F. H. Rhodes
Professor of Industrial Chemistry, Cornell University

THE column stills commonly used for the separation and rectification of liquids by fractional distillation consist of the following essential parts:

1. The still body, or "kettle."
2. The fractionating column, in which the original vapor from the still is caused to pass upward countercurrent to and in intimate contact with a downflowing stream of "reflux" introduced at the top of the column.
3. The partial condenser, or "dephlegmator," in which a portion of the vapor from the top of the column is condensed and returned to the top of the column as "reflux," while the remainder of the vapor is allowed to pass forward to the final condenser.
4. The final condenser, in which the vapor is condensed completely to "distillate" and the distillate is cooled so that it may be sent to the receivers

Of course the partial condenser method is the one that is generally practiced. This has certain distinct disadvantages as compared with the single condenser method of operating a column still, among which are the greater ease of control and the greater constancy of the reflux-distillate ratio under varying conditions of operation. This article tells why the single condenser method is better.

The general arrangement of such a still designed for operation by the "partial condenser method" is shown diagrammatically by the accompanying Fig. 1.

The primary purpose of the partial condenser is to provide the reflux to the column so that the column may continue to act as a fractionating device. The same result may be secured by omitting the partial condenser entirely and providing the necessary reflux by condensing all of the vapor in a single condenser and properly dividing this total condensate into reflux and distillate by means of valves or other suitable device. The general arrangement of such a still arranged for operation by the "single condenser method" is shown diagrammatically by the accompanying Fig. 2.

This method is not new; it has been described repeatedly in the literature and has been used commercially to a limited extent. In most industrial distillation operations, however, the feasibility of the single condenser method has not been realized and its advantages have not been appreciated, so that at present most fractional distillation operations are carried out in stills provided with a partial condenser and operated by the partial condenser method.

This present article was written for the purpose of calling attention to some of the advantages, from a practical operating standpoint, of the single condenser method of still operation. With any given column, operating on an initial vapor of any given composition, there is an optimum ratio between the portion of the total condensate returned to the column as reflux and the portion taken off as distillate. With less than this optimum reflux ratio the fractionation will be insufficient to give a distillate of the attainable and desired purity; with a reflux ratio greater than the optimum ratio a very slight increase in the purity of the distillate will be secured at the expense of a very considerable increase in the time and the amount of heat required to produce a given quantity of distillate. It is obvious, therefore, that the maximum efficiency and economy of operation can be secured only by maintaining, at each stage of the distillation, a certain definite ratio between the reflux and the distillate; and that variation from this optimum ratio will result either in unduly impure distillate or in unnecessary cost of operation.

It is difficult, with a partial condenser, to maintain a constant ratio between reflux and distillate. The usual type of partial condenser consists of a set of vertical tubes through which the vapor is passed and around which the water or other cooling medium is circulated, although in some cases partial condensers are used which consist of a set of horizontal tubes through which the water is circulated and around which the vapor is passed. In either case, a change in the temperature or in the rate of flow of the cooling liquid produces a change in the amount of vapor condensed in the partial condenser and thus causes a variation in the reflux ratio. Moreover, when the partial condenser is carefully regulated to give a uniform *amount* of reflux, the *ratio* of reflux to distillate may be changed by a variation of the rate of distillation of the charge within the still body. It is obvious, therefore, that in a still provided with a partial condenser maximum efficiency and economy can be secured only by maintaining very close control over the operation of the partial condenser.

In a still arranged for operation by the single condenser method it is possible to install, below the condenser, a dividing device which will automatically separate the condensate into reflux and distillate and which can be set to maintain any desired ratio between reflux and distillate. In this way the ratio of reflux to distillate can be kept constantly at the optimum value and the still can be operated constantly at maximum efficiency, irrespective of any probable fluctuation in the temperature or the rate of flow of the cooling water or in the rate of distillation. Therefore the still can be operated more efficiently and more economically and with less supervision than can a still operated by the partial condenser method.

Another advantage of the single condenser method of operation is the ease with which the reflux ratio can be adjusted to meet changes in the composition of the vapor entering the fractionating column. In any dis-

continuous distillation process the vapor entering the bottom of the column becomes progressively poorer in the lighter component as the distillation proceeds, and in running any particular fraction it is necessary to increase the reflux ratio progressively to meet this change in vapor composition; in any discontinuous distillation process there may occur variations in the composition of the feed which necessitate a change in the reflux ratio. In a still operated by the partial condenser method this change in reflux ratio is effected by changing the rate of flow of the cooling water. The exact effect of any given change in the rate of flow of cooling water can be predicted only by experience and determined only by trial. Moreover, the full effect of a given change in the rate of flow of cooling water does not appear at once, but develops rather slowly. These facts render it necessary to control a partial condenser still largely by the method of "trial and error" and necessitate close attention and frequent regulation in order to obtain satisfactory results.

Moreover, the difficulties of control make it difficult to standardize the operation of the still and make it necessary to rely very largely upon the judgment of the still runner. In a still operated by the single condenser method, the dividing device can be calibrated and provided with a scale to indicate the ratio between reflux and distillate corresponding to any position of the divider. The exact effect of a given change in the position of the divider can be foretold very closely and the change in reflux ratio necessary to meet any change in the conditions within the still can be made easily and quickly. Moreover, the full effect of a change in the reflux ratio appears very soon after the change is made. For these reasons, a still operated by the single condenser method requires a minimum of attention, and the operation of such a still can be standardized so that it is not necessary to rely so much upon the judgment and experience of the still runner.

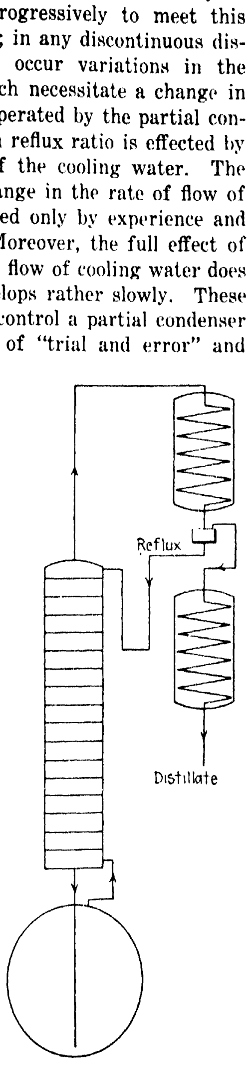

FIG 1—PARTIAL CONDENSER METHOD

A third advantage of the single condenser method is the fact that it can be applied successfully to the fractional distillation of high-boiling liquids, while with the partial condenser method the regulation of the reflux ratio (and therefore the proper control of the fractionation) becomes very difficult when working with substances which boil at temperatures considerably above the boiling point of water. In a partial condenser handling vapors which condense below, or only slightly above, 100 deg. C. the reflux may be regulated by varying the rate of flow of cooling water through the condenser. With vapors condensing at somewhat higher temperatures, the dephlegmator may be partly filled with water which is kept boiling by the heat absorbed from the vapor, and the amount of material condensed as reflux may be varied by varying the *height* of the boiling water surrounding the condenser tubes.

This method is not very satisfactory, because the exact regulation of the height of the boiling water in the condenser is rather difficult and because a slight change in the height of the water may produce a very large change in the amount of material condensed as reflux. With vapors which condense at temperatures considerably above the boiling point of water it is usually necessary to resort to the use of air-cooled partial condensers, which are very difficult to regulate, or to use partial condensers cooled by circulating oil, which present obvious operating difficulties. With the single condenser method of operation, high-boiling liquids can usually be handled in essentially the same manner as liquids which condense at relatively low temperatures—i.e., with a water-cooled condenser and a dividing box—and the reflux ratio can be controlled as accurately and as easily as when working with liquids which condense at temperatures below the boiling point of water.

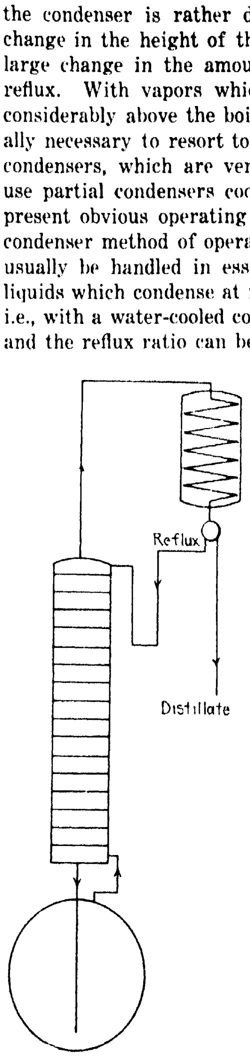

FIG. 2—SINGLE CONDENSER METHOD

For example, naphthalene may be distilled fractionally by the single condenser method about as easily as can benzene, whereas the fractional distillation of naphthalene in a still operated by the partial condenser method presents considerable difficulty. Of course, if the distillate has a melting point above the boiling point of water, it will be necessary to use an air-cooled condenser instead of a condenser cooled by water, but even this introduces no particular difficulty, since it is not necessary to *regulate* the amount of condensation in the air-cooled condenser, but only to insure that the amount of cooling surface is sufficient to condense all of the vapor. Thus it is evident that the single condenser method of distillation has a much wider range of application than has the partial condenser method.

Some Objections to the System

One objection to the single condenser method of operation that is sometimes raised is that it is not possible, by this method, to recover and utilize the heat contained in the vapor. In continuous stills operated by the partial condenser method the crude liquor going to the still is frequently used as the cooling medium in the partial condenser, so that the heat liberated by the condensation of the reflux is utilized to preheat the still charge. In a single condenser still exactly the same result may be secured by building the condenser in two sections in series, the upper section being cooled by the ingoing charge to the still and only the lower section being cooled by water, and the total condensate from the entire condenser being separated into reflux and distillate by means of the dividing device. In some

cases it is even possible to condense all of the vapor in a single condenser cooled by the ingoing charge and to pass only the condensed distillate through a water-cooled "cooler" placed below the dividing device; and in such cases the amount of heat recovered is actually greater than the amount usually recovered in stills operated by the partial condenser method. The use of such a two-stage condenser or of a condenser and cooler does not in any way interfere with or complicate the control of the reflux ratio. Therefore it is evident that the thermal efficiency of a still operated by the single condenser method is just as high as the thermal efficiency of a still operated by the partial condenser method and giving the same quality of distillate from the same still charge.

Another objection to the single condenser method of operation is that the reflux has exactly the same composition as the distillate, whereas the reflux obtained from a partial condenser is richer in the heavier components and poorer in the lighter component than is the distillate. In other words, by adopting the single condenser method we sacrifice the fractionating effect of the partial condenser. It is true that the partial condenser does act, to a certain extent, as a fractionating device, but it is also true that as a fractionating device the usual form of partial condenser is very inefficient. The contact between liquid and vapor is poor, there is considerable difference in temperature between vapor and condensate, and the condensate and vapor usually flow in parallel rather than in counter current through the condenser.

In running pure fractions the difference between the reflux and the distillate is usually so slight as to be undetectible; in running wide-boiling or intermediate fractions there may be considerable difference in composition. In practically every case, however, the increased fractionation and the greater purity of the product obtained by the use of a partial condenser could be secured in a still operating on the single condenser method by simply adding one more plate to the column. Furthermore, it is possible to use, in a single condenser installation, a condenser which is made up of two units in series, and so to arrange the dividing box that substantially all of the reflux is obtained from the first unit and substantially all of the distillate is obtained from the second unit. In this way the advantages of the single condenser method of operation can be secured without sacrificing the slight fractionation obtained by the use of a fractional condenser

SUMMARY

In summation, therefore, the single condenser method of operation offers the following advantages:

1. The ratio between the reflux and the distillate may be maintained constant at any desired value, irrespective of any fluctuation in the rate of flow or the temperature of the cooling water or of any variation in the rate of distillation.

2. The reflux ratio may be more easily regulated, thus permitting better control of the fractionation and making it possible better to standardize the operation of the still.

3. Fractional distillation may be applied to the separation and purification of high-boiling materials as well as to the rectification of liquids which boil at relatively low temperatures, and the close control of these high-temperature fractional distillations presents no particular difficulty.

The thermal efficiency of a fractional distillation process controlled by the single condenser method need be no lower than the thermal efficiency of a similar distillation process controlled by the partial condenser method—it may, in some cases, be higher.

The substitution of the single condenser method of operation for the partial condenser method may involve the sacrifice of the slight fractionating effect of the partial condenser, but this can be compensated for by a slight increase in the number of plates in the fractionating column or by the use of a double-effect condenser and a suitable arrangement of the dividing box.

Reduction of Hematite by Methane

While studying the reduction of iron ore by fuel gas, E. D. Eastman noted that at 700 deg. C. about one-fourth the hydrogen and CO and over half the unsaturated hydrocarbons were oxidized by reacting with iron ore, but the methane was practically untouched. C. M. Bouton, of the Bureau of Mines, verified this observation by passing a stream of mixed gas (40 per cent H_2 and 50 per cent CH_4) through a heated tube filled with fine hematite (+ 28, − 14 mesh) and analyzing the products of the reaction. If this gas take 30 seconds in passing the mass, Fe_2O_3 is reduced to Fe_3O_4 by the following reactions

$$3Fe_2O_3 + H_2 = 2Fe_3O_4 + H_2O$$
$$12Fe_2O_3 + CH_4 = 8Fe_3O_4 + 2H_2O + CO$$

the first going to completion (i.e., exhausting the gas mixture of free hydrogen) at any temperature between 600 and 900 deg. C. No CO is formed from the CO_2 or methane at these temperatures. Reduction of methane varies with the temperature, as follows:

Temperature Deg. C	Amount of CH_4 Consumed, Per Cent	K, Seconds
600	4	56,500
700	30	7,800
800	55	3,150
900	90	1,050

K is the number of seconds required for methane content of a gas to fall to one-tenth its value when the gas is agitated between walls of hematite 1 cm. apart.

In studying the reactions between gases and solids the scientists of the Bureau of Mines have erected the following hypotheses:

That the rate of reaction of each molecular species in the gas is directly proportional to the concentration of the molecular species.

That the passage of a gas through the intricate porosity of a fine ore is equivalent to passage between parallel walls of equal surface which inclose an identical volume.

That the rate of reaction of each molecular species (in terms of the percentage of the total gas) is inversely proportional to the distance between these equivalent walls.

Cascara Situation Causes Alarm

The Cascara tree, native of the Northwest, faces extinction. Unless steps are taken for its preservation and cultivation, this tree may not continue to flourish on this continent. It is cut at present as waste growth in many sections, despite the fact that its bark is of value commercially. When harvested the average tree of the Pacific coast yields 10 lb. of dry bark. Experiments conducted at the Agricultural Experiment Station on Vancouver Island indicate that the cultivation of this tree on cheap land may be fairly profitable.

Production Statistics of the Alkali Industry

The $81,884,100 Output in 1921 an 18 Per Cent Decrease From Record Total of 1919 —Soda Ash Leads

PRODUCTION statistics for one of the most formidable branches of the heavy chemical industry have just been released by the Census Bureau in the Department of Commerce. These figures show that the alkali industry of the United States had an output in 1921 aggregating in value $81,884,100, as compared with $99,689,828 in 1919, a decrease of 18 per cent.

Soda ash is the leading commodity of the group, with a production for sale of 776,520 tons, valued at $29,355,800, or 36 per cent of the group total in 1921, as compared with 1,033,480 tons, valued at $31,195,149, or 31 per cent of the total value in 1919.

Caustic soda is second, with 231,350 tons, valued at $18,434,300, or 23 per cent of the total value in 1921, and 302,121 tons, valued at $18,691,047, or 19 per cent of the total value in 1919.

TABLE I—PRODUCTION OF SODIUM COMPOUNDS IN THE UNITED STATES
(Ton, 2,000 lb.)

	1921	1919	1914
Aggregate value	$81,884,100	$99,689,828	
Inorganic			
Sodium			
Biborate (borax)			
Establishments	6	8	7
Production, tons	20,110		
For sale, tons	18,500	29,635	26,501
Value	$2,745,200	$4,622,286	$2,071,774
Bichromate			
Establishments	5	5	4
Production, tons	15,760	24,081	
For sale, tons	15,760	22,992	11,824
Value	$3,343,300	$5,337,389	$1,125,398
Bromide			
Establishments	*	5	*
Pounds		1,242,443	
Value		$511,812	
Carbonates			
Soda ash			
Establishments	20	18	10
Production, tons	959,780	1,507,424	
For sale, tons	776,520	1,033,480	935,305
Value	$29,355,800	$31,195,149	$10,937,945
Sal soda (crystals)			
Establishments	29	41	50
Tons	68,760	82,992	106,591
Value	$2,161,800	$2,272,770	$1,510,449
Bicarbonate			
Establishments	11	10	5
Production, tons	138,480	190,894	
For sale, tons	109,860	141,556	90,169
Value	$2,988,900	$3,695,417	$1,439,014
Sesquicarbonate			
Establishments	*	5	*
Tons		37,854	
Value		685,500	
Fluoride			
Establishments	*	4	*
Pounds		1,364,441	
Value		$177,420	
Hydroxide			
Establishments	35	29	25
Production, tons	236,760	312,736	
For sale, tons	231,350	302,121	291,539
Value	$18,434,300	$18,691,047	$9,104,920
Repacked, tons	22,500	20,625	
Value	$3,294,700	$2,101,648	
Hypochlorite			
Establishments	6	*	*
Production, tons	3,740		
For sale, tons	3,625		
Value	$324,000		
Iodide			
Establishments	7	7	*
Pounds	26,140	29,284	
Value	$88,300	$103,868	
Nitrate, refined			
Establishments	*	7	*
Tons		10,153	
Value		$934,643	
Phosphate			
Establishments	12	10	6
Production, tons	26,210	23,867	
For sale, tons	26,100	22,351	15,387
Value	$3,048,900	$2,438,917	$853,528
Silicate			
Establishments	16	17	13
Tons	195,320	286,791	169,049
Value	$4,320,200	$6,052,318	$1,648,854
Sulphates:			
Niter cake:			
Establishments	13	38	31
Production, tons	22,770	97,836	46,143
For sale, tons	16,600	81,170	24,129
Value	$255,100	$281,476	$31,580
Salt cake:			
Establishments	18	34	29
Production, tons	127,600	179,003	110,263
For sale, tons	91,890	122,908	90,442
Value	$1,955,500	$1,930,139	$841,887
Glaubers salt			
Establishments	18	27	20
Production, tons	60,160	42,206	
For sale, tons	52,040	38,330	34,537
Value	$1,289,000	$864,264	$427,808
Anhydrous (refined)			
Establishments	4	6	*
Production, tons	2,040	2,776	
For sale, tons	2,020	2,708	
Value	$154,000	$221,232	
Thiosulphate (hypo)			
Establishments	10	9	*
Tons	17,830	29,678	
Value	$1,202,900	$1,541,087	
Sulphide			
Establishments	14	17	5
Production, tons	24,680	39,735	
For sale, tons	22,680	35,178	20,263
Value	$1,740,100	$2,316,253	$516,644
Sulphite			
Establishments	7	8	5
Production, tons	3,740	8,666	
For sale, tons	3,440	7,209	
Value	$328,400	$539,636	$66,649
Bisulphite, etc.			
Establishments†	13	*	*
Production, tons	12,830		
For sale, tons	12,020		
Value	$1,010,300		
Washing compounds			
Establishments	*	3	7
Tons		861	12,441
Value		$71,021	$204,230
Other inorganic ‡ value	$3,729,900	$7,021,278	$1,703,535
Organic			
Acetate			
Establishments	6	12	*
Production, pounds	312,320	2,260,459	
For sale, pounds	312,320	2,196,113	
Value	$16,100	$165,505	
Benzoate			
Establishments	*	4	
Pounds		120,447	
Value		$68,004	$61,490
Citrate			
Establishments	7	6	*
Pounds	112,660	118,417	
Value	$74,000	$143,386	
Other organic, value	$23,400	$5,706,363	$80,630

* Figures not available
† Includes also polysulphide, hydrosulphites, and sulphydrates
‡ Includes metal, fluosilicate, refined chloride, nitrate, nitrite, bromate, bromide, fluoride, perborate, peroxide, chlorate and hypophosphite

Next in rank are the silicate with 195,320 tons, value $4,320,200 in 1921, and 286,791 tons, value $6,052,318 in 1919; the bichromate, with 15,760 tons, value $3,343,300 in 1921, and 22,992 tons, value $5,337,389 in 1919; the phosphate, with 26,190 tons, value $3,048,900 in 1921, and 22,351 tons, value $2,438,917 in 1919; the bicarbonate with 109,860 tons, value $2,988,900 in 1921, and 141,556 tons, value $3,695,417 in 1919.

Then follow, in the order named as to value, the biborate (borax), salt soda (crystallized), salt cake, sulphide, glaubers salt and thiosulphate.

Detailed statistics for 1921, 1919, and 1914 are given in Table I. The figures for 1921 are preliminary and subject to such change and correction as may be necessary from a further examination of the original reports.

Tarnish on Silver

An investigation at the Bureau of Standards has shown that the tarnish ordinarily observed on silver is the sulphide film, of which certain colors are characteristic and indicative of the extent of the tarnish. The effect of hydrogen sulphide gas by itself on silver is relatively small, but if small amounts of moisture and sulphur dioxide are present, the action is greatly accelerated. Tarnishing is also made more rapid by the presence of alkaline films and soap films.

Friction Testing of Lubricating Oils

Extended Investigations at the Bureau of Standards Indicate That Journal Friction Testing Machine Is Not a Convenient Instrument for Measuring Oiliness, Because the Clearance Changes With Wear

BY WINSLOW H. HERSCHEL
Associate Physicist, Bureau of Standards

THE relation between viscosity and friction has been considered by numerous investigators,[1] but oiliness has never been defined in c.g.s. units and is much more difficult to investigate. Among the many suggestions of possible methods of test, there is the tentative conclusion of Wilson and Barnard[2] that differences in oiliness are indicated by a difference in the conditions under which a minimum coefficient of friction may be obtained on a journal oil friction testing machine.

A considerable amount of work has been done at the Bureau of Standards to investigate the possibility of measuring oiliness with a friction testing machine, and although the machine used had an incomplete bearing, it is believed that the conclusions reached will apply to all machines with journal bearings.

DESCRIPTION OF TESTING MACHINE

The oil friction testing machine used in the tests to be described was of the "Cornell" type. The journal has a diameter of 3.748 in. (9.5 cm.) and is 3.48 in. (8.84 cm.) long. The width of bronze bearing block is 2.01 in. (5.1 cm.). If the area of the oil grooves is deducted, the net projected area is 6.10 sq.in. (39.4 sq.cm.). The maximum load ordinarily used was 5,000 lb., or 715 lb. per sq.in. (50 kg. per sq.cm.). The speed could be varied from 43 to 814 ft. per minute (2.2 to 41.3 cm. per second). Temperatures were taken from readings of a thermometer inserted in the bearing block.

The arc of contact of the bronze bearing block was 65 deg., or less than half the arc of 163 deg. used by Tower[3] in most of his tests. This shortness of arc made it improbable that complete film lubrication could be obtained, although the bottom of the journal was allowed to dip into an oil bath.

Since the most interesting results are obtained near the point of seizure, it was necessary to provide that as little damage as possible should be done when seizure occurred, as indicated by the slipping of the belt. In order to guard if possible against roughening of the journal, a special bearing block of Ulco hard metal was used. This consisted mainly of lead and was 2x3⅛ in. (5.08x9.37 cm.), without oil hole or grooves, the excess length as compared with the journal being necessary because the latter is given a slow reciprocating motion by an eccentric, while the bearing block remains fixed. This arrangement serves to spread the lubricant.

It was found that the coefficient of friction was about 0.0007 less on decreasing than on increasing loads, but the cause was never determined. When tests were made with decreasing load, the calculated values of the coefficient of friction were therefore corrected by this amount.

Results of Friction Tests

In a previous paper[4] a new method was proposed for plotting results of tests on friction testing machines, and this method, which will be used in this paper, may be briefly described as follows. The coefficient of friction is calculated as usual and is plotted against Sommerfeld's criterion, S.

$$S = \frac{\mu n}{p}\left(\frac{d}{2\Delta}\right)^2 \qquad (1)$$

where μ = viscosity in poises
n = speed, in revolutions per second
p = pressure, in dynes per square centimeter
$\frac{d}{2\Delta}$ = ratio of diameter of journal to difference between diameters of bearing and journal.

These units have been used in calculating S throughout this paper.

In the first series of tests, with speed of 111 r.p.m. and pressure of 714 lb. per sq.in. (50.2 kg. per sq.cm.), three oils were selected, a mineral oil of paraffine base, a second of naphthene base, and cottonseed oil, and all three were diluted with 300 deg. mineral seal oil, or in some cases with kerosene and gasoline, in order to vary the viscosity. The results are shown in Fig. 1, the minimum coefficient of friction being 0.00094 at a value of S = 0.00173 for a mixture of petroleum oil and kerosene of approximately the same viscosity as straight 300 deg. oil.

It will be noted that this value of S is much lower than the theoretical value, and it is believed that this is not due, primarily, to error in estimating the clearance, but to the fact, pointed out by Harrison,[5] that Sommerfeld's equations apply only when the friction is calculated from the moment of the journal, but that when, as is usual in friction machines, the measured moment is that of the bearing block, there is theoretically no value of S except zero, at which f is a minimum. Thus when, with decreasing values of S, the friction begins to increase rapidly, this should be taken as an indication that the oil film is ruptured and that there is metallic contact.

In a second series of tests, shown on Figs. 1 and 3, a certain 5-gal. can of a mineral oil known as "Viscolite"

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[1]A. Sommerfeld, *Z. tech. Phys.*, vol. 2, pp. 58, 89 (1921); A. G. M. Michell, *Z. Math. & Phys.*, vol. 52, p. 123, (1905) (in English); H. T. Newbigin, *Engineering*, vol. 108, p. 861 (1919).

[2]R. E. Wilson and D. P. Barnard, 4th, *Jour.*, S.A.E., vol. 11, p. 49 (1922).

[3]B. Tower, *Proc.*, Inst. M.E., p. 651 (1883).

[4]*Chem. & Met.*, vol. 28, No. 7, p. 302.

[5]W. J. Harrison, *Trans.*, Cambridge Philosophical Soc., vol. 22, p. 39 (1913).

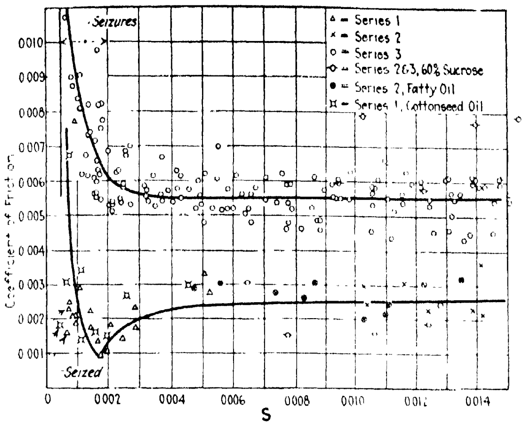

FIG 1—FRICTION TESTS, SERIES 1 TO 3, NEAR POINT OF MINIMUM FRICTION

was selected as a standard of comparison, so that by a repetition of tests under the same conditions it would be shown whether an apparent change in friction due to changing oils was due to variations in oiliness or to change in smoothness of the rubbing surfaces. The pressure was the same as in series 1, but the speed was varied.

The tests failed to show any superiority of fatty as compared with mineral oils, or even as compared with sucrose or glycerol solutions. The minimum value of the coefficient of friction was 0.00152, or somewhat higher than in series 1, and happened to be obtained with 60 per cent sucrose solution with a viscosity of 0.37 poise, the speed being 62 r.p.m. The point of minimum friction was, however, not reached in this series.

In series 3, shown in Figs. 1 and 4, most of the tests were made with Viscolite diluted with kerosene. In general the coefficient of friction, or location of the characteristic curve, is higher than in series 1 and 2, and the marked increase in friction, due to metallic contact, occurs at a higher value of S. The tests of this series, shown in Fig. 4, were not concordant enough to indicate the slope of the characteristic curve, and this was estimated from a few tests, made toward the end of the series, with blends of Viscolite and steam engine cylinder oil. The high friction in these tests may be due to failure of the highly viscous lubricant to reach the rubbing surfaces in adequate amounts.

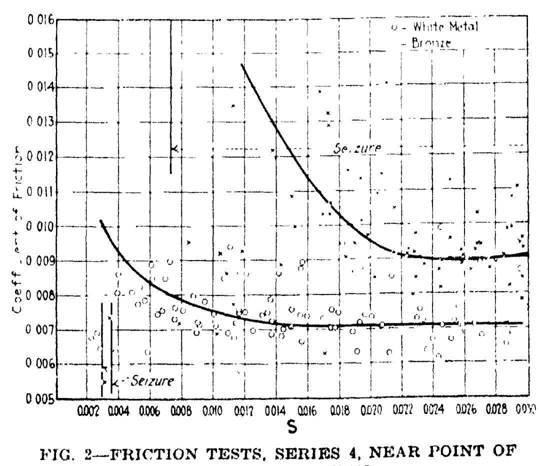

FIG. 2—FRICTION TESTS, SERIES 4, NEAR POINT OF MINIMUM FRICTION

TABLE I—SERIES 3 OF FRICTION TESTS UNDER CONDITIONS OF SEIZURE

Test No	Viscosity, μ, Poise	Speed, R.p.m.	Pressure, Lb Per Sq In	Pressure, Kg Per Sq Cm	Coefficient Of Friction	Sommerfeld's Criterion, S	Lowest Value Of S Without Seizure With Same Lubricant
			Lubricant Viscolite and Kerosene				
27	0.056	52	572	40.2		0.00132	0.00164
28	0.045	52	286	20.1	0.01700	0.00199	0.00158
28	0.047	87	714	50.2	0.00736	0.00138	0.00158
29	0.034	45	286	20.1	0.01760	0.00129	0.00121
29	0.034	87	714	50.2		0.00100	0.00121
			Lubricant Viscolite, Kerosene and Gasoline Blend				
30	0.007	170	572	40.2		0.00050	0.00067
30	0.010	116	429	30.2		0.00065	0.00067
30	0.009	87	286	20.1		0.00066	0.00067
30	0.009	45	143	10.1		0.00068	0.00067
			Lubricant Viscolite Blended With 15 Per Cent Steam Engine Cylinder Oil				
34	1.24	50	714	50.2		0.0210	0.0262
34	1.06	50	572	40.2		0.0224	0.0262
34	1.12	50	572	40.2	0.00582	0.0237	0.0262

Of special interest are the tests in which seizure occurred, concerning which data are given in Table I. The limits of S between which seizure occurred have been indicated on Fig. 1. Seizure would of course have occurred at values of S below the lower limit, which

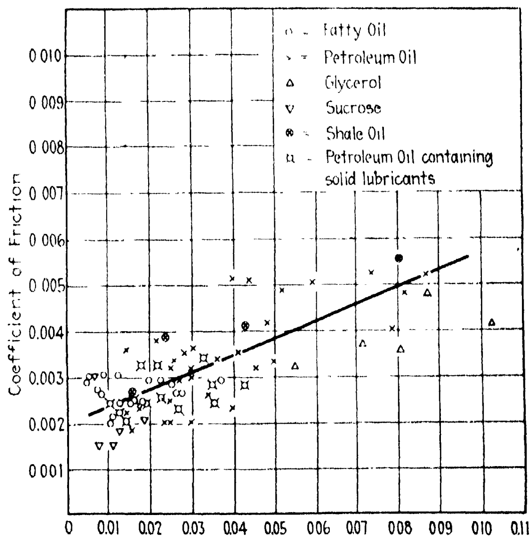

FIG 3—FRICTION TESTS, SERIES 2, ABOVE POINT OF MINIMUM FRICTION

merely indicates the boundary of the region in which the attempt to measure friction was made.

Leaving the last three lines of the table out of consideration, it will be seen that the maximum value of S at which seizure occurred was about half its value at the point of minimum friction. Series 1 shows a very similar result. It should be noted in considering the last column of the table that these values were not calculated from momentary observations, but each speed and pressure was maintained until a constant difference of temperature between the room and bearing was reached. Presumably if smaller increments of pressure, speed and viscosity had been used, lower values of S could have been reached without seizure, but even under the conditions of the investigation seizure sometimes occurred at higher values of S than the lowest attained.

In series 4 a comparison was made between the white metal bearing used in the previous tests and the regular bronze bearing supplied with the friction machine, a variety of lubricants being used as in series 2. Both

TABLE II—SERIES 4 OF FRICTION TESTS UNDER CONDITIONS OF SEIZURE

Test No.	Lubricant	Viscosity, Poise	Speed, R.P.M.	Pressure p: Lb. Per Sq.In.	Pressure p: Kg. Per Sq.Cm.	Coefficient of Friction, f	Lowest Value of S Without Seizure With Same Lubricant
31	50 per cent cutting	0.135	53	572	40.2	0.00303	0.00403
32	60 per cent cutting	0.298	54	714	50.2	0.00545	0.00681
30	50 per cent cutting	0.110	113	214	15.1	0.0140	0.0166
40	50 per cent cutting	0.113	53	129	9.0	0.0112	0.0166
37	Used sperm	0.252	51	429	30.2	0.00724	0.0105
33	60 per cent cutting	0.287	114	286	20.1	0.0277	0.0258
42	Cottonseed	0.43	51	429	30.2	0.0123	0.0185
25	Petroleum oil with graphite	0.65	54	572	40.2	0.0148	.0198
1	Viscolite	0.98	47	543	38.2	0.0205	0.0223
5	Viscolite with 10 per cent cylinder oil	1.62	52	572	40.2	0.0356	0.0434
39	Petroleum oil	0.1278	50	286	20.1	0.00540	0.00794
19	Petroleum oil	0.1140	117	429	30.2	0.00752	0.00794

speeds and pressures were varied. The results in Fig. 4 show a higher friction than in series 3, and a higher friction with bronze than with white metal. Using increments of 143 lb. per sq.in. (10.1 kg. per sq.cm.), a pressure of 572 lb. per sq.in. (40.2 kg. per sq.cm.) was reached only once with the bronze bearing, with speed of 56 r.p.m. The lubricant was a straight petroleum oil of 0.872 poise viscosity at the temperature of the bearing, and gave a value of $f = 0.0120$ with $S = 0.0207$.

Table II is similar to Table I and gives data concerning the tests in series 4 in which seizure occurred. The first two tests were with white metal, the others with the bronze bearing.

In test 1 seizure was obtained by gradually increasing the pressure, while in the other tests, as in those of Table I, the increments of speed and pressure were fairly large.

The limits of S between which seizure occurred are shown on Fig. 4 for the bronze bearing, omitting test 5, in which it is believed seizure was caused by the oil being too viscous to reach the rubbing surfaces. Even with the white metal bearing, seizure occurred at much higher values of S than in series 3, and the evidence appears to be that the material and smoothness of the bearing and journal have a much greater influence upon the point of seizure than does the nature of the lubricant. It will be noted that seizure took place with fatty oils on a bronze bearing at a value of S two or three times as high as could be reached without seizure on a white metal bearing, using an emulsion of 50 per cent soluble cutting oil as a lubricant.

SUPERIORITY OF WHITE METAL

To determine whether the difference in friction between the white metal and the bronze bearings was due to a difference in radius of curvature or of film thickness, careful measurements were made of both bearings. No difference would be detected, the radius varying from 1.873 to 1.875 in. on either bearing. It might of course be considered that the advantage of the white metal bearing was due to superior smoothness or fit, or to the lubricating power of the lead contained in it, but the possibility of obtaining a good fit with a given metal is just as truly a characteristic of that metal as any peculiar lubricating property which may be ascribed to it.

Other tests made with this same white metal[6] showed that the friction was about 60 per cent of that of "genuine babbitt of composition 89 per cent of tin, 7½ of antimony and 3½ of copper," so that these tests should be taken as confirming the superiority of this particular white metal, rather than as disproving the generally accepted belief that the coefficient of friction with bronze is less than with babbitt.

In order if possible to get a better fit between the journal and the white metal bearing, the attempt was made to run in a new white metal bearing by reversing it end for end after each increase of pressure. Theoretically, if the journal were a mathematically perfect cylinder, this would be the equivalent of reversing the direction of rotation, as is done in the Riehlé testing machine. It was found, however, impossible to raise the pressure to over 429 lb. per sq.in. (30.2 kg. per sq.cm.) or to get as low a coefficient of friction as with the white metal bearing previously employed.

EXPLANATION OF TOWER'S RESULTS

It is noteworthy that Tower obtained complete film lubrication with a machine similar to the Cornell except in length of arc of contact and in absence of reciprocating motion of the journal. Tower says of his machine: "A railway axle has a continual end play while running which prevents the brass from becoming the perfect oil-tight fit which it became in this apparatus."

To test this point, the eccentric which imparts the reciprocating motion to the journal was disconnected and the journal held rigidly in position as far as end play was concerned. A new journal was made of hardened steel and was provided with a magnolia metal bearing. With this new equipment the coefficient of friction was found at first to be about 0.009, as with the bronze bearing, but after 3 days' running it increased about 50 per cent, and examination showed that the bearing had worn in ridges which were easily visible and could also be perceived by the sense of touch. The tests were accordingly discontinued.

The most plausible explanation seems to be that Tower obtained complete film lubrication, which could not be obtained with the Cornell machine, because he had a longer bearing and a greater arc of contact, rather than because he had a better fit between bearing and journal.

If, as the above-described tests appear to indicate, the value of S at the point of minimum friction is decreased as the smoothness is increased, it might be

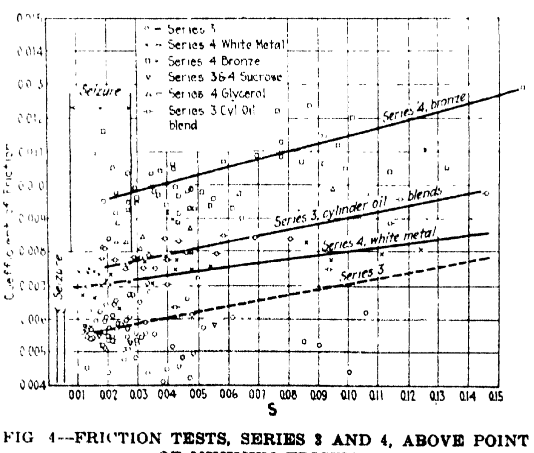

FIG. 4—FRICTION TESTS, SERIES 3 AND 4, ABOVE POINT OF MINIMUM FRICTION

[6] G. K. Burgess and R. W. Woodward, U. S. Bureau of Standards Technologic Papers, No. 109 (1919).

expected that S would vary with the oiliness of the lubricant or with its ability to smooth over inequalities in the rubbing surfaces. This replacing of the rubbing surfaces with new, smoother surfaces is undoubtedly the action of graphite,[7] and the adsorbed films from oils of good oiliness might be assumed to have a similar effect. Wilson and Barnard, basing their opinion upon the tests of Archbutt and Deeley[8] and of Heimann,[9] conclude: "The use of lubricants of high oiliness tends to lower the critical point, probably because the presence of an adsorbed semi-solid film on the metal surfaces helps to prevent rupture of the fluid lubricating film, even after it has become extremely thin."

Fig. 5 shows characteristic curves for various bearings, including those from Figs. 1 to 4, and the results

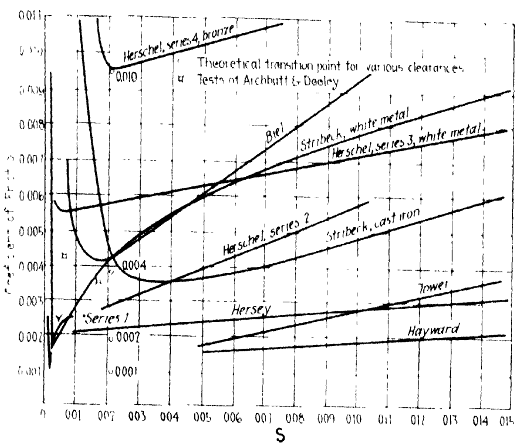

FIG. 5—COMPARISON OF FRICTION TESTS OF VARIOUS EXPERIMENTERS WHERE CLEARANCE WAS UNKNOWN

of Biel, shown separately in Fig. 6. Data concerning tests of Hayward, Tower, Hersey and Stribeck[10] were scaled from diagrams of Wilson and Barnard. Lasche's[11] tests have been omitted, because they covered only high values of S.

Examination of Wilson and Barnard's curve from tests of Archbutt and Deeley shows that the data were taken from table XCI E, assuming that tests were made at 60 deg. F., the temperature for which viscosities are given. Archbutt and Deeley do not state that this was the temperature of friction tests, and the present writer was unwilling to make this assumption and accordingly has omitted these tests from Fig. 5. Only in the case of tests with special red engine oil and rapeseed oil, in table XCI D, did it seem possible to identify the oils and to determine the viscosity at the temperature of the oil film, from data given elsewhere in the book. These two points are shown on Fig. 5, but merely serve to indicate the coefficient of friction at points presumably not very far from the point of minimum friction. For all curves of Fig. 5, $\frac{2\Delta}{d}$ was assumed to be equal to 0.001.

It will be noted that although there is considerable variation in the value of S at the point of minimum friction, the average is not far from the theoretical value of 0.0211 at the transition point for any clearance. This tends to prevent detection of the error, pointed out by Harrison, in applying Sommerfeld's formula for transition point to friction tests where, theoretically, there should be no point of minimum friction, and the critical point actually observed is due to rupture of the film and metallic contact.

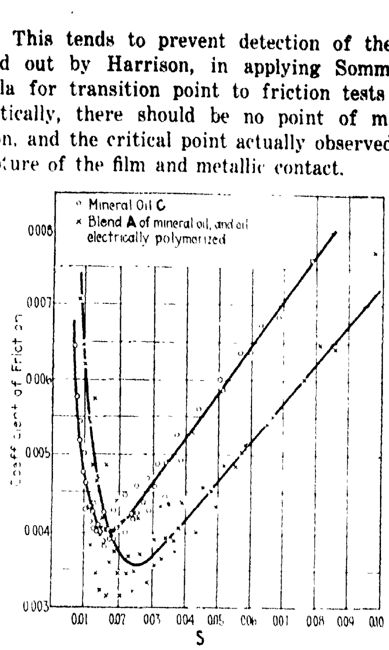

FIG. 6 FRICTION TESTS ON TWO OILS BY BIEL

In Fig. 7 are shown the very few tests in which all data, including clearance, are given. Kingsbury[12] gives complete data concerning his tests with a compressive lubricant, air, but special formulas, given by Harrison, are necessary, and these tests have been omitted from Fig. 7.

Both Heimann and Hersey state that $\frac{2\Delta}{d}$ is equal to 0.004 (although Hersey[13] adds the caution, "when the

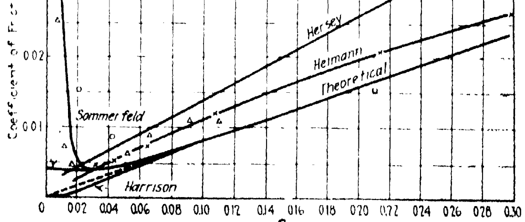

FIG. 7 FRICTION TESTS WHERE CLEARANCE WAS KNOWN

bearing was new"), and this makes it possible to compare the slope of the experimental curves with the theoretical slope. The necessary equations are given by Sommerfeld and by Harrison and may be written

$$\beta = \frac{2\pi a'}{\sqrt{a^2 - 1}\,(2a^2 + 1)} \qquad (2)$$

$$S\beta = \frac{1}{6} \qquad (3)$$

$$f = \frac{2\Delta}{d}\,\frac{(a^2 + 2)}{3a} \qquad (4)$$

$$f = \frac{2\Delta}{d}\,\frac{(a^2 - 1)}{3a} \qquad (5)$$

[7] See for example, C. F. Mabery, *Jour.*, A.S.M.E., vol. 32, pp. 163 803 (1910).
[8] L. Archbutt and R. M. Deeley, "Lubrication and Lubricants," pp. 190 385, 387 (1912)
[9] H. Heimann, *Z. Ver. deut. Ing.*, vol. 49, p. 1226 (1905).
[10] R. Stribeck, *Z. Ver. deut. Ing.*, Ingr., vol. 46, p. 1341 (1902)
[11] O. Lasche, *Z. Ver. deut. Ing.*, vol. 46, p. 1181 (1902).
[12] A. Kingsbury, *Jour.*, Am. Soc. Naval Engineers, vol. 9, p. 267 (1897)
[13] M. D. Hersey, *Jour.*, Washington Academy of Sciences, vol. 4, p. 549 (1914).

In using the above equations it is simplest to assume values of α, the ratio of the radial clearance Δ to the distance between centers of bearing and journal, remembering that $\alpha = \sqrt{2}$ at the transition point. When f is calculated from the moment of the journal, as in Heimann's deceleration tests, equation (4) should be used in connection with equations (2) and (3), giving a curve concave upward. If f is calculated from the moment of the bearing cap, as in Hersey's tests and is usually the case, equation (5) should be used instead of equation (4), giving a curve concave downward except at very low values of S. Both curves approach asymptotically to the straight line passing through the origin, the tangent of slope being

$$\frac{f}{S} = 2\pi^2\left(\frac{2\Delta}{d}\right) \tag{6}$$

For the Bureau of Standards tests in Fig. 5, the variation of f with S is indicated by straight lines above the point of minimum friction, but it is realized that the law of variation might be more accurately indicated by curved lines which the accuracy of tests was not sufficient to detect. In Hersey's tests also there is no indication of curvature. But in the great majority of tests, including those of Tower and Hayward when considered over a wide enough range, the curves are concave downward.

In Figs. 6 and 7 the points merely indicate the places at which data were scaled from the original diagrams. It will be seen that even in Heimann's tests, where, theoretically, equation (4) should apply, end leakage or other circumstance not considered in the equation has caused the curves to be concave downward. Fig. 7, where the clearance is known, as well as Fig. 5, where it is assumed, both show that the theoretical transition point serves fairly well to indicate the average value of S which may be expected at the point of minimum friction.

Results of Various Investigators

It is believed that Wilson and Barnard overlooked the effect of clearance upon the location of the point of minimum friction in coming to their conclusion that its location varied with the oiliness of the lubricant. Table III gives the small amount of available information upon which to base a conclusion.

With the exception of the Bureau of Standards tests, all the tests of Table III were made on complete bearings. It will be seen that in general S varies from about 0.02 to 0.04 no matter what lubricant is used, but that there appears to be a tendency toward lower values of S when the bearings are short. Hersey is the only experimenter to get a low value of S with a long bearing. While it might be expected that the bad effects of leakage would be more noticeable with a short bearing, it is possible that this is compensated for by the greater ease of getting a good fit on a shorter bearing.

Biel compared a mineral oil with a blend of electrically polymerized oil with mineral oil, expecting to show that the blend had superior oiliness. It will be noted that the blend did show a lower coefficient of friction, but the value of S at the point of minimum friction was higher than with the straight mineral oil.

Stribeck's comparison of a cast-iron and a white metal bearing is difficult to interpret, because the former was 3.29 diameters and the latter only 1.00 diameter in length. But he gives a comparison between the short white metal bearing and the original bearing from which it was cut and which was 1.96 diameters in length: "The shortened bearing showed at medium and high speeds almost exactly the same friction curves as for the 137-mm. long bearing which was run in. At low speeds (64 r.p.m. and less) and high enough pressures, there was an increase in the coefficient of friction with increasing pressure, and there was the difference that with the longer bearing the increase began sooner than with the shorter." He then goes on to say that his published data concern only the shorter bearing, which he selected because of the wider range in his tests of both speed and pressure. Thus the fact that the cast-iron bearing showed a higher value of S at the point of minimum friction than did the shortened white metal bearing is at least partly due to the greater length of the cast-iron bearing.

TABLE III—VALUE OF SOMMERFELD'S CRITERION, S, AT POINT OF MINIMUM FRICTION

Experimenter	Ratio Of Length To Diameter Of Bearing	Assumed Clearance, $\frac{2\Delta}{d}$	Metal Of Bushing	Lubricant	Coef of Friction	S
Heimann	1.67	0.004	Bronze	96 per cent glycerol	0.0087	0.0422
Heimann	1.67	0.004	Bronze	80 per cent glycerol	0.0047	0.0321
Heimann	1.67	0.004	Bronze	66⅔ per cent glycerol	0.0047	0.0161
Hersey	3.00	0.004	Brass	Mineral and fatty oils	0.0030	Note
Stribeck	3.29	0.001	C. I.	Mineral oil	0.0035	0.0315
Stribeck	1.00	0.001	White	Mineral oil	0.0016	0.0024
Biel	1.14	0.001	White	Electrically polymerized mineral oil	0.0035	0.0250
Biel	1.14	0.001	White	Mineral oil	0.0040	0.0170
Herschel						
Series 1	0.93	0.001	White	Mineral and fatty oils	0.0009	0.0017
Series 3	0.93	0.001	White	Mineral and fatty oils	0.0055	0.0040
Series 4	0.93	0.001	White	Mineral and fatty oils	0.0070	0.0140
Series 4	0.93	0.001	Bronze	Mineral and fatty oils	0.0090	0.0220

Note. A value of 0.0086 was attained without reaching the point of minimum friction

Conclusions

The conclusion which may be drawn from Table III is that there is little or no evidence available to show that the value of S at the point of minimum friction decreases as the oiliness improves. If the location of S does vary with the oiliness, this variation could be detected only with a friction machine, possibly of the disk type, in which wear of the rubbing surfaces would not cause a variation in smoothness or of clearance during the series of tests necessary to locate the point of minimum friction.

It is believed that the present paper justifies the following conclusions:

1. There is little probability that a journal friction testing machine will ever prove convenient for testing oiliness, because the clearance changes with wear.
2. There is no experimental evidence that the value of Sommerfeld's criterion at the point of minimum friction varies with the oiliness.

Lignite Utilization

Experiments have recently been made at the lignite utilization plant at Bienfait, Sask., for the purpose of testing a special retort designed at the Bureau of Mines in Washington, as the process of the Canadian Lignite Utilization Board has proved too delicate. The form of carbonization which is being tested at the Beinfait plant has been tried out in the United States with satisfactory results. It is believed that when the Canadian Lignite Utilization Board has completed the work for which it was established low-grade lignites can be placed on the market in healthy competition with anthracite.

Technical Education In Metallurgy

BY CARLE R. HAYWARD
Associate Professor of Metallurgy, Massachusetts Institute of Technology

IT IS DIFFICULT to say anything new about technical education, yet every conference on the subject, such as that held in New York on Feb. 21 by the Mining and Metallurgical Society of America and the A.I.M.E., stimulates interest, and even old ideas dressed in new phraseology and marshaled in a new order help to crystallize conviction on the subject.

The scathing statements regarding metallurgical courses in recent editorials in *Chemical & Metallurgical Engineering* and repeated by Mr. Thum with additions at the conference referred to above cause some of us to think, even if we don't agree with them. The experiences of men like E. P. Mathewson with large numbers of metallurgical graduates is evidence that must be considered in making final decisions, while the long years of experience of teachers like President McNair must also be weighed very carefully.

PROBLEMS OF EDUCATION

The writer is a teacher because he likes teaching and the satisfaction which comes from helping to prepare young men for their life work. It is probably fair to say that a majority of men have the same motives in teaching. All such are continually searching for methods which will enable them to send their students out better prepared. We think and talk about the problems which confront us and are continually trying experiments to see if improvements can be found. We don't all agree on everything by any means, and it is well that we don't, but it seems fair to assume that the experienced metallurgical teacher knows more about the problems of teaching than the average engineer. The engineer specifies certain qualities in his materials, but he usually leaves the methods of manufacture to the manufacturer. Why not apply the same principles in educating men to meet given requirements?

There is one point which must always be considered. It is one of the greatest problems in education. The manufacturer can go into the market and select his raw materials, while the school must take whatever comes to it after going through forms of examination which everyone recognizes are inadequate. Give us some method of selecting our stock that is as accurate as the manufacturer uses in selecting his raw materials and our finished product will not need the apologies that much of it gets now. Furthermore, the steel maker can take an ingot and with mathematical precision roll it to a given shape and size, but if anyone has the illusion that a technical school can perform a similar process with a student he has little conception of teaching.

There are four major subjects of discussion regardin technical education: 1. What should be taught? 2. How should it be taught? 3. How long should the course be? 4. Who should be admitted to technical schools?

WHAT SHOULD BE TAUGHT?

Practically everyone is agreed that every branch of engineering requires a thorough grounding in mathematics, and although there is not complete unanimity on the subject, probably most would agree that the metallurgist should go at least through calculus. It is becoming increasingly evident that the chemical training of the metallurgist should include a thorough course in physico-, thermo- and electrochemistry if he is to be adequately fitted to cope with leaching and electrodeposition problems and the pressing problems of furnace efficiencies. The metallurgical engineer should also know something of mechanical engineering and electrical engineering, but it is a mistake to attempt to make him a designer of mechanical or electrical machinery. With a thorough grounding in physics and chemistry, enough mineralogy and geology to understand the sources of his raw materials, a very brief course in mining to give him a background for first costs and a course in ore dressing the student is prepared for his study of metallurgy proper.

Certain principles of metallurgy are doubtless taught in all schools; beyond that there is inevitably a wide divergence in practice. Some stress copper, some gold and silver, some iron and steel, each with good reason. Some have much laboratory work, some very little; probably the proper amount lies between the two extremes. At M.I.T. we require a well-balanced course covering the entire field of metallurgy and then allow optional specialization along either ferrous or non-ferrous lines. An increasing demand for principles of accounting and economic consideration of processes must have an effect on metallurgical instruction and will inevitably modify some courses. The Massachusetts Institute of Technology has from the first insisted on a certain minimum of so-called general or cultural subjects, which necessarily cut the time allowed for technical subjects, and careful thought is necessary to make this limited time count to the greatest advantage. Non-essentials must be eliminated and the students given a proper perspective.

HOW SHOULD IT BE TAUGHT?

First and foremost a subject must be made interesting. Any art or artifice to bring this about is legitimate. Time spent in trying to instruct a class that is not interested is practically wasted. The student should be taught to use the library freely, not as a slave driven to a task but with a real thirst for knowledge that has been stimulated in the laboratory or the class room. Successfully to stimulate this interest is extremely difficult, but on it hangs success or failure as a teacher. The metallurgical laboratory can never teach practice, but it is invaluable for illustrating principles; here also the research spirit may be developed and the two words "Why" and "How" should be ever kept in the ears and minds of the students.

It is unfortunately necessary to devote a large proportion of the class-room time to teaching facts and describing operations, but the writer has found that the time which is most profitably spent is that used in discussing reasons for various operations. A class which can be induced to give theories or explanations of existing processes or suggestions for possible improvements in procedure or apparatus is doing some real thinking and even the most severe critics of present technical education agree that this is one of the most important things which should be accomplished.

It has been suggested that different branches of metallurgy be taught by bringing in specialists in each of these fields. The objection to this is that few of the specialists know how to teach or how to dress up their subject in a way in which it can be assimilated by the student who knows nothing about it in advance. A far

better way would be to have such specialists give one or two lectures after the student has learned the fundamentals of the subject from his regular teacher. In most cases these eminent specialists can do more good by speaking informally to the students about their personal experiences than by giving a formal lecture. We have tried both methods at M.I.T. and I feel sure that this is true.

How Long Should the Course Be?

There are many arguments in favor of taking a college course before attending technical school, especially if the student is ready for college by 16 or 17. Also in the exceptional case where a student knows definitely what line of work he is to follow on graduation an additional year of specialized technical study may be wise, but after weighing all the evidence that has come to my attention I am convinced that for the vast majority of students it is wise to start on life's real problem at once after 4 years of technical training. The metallurgical graduate who is going into the producing end must start at the bottom of the ladder. If he is too old or has spent too long a time in school, he does not adapt himself as readily to the trying conditions under which he must begin his career and thus labors under a severe handicap. The 4-year man who has been properly trained has a good technical foundation. If he has the right stuff in him, he will erect a durable superstructure on this foundation. If he hasn't the right stuff in him, a few additional years in school will do him little or no good.

Summer work in plants should be urged or required. Visits to various plants are desirable and it may be advantageous to work out a co-operative arrangement whereby certain work is done at plants under direct supervision of instructors.

Who Should Be Admitted to Technical Schools?

Some come because their parents want them to. Some because they expect to acquire great wealth in the engineering profession. Some because they think they will like engineering subjects. Some because some friends have gone or are going. About 50 per cent fall by the wayside before the degrees are conferred. Fifty per cent or more of the remainder do not practice engineering or amount to little in the profession. A small percentage become eminent or reach the goals they seek. Why did the first 50 per cent fail? The reasons are many and need not be enumerated. Many were improperly prepared and were unable to overcome the handicap. Should they have been excluded? Perhaps so, but many a man with inadequate preparation has finished with distinction. Many were wholly unfitted for engineering work. Should they have been excluded? They probably would have been if we knew fully how to apply intelligence tests, yet even many of these have received some benefit from their experience. Many have just ordinary ability and no amount of education will increase it. Should they be excluded? Some think so, but most of us think they have a right to all they can get and we can offer them.

What a joy teaching would be if we had to deal only with a handful of picked men! What encomiums would be heaped on the institutions whose alumni were all enrolled in "Who's Who"! Apparently this is the result expected by some of our critics, but there are some facts which should not be forgotten: 1. An engineering education is not wasted just because a man does not follow engineering as a profession. 2. No school can produce finished engineers. The patience and co-operation of industrial organizations is necessary to produce a finished product. 3. The biggest factor in ultimate success is a man's personal characteristics and mental ability. Such men will become successful without a technical training. The school can merely enhance that success. 4. Even at graduation there is no way yet available to predict surely the future success of the student. Often the least promising has undiscovered powers which will send him ahead of his apparently more able companion. Furthermore it should be pointed out that although curricula differ widely, men from different schools are everywhere coping successfully with the problems which confront them in greatly diversified fields.

All the above and many other points should be considered before criticising too harshly our technical schools. Their graduates are doing a magnificent work and many of them freely give fair credit to the schools. There will always be room for improvement, and improvements will continually be made if employers of graduates will co-operate in a broad and liberal spirit with those who are trying hard to turn out men who will fit in to a multitude of positions in a multitude of plants to the honor and profit of all concerned.

Use of Flash in Forgings

In the course of a lecture delivered before the British Association of Drop Forgers and reported in *The Engineer*, Leslie Aitchison pointed out that if the steel for making a forging was cut too short or of too small stock superfluous steel will not be forced out between the dies in sufficient quantity, and consequently there will be little or no flash. This might appear to be a benefit; actually it is a very serious danger because there is no cushion of steel between the dies. As a result the dies come together on their faces and mutually give each other a blow which is frequently of sufficient intensity to break one of them or badly damage some portion of the cylinder.

If too much steel is taken to make the forging, there is a gross waste of material. Excess steel is forced out between the dies in a comparatively thin squirt. This fin of metal is in close contact with the upper and lower dies, and consequently becomes chilled fairly rapidly, and the excess of material lying in the pattern cannot easily be squeezed out. A further consequence is that as the scrap becomes cold very readily it tends to split under the impact of the dies. The splits in the flash tend to spread inward and may actually proceed into the stamping itself.

Production of Rolled Zinc in 1922

The reports made to the United States Geological Survey by producers show that the output of rolled zinc in the United States in 1922 gained 76 per cent over that of 1921. At the beginning of 1922 the market quotation on rolled zinc in mill lots at the rolling plants was 8.5c. a pound, declining to 7.5c. by the middle of the year and rising to 9.5c. at the close of the year.

The large imports of zinc, which were a feature of the first half of 1921, were not repeated in 1922. Approximately 400 tons was imported during the early part of the year. The average declared value at the foreign mills was 7.1c. a pound, as compared with 3.7c a pound in 1921.

Synopsis of Recent Chemical & Metallurgical Literature

"Chem. & Met.'s" List of Reviewed Publications

Below are listed the publications that are reviewed by the staff of *Chem. & Met.* The important articles are listed in the synopsis box and the most significant contributions are abstracted and published on these pages:

American Fertilizer, 1010 Arch St., Philadelphia, Pa.
Blast Furnace and Steel Plant, 108 Smithfield St., Pittsburgh, Pa.
Brass World and Platers' Guide, Elm and Duane Sts., New York.
Brick and Clay Record, 610 Federal St., Chicago, Ill.
Canadian Chemistry and Metallurgy, 57 Queen St., West, Toronto, Ont., Canada
Chemical Abstracts, 1709 G St., N. W., Washington, D. C.
Chemical Age (New York), 381 Fourth Ave., New York
Chemical Age (London), 8 Bouverie St., London, E. C. 4, England
Chemiker Zeitung, Cothen, Anhalt, Germany
Chemistry and Industry, 46-7 Finsbury Square, London, E. C. 2, England
Chimie et Industrie, 49 Rue des Mathurins, Paris, France
Color Trade Journal, 21 East 40th St., New York.
Commerce Reports, Department of Commerce, Washington, D. C.
Drug and Chemical Markets, 3 Park Place, New York
Factory, 342 Madison Ave., New York
Facts About Sugar, 132 Front St., New York City.
Federal Reserve Bulletin, Government Printing Office, Washington, D. C.
Forging and Heat Treating, 108 Smithfield St., Pittsburgh, Pa.
Gas Age-Record, 52 Vanderbilt Ave., New York
Gas Journal, 11 Bolt Court, Fleet St., London, England
General Electric Review, General Electric Co., Schenectady, N. Y.
Glückauf, Essen, Germany.
Illustrated Official Journal, 168 Fleet St., London, E.C. 4, England.
India Rubber World, 25 West 45th St., New York.
Industrial and Engineering Chemistry, American Chemical Society, 810 15th St., N. W., Washington, D. C.
Industrial Digest, 25 West 45th St., New York.
Industrial Management, 120 West 32nd St., New York.
Industrial Survey, Kirby Bldg., Cleveland, Ohio
International Sugar Journal, 2 St. Dunstan's Hill, London, E. C. 3, England
Iron Age, 239 West 39th St., New York
Iron and Coal Trade Review, Bessemer House, Adelphi, Strand W. C. 2, London, England.
Journal of American Chemical Society, 810 18th St., N. W., Washington, D. C.
Journal of the Institution of Petroleum Technologists and Record of Transactions, 5 John St., Adelphi, Strand, London, W. C. 2, England
L'Echo des Mines et de la Métallurgie, 7 Rue d'Offemont, Paris, France.
L'Industrie Chimique, 8 Rue de Miromesnil, Paris, France
Management Engineering, 20 Vesey St., New York.
Metall und Erz, Berlin, S. W. 11, Königgrätzen Strasse 106.
Mining and Metallurgy, 29 West 39th St., New York.
National Provisioner, 407 South Dearborn St., Chicago, Ill
New Jersey Ceramist, 170 Roseville Ave., Newark, N. J.
Official Gazette of the United States Patent Office, Washington, D. C.
Oil, Paint and Drug Reporter, 100 William St., New York
Paper, 36 West 44th St., New York.
Pulp and Paper Magazine, Gardenvale, Que., Canada
Revue de Métallurgie, 5 Cité Pigalle, Paris, France.
Revue Universelle des Mines, 16 Quai des Etats-Unis, Liege, Belgium
Rock Products, 542 South Dearborn St., Chicago, Ill
Rubber Age, 225 Fourth Ave., New York.
Stahl und Eisen, Verlag Stahleisen m. b. H. Düsseldorf, Schlieszfach 664.
Sugar, 153 Waverly Place, New York
Taylor Society Bulletin, 29 West 39th St., New York

Road Tar Specifications

Gas Journal (London) for Feb. 21 gives a rather complete review of the new specifications for tar treatment of roads which has been adopted by the British Ministry of Transport (Roads Department). Copy of the full directions can be secured from His Majesty's Stationery Office, Imperial House, King's Way, London, W. C. 2, for 1s. each.

Important Articles in Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem. & Met.* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. Those that are of unusual interest will be published later in abstract in this department, but since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage. The magazines reviewed have all been received within a fortnight of our publication date

SULPHATE OF AMMONIA MANUFACTURE. *The American Fertilizer*, March 10, 1923, pp. 25-32.

TIN DEPOSITS IN THE MALAY. J. B. Newsom. *Eng. & Min. Jour.-Press*, March 17, 1923, pp. 485-491.

THE LAWS OF CRUSHING. J. Herman. *Eng. & Min. Jour.-Press*, March 17, 1923, pp. 498-499.

MANUFACTURE OF VARNISH. G. N. Hill, *Can. Chem. & Met.*, March, 1923, pp. 60-63.

REFRACTORY MATERIALS (IV). *La Technique Moderne*, March 1, 1923, pp. 144-148.

FALL RIVER GAS PLANT. A. C. Klein. *American Gas Association Monthly*, March, 1923, pp. 188-191.

FACTS CONSIDERED AS INDUSTRIAL STABILIZERS. R. H. Booth. *Iron Age*, March 8, 1923, pp. 673-677.

CHROME-NICKEL STEEL IN TRACK WORK. F. G. Hillbard. *Iron Age*, March 15, 1923, pp. 753-757.

RETORT VACUUM AND QUALITY CONTROL. W. H. Warren. *Gas Journal*, March 7, 1923, p. 619.

STUDY OF THE PLASTICITY OF PAINT. Eugene C. Bingham, Herbert D. Bruce and Martin O. Wolbach, Jr. *J. Franklin Inst.*, March, 1923, pp. 303-317.

OXIDATION OF HYDROCARBONS WITH SPECIAL REFERENCE TO FORMALDEHYDE PRODUCTION. Part II. Action of O_3 on CH_4. T. Sherlock Wheeler and E. W. Blair. *J. Soc. Chem. Ind.*, March 9, 1923, pp. 81-86T.

Low-Grade Oils in Water-Gas Making

In the carburetted water-gas plant that was designed and constructed by the Fall River (Mass.) Gas Works Co. by Stone & Webster in 1922, an attempt was made to anticipate gas-making conditions that may be expected within the next decade, particularly with respect to the supply of enriching oil. A. C. Klein describes this in the *American Gas Association Monthly* for March, 1923.

Due to the present condition in the supply of petroleum and future prospects of this supply, the gas industry well may ask itself what sort of enriching oil it may have to handle in the near future. It will undoubtedly be necessary to use such distillates and crudes as cannot be economically converted into gasoline. The two principal sources of these oils will be, first, the residuum from mid-continent crudes which remains after all the fractions that can be converted into gasoline have been removed; second, topped or untopped crudes of an asphalt base such as the heavy crude California and Mexican oils which are not desirable for use in cracking plants because the gasoline yielded is low and the residuum practically unsalable. These oils are low in gravity, viscous, high in sulphur and high in coke.

FIXED SULPHUR FORMATION

It has been found that the use of high-sulphur oils in enriching water gas results in high-hydrogen sulphide content and a high content of fixed sulphur impurity. The Stone & Webster heavy oil process is based upon the theory that the formation of such sulphur compounds takes place only in the presence of incandescent carbon. That is, the sulphur in the oil enters first into the form of hydrogen sulphide and in the presence of incandescent carbon the hydrogen sulphide is reduced and carbon bisulphide, a fixed form of sulphur, is formed. The formation of sulphur compounds in the carburetor appears to be proportional to the sulphur content of the oil used, equilibrium being reached, apparently, when the fixed sulphur in the gas is somewhat in excess of 10 per cent of the hydrogen sulphide content.

This maximum can be attained only in the presence of an excess of incandescent coke in the carburetor. This coke would be formed from the use of an oil high in coke.

This coke is formed during the carburation process and is deposited on the checkerwork in the carburetor. During the run in which it is deposited it is too cool to react with the hydrogen sulphide. If permitted to remain, however, it becomes incandescent during the succeeding blow-run and on the following run is active in the formation of carbon bisulphide. This makes it apparent that the way to keep fixed sulphur compound out of the carbureted gas is to remove the coke from the carburetor after every run,

hence starting each run with clean checkerwork.

STONE & WEBSTER PROCESS IS USED AT FALL RIVER

The water-gas installation at Fall River embodies some features of design which have been worked out especially for handling low-gravity, high-sulphur oils. A carburetor blast connection has been made 24 in. in diameter, and a meter is installed for the measurement of carburetor air used. A connection is installed between the top of the generator-carburetor angle connection and the top of the superheater. This connection is of 42-in. diameter pipe, brick lined, containing a hydraulically operated hot valve. In the lower generator connection an additional 24-in. hot valve has been installed alongside of the regular one, and the hydraulic cylinder of this valve has been interconnected with the extra 42-in. hot valve so that one valve will always be closed and the other always open.

This connection enables the generator to be isolated from the carburetor so that air may be admitted under the generator grate and to the top of the carburetor at the same time, the generator blast heating the fuel bed while the carburetor air consumes the carbon on the checker brick, thereby heating the brick. The generator gases bypass the carburetor and superheater and meet the carburetor gases at the superheater stack, where they are burned by the excess oxygen in the carburetor blast products, the heat so generated being recovered in waste heat boilers. Oils of 15 per cent coke content generate enough heat to restore the checker brick to the proper gas making temperature. With oils of lower coke content it may be necessary to burn the generator gases in the carburetor for a short time at the end of each blow run. The system here described provides for this.

Composition and Properties of Diaspore, Bauxite and Gibbsite

High-alumina refractories may be made from three ores—diaspore, bauxite and gibbsite. Diaspore is the monohydrate of alumina, gibbsite the trihydrate and bauxite is a mixture of the two. A careful study of the composition and properties of these ores, made by Raymond M. Howe and R. F. Ferguson, has been published in the *Journal* of the American Ceramic Society, March, 1923, p. 496.

It was found that the ores vary considerably in chemical composition, except in magnesia, alkalis and titania. Their fusion points are lowered most by lime and least by ferric oxide and silica. The burning shrinkages of the minerals high in silica were lowest, while those high in ferric oxide shrank the most. Gibbsite was found to have a higher burning shrinkage than diaspore. Some general data for bauxite and diaspore are given in the accompanying table.

On page 501 of the same issue is an article by D. C. Wysor on "Diaspore Clay of Arkansas and Missouri," followed by discussions which bring out many points of interest in connection with diaspore deposits.

GENERAL DATA FOR BAUXITE AND DIASPORES

	1	2	3	4	5	6	7
Fusion point in cones	41	34	42	40	42	40	42
Shrinkage	8 3	5 5	11 6	5 8	8 4	3 7	10 2
Porosity cone 3	59 6	47 1	45 4	40 3	53 1	48 0	49 0
Porosity cone 18	42 9	31 7	38 8	36 7	8 9	31 8	46.3
Difference	16 7	15 4	6 6	3 6	44 2	16 2	2 7
Burning shrinkage to cone 3	18 0	12 7	8 2	12 2	12 2	16 7	1.3
Burning shrinkage to cone 18	42 6	30 8	29 9	16 3	55 2	38 2	16 3
Difference	24 6	18 1	21 7	4 1	43 0	21 5	15 0
Per cent H_2O	28 08	17 90	13 74	13 41	9 88	14 98	14.24
Per cent SiO_2	9 70	18 90	13 96	20 50	1 36	17 84	5.36
Per cent Al_2O_3	56 31	52 48	67 21	60 89	60 66	61.98	73 70
Per cent Fe_2O_3	3 10	4 39	0 75	0 55	23 55	1 47	2 28
Source	rk.	France	Mo.	Mo.	France	France	Mo.

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Hot Drawing on a Mandril

This article[1] was read by Eugene Schneider at the autumn (1921) meeting of the Iron and Steel Institute, and can be considered as a sequel to one published in the journal of that Institute in 1920, No. 2, p. 223, under the title "An Investigation of Various Forging Operations Carried Out Under Hydraulic Presses."[2]

Drawing on a mandril has for its object the lengthening of a hollow blank obtained by punching or casting, while keeping it, by means of a mandril, at the required internal section. The operation is relatively simple, but the conditions under which the work is actually carried out are but little known.

In the present contribution the relation is worked out between the resistance of the metal to displacement and the strain per square millimeter carried by the remaining section.

It is necessary, of course, that in order for a blank to be drawn the strain per square millimeter of remaining section be less than the breaking strain at the working temperature. It is demonstrated that if we operate under the same conditions of temperature and with dies whose surfaces of contact are in the same state, the resistance to displacement increases as the angle of contact between hot metal and die decreases.

The strain in the material varies according to the temperature at which the drawing is done, but is further a direct function of the elongation effected during the operation. The maximum elongation that can be given a blank is much greater as the blank becomes thinner.

In a general manner it is better to keep a little below the maximum elongation obtainable and thus avoid the consequences which may be caused by large differences of temperature.

The dies should have as nearly as possible the ideal section indicated and should be very smooth and very hard.

The punches require every care, both as to finish and quality; tool marks and rough surfaces should be scrupulously avoided. The tensile strength should be 65 to 70 kg. per sq.mm. (100,000 lb. per sq.in.).

A very large number and variety of blanks of all dimensions were manufactured and studied in this investigation and enabled the author to make numerous observations especially applicable to the needs of the shop. Following these results the method of working no longer need follow empirical lines.

[1] *Revue de Métallurgie, Mémoires*, March, 1922, pp 121-141
[2] Abstracted in *Chem & Met* Feb 9, 1921, vol 24 p 269

Book Reviews

CRYSTALLIZATION OF METALS By *Colonel N T. Belaiew, C B*, published by the University of London Press, Ltd, 17 Warwick Square, London, England. 5 x 7¼ in 113 pp, with 37 illustrations in the text and 21 plates Price, 7s 6d. net.

Colonel Belaiew is quite well known for his researches on Damascene swords and various curious stable structures in iron and steel. He was also perhaps the first to produce Widmanstättian structure—well known in meteorites—in artificial alloys. His researches were started in 1906 at the Michael Artillery Academy, Petrograd, under the guidance of Professor Tschernoff. Having been invalided from the Russian Army during the great war, he was sent to England to serve with the inspection staff on Russian munitions. Advantage was taken of his presence in Great Britain by the University of London to enlist him as a special lecturer, and one course of these lectures forms the basis of this little volume.

The author's researches on crystallization of steel were animated by the idea of bringing into closer harmony the processes of crystallization with various areas of the iron-carbon diagram. Studying the works of Sorby, who gradually was brought from the study of the macrostructure of meteorites to the microstructure of steel, and learning how Anossoff likewise started from the macrostructure of Damascene blades, the author felt deeply impressed by the importance of macrostructure, and directed his early efforts toward obtaining large structures easily discernible with the naked eye.

In view of the growing realization that macrostructure and "fiber" have a great but not as yet understood influence on the quality of finished pieces, this little book should prove interesting reading to a large number of men charged with technical control of metallic manufacturing. E. E. THUM.

Recent Chemical & Metallurgical Patents

Production of Metal Hydrates and Gas, Including Acetylene—J. H. Reid has assigned to Thomas Q. Hogan, of Boston, his patent on a process and material for the production of sodium or potassium hydroxide, together with carbide materials "suitable for the generation of acetylene or the preparation of nitrified material" and also simultaneous production of large quantity of fuel gas. This invention requires a mixture of cokable carbonaceous material (preferably bituminous coal) with either sodium or potassium feldspar in about the proportions of 100 lb. of the feldspar to 41 lb. of the coal, the feldspar and the coal having been previously reduced to a finely divided condition and intimately mingled. This mixture is subjected in retorts, such as are used in the manufacture of gas or coke ovens, to a temperature of from 1,400 to 2,800 deg. F. to convert the coal into coke and to obtain a strong coke-like aggregate of the feldspar and coke "capable of most efficient reduction in an electric furnace."

In such furnace, the material will be reduced to aluminum carbide, aluminum oxycarbide or to a material of the nature of silicon carbide, but harder than the latter, dependent upon the temperature and other conditions within the furnace. During the carbide reaction, Na_2O or K_2O will be evolved, depending upon the use of sodium or potassium feldspar, together with a gas consisting mainly of carbon monoxide.

"With the proportion of feldspar and coal as given, the most probable solid products in the electrical furnace will be $Al_4C_3 10SiO_2$; but, by increasing the proportion of carbon, the oxygen of the SiO_2 may be taken up, leaving aluminum silicon carbide—of the nature of carborundum, but probably harder." (1,445,645. Feb. 20, 1923.)

Coke Manufacture From Coal Blends—S. R. Illingworth's process for the manufacture of coke by heating a blend of two coals "which is such that its resinic content is not less than 5 per cent but preferably not less than 8 per cent of its weight" to a temperature not exceeding 500 deg. C. The resinic constituents are defined as those portions of the coal soluble in boiling phenol or boiling pyridine and also soluble in chloroform. (1,445,954. Feb. 20, 1923.)

Bauxite Refractory Bonded With Bentonite—For use in crucibles or furnace linings, the amount of clay required to produce a workable mix may be reduced from over 20 per cent to 5 per cent by substituting bentonite for ordinary plastic clay. (1,442,413. Zacharias Alsson, of New York, assignor of six-tenths to August Rust-Oppenheim, of New York. Jan. 16, 1923.)

Manufacture of Anhydrous Aluminum Chloride—Aluminum bromide is first formed in this process (described by Bernard H. Jacobson, of Charleston, W. Va., and assigned to E. C. Klipstein & Sons Co.) by treating small pieces of aluminum with liquid bromine in a closed vessel provided with a reflux con**denser and cooling facilities for removing the heat of reaction. Through the liquid anhydrous aluminum bromide (m.p. 93 deg. C., b.p. 263 deg. C.) thus** formed a stream of chlorine gas is passed, forming anhydrous $AlCl_3$ and liberating bromine vapor, which is condensed for re-use. (1,445,082. Feb. 13, 1923.)

Increasing Emulsifying Properties of Sulphite Waste Liquor—For many applications of neutralized and concentrated sulphite waste liquor, it is desirable to emulsify the liquor with various oils. While the lignonesulphonates contained in solution in the liquor are in themselves fairly good emulsifying agents for oils of fatty and hydrocarbon nature, the permanency of the emulsions is much improved by the addition of small amounts, say 1 per

American Patents Issued March 13, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,447,973—Treatment of Clay. William Feldenheimer and Walter William Plowman, London England.

1,448,010—Artificial Magnesia Spinel and Process of Manufacture. Frank J. Tone, Niagara Falls, N. Y., assignor to the Carborundum Co., Niagara Falls.

1,448,011—Sagger Structure. Frank J. Tone, Niagara Falls, N. Y.

1,448,036—Reduction of Oxides of Metals of the Chromium Group. Richard Edgar Pearson and Eustace Neville Craig, London, England, assignors to Dureleo, Ltd., London.

1,448,037—Electrolysis of Water. Rodolphe Pechkranz, Geneva, Switzerland.

1,448,038—Apparatus for the Carbonization of Woolen Rags, Combings and the Like. Vittorio Piana, Turin, Italy.

1,448,084—Method of Producing Lubricating Oils. Thomas F. Ott, Berkeley, Calif.

1,448,091—Purification of Cellulose Ether. Paul C. Seel, Rochester, N. Y., assignor to Eastman Kodak Co., Rochester.

1,448,110—Purification of Manganiferous Material. Harold de Olaneta, New Haven, Conn., assignor to Winchester Repeating Arms Co., New Haven.

1,448,128—Method of and Apparatus for Cracking Petroleum Products. Cornelius Kroll, Tulsa, Okla.

1,448,155—Waterproofing Element. Karl Schutte, Rutherford, N. J., assignor to the Flintkote Co., Boston, Mass.

1,448,245—Liquid Fuel. Miguel Llompart y Valdés and Vincente Bacallas y Villar, Havana, Cuba.

1,448,246—Lubricating Oil. Edward Goodrich Acheson, New York, N. Y.

1,448,251—Product for Dyeing and Printing Textile Materials. Marcel Bader and Charles Sunder, Alsatia, France, assignors of one-half to Durand & Huguenin, S. A., Basel, Switzerland.

1,448,276—Composition of Matter and Method for Preserving Organic Porous Materials. Max Landau, Berlin, Germany, assignor, by mesne assignments, to the Chemical Foundation, Inc.

1,448,278—Tanning Means, Their Preparation and Use. Willy Moeller, Hamburg, Germany, assignor by mesne assignments to the Chemical Foundation, Inc.

1,448,284—Paint. Alonzo C. Tutt, Galena, Kan., and Levi F. Snelson, Joplin, Mo.

1,448,340—Process and Furnace for Reducing and Roasting Ores. Emil Fleischer, Dresden, Germany, assignor by mesne assignments to the Chemical Foundation, Inc.

1,448,386—Alkali and Heat Resistant Insulation. Gordon Q. Barr and John R. McClain, Wilkinsburg, and Leslie E. Frost, Pittsburgh, Pa., assignors to Westinghouse Electric & Manufacturing Co.

1,448,387—Method of and Apparatus for the Direct Synthesis of Ammonia at Very High Pressures. George Claude, Paris, France, assignor to L'Air Liquide, Société Anonyme pour l'Etude et l'Exploitation des Procédes Georges Claude, Paris, France.

1,448,390—Apparatus for Burning Pulverized Fuel. Charles P. Crawford, Salt Lake City, Utah.

1,448,391—Process of Treating or Retting and Curing Hemp, Flax, Perini, Jute or Other Fibrous Material. Harry L. Cromer, Oak Park, Ill.

1,448,421—Process of Purifying Raw Cane Juice. Carl J. J. Sorensen, Frederiksted, St. Croix, Virgin Islands.

1,448,432—Process of Dyeing Cellulose Acetate or Products Made Therewith. René Clavel, Basel, Switzerland.

1,448,512—Method of Dehydrating Vegetable, Animal and Other Materials. George Hillard Benjamin, New York, N. Y.

1,448,514—Wet Process of Classifying Comminuted Material. Walter O. Borcherdt, Austinville, Va., assignor to the New Jersey Zinc Co., New York.

1,448,515—Treatment of Minerals. Walter O. Borcherdt, Austinville, Va., assignor to the New Jersey Zinc Co., New York.

1,448,556—Synthetic Gum and Process of Making Same. James McIntosh, Norristown, Pa., assignor to Diamond State Fibre Co., Elsmere, Del.

1,448,557—Dumbturner for Sugar-Cane Mills. Charles McNeil, Glasgow, Scotland.

1,448,571—Alloy. Andrew O'Rourke, Chicago, Ill., assignor to Crane Co., Chicago, Ill.

1,448,581—Process of Purifying Oleaginous Substances. Francis M. Turner, New York.

1,448,586—Process of Manufacturing Aluminous Abrasives. Thomas B. Allen, Hamilton, Ont., Canada, assignor to Abrasive Co., Philadelphia, Pa.

1,448,593—Method and Apparatus for Separating Water From Coal Tar. Paul Jaworski, Bismarckhutte, Germany.

1,448,643—Method for Treating Hydrocarbons and Particularly Crude Petroleum. Peter von Ditmar, Hamburg, Germany.

1,448,709—Art of Oil Distillation. John E. Schulze, Chicago, Ill., assignor to Red River Refining Co., Inc., Shreveport, La.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

cent, of sulphonates of more oily or hydrocarbon nature, as set forth by Karl P. McElroy, of Washington, D. C., in a patent assigned to Robeson Process Co., of New York. Either the free sulphonic acids or their salts may be used, the soda sludge from petroleum refining having been found particularly adaptable for this purpose. The emulsions formed with linseed oil, for example, may be used as core binders, road binders, briquet binders, etc. (1,444,844. Feb. 13, 1923.)

Treatment of Sulphite Cellulose Liquors—Neutralization of sulphite waste liquor with lime according to the usual practice has certain disadvantages. If the liquor is completely neutralized a lime organic compound separates as a bulky precipitate and the liquor is so changed as materially to decrease its adhesiveness. Furthermore, the neutralized liquor still contains acid sulphites. Jacob S. Robeson, of Pennington, N. J., in a patent assigned to J. S. Robeson, Inc., of Wilmington, Del., first sprays the unconcentrated liquor into a current of air, so that all of the free SO_2 and loosely combined sulphur are almost instantly permitted to escape or are oxidized to firmly bound condition. The liquor is then neutralized with magnesia, an excess of which precipitates only magnesium hydroxide and not an organic compound. As a result it is found that the adhesiveness of the evaporated liquor is increased. It is also possible to concentrate the liquor after oxidation to about 1.11 to 1.15 sp.gr. in the first two effects of a quadruple effect evaporator, ferment this liquor, return it through counter current heat exchanges to the third effect for the removal of alcohol, and complete the concentration of the residual liquor in the last effect. (1,445,603. Feb. 13, 1923.)

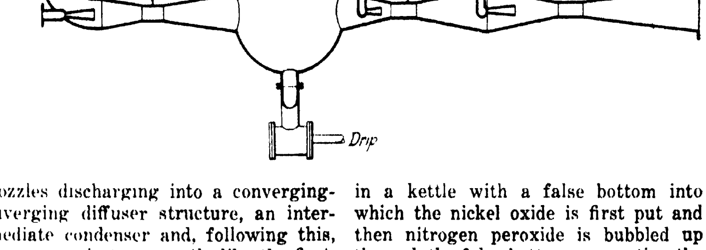
Fume Control—This invention is for the purpose of shielding, controlling and removing fumes from devices used in heating organic matter, such as paint vehicles, varnishes and similar products. When products of this type are heated, the volatile constituents are converted into fume and it is necessary to remove these fumes from the container and from contact with the residue.

These fumes are often of considerable value, and it is desirable to remove them in such a way that they may be saved and the smallest loss possible may occur. In the ordinary distillation of products such as mentioned above, the volatile portions are often decomposed by the high temperatures necessary. It has been the custom to complete the distillation of the material being distilled and still not decompose the volatile matter by resorting to a reduction of gas pressure and a consequent dropping of the temperature of distillation by the use of some sort of vacuum apparatus. The invention here discussed aims to conserve fume values and protect the fumes from destructive temperatures within the heating container and also to protect the container itself from the action of the fumes while the distillation is in process.

The method of this invention is to admit a current of air into the heating container in such a way as to form a pressure and cause the current of air to circulate over the interior surfaces of the container between the fumes which are distilled and the surfaces. This serves to protect the surfaces, and in case any portion of the fume penetrates this blanket of air, it will be sucked up to the outlet with the air and diffused. This circulation of air also enables the fume to be removed from the container without any return by condensation to the charge and without any decomposition of unstable portions of the fume. The current introduced into the container may be any other inert gas besides air. (1,446,480. Robert S. Perry and Paul W. Webster, assignors to Perry & Webster, Inc., of New York, Feb. 27, 1923).

Apparatus for Exhausting Air—The object of this invention is to increase the efficiency of apparatus used for exhausting air and liquids from condensers or other similar pieces of equipment. The improvement embodied here consists in having, as shown in the accompanying drawing, two stages to the ejector beyond the small condenser which is included in the injecting apparatus for the purpose of removing liquid from the air.

By reference to the drawing it will be noticed that this apparatus consists of an ejector, comprising a nozzle or nozzles discharging into a converging-diverging diffuser structure, an intermediate condenser and, following this, two more ejectors exactly like the first. This differs from the usual construction of such ejectors by having two ejectors following the intermediate condenser. The inventor claims that as the result of the use of two ejectors, he is able to attain considerably more efficient operation and superior economy in steam used. It is claimed for this type of exhauster that with a pressure less than 2 in. of mercury, air can be exhausted from a main condenser with an expenditure of at least 25 per cent less steam than that used by any previous equipment. Or that with a given exhauster pressure, the improved apparatus will exhaust a far greater amount of air from the main condenser than could be done with former designs. (1,447,014. Raymond N. Ehrhart, of Pittsburgh, assignor to Elliott Co. of Pittsburgh, Pa. Feb. 27, 1923.)



Colloidal Fuel—Lindon W. Bates has been granted a patent on his mixture of liquid hydrocarbon and solid carbonaceous substance which he prepares in "a composite usable for atomizable fuel purposes" and calls a "colloidal fuel." This patent covers the product and the method of producing it. The product is described by the patentee in one of his claims as "a stable mobile atomizable liquefiable fuel comprising solid particles of carbonaceous substance, liquid hydrocarbon, and saponified resinous matter." The method of producing the product is defined in another claim as consisting "essentially in mixing liquid hydrocarbon and particles of solid carbonaceous substance in amounts which will produce a composite of specific gravity greater than that of water without destroying the atomizable character of the composite; and colloidalizing the components." (1,447,008. Feb. 27, 1923.)

Revivifying Nickel Oxide—Thomas Midgley, Jr., of Dayton, Ohio, has developed a process and an apparatus for revivifying spent nickel oxide which is used in the hydrogenation processes. This is done by treating with water and oxide (NO_2). The resulting solution contains nickel nitrate, and the nitrated material is then heated to a sufficiently high temperature to break down and drive off the NO_2 gas, leaving the oxide behind.

This oxide has been found to have the same degree of catalytic activity as that originally used. The apparatus used for carrying it out consists largely in a kettle with a false bottom into which the nickel oxide is first put and then nitrogen peroxide is bubbled up through the false bottom, converting the material into nickel nitrate. (1,446,984, assigned to the General Motors Research Corporation, of Dayton, Ohio. Feb. 27, 1923.)

Guanidine Salts—J. S. Blair and J. M. Braham have patented a process for the preparation of guanidine salts. Their process involves the use of cyanamide solutions treated with an ammonium salt under pressure. Lime nitrogen is first treated with a mineral acid and the resulting solution is heated in an autoclave at a temperature of 150 to 180 deg. with ammonium nitrate. Reaction should be completed within 3 hours under normal conditions. Good yields are reported obtained and conditions distinctly different from those specifically mentioned can be used. (1,441,206. Jan. 9, 1923.)

British Patents

For complete specifications of any British patent apply to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Chromium Compounds — Chromium compounds free from iron are prepared by dissolving ferrochromium in sulphuric acid, adding calcium carbonate or its equivalent in quantity insufficient to precipitate all the chromium, dissolving out the chromium from the precipitate by an acid, such as sulphuric acid and, when chrome alum is desired, adding potassium sulphate to obtain the alum. The filtrate is treated with another quantity of calcium carbonate or the like to precipitate the rest of the chromium together with some iron and the precipitate is treated with sulphuric acid to dissolve the chromium and iron. The solution is then mixed with sulphuric acid to be used in dissolving more ferrochromium. (Br. Pat. 188,338; not yet accepted. Kinzlberger & Co., Prague, Czecho-Slovakia. Dec. 29, 1922.)

Lubricants—Derivatives of polyhydric alcohols or phenols in which the hydroxyl groups are partly replaced by fatty or other acid radicles are added to mineral oils or to saponifiable oils, fats or waxes, to increase their lubricating and emulsifying properties and to give them greater consistency. The mono-glycerides of oleic and lauric acids may be used, and in an example, 5 per cent of mono- or di-glyceride of oleic acid is added to a mineral lubricating-oil. (Br. Pat. 188,364. Technical Research Works, Ltd., and R. G. Pilly, London. Dec. 30, 1922.)

Organo-Mercury Compounds — Aromatic mercury cyanide compounds are prepared by treating complex mercury compounds of phenol and its homologues with alkali cyanides in aqueous solution, or by heating phenol and its homologues with mercury cyanide in alkaline solution or with mercuric oxide in alkali cyanide solution. The products are efficacious against plant diseases. According to examples, (1) mercury cresol cyanide is obtained by dissolving mercuric oxide in dilute sulphuric acid, adding o-cresol, boiling the resulting precipitate with sodium cyanide solution and evaporating the filtrate *in vacuo;* (2) o-cresol is boiled with mercury cyanide and dilute sodium hydroxide and the mercury cresol cyanide separated by carbon dioxide or dilute acids; (3) mercury phenol cyanide is prepared by boiling phenol with mercuric oxide in sodium cyanide solution and treating the cooled solution with carbon dioxide or dilute acids. (Br. Pat. 188,376. A Klages and Saccharin-Fabrik Akt. Ges. vorm. Fahlberg-List & Co., Magdeburg. Dec. 30, 1922.)

Gas Producer—In a gas producer the whole or part of the gases generated is carried to pass through a considerable depth, say 14 ft., of fresh fuel, which is thereby distilled in stages and at low temperature so that the gases leaving the upper part of the producer have a temperature of between 150 and 300 deg. C. and a calorific value of about 170 B.t.u., high yields of ammonia and low-temperature distillation products being obtained. The temperature of the upper fuel zone may be controlled by removing part of the gases generated in the lower part of the producer prior to their reaching the upper zone. A central gas off-take comprises a bell situated near the top of the upper zone so that the ascending gases are distributed evenly over the cross-sectional area of the descending column of fresh fuel. (Br. Pat. 188,607. W. Beswick and N. E. Rambush, Stockton-on-Tees, England. Jan. 10, 1923.)

Extracting Metals—Vapors of metallic chlorides are passed over a heated mixture of carbon and alkalis, alkaline earths or magnesia; or the vapors of the chlorides mixed with excess of a gaseous or liquid reducing agent may be passed over the alkaline substance alone. The temperature is kept sufficiently high to melt the metal and the alkali chloride, which are both discharged in a molten state. The process may be carried out in a producer charged with carbonaceous fuel and burnt or unburnt limestone or dolomite, the chloride vapor being supplied thereto mixed with air. (Br. Pat. 188,657; not yet accepted. S. J. Vermaes and L. L. J. Van Lijnden, The Hague. Jan. 10, 1923.)

Active Carbon for Drying Gases—A process of drying gases or separating mixtures of gases consists in treating them with active carbon, preferably of vegetable origin and dehydrated by ignition or by heating in vacuo before use, and in drying the gases or separating them by adsorption. One method of carrying out the invention consists in passing the gases through containers filled with granules of active carbon and arranged in series so that as one container becomes exhausted it can be cut out of the series and the saturated carbon reactivated by heated inert gas, the inert gas being passed directly into the container or into a perforated tube in the container with means for closing the perforations. The containers may be cooled to remove the heat of adsorption, the last containers of the series being cooled more than the first, and the cooled gas used for cooling the moist gas on the countercurrent principle. The drying is facilitated if the gas is compressed or its temperature reduced to about 0 to 5 deg. C. The process can be used to separate light and heavy hydrocarbons, or to remove impurities such as hydrocarbons and carbon dioxide from hydrogen. (Br. Pat. 188,666; not yet accepted. Algemeene Norit Maatschappij, Amsterdam. Jan. 10, 1923.)

Activated Carbon in Gaseous Reactions—The treatment of liquids with gases is rendered more effective by carrying out the treatment in the presence of activated carbon. The carbon is preferably obtained from vegetable raw material in such a manner that the structure of the raw material is retained. Powdered carbon may be mixed with the liquid and the mixture then treated with the gas, preferably under pressure. Or the liquid and gas may be passed in countercurrent fashion through a column of granular carbon. Or the carbon may be caused to adsorb the gas and then used to treat the liquid. Such adsorption may be secured by treating the carbon with gas under pressure at a low temperature, or with a solution of the gas in a portion of the liquid to be treated or in another liquid. The carbon may before use be treated to remove gases either by ignition or by heating in a vacuum. The process is stated to be applicable in bleaching liquids, in oxidizing drying and semi-drying oils, in the decomposition or oxidization of mineral oils for the purpose of converting them into fatty acids and other products, and in purifying and sterilizing water or other liquids with chlorine. (Br. Pat. 188,667; not yet accepted. Algemeene Norit Maatschappij, Amsterdam, Jan. 10, 1923.)

Tanning—A starch-tannin preparation is made by heating starch with a tanning extract, at or near the boiling point of the liquor but well above 180 deg. F., if necessary with the addition of a weak acid, until the starch is highly dispersed beyond the jelly stage—that is, it remains in the form of a colloidal solution and does not form a jelly on cooling. Tanning extracts of the pyrogallol class, such as chestnut wood, oakwood and myrabalans, can be used without acid, while those of the catechol class, for example mimosa bark and quebracho, require the more vigorous treatment. Weak acids specified are such as acetic, lactic, sulphonic acids and sulphur dioxide. Gallic and tannic acids may be substituted for the mixture of acid and tanning material. According to examples, Japanese farina is dispersed by vigorous boiling with myrabalan extract, with quebracho extract and sodium bisulphite or with mimosa bark and gallic acid. The preparation is applicable for tanning hides or, according to the provisional specification, for pharmaceutical purposes. Specification 110,470 is referred to. (Br. Pat. 189,236. R. R. Howroyd, Liverpool, and A. Turnbull, Helsby, Cheshire. Jan. 17, 1923.)

Formaldehyde—Formaldehyde is produced by passing a mixture of methylene chloride vapor and water vapor at a raised temperature over a porous body, such as pieces of clay, infusorial earth, ordinary or activated wood charcoal. The condensate consists of a hydrochloric acid solution of formaldehyde. (Br. Pat. 189,432; not yet accepted. Farbwerke vorm. Meister Lucius and Brüning, Hoechst-on-Main. Jan. 17, 1923.)

Varnishes and Polishes—Chlorinated montan or other mineral wax is used as an ingredient of varnishes and polishes. It may be used alone in solution or mixed with oils, pigments, other waxes and resins. (Br. Pat. 189,104. A. Schmidt, Paris. Jan. 17, 1923.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

New Haven Meeting Plans of A.C.S. Are Announced

Large Attendance Expected at Spring Gathering—Full Program Is Now Available

ANNOUNCEMENT of the final program for the spring meeting of the A.C.S. promises a session of great interest. The various divisions have arranged several symposiums in connection with the usual presentation of papers. Social as well as technical activities for the week at New Haven from April 2-7 have been carefully planned.

It is requested that on arrival all members and guests go direct to Byers Memorial Hall, where full information regarding reservations, etc., may be obtained and where registration should be made.

Outline of Monday's Events

The first day's general activities will open with a Council meeting in the afternoon, followed by a complimentary dinner given to the councilors by the New Haven Chamber of Commerce, at which the president of that body will preside. Other members may also attend, tickets being obtainable at Byers Hall. Speakers at the dinner will include the president of Yale, James R Angell; E. C. Franklin, president of the A.C.S.; Brigadier-General A. A. Fries, and A. D. Little.

Tuesday's Meetings of General Interest

On Tuesday, the second day, a general public meeting will be held at Woolsey Hall in the morning at which Francis P. Garvan will speak on "Chemistry and the Public." In the afternoon a general scientific meeting will be held, when special addresses will be given by the following speakers: Carl L. Alsberg, "Chemistry and Our Food Resources;" C. O. Johns, "The History and Status of Petroleum Chemistry Research;" H. E. Barnard, "The Baker Turns to the Chemist;" Oskar Baudisch, "The Influence of Light on Inorganic Material and Life Processes;" W. O. Mitscherling, "Cellulose Silk;" and Arthur Hirschfelder, "The Influence of Modern Chemistry on Pharmacology."

On Tuesday evening the men are to stage a smoker at the university dining hall, while the women will visit the Shubert Theater.

Wednesday's program will be devoted largely to functions arranged by Yale University, the most important being the dedication of the new Sterling Chemistry Laboratory. The time set for this event is 11 a.m., when among other speakers Past President E. F. Smith will give a special address entitled, "The History of Chemistry in America, With Special Reference to Yale." Following a complimentary luncheon at which foreign guests will speak, the laboratory will be open to inspection. In the evening a special dinner will be in charge of the Rubber Division. At the public evening meeting Sir J. J. Thompson, F.R.S., will speak.

Calendar

The following important technical meetings are scheduled for the immediate future

AMERICAN CHEMICAL SOCIETY
New Haven, Conn., April 2-7

AMERICAN ELECTROCHEMICAL SOCIETY
New York City, May 3-5

AMER SOCIETY MECHANICAL ENGRS
Montreal, May 28-31

AMERICAN FOUNDRYMEN'S ASSOCIATION
Cleveland, O., April 28-May 4

AMERICAN OIL CHEMISTS' SOCIETY
Hot Springs, Ark., April 30-May 1

AMER SOCIETY MECHANICAL ENGRS
Montreal, May 28-31

CANADIAN INSTITUTE OF CHEMISTRY
Toronto, May 29-31

SOCIETY OF CHEMICAL INDUSTRY
Canadian Section
Toronto, May 29-31

SOCIETY OF INDUSTRIAL ENGINEERS
Cincinnati, O., April 18-20

SOCIETY OF CHEMICAL INDUSTRY
New York, Joint meeting with other societies, April 13

Special Sessions Begin Thursday

On Thursday, following the morning and afternoon sessions of the divisional and sectional meetings, there will be fraternity and college alumni dinners. The women of Iota Sigma Pi have arranged a special 5 o'clock meeting at Sheffield Hall. In the later evening entertainment will be provided by an indoor polo game of the Yale R.O.T.C. at the armory.

Friday will be given over largely to special meetings. In the evening a reception is to tendered visiting members and guests by the New Haven Section. Dancing will be in order from 9 to 12, with supper at 10:30.

Several plants in the vicinity of New Haven will be open to inspection on Saturday. Throughout the week regular and special exhibits will be on display in the various Yale halls. The ladies' time is well arranged for with several teas, auto excursions, etc., provided.

Divisional Meeting Program

Division of Petroleum Chemistry, Thursday and Friday; 19 papers.

Section of Gas and Fuel Chemistry, Thursday; 7 papers.

Division of Industrial and Engineering Chemistry, Thursday and Friday; 27 papers.

Division of Rubber Chemistry, Thursday and Friday; 15 papers.

Division of Cellulose Chemistry, Thursday and Friday; 19 papers.

Section of History of Chemistry, Friday; 12 papers.

Section of Chemical Education, Thursday and Friday; 16 papers.

Division of Water, Sewage and Sanitation, Thursday; 10 papers.

Division of Chemistry of Medicinal Products, Thursday; 8 papers.

Division of Biological Chemistry, Thursday and Friday; 38 papers.

Division of Sugar Chemistry, Thursday and Friday; 15 papers.

Division of Physical and Inorganic Chemistry, 1. Section of Inorganic and Physical, Thursday and Friday; 42 papers. 2. Section of Colloids, Friday; 12 papers.

Division of Organic Chemistry, Thursday and Friday; 63 papers.

Division of Agricultural and Food Chemistry, Thursday and Friday; 35 papers.

Educational Movies Made by U. S. Bureau of Mines

An industrial film picturing the manufacture of heavy clay products is to be made by the Bureau of Mines in cooperation with manufacturers. The bureau has been very successful in the development of other industrial moving pictures. Among those already made are: Story of Petroleum; Story of Sulphur; Story of Ingot Iron; Saving Coal at Home; Story of Asbestos; Story of Rock Drilling; Story of Abrasives; Mexico and Its Oil; Story of Heavy Excavating Machinery; Oxygen, the Wonder Worker; Story of the Electric Beater; Story of an Automobile; Story of Compressed Air; Water Power; Transportation; Story of Alloy Steel; Story of Machine Tool Manufacture; Story of Steel, and Story of Portland Cement.

Federal Restrictions Cause Action By Industrial Alcohol Users

Committee Calls on Commissioner Blair Urging Revision of Present Rules

EXASPERATION on the part of many users of industrial alcohol has been growing. Recently a committee representing the industries that have had difficulty in obtaining the supply required for their business made an earnest plea for revision of present methods of handling the situation. As a result Commissioner D. H. Blair has announced that he will name a committee representing producers, dealers and consumers in the industry to advise with bureau officials regarding all regulations and matters affecting the industry. The ultimate object of this move is to separate industrial alcohol from the general police activities of the prohibition unit and at the same time to comply with the letter and spirit of the Volstead act, which purports to provide for the encouragement of legitimate uses of industrial alcohol.

Tendency Toward Undue Restriction

It was pointed out to the commissioner that while no special complaint was being lodged against the orders or actions of Prohibition Commissioner R. A. Haynes, the tendency in the prohibition unit has been to issue restrictive regulations rather than to devote attention to the development of the legitimate business of producing, selling and using industrial alcohol. For this reason, it was suggested that the activities in this matter be placed in a special division with a technical man at its head.

Attention was called to the fact that section 13 of the Volstead act has been virtually overlooked. This section provides methods for the bonding and operation of plants manufacturing industrial alcohol, denaturing plants and such matters "to prevent diversion of the alcohol to illegal uses and to place the non-beverage alcohol industry using alcohol . . . upon the highest possible plane of scientific and commercial efficiency consistent with the interests of the government, and which shall insure an ample supply . . . and promote its use in scientific research and the development of fuels, dyes and other lawful uses."

Not only have the regulations been restrictive of development, the commissioner was told, but it has been made difficult to obtain promptly a supply required by legitimate industries.

Personnel of Committee

Included among the committee calling on the commissioner were Dr. Martin H. Ittner, of the American Chemical Society; A. Homer Smith, secretary of the American Drug Manufacturers' Association and of the National Drug Trade Conference; W. L. Crounse, of the National Wholesale Druggists Association; Harry B. Thompson, of the Proprietary Association of America; James P. McGovern, of the U. S. Industrial Alcohol Co. and the U. S. Industrial Chemical Co.; Horace W. Bigelow, of Parke, Davis & Co.; Mortimer Bye, of Frederick Stearns & Co., and others.

Resolutions of the National Wholesale Druggists Association and of the National Drug Trade Conference, asking appointment of an advisory committee, were presented to Commissioner Blair.

Blair Announces Intention to Act

In an announcement after the conference, stating that he had the appointment of an advisory committee "under consideration" and indicating that it would be approved and the personnel then made public, Commissioner Blair said that the proposal contemplated a committee of ten members representing the retail and wholesale druggists, toilet manufacturers, flavoring manufacturers and chemists representing other consumers and producers.

Fuel Utilization Discussed

Several Speakers at Chemical Industry Meeting Present Ideas

The American Section of the Society of Chemical Industry held its regular monthly meeting on March 23 at the Chemists' Club, New York City. The topic of the evening was the latest developments in the utilization of fuel.

The first of the speakers, H. O. Loebell, vice-president of the Combustion Utilities Corporation, spoke on the complete gasification of coal. Mr. Loebell's thesis was that coal, to be used most efficiently, must be completely gasified. In developing this subject he described the present systems of complete gasification, detailed the methods by which results were obtained and pointed out that a market must be found for the greatly increased production of tar that would result from complete gasification.

Prof. J. J Morgan, of Columbia University, the next speaker, gave a description of the make-up and character of tars obtained by complete gasification and low-temperature distillation methods. This tar, he stated, may best be regarded as primary tar and is not a substitute for petroleum. A complete development of this subject by Professor Morgan can be found in *Chem. & Met.*, vol. 26, pp. 923, 977, 1025.

A. C. Fieldner, of the Bureau of Mines, the last speaker of the evening, recounted the bureau's work on producing lignite chars and described the successful experimental plant built in conjunction with the University of North Dakota. He concluded his remarks with a short account of the characteristics and methods of utilization of this fuel.

Announce Applicants for Tariff Revision

The Tariff Commission has just made public the names of the firms seeking changes in the existing tariff. As announced in last week's *Chem. & Met.* these commodities are to be especially investigated. The list follows:

Oxalic acid, Victor Chemical Works, Chicago.

Diethyl barbituric acid, Abbott Laboratories, Chicago

Barium dioxide, increase asked by the J. H. R. Products Co., Willoughby, Ohio; decrease asked by John Bene & Sons, Inc., Brooklyn, N. Y.

Casein, committee representing various coated paper manufacturers

Logwood extract, American Dyewood Co., New York

Potassium chlorate, increase asked by the National Electrolytic Co., Niagara Falls, and the North American Chemical Co., Bay City, Mich. decrease asked by the Diamond Match Co.

Sodium nitrate, American Nitrogen Products Co., Seattle, Wash

Boll Weevil Reports Sought by Agricultural Bureau

In its fight on the boll weevil the Department of Agriculture is preparing to send out notice to 100,000 farmers this season advising them they will be asked to give detailed information next fall as to the efficacy of the various methods of fighting the pest.

In the past the department has been handicapped by lack of detailed data as to what the relative effects of different methods are. Three expert statisticians, H. R. Tolley, D. B. Smith and D. R. Pettit, have been sent to Tallulah, La., to check over field observations of entomologists.

China to Produce Cement

China is to meet her own demands for cement. According to a report from Consul J. K. Daves, Nanking, a new plant is being erected in the Yangtze Valley. This plant, midway between the two greatest markets of China, will have an initial output of four hundred 375-lb. barrels per day. The China Cement Manufacturing Co., the first to produce in this vicinity, has invested approximately $380,000 in the enterprise.

With the completion of this plant, which is to begin operations soon, and of another in Shanghai, China's demands for cement will be met by domestic production to a large extent.

Antipodean Shale Oil Industry Fails

Due to the high cost of production the shale oil operations of John Fell & Co., in New South Wales, have been discontinued, according to official consular reports. It is stated that the cost of putting the oil on the market is approximately five times that of importing crude oil; that the small government bounty is insufficient to protect the industry. The plant which has been used in shale-oil recovery is being remodeled and will be opened in the near future as a crude oil refinery.

Standards Bureau Research Should Be Fundamental

Distinguished Board of Visitors Makes This Finding After Investigation

"It is of the highest importance to the future of American industry and scientific progress that the activities of the Bureau of Standards should continue more and more devoted to scientific research of a profound and fundamental character, beyond the means of most college laboratories, where instruction to students is the chief purpose, and that these investigations should be of a broader scope than can be expected from research and testing laboratories in the service of special industries."

The foregoing is a portion of the findings of the board of visitors to the bureau after a careful survey of the establishment's current activities. The board of visitors is composed of John R. Freeman, former president of the American Society of Civil Engineers; Ambrose Swazey, former president of the American Society of Mechanical Engineers; F. W. McNair, president, Michigan School of Mines; S. W. Stratton, president, Massachusetts Institute of Technology, and Wilder D. Bancroft, professor of chemistry, Cornell University.

"The determination of the physical constants of materials and the more thorough investigation of the properties of substance, apart from immediate applications seen in the industries," continues the report of the board of visitors, "seem particularly appropriate under the organic act creating this bureau. We venture to suggest specific appropriations in the budget for such research."

Explosion Hazard Met With Little Loss

Losses have greatly decreased in transporting explosives, according to a recent report of the Bureau for the Safe Handling of Explosives and Other Dangerous Articles. The following extract shows to what a remarkably low level this loss has been reduced:

"During the year 1922, the railroads of the United States transported 168,301 tons of commercial explosives, and in addition a very large but unknown tonnage of fireworks and salvaged war ammunition. The total losses were one man injured and $75 property loss. This is much below the average of previous records. Moreover, it is encouraging in showing what can be accomplished."

Old Explosives Being Used

Additional large quantities of surplus explosives, left from the war period, have reached the point where their value as a *military reserve* is becoming impaired. Steps now are being taken to allocate these supplies for use in highway building, reclamation and other construction in which the

Fed'l government is interested.
the de.

Arsenic Stays in Limelight

The attention of several government departments is focused upon the calcium arsenate situation. The production, the possible shortage and means of immediate augmentation of the supply are being looked into. The Bureau of Mines, the United States Geological Survey and the Bureau of Entomology and the Bureau of Chemistry of the Department of Agriculture are co-operating in studying the problem. This interdepartmental investigation is the outgrowth of the recent Senate resolution directing an inquiry into the subject.

Producers, manufacturers, consumers and federal bureaus are also engaged in making a study of possible means of stabilizing the arsenic market to encourage production. Data and a suitable bibliography with reference to the storage of arsenic trioxide as an intermediate material for the manufacture of calcium arsenate are being compiled by Dr. Andrew Stewart. Obtaining arsenic from ores will be studied following the investigation of the problems upon which the various bureaus are now engaged.

Italy Liquidates Sulphur Debts

In view of the agreement said to have been reached between the American Sulphur Export Association and the Italian sulphur producers, there is particular interest in the advices to the Department of Commerce that the Italian Government has guaranteed a bond issue for 100,000,000 lire. The proceeds of the bond issue are to be employed in liquidating debts contracted by the Sicilian Sulphur Consortium and the redemption of certificates issued to cover advances made on sulphur delivered during the fiscal year 1920.

The basic security for the bonds is the stock of 273,740 tons of sulphur held in the warehouses of the consortium on April 30, 1922. The consortium will calculate that one-ninth of the stock in question has been sold during each period of 12 months. In case sales exceed production plus one-ninth of the stock, an appropriate adjustment will be made. In addition, the bonds are guaranteed by the net assets of the consortium, including its reserve fund, as well as other assets of the consortium and of the individual producers of sulphur.

Tariff Board Plans Hearings

Work on the investigation of the production costs of the chemicals listed in last week's *Chem. & Met.* is under way. Although it is expected that months will elapse before the data *sought are complete, plans are already* being made for public hearings. Rules of procedure and regulations for government are being drawn up. As soon as any investigation is complete it is planned to give all interested parties a chance to appear in defense of an increase or decrease of the existing rate of duty.

Colloid Symposium Coming in June

Svedberg to Give Summer Course in Colloidal Chemistry—Many Noted Speakers to Be Present

Plans are rapidly maturing for the national symposium on colloid chemistry to be held at the University of Wisconsin in June. Professor Svedberg intends to follow the symposium with a course of about thirty lectures on colloid chemistry in the summer school, which commences June 25 and closes Aug. 4. Research will be continued under his direction during this period.

Since this is to be the first national symposium on this subject to be held in America, the program has been arranged with the idea of having the whole field represented as far as possible. With one or two exceptions the papers will be presented in person by the author and ample time will be afforded for discussion. According to present plans these papers and discussions will be published in monograph form. Following is the tentative program for the symposium:

Alexander, J., "The Colloidal State in Metals and Alloys."
Bancroft, W. D., "Precipitation of Sols by Alcohol."
Bartell, F. E., "Some Adsorption Studies."
Bogue, R. H., "Conditions Affecting the Hydrolysis of Collagen to Gelatin."
Browne, F. L., "Thermochemistry of Sulphur Sols."
Burton, E. F., "General Considerations of the Forces Determining the Limiting Size of the Colloidal Particle in Any Given Solution."
Fischer, Martin, "On the Theory of the Lyophilic Colloids."
Gortner, R. A., "The Application of Colloid Chemistry to Agricultural Problems."
Holmes, H. N., "Gel Formation."
Kahlenberg, L., "On the Precipitation of Colloidal Metals by Means of Metals in the Solid State."
Klein, D., "The Colloid Chemical Problems in the Manufacture of Enzymic and Animal Glandular Products."
Mathews, J. H., and Rowland, B. W., "The Thermochemistry of Protein Behavior."
Sheppard, S. E., "Dispersity of Silver Halides in Relation to Their Photographic Behavior."
Spear, E. B., "Colloidal Properties of Rubber and Compound Ingredients."
Svedberg, The, "Demonstrations of Colloid Chemistry Technique."
Taylor, H. S., "The Problem of Adsorption From the Standpoint of Catalysis."
Weiser, H. B., "The Formation of Inorganic Jellies."
Wilson, John A., "The Swelling of Protein Jellies."
Wilson, Robert E., "Surface Films as Plastic Solids."

Papers are expected from T. R. Briggs, C. W. J. Frazer, Jacques Loeb and W. A. Patrick.

Pottery Men Face Trial

The alleged "potteries combine," composed of twenty-three corporations and twenty-four individuals, faces trial in the Federal District Court. The charge, made in the form of a Sherman law *indictment, is that of violation of the* criminal provisions of the anti-trust law.

The indictment was returned by the United States Grand Jury on Aug. 8, last, and a month later all of the individual defendants excepting J. F. Slater and J. W. Bowers appeared and entered pleas of not guilty.

Presents American View of Rubber Situation

Horace DeLisser, President of American Rubber Association, Answers Winston Churchill

That present British policy threatens industry is the belief of H. DeLisser, president of the American Rubber Association. In a recent reply to the speech of Colonial Secretary Winston Churchill, referred to in last week's *Chem. & Met.*, he says:

"Mr. Churchill in a recent statement published in London and this country declared that the British rubber growers were 'under no obligation to supply the United States with rubber below the cost of production' and that it was 'impossible for the Colonial Office to witness the financial ruin of the rubber producing colonies owing to the continued sale of their products below the cost of production.'

No Unfairness Intended

"In the first place the Rubber Association of America, which represents 95 per cent of the rubber manufacturers in the United States, does not seek a supply of crude rubber below the cost of production, nor does the association have the slightest intention of causing or witnessing the financial ruin of plantation owners. No industry can prosper on the adversity of another.

"It is because the Rubber Association of America, the largest consumer of rubber in the world, is convinced, after a most thorough investigation, that the policy of the British colonies in restricting the exports of crude rubber threatens the whole rubber industry here and abroad, and the association is pressing the Rubber Growers' Association of London for a repeal of the restriction order or an immediate modification to permit greater flexibility in the supply of rubber.

Stevenson Plan Induces Speculation

"The Stevenson plan for restricting the export of crude rubber today threatens to introduce wide speculation in rubber prices. Its ultimate effect will be to curtail rubber production on the plantations. Such a course would be ruinous to the rubber growers.

"Members of the Rubber Association are looking forward to a greater consumption of rubber during the summer. To take care of our needs this year and in the future, it is imperative that the planting of new rubber be encouraged. This association believes that the policy of the British colonies today will be far more injurious to the plantations than to the rubber industries of this country."

Helium Plant Goes West

The helium repurification plant at Langley Field, Va., is to be moved to Scott Field, near St. Louis. This is made necessary by the fact that the army is transferring most of its lighter-than-air work to Scott Field, where conditions have been found to be most favorable.

Canadian Prairie Provinces Yielding Commercially Valuable Salts

Range of Resources Broad and Little Worked—Development Now Beginning in Several Localities

COMPARATIVELY unworked sources of mineral wealth exist in the western provinces of Canada. Areas which have been considered valuable only from an agricultural standpoint are proving to be fairly rich in non-metallic mineral resources. Clays, coal, oil, gas and the sodium and magnesium salts, which occur in the numerous alkali lakes and sloughs throughout the area, are attracting the attention of capital with the result that considerable activity is evidenced in all these lines. The increased interest in the alkali deposits of western Canada has induced the Canadian Department of Mines to institute a detailed investigation of these deposits with a view to determining their possible economic value and the extent of reserves.

Salt Deposits Already Worked

Natural occurrences of soluble mineral salts are known in the provinces of Manitoba, Saskatchewan, Alberta and British Columbia, either in the form of bedded deposits or as brines. Some are of considerable extent and are probably of sufficient size to warrant commercial exploitation, provided economical methods of recovery can be developed and sufficient markets can be established. Three of these deposits are being operated or will shortly be operated in the prairie provinces and plans are under way for the development and operation of a fourth deposit.

Salt Cake Extraction

At Dana, Sask., a half million dollar plant is nearing completion, to extract salt cake and other chemical products from the brines of Muskiki Lake, 23 miles west of Humboldt, Sask. The company operating this deposit is Salts & Chemicals, Ltd., controlled by Canadian and United States interests. The main plant of this company is at the deposit at the lake and it has a refining plant at Kitchener, Ont. When this plant is in operation it is estimated that the output will be 30,000 tons of salt cake per year besides the output of magnesium sulphate and other salts recovered as byproducts.

At Frederick Lake, 5 miles southwest of Dunkirk, Sask., and 38 miles from Moose Jaw, Sask., another salt cake recovery plant has been erected by the Bishopric & Lent Co. with head-offices at Cincinnati, Ohio. This plant is practically completed with a capacity of 50 tons of salt cake per day, and as soon as it proves commercially successful further units are to be added to increase the output to 200 tons per day.

Magnesium Sulphate and Sodium Carbonate

In British Columbia the Basque Chemical Co. is operating on a series of five lakes situated 15 miles west of Ashcroft. From these lakes the company is excavating crude magnesium sulphate, which is shipped to Vancouver, where it is refined and sold to the pharmacal trade and to the tanning industry. Plans are now under way for greatly extending the development of this deposit.

In the vicinity of Meadow Lake, 50 miles north of Clinton, B. C., the Lillooet Soda Co. is operating a sodium carbonate lake and shipping the product to Vancouver. This material is being disposed of at the present time to the soap manufacturers of the Pacific coast, but plans are under way to dry the material at the lake and increase the output.

American Relief Association Makes Announcement

The extension of the work of the A.R.A. to cover home activities has been announced by its chairman, Herbert Hoover, in the following circular letter:

Dear Friend.—I wish to bring before you, as a supporter of the American Relief Administration, a problem in connection with our own American life.

As you are aware, the American Relief Administration has at one time or another during the last four years found support necessary to maintain life in upwards of 15,000,000 children. It has thereby acquired great experience in problems of child health, which it seems to be important should be translated into American child life, more particularly in relation to the children in backward sections and in large industrial centers of the country. Our physicians report that over 80 per cent of all children in America are born normal, whereas less than 20 per cent reach maturity in normal physical health. Much constructive work has been done by public agencies and by voluntary agencies in endeavoring to develop the proper care of normal children as distinguished from the care of those who have fallen by the wayside and require actual medical treatment, but the field in many sections of our country is as yet almost untouched.

With a view of furthering these efforts and translating our experience in Europe into the most effective service to our own American children, the important personnel of the American Relief Administration have joined in a consolidation of the American Child Hygiene Association and the Child Health Organization of America, in the formulation of a new, stronger, voluntary agency for the advancement of these questions. The American Relief Administration can give no more complete indorsement and expression of its confidence in the national necessity for such action. The name of the new organization is the American Child Health Association.

The American Relief Administration has undertaken as a voluntary service to guide the executive effort of the new organization in its endeavor to provide the essential finances necessary to carry on this most important work. I am therefore taking the liberty of appealing to you who have supported our past efforts, for support in this new activity of the American Relief Administration. The matter is one of national importance and of urgent character. I trust you may find it possible to contribute to the American Relief Administration for this purpose. HERBERT HOOVER.

Denaturing Rule Revised

An error in the regulations of 1915 covering the amount of caustic soda sufficient to denature 100 gal. of olive oil has been corrected by the Treasury to provide for the use of 114 lb. of caustic soda instead of 15 lb.

Fire Does Not Stop Work

Mines Bureau at Cornell Carries On Investigation Despite Loss of a Building

Fire recently destroyed one of the Cornell laboratories of the Bureau of Mines. The loss, however, is not such as to interfere seriously with the interesting work on alloy steels being carried on there.

The tests being made deal chiefly with endurance under repeated bending of various steels containing the rarer elements. Especial attention is being given to molybdenum as an alloying element.

About fifty steels, each with various heat-treatments, ranging in composition through plain C, Ce, Mo, V and CrCrMo, CrCe, CrV, NiCr, to various NiCrMo, NiCrCe and NiCrV steels are being studied. The ordinary tensile, impact and repeated impact tests have been made and a good deal of endurance data has been collected. Over 1,000 endurance test bars will be required, and nearly all of these are ready for testing. Two endurance machines are running night and day, and it will take all the present fiscal year and probably more to obtain the data desired.

While the work is aimed primarily to show the effect of Mo on endurance in comparison with other alloying elements, it is planned also with the view of getting as much information as possible on the general problems of endurance and endurance testing.

Flotation Process Case Heard by Commission

Three firms in the minerals separation industry are charged with unfair trade practices. To determine whether or not Minerals Separation, Ltd., Minerals Separations North American Corporation, Ltd., and Beer, Sondheimer & Co. have established a monopoly in connection with the leasing to American mining interests patents for the separation of minerals by the flotation process, the Federal Trade Commission heard final arguments recently on its complaint against these concerns.

In prosecution of the case the counsel for the commission charged that the respondents have set up a monopoly in the United States, compelling operators to surrender improvements, charging excessive royalties, and that they have been guilty of other unfair practices.

In defense, counsel for the respondents asserted that the services rendered the American mining industry have been of vast value in reclaiming ores.

Seeking More Import Data

To have immediately available detailed information as to dye imports has proved of such value that an insistent demand has arisen in the chemical industry for the expansion of that service to all of the coal-tar products. In various quarters hope is expressed that eventually the service may be extended to all synthetic organic chemicals.

Alabama to Produce Arsenic

Large quantities of calcium arsenate are to be manufactured at Anniston, Ala., this spring. The plant of the Federal Phosphorus Co. has recently added machinery for the extraction of the arsenic from arsenical pyrites ore.

Chemists in the vicinity of Anniston are making other experiments with different poisons for the extermination of the boll weevil. Although the results of their work indicate the possible development of a better poison than calcium arsenate, no definite information regarding its composition has been made public. In the meantime the arsenate industry at Anniston is expected to grow because of its availability of pyrites in almost unlimited quantities in close proximity to the plant.

Chemical Warfare Program of Secretary Davis

Country Divided Into Four Districts—Emergency Output of Industries Planned

The recommendations of J. M. Wainwright, retiring Assistant Secretary of War, as outlined in last week's *Chem. & Met.*, form the basis of a definite program of the War Department. Peace-time planning for the handling of industries during war has progressed further than ever before. Assistant Secretary Davis, who succeeds Colonel Wainwright, announces that he will carry forward this program actively.

Progress Already Made

Just what has been done in the way of chemical preparedness is indicated by extracts from the following C.W.S. report:

The country has been divided into four districts. The first district, which includes the New England States, will have its headquarters in Boston; the second district, which includes New York, New Jersey and Delaware, will have headquarters in New York City; the third district, with headquarters at Pittsburgh, will include Ohio, Pennsylvania and all states south of these two and east of the Mississippi and Ohio Rivers; the fourth, with headquarters in Chicago, will include all other states, those lying west of the Mississippi and Ohio Rivers and the state of Ohio. Each district will be assigned a chief, who will be a reserve officer Each chief will have two assistants, both to be reserve officers and, if practicable, one to be a chemical engineer and the other a mechanical engineer

In addition to this military organization, which will have direct charge of procurement planning, there are to be appointed civilian advisers to assist the officers in securing information and work out the details of the planning. There are to be eight such advisers for each district, one on manufacturing chemicals and one each for fine chemicals, rubber, charcoal, die castings, sheet metal stampings, war gases and chemical engineering equipment. Each of these men is to be an expert in the particular line assigned to him

Present Procurement Plans

The work on procurement planning for the coming year is based on the war plans which have just been completed These plans are the first attempt to work out in detail the quantities of each and every item which the Chemical Warfare Service would be required to furnish in case of war. With these requirements as a basis there has also been worked out the sources of supply of both raw materials and finished products necessary to meet the requirements. This information, on sources of supply, has been obtained in part from statistical tables prepared by various government bureaus and in part by dealing directly with the various industrial organizations concerned In all, about eighty plants have been visited and estimates of their present production and possibilities for expansion have been obtained.

Allotment of War-Time Production

To these and other manufacturers have been allotted definite quantities of the various items which they will be expected to deliver in case of war. It is probable that some of these allotments cannot be filled, and in other cases manufacturers will be able to do much more than meet their allotments

The Chemical Warfare Service will furnish each district chief with a list of manufacturers in his district allocated to the Chemical Warfare Service and the quantities of the various items which we have estimated each manufacturer can deliver. With this information as a basis, any errors in the estimates are to be corrected, in part by conference with the advisers in the districts and also by dealing directly with the manufacturer concerned.

U. S. Timber Going Fast

Reforestation Stated to Be the Only Hope of Future Pulp Supply by Secretary Wallace

That only one-third of America's timber supply remains is the finding of the special Senate committee appointed to look into wood and pulp problems. This committee is endeavoring to devise a workable plan for reforestation to submit to Congress. H. P. Baker, executive secretary of the A.P.P.A., and Secretary Wallace have given the committee figures showing the significance of the present situation.

Of our original supply of approximately 5.2 trillion board feet not over 1.6 trillion remains. Secretary Wallace estimates a possible reforestation of from 25 to 30 million feet per year.

Views of Mr. Baker

Mr. Baker, speaking for the pulp and paper manufacturers, gave it as his opinion that many "lean years," due to the depletion of the raw materials, were ahead of the industry in this country. The problem of the forests, he added, was entering the economical stage, and in the future the spruces and other pulp woods would bring such increased prices as to make forest conservation a paying business.

Another problem now being worked upon, as pointed out by Mr. Baker, is the utilization of Southern pine for pulp. He believes the South is to be the home of a great paper industry once a method is discovered for removing the resin from pine timber.

Canadian Paper and Pulp Exports Show Increase

A special report just issued by the Canadian Pulp and Paper Association shows that the total value of pulp and paper exports for January was $10,298,243, being an increase of $1,466,763 over January, 1922. Of this amount pulp and paper to the value of $9,286,186 went to the United States. Exports of pulpwood for January were 133,328 cords, valued at $1,195,886, compared with 66,094 cords, of the value of $696,943, in January, 1922.

Figures for the first 10 months of the fiscal year show newsprint exports were nearly 50 per cent greater than in the same period of the previous year.

German Dye Trade Faces No Immediate Shortage

Sufficient stocks to meet market demands for at least 6 months are on hand, according to Dr. Carl Duisberg, director of the Leverkusen Dye Works. In discussing the condition existing in the dye industry he said in part:

"The chemical industry also has taken part in the price reduction movement and has cut the prices of a number of its products, especially such as exceeded the world market prices.

"The situation in the chemical industry at present is completely different in the various districts. As is known, Ludwigshafen already lies idle, and the other works have no great supplies of fuel. For the present they will not get new coal in sufficient quantities, since they refuse to pay the taxes demanded by the French. The workmen will continue to be employed at other labors in case production is brought to a standstill.

"The Badische Soda und Anilin Fabrik faces this condition, as well as the Oppau works. Hoechst already is working with heavy curtailments. In Elberfeld, the parental plant of the Leverkusen works, the circumstances are even more difficult.

"The works in Leverkusen itself, which lies in part in the English zone, are not so severely stricken by the Ruhr war, and favorable conditions still prevail. They have chiefly lignite coal obtained in the English zone itself."

After his assertion that the dye industry is well supplied with stocks, Dr. Duisberg says that, in case of necessity, one source of supply could help another out and that, "during the French boycott on exports," the workmen will be engaged in handling the stocks on hand and keeping the plants in operating order.

Chemistry Chief to Be Selected

Congress having failed to act on the proposal to increase salaries for chiefs of bureaus and scientific investigators in the Department of Agriculture, it has been determined to fill the vacancy in the office of chief of the Bureau of Chemistry at the earliest possible time. The place has been held open in the hope that a salary higher than $5,000 could be offered to those best qualified to fill the position.

Dr. E. D. Ball, director of scientific work for the department, will appoint a consulting committee on which he hopes to induce some of the outstanding men in the chemical industry to serve. With this committee he will discuss not only the filling of the vacancy but the whole program of future work for the Bureau of Chemistry.

Constants Meeting Held

The board of editors of the International Table of Physical and Chemical Constants held a meeting at the National Research Council in Washing-

Would Give Prize for Oil Disposal Method

Interesting Bill Introduced Into New York Legislature for Solution of Knotty Problem

Considerable agitation has recently arisen for finding a solution to the vexing problem of what to do with the oil refuse dumped into New York harbor and the waters adjacent thereto. The State Senate not long ago passed a resolution memorializing Congress to adopt appropriate legislation to prohibit such practice.

In order to combat the nuisance a cheap economical method of disposal of this waste must be obtained. That inducement for research along this line may be offered a bill has been introduced into the New York State Legislature offering awards or prizes of $20,000 for the solution of the problem.

Annual Convention Business and Technical Librarians

The Special Libraries' Association, which is a national organization of all business and special librarians in the country, will hold its fourteenth annual convention in Atlantic City, Tuesday, May 22, to Friday, May 25, at the Hotel Chelsea. On Monday evening, May 21, the New York Special Libraries' Association will hold its last monthly meeting of the year, to which all delegates to the convention are invited. On Tuesday all the special libraries of New York City will be open to visitors. Saturday, May 26, following the convention at Atlantic City, the Special Libraries' Council of Philadelphia and the District of Columbia Library Association will have local meetings to which all the librarians are cordially invited, and an opportunity is thereby given to visit the special libraries in these two cities.

All librarians, special and public, are cordially invited. Business men and research workers and statisticians are also urged to meet at the Special Libraries' Association Convention.

Norway to Hold Industries Fair

Norway is to have an industries fair this year This is in keeping with the custom inaugurated in 1920, which has been followed in successive years and which each year has proved to be a great success. Keen interest both in the home country and abroad has been aroused in these fairs. The number of entries last year was very large. Practically every branch of Norwegian industry and handicraft was represented and exhibits were sent in from every manufacturing center throughout the country.

This year the fair is to be held the week of Sept. 2 to 9. It is planned to give foreign buyers a good opportunity of acquainting themselves with Norwegian products and manufactures of every description and of getting into closer personal contact with firms in various lines of trade.

Illinois Alumni to Gather at New Haven

Chemists from the University of Illinois are not to be outdone by the alumni of Harvard, Ohio State and other institutions who in the past have held their luncheon reunions in connection with the semi-annual meetings of the American Chemical Society. On April 5 at 1 p.m. in Woolsey Hall at Yale University the Illinois alumni will gather for the first of their reunions. Dr. C. S. Palmer, Box 1811, Yale station, New Haven, Conn., is in charge of the preparations for this event.

City Air Pollution by Auto Exhaust Is Menace

Chemical engineering may be required to solve the problem of handling the carbon monoxide in city streets. Automobiles in New York City are giving off so much of this gas that it has become a menace to health, according to the public health committee of the New York Academy of Medicine.

According to a report issued by this body:

"The increasing concentration of motor traffic in New York City has resulted in contamination of the air with carbon monoxide in certain sections of the city which has reached the point where it is regarded as deleterious to health. Carbon monoxide constitutes from 7 to 12 per cent of the exhaust gas, depending upon the mixture of the gasoline. It oxidizes very slowly, if at all, and the rate of rapidity of its diffusion in the streets varies with atmospheric conditions and the velocity of the winds.

"The studies of J. S. Haldane in London have led to the formulation of a safety standard in the London underground railways of not more than one part of carbon monoxide in 10,000 parts of air. The standard adopted for the New York-New Jersey vehicular tunnel is a maximum of four parts of carbon monoxide to 10,000 parts of air, provided no one is exposed for more than thirty or forty minutes.

"The committee engaged the services of Prof. Yandell Henderson to study the extent of contamination of the air in New York City streets. This study has not been completed, but the preliminary indications are that at certain periods of the day and in certain areas of the city the concentration of carbon monoxide is such as to require remedial measures."

Mines Bureau Loses Building

The building of metallurgy at the Michigan College of Mines, Houghton, Mich., was destroyed by fire, March 15, with loss estimated between $250,000 and $275,000. Valuable records were lost in the disaster, including those of the United States Bureau of Mines, occupying offices in the building. It is said that the structure will be rebuilt as soon as plans are prepared and arrangements perfected.

Chemical Production Figures Coming Soon

Many replies to the Tariff Commission's questionnaire are being received from domestic producers. Present indications show that the annual census of production of coal-tar and synthetic organic chemicals and dyes for 1922 will be issued this year considerably earlier than previously.

Last year, for the 1921 census, there were 201 producers of coal-tar chemicals, some of whom also produced synthetic organic chemicals from other than a coal-tar base, and there were about forty manufacturers who produced the latter only. There is a slight reduction in the number of manufacturers this year, several small plants having gone out of business. Up to March 21, replies had been received by the commission from 189 manufacturers. If reports for 1922 production continue to be received with satisfactory speed, there will be no preliminary report this year, but the final report will be ready some time in May.

Develops Leaching System

Dr. J. W. Turrentine, formerly in charge of the experimental kelp-potash plant of the Bureau of Soils at Summerland, Calif., has developed a lixiviating system for industrial use, involving some new principles of counter-current leaching, for which a public patent is being sought. This process and apparatus was given a thorough try-out and demonstration in the extraction of potash and iodine from kelp. It is applicable to several industrial processes where continuous and economic leaching is desired.

To Dismantle Chlorine Plant

Officers of the Chemical Warfare Service announce that a portion of the chlorine plant at Edgewood Arsenal must be dismantled. Plans are being made at present to engage a competent chemical engineer to direct this work so that the equipment can be taken down and stored with the certainty of subsequent reassembly when the need arises without technical difficulty or damage to the equipment. It is hoped that this work can begin at an early date, but the time is contingent upon finding a proper chemical engineer to direct the job.

Obituary

LEWIS E. RANSOM, of Hempstead and New York, and president and founder of the L. E. Ransom Co., importer of dyestuffs, died recently.

WALL EDWARD SMOTHERS passed away in Denver, Jan. 31, 1923. Although but 29 years of age, he had attained unusual prominence in his chosen profession, that of radium technology. Upon his graduation from the University of Colorado in 1916 as a bachelor of science, he entered the employ of the Schlesinger Radium Co. of Denver. For some time he was occupied with radium measurements by both emanation and gamma-ray methods, with considerable analytical work connected with proposed processes for the treatment of carnotite. Later he was placed in charge of the refining and crystallizing of the radium product and its distribution into the many types of therapeutic applicators. He conducted many courses of instruction in the physics and therapy of radium for physicians and surgeons. Tireless energy and painstaking care were characteristic of all his work. His untimely death is a great loss to the science of radio-activity. He was married to Elizabeth L. Hoskin, of Denver, June 15, 1917. He was a member of Alpha Tau Omega and the national chemical fraternity, Alpha Chi Sigma.

Personal

WILLIAM B. BOYD has been elected president of the Dominion Alloy Steel Co., Ltd. Mr. Boyd was formerly electrical engineer of the Illinois Steel Co., Chicago; chief electrical engineer of the Dominion Iron & Steel Co., Sidney, N. S., and chief engineer of many large Canadian industries.

CHARLES T. BRAGG, formerly chief metallurgist of the Michigan Smelting & Refining Co. and more recently president of the Michigan Valve & Foundry Co., has resigned from the latter position.

W. J. COPE, Akron, Ohio, has been elected treasurer of the Mohawk Rubber Co., to succeed C. W. MCLAUGHLIN, resigned. Mr. Cope has been assistant treasurer for a number of years.

Prof. T. E. DONNAN, of the University College of London, has accepted an invitation to attend the New Haven meeting of the American Chemical Society.

R. E. DOOLITTLE of Chicago, chief of the central food and drug inspection district of the Bureau of Chemistry, attended a meeting of the joint committee on definitions and standards in Washington during the week of March 19.

WILLIAM HAYNES has accepted the chairmanship of the chemical division in the forthcoming Home Service Appeal of the Salvation Army for a $500,000 fund with which to maintain and extend its activities in Greater New York.

Dr. KUNO B. HEBERLEIN has left for Europe on business.

O. P. HOOD, chief engineer of the U. S. Bureau of Mines, spoke March 23, at Akron, Ohio, on "Smoke Abatement and Smokeless Combustion."

G. F. MOULTON has resigned his position at the Bureau of Standards to accept a place as chemist of the research department of F. C. Huyck & Sons, Albany, N. Y.

Dr. WALTER ROSENHAIN, chief of the metallurgical department of the National Physical Laboratory, Teddington, England, addressed the members of the Detroit, Mich., chapter of the American Society for Steel Treating at its regular monthly meeting March 19, on "Strain and Fracture in Metals." He also spoke recently before a joint meeting of the scientific and technical societies of Schenectady, under the direction of the Eastern New York Section of the American Chemical Society, on "The Relation Between the Properties and Structure of Metals." Dr. Rosenhain expects to reach Washington, D. C., March 30 for a 5-day visit. On the afternoon of that date he is scheduled to speak at the Bureau of Standards. On the following day he will be tendered a banquet at the Cosmos Club which will be under the auspices of the Washington Academy of Sciences. Following the dinner he will speak on "The Structure and Constitution of Alloys." He expects to spend April 2 and 3 exclusively at the Bureau of Standards, where he hopes to gather a detailed idea of the manner in which that bureau is conducting its research.

JEROME STRAUSS, chief chemist of the U. S. Naval Gun Factory, Washington, D. C., addressed the Washington chapter of the American Society for Steel Treating on March 16. His topic was "Performance of High-Speed Cutting Tools."

LEONARD SUMNER was elected president of the British Institute of Metals at the annual general meeting on March 7.

Sir J. J. THOMPSON, of Cambridge University, is to give a series of lectures at Franklin Institute during the week of April 9.

Dr. F. C. WEBER, chemist in charge of the Animal Physiological Laboratory, Bureau of Chemistry, has resigned to accept a position with the Fleischmann Laboratories, New York. Dr. Weber entered the Bureau of Chemistry as a scientific aid in 1902 and after receiving an M.D. degree from George Washington University assisted in experimental work to determine the effect of preservatives on health. He was placed in charge of the Animal Physiological Laboratory in 1907 and directed the work of that laboratory until his resignation, except for a short period of detail to the Tariff Commission.

W. R. M. WHARTON of New York, chief of the Eastern food and drug inspection district of the Bureau of Chemistry, was in Washington recently conferring with officials of the bureau regarding regulatory campaigns.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities. Prevailing Prices and Market Letters From Principal Industrial Centers

Better Business Conditions Are the Result of Increased Productive Activity

Expansion in Output of Basic Industries a More Substantial Basis for Prosperity Than Increasing Credits or Rising Prices

IT IS especially significant in the view of many of our leading economists that the prosperity being enjoyed by many of our industries is based on expanding production rather than expanding credit—the principal cause of the inflation of 1919 and 1920. The production figures obtained by the Department of Commerce indicate record industrial activity during the first two months of the current year.

One of the industries reflecting this stimulation to marked extent is the manufacture of textiles—important as a basic industry and a large consumer of chemicals and allied products. The daily rate of cotton production was even higher than the January high record and silk consumption was the highest with one exception since 1919. Wool receipts at Boston were the highest since April, 1921, except for July, 1922. Stocks of cotton at mills were the lowest reported for this season of the year since 1914.

The construction industry, a market for oils and paints, steel, glass and other products, also made new records. The volume of building contracts awarded in February, contrary to an expected seasonal decline, increased in twenty-

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	**181.44**
Last week	179.51
March, 1922	156.00
March, 1921	157.00
March, 1920	252.00
April, 1918 (high)	286.00
April, 1921 (low)	140.00

The effect of the many price advances and the continued strength of the chemical market is reflected in this week's index number. Potassium carbonate and hydroxide and linseed and cottonseed oils were the index commodities to show advances.

TABLE I—PRODUCTION AND PRICES OF CHEMICALS, 1913-1922

(Compiled by the *Survey of Current Business* from government and non-government sources.)

(Base year in bold-faced type.)

Year and Month	A.—INDEX NUMBERS: Production[1] Acetate of Lime (Relative to 1920)	Production[1] Methanol (Relative to 1920)	Consumption[1] Wood, Carbonized (Relative to 1920)	Stocks[1] Wood (Relative to 1920)	Wholesale Prices: Drugs and Pharmaceuticals[3] (Relative to August, 1914)	Essential Oils[3] (Relative to August, 1914)	Crude Drugs[3] (Relative to August, 1914)	Chemicals[4] (Relative to 1913)	Sulphuric Acid 66° New York[5] (Relative to 1913)	B—NUMERICAL DATA: Production[1] Acetate of Lime Thousands of Pounds	Production[1] Methanol Gallons	Consumption[1] Wood, Carbonized Cords	Stocks[1] Wood Cords	Wholesale Price Sulphuric Acid 66° New York[5] Dollars Per 100 Lb.
1913 mo. av.								**100**	**100**					**1.00**
1914 mo. av.					**[2]100**	**[2]100**	**[2]100**		100					1.00
1915 mo. av.									129					1.30
1916 mo. av.									200					2.00
1917 mo. av.								212	169					1.70
1918 mo. av.								279	163					1.60
1919 mo. av.					201	213	185	242	95					1.00
1920 mo. av.	**100**	**100**	**100**	**100**	196	265	202	255	112	**12,150**	**635,438**	**76,028**	**846,204**	1.12
1921 mo. av.	39	46	42	84	129	158	134	153	91	4,704	291,697	32,064	714,302	.91
1922 mo. av.	81	87	81	108	120	137	174	155	76	9,833	550,594	61,371	911,211	.80
1921														
January	51	71	70	79	155	200	153	181	92	6,243	448,831	53,192	669,010	.92
February	49	64	59	74	149	189	145	166	98	5,971	407,363	44,527	622,041	.98
March	44	64	57	70	141	178	141	157	100	5,381	407,143	43,640	676,765	1.00
April	26	37	34	84	135	168	138	140	95	3,162	234,835	26,191	709,043	.95
May	28	33	31	90	129	165	136	143	90	3,355	211,078	23,483	762,013	.90
June	29	31	28	88	126	159	135	147	90	3,474	198,675	21,641	742,857	.90
July	21	25	22	83	125	151	130	148	90	2,603	160,724	16,827	702,445	.90
August	24	24	23	82	123	142	126	158	90	2,937	155,020	17,744	697,566	.90
September	29	31	29	81	119	138	123	147	90	3,552	197,230	21,670	688,899	.90
October	39	41	37	85	117	138	126	151	85	4,785	258,599	28,491	721,696	.85
November	54	57	51	84	116	135	127	147	85	6,517	362,317	38,982	714,027	.85
December	70	72	64	102	118	137	132	145	85	8,465	458,553	48,382	865,258	.85
1922														
January	69	74	65	103	117	136	134	144	80	8,330	468,818	49,559	875,010	.80
February	66	72	65	111	115	136	139	148	80	7,993	457,656	49,465	936,859	.80
March	80	84	76	105	116	135	155	156	80	9,660	534,812	57,874	899,781	.80
April	61	65	58	106	117	135	177	158	84	7,390	416,112	43,775	895,826	.84
May	58	64	59	105	116	135	177	159	80	7,064	404,847	44,496	889,219	.80
June	62	69	66	107	115	133	177	157	80	7,495	441,149	50,207	904,909	.80
July	72	75	74	112	115	130	178	156	71	8,718	475,376	56,570	943,792	.70
August	76	80	77	104	115	135	177	152	70	9,253	508,644	58,887	881,858	.70
September	78	85	78	111	121	131	182	149	74	9,537	537,803	59,486	937,748	.70
October	101	105	98	113	128	122	195	154	73	12,217	664,933	74,582	956,425	.70
November	122	125	121	110	131	121	196	160	70	14,779	795,569	91,944	928,499	.70
December	133	142	131	105	137	123	204	164	70	16,154	901,403	99,605	884,609	.70

[1] Compiled from reports of the National Wood Chemical Association to which are added reports from the principal non-member firms. Total reports for each month vary from firms with a capacity of 3,200 cords to 4,500 cords daily; all months are therefore prorated to a daily capacity of 4,500 cords, representing about 90 per cent of the industry, on the basis of capacity reporting each month.

[2] August, 1914.

[3] Compiled from weekly wholesale quotations by the *Oil, Paint and Drug Reporter*.

[4] The chemical price index from *Chemical & Metallurgical Engineering* includes quotations on 25 commodities selected on the basis of their importance as representing both qualitatively and quantitatively the principal branches of the chemical industry. These prices are weighted on the basis of total production plus total imports in the year 1919. The figures are averages of weekly prices.

[5] Wholesale average monthly price of sulphuric acid from United States Department of Labor, Bureau of Labor Statistics.

seven northeastern States to 41,611,000 sq.ft. All classes of buildings except residential and public buildings participated in this increase, which has continued into March. The week of March 10 showed the highest total of building awards of any week since July, amounting to $78,411,000.

Trend of Chemical Production

In Table I are given the Commerce Department's figures for the production and prices of those chemicals and groups of products which are included in the monthly compilations of the *Survey of Current Business*. Statistics for 1923 are not given in this tabulation, but in a statement made on March 23 the department declared that the production of acetate of lime and of methanol declined slightly in January from the high mark set in December. Acetate of lime output amounted to 16,544,000 lb., as against 16,814,000 lb. in December, and methanol production was 933,171 gal., as against 942,008 gal. in December. Consumption of wood, however, increased to 104,180 cords, while stocks of wood at chemical plants declined to 833,767 cords, the lowest since November, 1921.

Wholesale Prices Rise in February

A slight rise in the general level of wholesale prices in February as compared with January is shown by the Bureau of Labor Statistics in its weighted index numbers. The all commodity index, based on 404 price series, stands at 157 for February, or one point higher than in January.

The principal increases were in the case of metals and metal products, although the chemicals, building materials and miscellaneous groups recorded advances. The bureau's index numbers for May, 1920, which was practically the month of peak prices, are compared with the more recent figures in the accompanying table.

Group	May 1920	Jan 1922	Nov 1922	Dec 1922	Jan 1923	Feb 1923
Farm products	241	122	143	145	143	142
Food, etc.	248	131	143	144	141	141
Cloths and clothing	328	176	192	194	196	199
Fuel and lighting	239	195	218	216	218	212
Metals and metal products	202	112	133	131	133	139
Building materials	293	157	185	185	188	192
Chemicals and drugs	213	124	127	130	131	132
House furnishing goods...	247	178	179	182	184	184
Miscellaneous	208	117	122	122	124	126
All commodities	247	138	156	156	156	157

Comparing prices in February with those of a year ago, the report of the Bureau of Labor Statistics points out that the general level has risen over 11 per cent. Metals and metal products show the largest increase, 26¼ per cent. Building materials follow next with an increase of 23 per cent. Cloths and clothing have increased 14¼ per cent, fuel and lighting 11 per cent, and farm products 8½ per cent in price in the year. Food articles, chemicals and drugs, housefurnishing goods and miscellaneous commodities all show smaller increases compared with prices of a year ago.

Higher Quotations on Potash Salts Feature New York Market

Potassium Permanganate, Carbonate and Bichromate Figure in General Advance Said to Be Due to Importing Difficulties

NEW YORK, March 26, 1923.

MATERIAL improvement was noted in the chemical market during the past week in the case of many imported commodities. Importers reported higher cables from abroad on all potassium salts and stated that round-lot shipments were quite difficult to locate. The feature of the week's activities was the sharp advance in permanganate of potash. Dealers were not anxious to quote large quantities, due to the extremely high foreign quotations and the strong domestic demand. Importers of carbonate of potash advanced quotations on 80-85 per cent calcined material. Dealers in arsenic also announced an advance.

Costs Are Mounting

Manufacturers of amyl acetate reported higher quotations on account of increased production costs and heavier demand. Resale oxalic acid was not as plentiful, as previously noted, and spot goods were sharply advanced. Producers and importers announced higher prices on powdered and crystal tartaric acid. Manufacturers of bichromate of potash raised their prices, due to the strong domestic and foreign demand. Resale supplies have been gradually absorbed. Second hands in formaldehyde were anxious to book business at concessions and the general range was fractionally lower. The alkali market continued with prices practically unchanged. The demand was said to be quite satisfactory to the leading producers. Manufacturers of salicylic acid announced advances on the technical and U.S.P. varieties. The market in general has already begun to show the long-contemplated spring activity and those close to the pulse of trading were firm in their belief that the beginning of a general swing toward increased trading has already shown itself.

Many Price Advances

Amyl Acetate — Leading producers announced a sharp advance, due to the increased cost of production and strong domestic inquiry. Prices range around $3.25@$3.50 per gal.

Arsenic—Dealers were inclined to advance prices to 15½c. per lb. on spot and 15c. for future arrivals. Consumers have shown some desire to purchase at the new levels.

Bichromate of Potash—Large producers announced an advance, due to increased export demand. Prices range around 10⅜@11c. per lb. for immediate shipment.

Bleaching Powder — **Activity was along former lines, with producers quoting $2.20 per 100 lb., f.o.b. works,** large drums. Spot material was rather scarce at $2.50 per 100 lb.

Carbonate of Potash— Leading importers reported an advance on 80-85 per cent calcined, due to the difficulty in obtaining any round-lot shipments from abroad. Consuming demand has shown material increase and dealers were not inclined to offer any spot goods below 6c. per lb. The range was around 6@6½c. per lb.

Caustic Soda—Export inquiries continued along moderate lines, with leading dealers quoting $3.45@$3.50 per 100 lb., f.a.s. Domestic goods held around 3¾c. per lb. ex-store. Contracts were quotably unchanged.

Formaldehyde — Resellers were inclined to shade prices on actual business. Quotations ranged around 14½@15c. per lb. on spot. Producers quoted 16c. per lb. for carload lots and 16½c. for lesser quantities.

Permanganate of Potash — Importers reported a sharp increase in foreign cables, due to the present unstable conditions in Germany. Quotations on spot were sharply advanced by local dealers and the general range was 25@26c. per lb. for limited quantities. Shipments were quoted at 18c. per lb., duty unpaid.

Salicylic Acid — Manufacturers announced increases in technical and U.S.P. goods. Quotations for U.S.P. range around 50@52c. per lb., with technical at 47@48c. per lb. Demand continued along moderate lines.

Naphthalene—A very active market exists for this article, with quotations on all grades sharply higher. Naphthalene balls were quoted at 10@10½c. per lb., with flakes at 9@9½c. per lb. on spot. Futures were quoted around 8¾c. per lb. Crushed material was difficult to locate for any shipment.

Phenol—Demand continued quite active at 50c. per lb. on spot. Trading was mostly for small quantities.

Vegetable Oils

Linseed Oil—Leading crushers announced several advances during the past week. Prices changed from $1.01 per gal. to $1.03 and another advance brought quotations up to $1.05 per gal. on spot. Demand has been quite active at the present high levels.

Cottonseed Oil—Crude oil advanced early in the week to 11c. per lb. in tanks, but receded later to 10¾c. per lb. f.o.b. mills, southeast and valley. The demand has not been unusually strong due to the high prices. Prime summer yellow was quite active around 12¾@13c. per lb. in barrels.

China Wood Oil—**Prices have again been advanced on spot. Quotations range around 25@26c. per lb. in barrels.**

Price Advances Rule in St. Louis Market

Indications Point to Firmer Market for Some Time to Come

ST. LOUIS, MO., March 22, 1923.

Price advances on some of the important chemicals during the past few weeks have stimulated buying, and the volume of business tranacted in the St. Louis market has been very satisfactory. Prices today are firm, and indications are for an advancing market for some time to come. Imported materials are much higher today than for some time past, and in view of conditions abroad further advances would not be surprising.

Firm Alkali Market

The market for alkalis continues firm and a good volume of business is being transacted. However, the last 2 weeks have not been as good as the months of January and February. *Caustic soda* is maintaining the regular schedule, though a slight decline in volume is reported. Flake caustic in 5- and 10-drum lots is generally quoted at \$4.25 per 100 lb. and one producer is holding the price at \$4.30. Solid caustic in like quantities is offered around \$4.85@\$4.90 per 100 lb. These prices are delivered buyer's door. *Soda ash* 58 per cent light can be had in round lots at \$2.25 in barrels and \$2.10 in bags. These quotations are on a 5- or 10-package basis and are usually shaded from 5 to 10c. per 100 lb. when bought in truckloads. *Bicarbonate of soda* is maintaining its strength, the recent advance in price apparently not affecting the volume of business. *Sal soda* has shown some life recently and better business on this item is expected.

General and Special Chemicals

Heavy mineral acids, particularly *muriatic*, are moving in large volume. It is reported that the production has been increased, but manufacturers have little to dispose of above their contract requirements, and supplies have become very tight. The movement of *sulphuric* and *nitric* has also been very good. Inquiry for *citric acid* has been somewhat better; however, trading is not so good. Importations have been very light and stocks are also low of both the foreign and domestic article. The *cresylic acid* market is almost bare of stocks. The output of domestic producers is very small and has been sold up for some months to come, and with the present cost of importing foreign goods there is no relief looked for in the immediate future. *Oxalic acid* has shown no unusual activity and trading is being done only through regular channels. *Tartaric acid* has been showing more life and some fairly large sales are being made. Trading in *white arsenic* has quieted down as far as spot goods are concerned, and consumers apparently have sufficient supplies for their immediate need. *Cream of tartar* is in better demand. The demand for *copperas* has been very good and supplies have been absorbed as quickly as they became available. Quotations are firm, with the sugar grade quoted at \$1.13 per 100 lb. in bulk in carload lots f.o.b. St. Louis, and \$1.38 per 100 lb. in barrels in carload lots f.o.b. St. Louis. *Glycerine* continues to hold its own very well at 18¾c. in drums. As previously reported, this is a buyers' market and the price is not expected to decline in the face of a lively demand. In fact a higher level on this commodity is not beyond the bounds of possibility. The *phenol* market is exceedingly strong and supplies continue to be very scarce. Large quantities are not available and only occasional small lots are heard of. *Potassium bichromate* is moving in a fair way. The demand for *cyanide of potash* is normal. *Permanganate* prices are going up steadily, with spot stocks very small and held in firm hands.

The *zinc* market is advancing and *spelter* is now quoted at \$8 per 100 lb. f.o.b. St. Louis and \$8.35 per 100 lb. f.o.b New York. *Zinc sulphate* has had no change since our last report and is still quoted at 3¼c. f.o.b. St. Louis in carload lots and 3½c. f.o.b. St. Louis in less than carload lots, with a very good demand. *Zinc dust* is offered today at 11c. per lb. f.o.b. St. Louis, with a very good demand.

Rumors of Wage Advances Affect Steel Market

Prices Are Stiffening All Along the Line, Although Production Is Still High

PITTSBURGH, March 23, 1923.

Production of steel continues to run very heavy. The rate of ingot production at this time is probably well above 45,000,000 tons a year, which until recently was the record high since the armistice, reached in March, 1920, but by no means sustained.

The steel mills will make every effort to maintain their present high rate of production. Earlier in the year there were fears that the labor shortage of last October would reappear in greater strength in the spring, with resumption of outdoor work on a larger scale. While labor shortage would of course tend to restrict the consumption of steel, the production of steel would hardly escape feeling an influence. In this connection there are now two points. It is the prevalent expectation among independent steel producers that the Steel Corporation, which always leads in such matters, will announce a general wage advance shortly, probably to be effective April 1. There is absolutely no confirmation of this view from any Steel Corporation source, but such announcements are not unusually preceded by unofficial information leaking out. In some steel circles prognostication goes farther, to the effect that such a wage advance might be followed by another in mid-summer. Undoubtedly there will be strenuous bidding for labor on the part of many contractors, but wage advances would help to retain men. Another point is this, that a steel mill once operating smoothly and with large tonnage output does not need as large a force to maintain operations as it did to get going, and the steel industry has now got the start.

Steel Prices Stiffening

At various points the steel market is growing stronger in the matter of prices. Recently bars, shapes and plates reached 2.25c. as a basis market for late or extended delivery, while premiums have been ruling on small lots for early shipment. On shapes and plates the minimum for any delivery may now be considered 2.35c., or \$2 a ton advance. Premiums are greater. Plates do not stop at 2.60c., but command 2.75c. frequently and perhaps 3c. in some cases. One mill is quoting bars at 3c., and many obtain the price.

Sheets show a variegated market. Reports to the association of independents, covering about 70 per cent of the productive capacity, show order books March 1 for the reporting mills representing about 2 months of work, but this is merely a composite. Some mills are fairly well sold up through the second quarter at what may be denominated conservative prices, say 3.60c. on common black, while other mills have correspondingly less business ahead. These mills, able to offer relatively early deliveries, are out for premiums. Some are quoting as high as 4c. on black, 5.25c. on galvanized and 7c. on automobile sheets, and are presumably effecting sales. A wire mill has put out a price of \$3 a keg on nails, although stating it is fully sold up, while the common market, for late delivery, is nearer \$2.80.

Pig Iron and Coke

One additional second quarter contract in Connellsville furnace coke has been made since last report, for 10,000 tons a month, at \$7.50 or perhaps a trifle more. The total in the movement a week ago was about 300,000 tons a month, chiefly at \$7, with perhaps a fourth of the total at \$7.25. Export demand has lately been a factor in the coke market, between 75,000 and 100,000 tons having already gone, chiefly from the Connellsville region, at an average of not much under \$7.50.

Valley pig iron has advanced a straight dollar a ton in the week, bessemer, basic and foundry being now quotable at \$31 valley on the basis of latest sales, while \$32 is predicted as a probability within a week. It is to be noted, however, that the bulk of the second quarter business was done before prices advanced above about \$28. There is now a delicate balance between uncovered consumption and unsold production for the second quarter. Furnaces would like to push the market to \$32, or perhaps \$33, but not higher, the chief end to be gained being to have a ready made market when the time comes for third quarter business.

Current Prices in the New York Market

FOR CHEMICALS, OILS AND ALLIED PRODUCTS

Although these prices are for the spot market in New York City, a special effort has been made to report the American manufacturer's quotations whenever available. In many instances these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported and resale stocks are reported when of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb.	$0 36 - $0 38
Acetone, drums	lb.	22 - 23
Acid, acetic, 28%, bbl	100 lb.	3 15 - 3 40
Acetic, 56%, bbl	100 lb	6 25 - 6 50
Glacial, 99½%, carboys	100 lb.	12 00 - 12 50
Boric, crystals, bbl	lb	11½ - 11½
Boric, powder, bbl	lb	11 - 11½
Citric, kegs	lb	49 - 50
Formic, 85%	lb.	15 - 17
Gallic, tech	lb	45 - 50
Hydrochloric, 18° tanks, 100	lb	90 - 1 00
Hydrofluoric, 52%, carboys	lb	.12 - 12½
Lactic, 44%, tech., light, bbl.	lb	11½ - 12
22% tech., light, bbl	lb	05½ - 06
Muriatic, 20°, tanks, 100	lb.	1 00 - 1 10
Nitric, 36°, carboys	lb	.04¾ - 05
Nitric, 42°, carboys	lb	06 - 06½
Oleum, 20%, tanks	ton	17 00 - 18 00
Oxalic, crystals, bbl	lb.	13½ - 14
Phosphoric, 50%, carboys	lb	08 - 09
Pyrogallic, resublimed	lb	1 50 - 1 60
Sulphuric, 60°, tanks	ton	9 00 - 10 00
Sulphuric, 60°, drums	ton	12 00 14 00
Sulphuric, 66°, tanks	ton	14 50 15 00
Sulphuric, 66 drums	ton	19 00 - 20 00
Tannic, U.S.P., bbl	lb.	65 - 70
Tannic, tech., bbl	lb.	40 - 54
Tartaric, imp. crys., bbl	lb.	33 - 34
Tartaric, imp., powd., bbl	lb.	33 - 34
Tartaric, domestic, bbl.	lb.	- 33½
Tungstic, per lb	lb.	1 00 - 1 20
Alcohol, butyl, drums, f.o.b. works	lb.	.27 - .29
Alcohol ethyl (Cologne spirit), bbl	gal.	4.75 - 4 95
Alcohol, methyl (see Methanol)		
Alcohol, denatured, 188 proof No. 1	gal.	.38 - 40
Alum, ammonia, lump, bbl	lb.	.03½ - 03½
Potash, lump, bbl	lb	.03 - 03½
Chrome, lump, potash, bbl	lb.	.05½ - 05½
Aluminum sulphate, com., bags	100 lb	1 50 - 1 65
Iron free bags	lb	02½ 02½
Aqua ammonia, 26°, drums	lb.	06½ - 07½
Ammonia, anhydrous, cyl	lb.	30 - 30½
Ammonium carbonate, powd casks, imported	lb.	09½ - 10
Ammonium carbonate, powd domestic, bbl	lb	.13 - 14
Ammonium nitrate, tech., casks	lb	10 - 11
Amyl acetate tech., drums	gal.	3 25 - 3 50
Arsenic, white, powd., bbl	lb	.15½ - 16
Arsenic, red, powd., kegs	lb	12½ - .13
Barium carbonate bbl	ton	78 00 - 80 00
Barium chloride, bbl	ton	90.00 - 95 00
Barium dioxide, drums	lb.	18 - 18½
Barium nitrate, casks		08 - 08½
Barium sulphate, bbl	lb.	04 - 04½
Blanc fixe, dry, bbl	lb.	04 - 04½
Blanc fixe, pulp, bbl	ton	45 00 - 55 00
Bleaching powder, f.o.b. wks., drums	100 lb	2 20 - 2 50
Resale drums	100 lb	2 50 - 2 75
Borax, bbl	lb	05½ - 05½
Bromine, cases	lb	.28 - 30
Calcium acetate, bags	100 lb	3 50 - 3 60
Calcium carbide, drums	lb	04½ - 04½
Calcium chloride, fused, drums	ton	22 00 - 23 00
Gran. drums	lb	01½ - 01½
Calcium phosphate, mono, bbl	lb.	.06½ - 07
Camphor, cases	lb.	.91 - 93
Carbon bisulphide, drums	lb.	.07 - 07½
Carbon tetrachloride, drums	lb.	.09½ - 10
Chalk, precip.—domestic, light, bbl	lb.	04½ - 04½
Domestic, heavy, bbl	lb.	03½ - 03½
Imported, light, bbl	lb.	04½ - 05
Chlorine, liquid, cylinders	lb.	06 - 06½
Chloroform, tech., drums	lb	35 38
Cobalt oxide, bbl	lb.	2 10 - 2 25
Copperas, bulk, f.o.b. wks	ton	16 50 - 20 00
Copper carbonate, bbl	lb	19 - 20
Copper cyanide, drums	lb	47 - 50
Copper sulphate, crys., bbl	100 lb	6 40 6 50
Cream of tartar, bbl	lb	24 - 25
Dextrine, corn, bags	100 lb	3 25 3 50
Epsom salt, dom., tech., bbl.	100 lb	2 00 - 2 25
Epsom salt, imp., tech., bags.	100 lb.	1.10 - 1 25
Epsom salt, U.S.P., dom., bbl.	100 lb	2.50 - 2 75
Ether, U.S.P., drums	lb.	.13 - .15
Ethyl acetate, com., 85%, drums	gal.	.80 - .85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 - 1.00
Formaldehyde, 40%, bbl	lb	$0 14½ - $0.16½
Fullers earth, f.o.b. mines	net ton	16 00 - 17 00
Fullers earth—imp., powd.	net ton	30 00 - 32 00
Fusel oil, ref., drums	gal	3 55 - 4 05
Fusel oil, crude, drums	gal	2 30 - 2 40
Glaubers salt, wks., bags	100 lb	1 20 - 1 40
Glaubers salt, imp., bags	100 lb	1 00 - 1 25
Glycerine, c.p., drums extra	lb	18½ - 19
Glycerine, dynamite, drums	lb	17 - 17½
Iodine, resublimed	lb	4 55 - 4 65
Iron oxide, red, casks	lb	12 - .18
Lead		
White, basic cabonate, dry, casks	lb	10 - 10½
White, in oil, kegs	lb	12½ - 14
Red, dry, casks	lb	11½ - 12
Red, in oil, kegs	lb	13½ - 15
Lead acetate, white crys., bbl.	lb	13½ 14
Lead arsenate, powd., bbl	lb	23 - 24
Lime-Hydrated, bbl	per ton	16 80 - 17 00
Lime, Lump, bbl	280 lb	3 63 - 3 65
Litharge, comm., casks	lb	10½ - 11
Lithophone, bbl	lb	06½ - 07
Magnesium carb., tech., bags	lb	08 - 08½
Methanol, 95%, bbl	gal	1 23 - 1 25
Methanol, 97%, bbl	gal	1 25 - 1 27
Nickel salt, double, bbl	lb	10 - 10½
Nickel salts, single, bbl	lb	11 - 11½
Phosgene		60 - 75
Phosphorus red, cases	lb	35 - 40
Phosphorus, yellow, cases	lb	30 - 35
Potassium bichromate, casks	lb	10½ - 11½
Potassium bromide, gran., bbl	lb	16 - 23
Potassium carbonate, 80-85%, calcined, casks	lb	06 - 06½
Potassium chlorate, powd	lb	07 - 08
Potassium cyanide, drums	lb	45 - 50
Potassium hydroxide (caustic potash) drums	100 lb	8 25 - 8 75
Potassium iodide, cases	lb	3 65 - 3 75
Potassium nitrate, bbl	lb	06½ - .07½
Potassium permanganate, drums	lb	25 - 27
Potassium prussiate, red, casks	lb	80 - 85
Potassium prussiate, yellow, casks	lb	37½ - 38
Salammoniac, white, gran., casks, imported	lb	06½ - 06½
Salammoniac, white, gran., bbl., domestic	lb	.08 - .08½
Gray, gran., casks	lb	08½ - 08½
Salsoda, bbl	100 lb	1 20 - 1 40
Salt cake (bulk)	ton	26 00 - 28 00
Soda ash, light, 58% flat, bags, contract	100 lb	1 60 - 1.67
Soda ash, light, basis, 48%, bags, contract, f.o.b. wks	100 lb	1 20 - 1 30
Soda ash, light, 58%, flat, bags, resale	100 lb	1.75 - 1.80
Soda ash, dense, bags, contract, basis 48%	100 lb	1.17½ - 1.20
Soda ash, dense, in bags, resale	100 lb	1 85 - 1.90
Soda, caustic, 76%, solid, drums, f.a.s	100 lb	3 45 - 3.70
Soda, caustic, 76%, solid, drums, contract	100 lb	3 35 3 40
Soda, caustic, basis 60%, wks., contract	100 lb	2 50 - 2 60
Soda, caustic, ground and flake, contracts	100 lb	3 80 - 3.90
Soda caustic, ground and flake, resale	100 lb	4 00 - 4 15
Sodium acetate, works, bags	lb.	06 - 06½
Sodium bicarbonate, bbl	100 lb	2 00 - 2 50
Sodium bichromate, casks	lb	.07½ - 08
Sodium bisulphate (niter cake)	ton	6 00 - 7 00
Sodium bisulphite, powd., U.S.P., bbl	lb	04½ - 04½
Sodium chlorate, kegs	lb	06½ - .07
Sodium chloride	long ton	12 00 - 13 00
Sodium cyanide, cases	lb.	20 - 23
Sodium fluoride, bbl	lb	09 - 10
Sodium hyposulphite, bbl	lb	03 - 03½
Sodium nitrite, casks	lb.	08½ - 09
Sodium peroxide, powd., cases	lb	28 - 30
Sodium phosphate, dibasic, bbl	lb	03½ - 04
Sodium prussiate, yel. drums	lb	18½ - 19
Sodium silicate (40°, drums)	100 lb	80 - 1.15
Sodium silicate (60°, drums)	100 lb.	2.00 - 2.25
Sodium sulphide, fused, 60-62% drums.	lb	.04½ - .04½
Sodium sulphite, crys., bbl.	lb.	.03½ - .03½
Strontium nitrate, powd., bbl.	lb.	.09½ - .10
Sulphur chloride, yel drums.	lb.	.04½ - .05
Sulphur, crude	ton	18.00 - 20.00
Sulphur dioxide, liquid, cyl.	lb.	.08 - .08½
Sulphur, flour, bbl.	100 lb.	2.35 - 3.15
Sulphur, roll, bbl	100 lb.	$2.00 - $2.50
Talc—imported, bags	ton	30.00 - 40.00
Talc—domestic powd., bags	ton	18.00 - 25.00
Tin bichloride, bbl	lb.	.13½ - .14
Tin oxide, bbl	lb.	.52 - .54
Zinc carbonate, bags	lb.	.14 - .14½
Zinc chloride, gran, bbl	lb.	.06 - .07
Zinc cyanide, drums	lb.	.37 - .38
Zinc oxide, XX, bbl	lb.	.07½ - .08
Zinc sulphate, bbl	100 lb.	2.75 - 3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl	lb	$0 80 - $0.85
Alpha-naphthol, ref., bbl	lb	1.05 - 1.10
Alpha-naphthylamine, bbl	lb.	.38 - 40
Aniline oil, drums	lb	.16½ - .17
Aniline salts, bbl	lb.	.24 - .25
Anthracene, 80%, drums	lb.	.75 - 1.00
Anthracene, 80%, imp., drums, duty paid	lb.	.65 - .70
Anthraquinone, 25%, paste, drums	lb	.70 - .75
Benzaldehyde U.S.P., carboys	lb.	1.40 - 1.45
Benzene, pure, water-white, tanks and drums	gal.	.30 - .35
Benzene, 90%, tanks & drums	gal.	26 - .32
Benzene, 90%, drums, resale	gal.	.33 - .35
Benzidine base, bbl	lb.	85 - .90
Benzidine sulphate, bbl	lb.	75 - .80
Benzoic acid, U.S.P., kegs	lb.	.72 - .75
Benzoate of soda, U.S.P., bbl.	lb.	.57 - .65
Benzyl chloride, 95-97%, ref., drums	lb.	.25 - .27
Benzyl chloride, tech., drums	lb.	.20 - .23
Beta-naphthol, subl., bbl.	lb.	.55 - .60
Beta-naphthol, tech., bbl	lb.	.24 - .25
Beta-naphthylamine, tech	lb.	.80 - .90
Carbazol, bbl	lb.	.75 - .90
Cresol, U.S.P., drums	lb.	.25 - .29
Ortho-cresol, drums	lb.	.24 - .26
Cresylic acid, 97%, resale, drums	gal.	1.30 - 1.40
95-97%, drums, resale	gal.	1.15 - 1.20
Dichlorbenzene, drums	lb.	.07 - .09
Diethylaniline, drums	lb.	.50 - .60
Dimethylaniline, drums	lb.	.41 - .42
Dinitrobenzene, bbl	lb.	.19 - .20
Dinitroclorbenzene, bbl	lb	.22 - .23
Dinitronaphthalene, bbl.	lb	.30 - .32
Dinitrophenol, bbl	lb.	.35 - .40
Dinitrotoluene, bbl	lb	.20 - .22
Dip oil, 25%, drums	gal.	.25 - .30
Diphenylamine, bbl	lb.	.50 - .52
H-acid, bbl	lb.	.80 - .85
Meta-phenylenediamine, bbl.	lb.	95 - 1.00
Michlers ketone, bbl	lb.	3.00 - 3.50
Monochlorbenzene, drums	lb.	.08 - .10
Monoethylaniline, drums	lb.	.95 - 1.10
Naphthalene, crushed, bbl	lb.	.08 - .09
Naphthalene, flake, bbl	lb.	.09½ - .10
Naphthalene, balls, bbl	lb.	.10 - .10½
Naphthionate of soda, bbl.	lb.	.58 - .65
Naphthionic acid, crude, bbl.	lb.	.60 - .65
Nitrobenzene, drums	lb.	.10 - .12
Nitro-naphthalene, bbl	lb.	.30 - .35
Nitro-toluene, drums	lb.	.15 - .17
N-W acid, bbl	lb.	1.25 - 1.30
Ortho-amidophenol, kegs	lb.	2.30 - 2.35
Ortho-dichlorbenzene, drums	lb.	.17 - .20
Ortho-nitrophenol, bbl	lb.	.90 - .92
Ortho-nitrotoluene, drums	lb.	.10 - .12
Ortho-toluidine, bbl	lb.	.13 - .15
Para-amidophenol, base, kegs	lb.	1.15 - 1.20
Para-amidophenol, HCl, kegs	lb.	1.20 - 1.25
Para-dichlorbenzene, bbl.	lb.	.17 - .20
Paranitraniline, bbl	lb.	.74 - .75
Para-nitrotoluene, bbl	lb.	.55 - .65
Para-phenylenediamine, bbl.	lb.	1.45 - 1.50
Para-toluidine, bbl.	lb.	.90 - .95
Phthalic anhydride, bbl.	lb.	.35 - .38
Phenol, U.S.P., drums	lb.	.50 - .55
Picric acid, bbl	lb.	.20 - .22
Pyridine, dom., drums	gal.	nominal
Pyridine, imp., drums	gal.	2.30 - 2.50
Resorcinol, tech., kegs	lb.	1.50 - 1.55
Resorcinol, pure, kegs	lb.	2.00 - 2.10
R-salt, bbl	lb.	.60 - .65
Salicylic acid, tech., bbl.	lb.	.47 - .48
Salicylic acid, U.S.P., bbl	lb.	50 - .52
Solvent naphtha, water-white, drums	gal.	.37 - .40
Crude, drums	gal	.22 - .24
Sulphanilic acid, crude, bbl.	lb.	.18 - .20
Thiocarbanilide, kegs	lb.	.35 - .38
Toluidine, kegs	lb.	1.20 - 1.30
Toluidine, mixed, kegs	lb.	.30 - .35
Toluene, tank cars	gal.	.35 - .37
Toluene, drums	gal.	.40 - .45
Xylidines drums	lb.	.40 - .45
Xylene, pure, drums	gal.	.45 - .50
Xylene, com., drums	gal.	.40 - .42
Xylene, com., tanks	gal.	[illegible]

Naval Stores

Rosin B-D, bbl.	280 lb.	$6.00 -	
Rosin E-I, bbl	280 lb.	6.10 -	$6 15
Rosin K-N, bbl.	280 lb.	6 40 -	6.80
Rosin W.G.-W.W., bbl.	280 lb.	7 35 -	8 05
Wood rosin, bbl.	280 lb.	6 25 -	
Turpentine, spirits of, bbl.	gal.	1 53 -	1 54
Wood, steam dist., bbl.	gal.	1 35 -	
Wood, dest. dist., bbl.	gal.	1.25 -	
Pine tar pitch, bbl.	200 lb.	-	6 00
Tar, kiln burned, bbl.	500 lb.	-	12 00
Retort tar, bbl.	500 lb	-	11 00
Rosin oil, first run, bbl.	gal.	.43 -	
Rosin oil, second run, bbl.	gal.	.47 -	...
Rosin oil, third run, bbl.	gal.	.53 -	...
Pine oil, steam dist.	gal.	......-	.90
Pine oil, pure, dest. dist.	gal.	......-	85
Pine tar oil, ref.	gal.	......-	.46
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal.	......-	35
Pine tar oil, double ref., bbl.	gal.	-	75
Pine tar, ref , thin, bbl.	gal.	-	25
Pinewood creosote, ref., bbl	gal.	......-	.52

Vegetable Oils

Castor oil, No. 3, bbl.	lb.	$ 13½-	$.13¾
Castor oil, AA, bbl.	lb.	.14 -	14¾
Chinawood oil, bbl.	lb.	.25 -	26
Coconut oil, Ceylon, bbl.	lb.	10½-	10¾
Coconut oil, Cochin, bbl.	lb.	10¾-	
Corn oil, crude, bbl	lb.	.12¼-	
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	10½-	10¾
Summer yellow, bbl.	lb.	12½-	13
Winter yellow, bbl.	lb	13 -	13½
Linseed oil, raw, car lots, bbl	gal.	1 05 -	
Raw, tank cars (dom)	gal.	1 00 -	
Boiled, 5-bbl lots (dom.)	gal.	1 10 -	
Olive oil, denatured, bbl.	gal.	1 10 -	1 15
Palm, Lagos, casks	lb.	08¼-	08¾
Palm kernel, bbl	lb.	09½-	
Peanut oil, crude, tanks (mill)	lb.	.13½ -	13¾
Peanut oil, refined, bbl.	lb.	17 -	
Rapeseed oil, refined, bbl	gal.	84 -	85
Rapeseed oil, blown, bbl.	gal.	90 -	91
Soya bean (Manchurian), bbl.	lb.	12¼-	.
Tank, f.o b Pacific coast.	lb.	10½-.	.

Fish Oils

Menhaden, light pressed, bbl.	gal	$0 70 -	
White bleached, bbl.	gal.	72 -	.74
Blown, bbl.	gal.	76 -	78
Whale No 1 crude, tanks, coast	lb	06½-	

Dye & Tanning Materials

Divi-divi, bags	ton	$38 00 -	$39 00
Fustic, sticks	ton	30 00 -	35 00
Fustic, chips, bags.	lb	04 -	05
Logwood, sticks	ton	28 00 -	30 00
Logwood, chips, bags	lb.	02½-	03½
Sumac, leaves, Sicily, bags	ton	65 00 -	
Sumac, ground, bags	ton	55 00 -	60 00
Sumac, domestic, bags.	ton	35 00 -	...
Tapioca flour, bags.	lb.	.03½-	05

EXTRACTS

Archil, conc., bbl.	lb.	$0 17 -	$0 18
Chestnut, 25% tannin, tanks.	lb.	.02 -	03
Divi-divi, 25% tannin, bbl.	lb.	04 -	05
Fustic, crystals, bbl.	lb.	.20 -	22
Fustic, liquid, 42°, bbl.	lb.	08 -	09
Gambier, liq., 25% tannin, bbl.	lb.	.08 -	09
Hematine crys., bbl.	lb.	.14 -	18
Hemlock, 25% tannin, bbl.	lb.	.04 -	05
Hypernic, solid, drums	lb.	.24 -	26
Hypernic, liquid, 51°, bbl.	lb.	.14 -	17
Logwood, crys., bbl.	lb.	19 -	20
Logwood, liq., 51°, bbl.	lb.	.09 -	.10
Quebracho, solid, 65% tannin, bbl.	lb.	.04½-	05
Sumac, dom., 51°, bbl.	lb.	.06½-	07

Waxes

Bayberry, bbl.	lb.	$0.28 -	$0 30
Beeswax, refined, dark, bags.	lb.	.30 -	32
Beeswax, refined, light, bags.	lb.	.34 -	35
Beeswax, pure white, cases.	lb.	.40 -	41
Candellila, bags.	lb.	.25 -	27
Carnauba, No. 1, bags.	lb.	40 -	.41
No. 2, North Country, bags	lb.	.23½-	24
No. 3, North Country, bags	lb.	.19 -	.19½
Japan, cases	lb.	.14½-	.15
Montan, crude, bags.	lb.	.04 -	.04¼
Paraffine, crude, match, 105-110 m.p.	lb.	.04 -	04½
Crude, scale 124-126 m.p., bags	lb.	.02¾-	.03
Ref., 118-120 m p., bags.	lb.	.03¼-	.03½
Ref., 125 m.p., bags.	lb.	.03¼-	.03½
Ref, 128-130 m.p., bags.	lb.	.04 -	.04¼
Ref., 133-135 m.p., bags.	lb.	.04½-	.04¾
Ref., 135-137 m.p., bags.	lb.	.05 -	05¼
Stearic acid, sgle pressed, bags	lb.	.14 -.	.
Double pressed, bags.	lb.	.14½-	
Triple pressed, bags.	lb.	.16 -	...

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb.	$3.30 -	$3.40
F.a.s. double bags	100 lb.	4.15 -	4.25
Blood, dried, bulk	unit	4.60 -	...
Bone, raw, 3 and 50, ground.	ton	30.00 -	35.00
Fish scrap, dom., dried, wks.	unit	5.00 -	5.10
Nitrate of soda, bags	100 lb.	2.62½-	2.65
Tankage, high grade, f.o.b. Chicago	unit	4.70 -	4.80

Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$4.00 -	$4.50
Tennessee, 78-80%	ton	8.00 -	8.25
Potassium muriate, 80%, bags	ton	35 00 -	36.00
Potassium sulphate, bags.	unit	1.00 -	...

Crude Rubber

Para—Upriver fine	lb	$0 33 -	$0 33½
Upriver coarse	lb	.27½-	.28
Upriver caucho ball	lb	29½-	.30
Plantation—First latex crepe	lb	34½-	.35
Ribbed smoked sheets	lb	34½-	.35
Brown crepe, thin, clean	lb	31 -	.32
Amber crepe No. 1	lb	.31 -	.32

Miscellaneous Materials

Asbestos, crude No. 1, f o b, Quebec	sh. ton	$450 00 -	$550 00
Asbestos, shingle, f.o.b., Quebec	sh. ton	60.00 -	80 00
Asbestos, cement, f o b., Quebec	sh. ton	15 00 -	17 00
Barytes, grd., white, f o.b. mills, bbl.	net ton	16.00 -	20.00
Barytes, grd., off-color, f o.b. mills bulk.	net ton	13.00 -	15.00
Barytes, floated, f.o b. St Louis, bbl	net ton	28.00 -.	.
Barytes, crude f.o b. mines, bulk	net ton	11.00 -	11.50
Casein, bbl, tech	lb.	.11 -	.12
China clay (kaolin) crude, f o b Ga	net ton	7 00 -	9 00
Washed, f o b Ga	net ton	8.00 -	9 00
Powd, f o b Ga	net ton	13 00 -	20 00
Crude f.o b Va.	net ton	8 00 -	12 00
Ground, f o b Va	net ton	13 00 -	20 00
Imp., lump, bulk	net ton	15 00 -	20 00
Imp, powd	net ton	45 00 -	50 00
Feldspar, No. 1 pottery	long ton	6 00 -	7 00
No 2 pottery	long ton	5 00 -	5 50
No 1 soap	long ton	7 00 -	7.50
No 1 Canadian, f o b mill	long ton	25.00 -	27.00
Graphite, Ceylon, lump, first quality, bbl	lb	06 -	.06½
Ceylon, chip, bbl	lb.	.05 -	.05½
High grade amorphous crude	ton	35.00 -	50.00
Gum arabic, amber, sorts, bags	lb	.15 -	16
Gum tragacanth, sorts, bags	lb.	.50 -	60
No 1, bags	lb.	1.75 -	1 80
Kieselguhr, f o b Cal	ton	40 00 -	42 00
F o b N Y	ton	50 00 -	55 00
Magnesite, crude, f.o b Cal.	ton	14 00 -	15 00
Pumice stone, imp, casks.	lb.	03 -	05½
Dom., lump, bbl	lb.	05 -	.05½
Dom, ground, bbl	lb.	06 -	.07
Shellac, orange fine, bags	lb.	82 -	83
Orange superfine, bags.	lb.	.84 -	85
A C garnet, bags.	lb.	78 -	79
T N., bags	lb.	79 -	.80
Silica, glass sand, f o b Ind	ton	2 00 -	2 50
Silica, sand blast, f o b Ind	ton	2 50	5.00
Silica, amorphous, 250-mesh, f o.b. Ill.	ton	17.00 -	17.50
Silica, bldg sand, f.o b. Pa.	ton	2 00 -	2.75
Soapstone, coarse, f.o b. Vt., bags	ton	7 00 -	8.00
Talc, 200 mesh, f.o.b., Vt., bags	ton	6.50 -	9 00
Talc, 200 mesh, f.o b. Ga., bags	ton	7 00 -	9.00
Talc, 200 mesh, f.o.b. Los Angeles, bags.	ton	16 00 -	20.00

Refractories

Bauxite brick, 56% Al_2O_3, f o.b. Pittsburgh	ton	$45-50
Chrome brick, f.o.b. Eastern shipping points	ton	50-52
Chrome cement, 40-50% Cr_2O_3.	ton	23-27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st quality, 9-in shapes, f.o.b. Ky wks.	1,000	40-46
2nd. quality, 9-in shapes, f.o.b. wks.	1,000	36-41
Magnesite brick, 9-in straight (f.o b wks.)	ton	65-68
9-in. arches, wedges and keys.	ton	80-85
Scraps and splits.	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48-50
Silica brick, 9-in. sizes, f.o.b. Birmingham district.	1,000	48-50
F o.b. Mt. Union, Pa.	1,000	42-44
Silicon carbide refract brick, 9 in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18% f o b. Niagara Falls, N. Y.	ton	$200.00 -	$225.00
Ferrochromium, per lb. of Cr, 6-8% C.	lb.	.11½	.11½
4-6% C.	lb.	.12 -	.13
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	115.00 -	120.00
Spiegeleisen, 19-21% Mn.	gr. ton	35.00 -	37.00
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb.	1.90 -	2.15
Ferrosilicon, 10-15%	gr. ton	38.00 -	40.00
50%	gr. ton	86.00 -	89.00
75%	gr. ton	150.00 -	160.00
Ferrotungsten, 70-80%, per lb. of W	lb.	$0.85 -	$0.90
Ferro-uranium, 35-50% of U, per lb. of U	lb.	6.00 -	...
Ferrovanadium, 30-40%, per lb of V	lb.	3.75 -	4.00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f o b shipping points	ton	$6.50 -	$8.75
Chrome ore, Calif. concentrates, 50% min Cr_2O_3	ton	22.00 -	23.00
C i f Atlantic seaboard	ton	18.50 -	19.00
Coke, fdry, f.o b ovens	ton	8.25 -	8.50
Coke, furnace, f o b ovens	ton	7.00 -	7.25
Fluorspar, gravel, f o b mines, Illinois	ton	21.50 -	...
Ilmenite, 52% TiO_2	lb.	.01½-	.01¾
Manganese ore, 50% Mn, c i f. Atlantic seaport	unit	.33 -	...
Manganese ore, chemical (MnO_2)	ton	75.00 -	80.00
Molybdenite, 85% MoS_2, per lb MoS_2, N Y	lb.	.65 -	.70
Monazite, per unit of ThO_2, c i f, Atl seaport	lb.	.06 -	.08
Pyrites, Span, fines, c i f Atl seaport	unit	.11½-	.12
Pyrites, Span, furnace size, c i f Atl. seaport	unit	.11½-	.12
Pyrites, dom. fines, f.o b mines, Ga	unit	.12	
Rutile, 95% TiO_2	lb.	.12 -	...
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.50 -	8.75
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	8.00 -	8.25
Uranium ore (carnotite) per lb of U_3O_8	lb	3.50 -	3.75
Uranium oxide, 96%, per lb. U_3O_8	lb	2 25 -	2.50
Vanadium pentoxide, 99%	lb	12 00 -	14.00
Vanadium ore, per lb V_2O_5	lb	1 00 -	...
Zircon, washed, iron free, f o.b. Pablo, Fla	lb	.04½-	.13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	17.375
Aluminum, 98 to 99%	25 00-25.50
Antimony, wholesale, Chinese and Japanese	8 75-9.00
Nickel, virgin metal	25.00-27.00
Nickel, ingot and shot	29.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	38.00
Monel metal, sheet bars	45.00
Tin, 5-ton lots, Straits	48.625
Lead, New York, spot	8.25
Lead, E St. Louis, spot	8.25
Zinc, spot, New York	7.90-8.10
Zinc, spot, E St. Louis	7.65-8.00

OTHER METALS

Silver (commercial).	oz.	$0.67⅞
Cadmium	lb.	1.10
Bismuth (500 lb. lots)	lb.	2.55
Cobalt	lb.	2.65@2.85
Magnesium, ingots, 99%	lb	1 00@1.05
Platinum.	oz	110 00
Iridium	oz	260.00@275.00
Palladium	oz.	79.00
Mercury	75 lb.	69.00@70.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.75
Copper bottoms	30.75
Copper rods	20.50
High brass wire	19.50
High brass rods	17.00
Low brass wire	21.10
Low brass rods	22.00
Brazed brass tubing	24.25
Brazed bronze tubing	29.00
Seamless copper tubing	25.25
Seamless high brass tubing	23.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.30@11.50
Copper, heavy and wire.	11 25@11.50
Copper, light and bottoms	9.25@ 9.50
Lead, heavy	5.75@ 6.00
Lead, tea	3.50@ 3.75
Brass, heavy	6.25@ 6.40
Brass, light	5.35@ 5.75
No. 1 yellow brass turnings	6.30@ 6.50
Zinc	3.50@ 4.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.29	$3.14
Soft steel bars	3.19	3.04
Soft steel bar shapes	3.19	3.04
Soft steel bands	3.29	3.19
Plates, ¼ to 1 in. thick	3.29	3.14

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

ACIPCO—The American Cast Iron Pipe & Foundry Co. will rebuild the portion of its testing department, destroyed by fire March 8. An official estimate of loss has not been made.

Arizona

PHOENIX—The Riverside Portland Cement Co., Riverside, Calif., has tentative plans under consideration for the construction of a new cement plant in the vicinity of Phoenix, estimated to cost in excess of $750,000, including machinery. Harry Welch, secretary of the Phoenix Chamber of Commerce, is co-operating with the company in connection with site selection. Loren Barton is assistant general manager.

California

McPHERSON—The Orange Belt Oil Refining Co., McPherson, near Orange, will commence the immediate erection of a new local refinery, estimated to cost $55,000.

ANTIOCH—The Paraffine Companies, Inc., 34 1st St., San Francisco, has awarded a contract to Fred Stamm, 25 A St., Antioch, for the erection of its proposed new 1-story plant addition, estimated to cost $40,000. Leland Rosener, Insurance Bldg., San Francisco, is architect.

SAN DIEGO—The Vitrified Products Co. is completing plans for the construction of a new plant on site at Old Town, near San Diego, totaling 17 acres, for the manufacture of vitrified brick. It will be equipped for an initial output of 50,000 bricks daily. The company has extensive clay deposits in the vicinity of Linda Vista. Victor Kremer is president.

MARICOPA—The Pacific Midway Oil Co., which heretofore has had a topping plant in operation on its property, is expanding its operations and installing a new separate "jitney refinery" unit for a complete rundown of its crude. H. F. Everard and E. D. Goldsmith are the designers and E. D. Goldsmith has charge of the construction.

ONTARIO—The Interlocking Tile & Sewer Pipe Co. is considering the construction of a local plant for the manufacture of special burned clay products. The purchase of an extensive tract of land at Indio, in the same district, is planned, to be used for raw material supply. J. F. Gale and D. E. Badger represent the company in connection with the project. B. W. Spencer, secretary of the Ontario Chamber of Commerce, is interested in the new plant.

SUNNYVALE—The Sunnyvale Concrete Products Co. has commenced the erection of an addition to its plant, to be equipped for the manufacture of concrete pipe. It will cost about $15,000.

LOS ANGELES—A 1-story foundry addition, 40x100 ft., will be erected at the plant of the Union Tool Co., Torrance, near Los Angeles, for iron casting production.

Connecticut

WATERBURY—The Connecticut Brass Foundry Co., 660 East Main St., will build a new addition to its plant, 1-story, 25x40 ft. Henry F. Wenzel, Waterbury, is architect.

Illinois

CHICAGO—The Alberene Stone Co., 214 North Clenton St., manufacturer of soapstone products for domestic and other service, has purchased the plant of the United States Industrial Alcohol Co., Elston and Wabansia Aves., 100x150 ft., improved with a 1- and 2-story building. The property was acquired for a consideration of $45,000, and will be used by the new owner for its plant. The present works will be removed to the location and a number of extensions made.

Indiana

INDIANAPOLIS—The Lilly Varnish Co., 670 South California St., has filed plans for a 1-story factory addition.

BROOKLYN—The Brooklyn Brick Co. has work under way on improvements in its plant to include the construction of new down-draft kilns, and the installation of considerable equipment. It is proposed to establish a department for the manufacture of face brick. The common brick output will be maintained on a basis of 60,000 bricks per day.

Kansas

EMPORIA—The Common Council is completing plans for extensions and improvements in the municipal waterworks, to include the installation of a new chlorinator and other equipment. E. T. Mendel is clerk.

Kentucky

LOUISVILLE—The Louisville Gas & Electric Co. has purchased a 70-acre site for the construction of a new artificial gas plant. The structure will be arranged in a series of individual units, capable of expansion as desired, estimated to cost more than $5,000,000. Plans for the first unit will be prepared and work placed in progress at an early date. Donald McDonald is vice-president.

PADUCAH—The Tucker Chemical Mfg. Co., recently organized with a capital of $250,000, has tentative plans under consideration for the establishment of a local plant for the manufacture of chemical products for the textile industry, as well as other service. The new company is headed by E. C. Pace, W. C. Richman and T. A. Miller.

CHINNVILLE—The Kentucky Refractories Corp., Ironton, Ky., has plans under way for the construction of a local plant for the manufacture of firebrick, refractory linings and other refractories. A 12-acre site has been acquired for the plant, which is estimated to cost $80,000, with machinery. C. K. Turtley is president.

Louisiana

NEW ORLEANS—Godchaux Sugars, Inc., 527 Canal St., has abandoned plans for the rebuilding of its refining plant at Elm Hall, destroyed by fire several months ago, and will enlarge its Reserve and Raceland refineries to make up the necessary capacity. Work will be commenced at once on an addition to the first noted plant, and considerable new machinery will be installed.

WEST BATON ROUGE—The Glynn Planting Co., operating the local Kelson plant for the manufacture of sirups, is planning for the erection of an addition to be equipped as a sugar refinery. Work will be commenced at an early date.

Maryland

BALTIMORE—Johns Hopkins University has filed plans for the immediate erection of its proposed new chemical laboratory at Charles St. and the University Parkway, to be 3 story, 118x160 ft., estimated to cost about $400,000. Contract for the work was awarded recently to the Consolidated Engineering Co., Calvert Bldg.

Massachusetts

ROCKPORT—The Board of Selectmen has plans under consideration for the installation of a filter system at the municipal waterworks. John Dennis is head of the board.

EAST BOSTON—The East Boston Pottery Co. is planning for enlargements in its plant, including the installation of additional equipment and three new kilns. Work will be placed under way at an early date.

WESTFIELD—The H. B. Smith Co. is planning for the early erection of a new 1-story foundry at its local boiler-manufacturing plant, to be equipped for the production of iron castings. Monks & Johnson, 99 Chauncey St., Boston, are engineers.

WATERTOWN—The Hood Rubber Co., Nichols Ave., is completing the erection of a 3-story addition to its tire and rubber plant, 64x128 ft., and plans for the installation of machinery at an early date. The Aberthaw Construction Co., 27 School St., Boston, is the general contractor. F. C. Hood is general manager.

Michigan

ESCANABA—The Universal Magnesite Products Co., recently organized, has leased a local building and will commence the immediate installation of machinery for the manufacture of composition materials for construction service, magnesite stucco, wall plaster and affiliated products. L. K. Edwards is president; and P. L. Sullivan, vice-president and general manager.

MUSKEGON—A 1-story foundry, 120x220 ft., estimated to cost about $175,000, will be constructed at the plant of the Piston Ring Co., to be used for the production of steel castings.

ONTONAGON—The Ontonagon Fiber Co., now being organized, has taken over the former local plant of the Northern Fiber Co., temporarily abandoned in 1921. The mill is designed for the manufacture of unbleached soda pulp, and will be remodeled by the new owner for the production of bleached and unbleached sulphate pulp and soda pulp. Equipment will be installed for a daily capacity of about 75 tons of material, and it is expected to have the plant ready for service before the close of the year. D. Clark Everest, one of the heads of the Ewing-Everest Pulp Co., Merrill, Wis., and secretary and general manager of the Marathon Paper Co., Rothschild, Wis., is one of the principal organizers of the new Ontonagon company.

New Jersey

FORDS—The Fords Art Stone Co., Inc., has commenced the erection of a new 1-story plant addition, and plans for the installation of additional equipment.

NEWARK—The Metal Products Co., 134 Lafayette St., is arranging for the immediate rebuilding of the portion of its lacquer department, damaged by fire, march 12. An official estimate of loss has not been made.

NEWARK—J. Hague Armitage & Sons, Inc., Thomas and Dawson Sts., manufacturer of waterproofing products, coated specialties, etc., has acquired the vacant plot of land, 100x225 ft., at Dawson and Parkhurst Sts., in the vicinity of its plant, for proposed future additions.

New York

NIAGARA FALLS—The Pittsburgh Metallurgical Co., Highland Ave., is planning for the rebuilding of the portion of its plant, destroyed by fire, March 12.

GLEN PARK—The National Paper Products Co., Carthage, N. Y., has negotiations in progress for a lease of the C. R. mill of the International Paper Co., located at Glen Park. It is purposed to improve the plant upon acquisition, with the installation of equipment for the manufacture of tissue and other papers.

ITHACA—Cornell University is planning for the rebuilding of the portion of the laboratory of the Sibley College of Engineering, destroyed by fire March 13, with loss estimated at $10,000.

BALSTON SPA—The Adirondack Paper Corp., recently organized, has leased the local mill of the Island Paper Co. for a new plant, and will take immediate possession. Improvements will be made and necessary equipment installed. The company is headed by F. B. Oldham, Newtonville, B. G. MacDonald, Albany; and L. C. Case, Guilderland.

North Carolina

KERNERSVILLE—The American Iron Works, P. O. Box 138, recently formed with a capital of $75,000, is planning for the erection of a 1-story foundry in connection with its proposed local plant, to be equipped for the manufacture of iron castings. A 2-ton cupola will be installed. O. L. Smith is secretary.

Ohio

COSHOCTON—The Pope Gosser China Co. will soon commence the erection of an addition to its plant to cost about $25,000.

Oklahoma

ARDMORE—The Monterey Glass Co., Monterey, Mex., is considering plans for the construction of a branch plant at Ardmore. A site is being selected in the vicinity of glass sand properties.

Oregon

PORTLAND—The Astoria Brick & Building Material Co. has purchased a portion of the former property of the Northern Pacific Brewing Co., and plans for the erection of a new brick-manufacturing plant, with initial capacity of 65,000 bricks daily. The main building will be 100x200 ft.

Pennsylvania

HARRISBURG—The Harrisburg Gas Co. is planning for extensions and improvements in its artificial gas plant, to include the installation of new compressors and other machinery.

CORAOPOLIS—The Vulcan Refining Co., is planning for the rebuilding of the portion of its local oil refinery and byproducts plant, destroyed by fire, March 12, with loss estimated at close to $60,000, including machinery. The wax plant was destroyed. Thomas Allen is general manager.

READING—The Consumers' Gas Co., a subsidiary of the United Gas Improvement Co., Broad and Arch Sts., Philadelphia, has purchased additional property at Willow Grove, as a site for the construction of a new artificial gas plant.

PITTSBURGH—The Federal Enameling & Stamping Co., McKees Rocks, has plans in progress for the rebuilding of the portion of its plant, destroyed by fire, March 12, with loss estimated at $250,000, including buildings and machinery.

South Carolina

GREENWOOD—The J. W. Sprole Oil Co. is considering plans for the rebuilding of the portion of its local plant, recently destroyed by fire. An official estimate of loss has not been made.

Tennessee

GALLATIN—The Gillespie Oil Corp. is planning for the installation of additional machinery at its local oil refinery. The capacity will be increased.

MEMPHIS—The Railway Paint Products & George M. Tagg Paint Companies, Consolidated, Inc., recently formed by a merger of the two local companies of names noted, is planning for the installation of additional machinery at its plant for large increase in output. George M. Tagg heads the company.

LEWISBURG—The City Council is considering plans for the installation of a new filtration plant at the municipal waterworks.

Texas

ELECTRA—The Griswold Oil Co. will soon commence the construction of a new refining plant, with daily capacity of about 2,500 bbl., estimated to cost close to $500,000, with machinery. A gasoline refinery will also be built, costing approximately $100,000, with "cracking" machinery and other operating equipment.

EASTLAND—The Arab Gasoline Co. has plans in progress for the construction of a new gasoline refinery, with daily capacity of 10,000 gal., estimated to cost approximately $150,000, with machinery.

WHITE CASTLE—L. N. Folse, operating a sugar cane mill, is planning for the installation of new crushing machinery and other equipment.

DALLAS—The Dallas Refining Co., recently incorporated with a capital of $175,000, has purchased property on the West Dallas Pike for the construction of a new *gasoline refinery. An oil-refining plant* will also be erected, with initial daily production approximating 1,000 bbl. The installation is estimated to cost about $150,000. O. F. Kullenberg heads the company.

ABILENE—R. K. Wooten, Chickasha, Okla., and R. M. Simmons, Sweetwater, Tex., have organized a company to construct and operate a local cotton oil mill. Plans will be prepared and work placed in progress at an early date. The plant is estimated to cost $350,000, with machinery.

AUSTIN—J. W. Hassell, formerly chief of the gas and oil division of the State Railroad Commission, is at the head of a new company which purposes to construct and operate a plant in Stephens County for the production of carbon black, utilizing residue natural gas from casinghead gasoline plants. The initial installation is estimated to cost $300,000, with machinery. It will be located in the vicinity of Breckenridge.

FORT WORTH—The General Foundry Co., lately organized, has acquired property at 607 North Main St., and plans for the immediate installation of equipment for the production of grey-iron castings. B. N. Wadley is president, and T. H. Stewart, secretary-treasurer.

Virginia

RICHMOND—The Standard Paper Mfg. Co., Hull and Canal Sts., has awarded a contract to the Wise Granite & Construction Co., American Bank Bldg., for the erection of a 2-story plant addition, 64x110 ft., to cost about $35,000. M. E. Wright, American Bank Bldg., is architect.

RICHMOND—The Southern Crockery Co. is planning for the rebuilding of the portion of its plant, recently destroyed by fire with loss of about $25,000. F. F. Socoloff is president.

Vermont

RUTLAND—The Rutland Fire Clay Co. has plans under consideration for the erection of an addition to its plant on Curtis Ave., including the installation of additional equipment.

West Virginia

KEYSER—The City Council is perfecting plans for the installation of a new filtration plant at the municipal waterworks, estimated to cost about $90,000. L. D. Warner is city clerk.

FAIRMONT—The Consolidation Coal Products Co. will soon commence the installation of a byproducts coke plant at its local properties.

Canada

MERRITTON, ONT.—The Garden City Paper Mills, Ltd., St. Catherines, specializing in the production of tissue and light-weight papers, is planning for the early erection of a new mill at Merritton. L. H. Gardner is president.

Industrial Developments

CERAMIC—The Colfax Drain Tile Co., Colfax, Ind., is planning to resume production within the next few weeks. The works have been idle for about 3 years past.

The Hocking Valley Products Co., Columbus, O., manufacturer of brick and hollow tile, is arranging for immediate increase in production, and will place the plant on a capacity basis.

Due to natural gas scarcity in the East Liverpool, O., district operations have been curtailed at a number of the general ware plants during the past few weeks. Orders on hand are said to warrant maximum output, and resumption on full schedule will be carried out as soon as fuel is available.

The Mid-Continent Clay Co., Peru, Kan., will devote its entire production to roofing tiles and purposes to develop a maximum output in this line. The manufacture of face brick will be discontinued.

The Acme Brick Co., Forth Worth, Tex., is running full at its plants at Denton, Millsap and Bennetts. A portion of the output is devoted to firebrick and special molded shapes. The plants have a gross output of 15,000,000 bricks per year. The present schedule will be maintained for an indefinite period.

The Hazleton Brick Co., Hazleton, Pa., has arranged for the immediate resumption of operations at its plant, and will run on a *full capacity schedule until further notice.* Recent orders aggregate close to 1,000,000 bricks for immediate delivery. A full working force will be employed.

PAPER—The Flower City Tissue Mills, Scottsville, N. Y., *is arranging for the resumption* of production at an early date and will make a number of improvements in plant and machinery. The mill has been closed for more than 12 months past.

The St. Lawrence Paper Mills, Ltd., Three Rivers, Que., will soon start the second machine at its mill. The first paper machine at the plant is now in full operation. The working force will be increased.

Paper mills in Wisconsin are increasing production, and the majority are giving employment to full working forces. Orders on hand are said to insure capacity for several months to come.

The Grass Fibre Pulp & Paper Co., Leesburg, Fla., is maintaining full operations at its new local mill, which was placed in service early in February. The bulk of production is devoted to newsprint, utilizing saw-grass as raw material. The working force will be advanced.

The Provincial Paper Mills, Ltd., Port Arthur, Ont., has commenced operations at its new local mill and will gradually advance production. A large working force is being employed. The plant will be devoted to the manufacture of fine papers.

CEMENT—The Lehigh Portland Cement Co., Allentown, Pa., is pushing construction on its new mill at Tarrant City, Ala., and expects to have the plant ready for operation late in May. The company is maintaining active production at its Lehigh Valley mills.

The Atlas Portland Cement Co. is running full at its large mill at Northampton, Pa., with regular working force, and will maintain this schedule for an indefinite period.

The International Cement Co., Kansas City, Mo., is advancing production at its different mills. Plans are being perfected for early enlargements in the plant of the Bonner Portland Cement Co., Bonner Springs, Kan.

The Phoenix Portland Cement Co., Nazareth, Pa., is making ready for early operations at its new plant at North Birmingham, Ala., and it is expected to have the unit running full within 60 days. The plant was originally scheduled to commence manufacture in June. It has a rated capacity of more than 1,000,000 bbl. per year. The company is maintaining full operations at its Nazareth plant.

GLASS—The Inland Glass Co., Chicago, Ill., specializing in the production of illuminating glassware, is advancing operations at its new local plant at 6101 West 65th St. The factory was placed in operation about the middle of February. The working force will be increased.

The American Plate Glass Co., James City, Pa., recently acquired by the Durant Motor Co., is giving employment to about 500 operatives on a full time basis. Wages have been advanced 10 per cent since the acquisition of the property by the Durant interests.

Window glass plants in Western Pennsylvania are running at maximum capacity, with heavy orders on hand to insure this schedule for a number of months to come. Plate glass plants also report an unprecedented demand for material and are giving employment to every available worker.

The National Plate Glass Co., Blairsville, Pa., an interest of the Fisher Body Co., Detroit, Mich., manufacturer of automobile bodies, is running at full capacity with full working force and will keep to this schedule indefinitely. Employees have been given an advance in wages, averaging about 6 cents an hour.

IRON AND STEEL—The Stewart Furnace Co., Cleveland, O., is making ready to blow in its stack at Sharon, Pa., at an early date.

The Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., is preparing its old Oxmoor furnace for the torch, and expects to blow in the unit at an early date.

The McKeefrey furnace, Leetonia, O., is planning to go into blast at an early date. The unit has been made ready for service.

The Jones & Laughlin Steel Corp., Pittsburgh, Pa., has all of its blast furnaces on the active list, and purposes to maintain this schedule for an indefinite period.

The Woodward Iron Co., Birmingham, Ala., will soon place its second blast furnace in operation at Vanderbilt. The unit has been repaired and made ready.

The Reliance Coke Co., Youngstown, O., will blow in its Ella furnace in this district at once. The stack has been idle for about 36 months.

Steel ingot and pig-iron production in the Pittsburgh, Pa., district is exceeding the best war-time records. Every furnace now on the active list will be continued in blast for several weeks to come.

The East Rolling Mills, Inc., Baltimore, Md., *specializing in the manufacture of steel* sheets, is running at maximum capacity, and will adhere to this schedule for many weeks to come.

Twenty of the thirty steel mills of the Carnegie Steel Co., at Farrell, Pa., were forced to curtail operations for 3 days during the past fortnight owing to shortage of raw materials. Resumption has now been effected. Employment is being given to full working forces.

MISCELLANEOUS—The Sinclair Consolidated Oil Corp., New York, is running full at its East Chicago, Ind., refinery [illegible] breaking previous production [illegible]

Glazed kid tanneries at [illegible] are being forced to [illegible] due to a shortage of raw skins [illegible]

Coke plants in the vicinity of Connellsville, Pa., are running at maximum capacity, and the highest production record during the past 3 years is being made on a basis of 250,000 to 260,000 tons weekly.

The Tennessee Copper & Chemical Corp., 61 Broadway, New York, is maintaining capacity production at its sulphuric acid plants in different parts of the country.

Manufacturers' Catalogs

THE RUGGLES-COLES ENGINEERING CO., New York, in a 4-page bulletin covers the principles of operation of the various types of Ruggles-Coles driers and gives information on drying problems in a concrete way so as to save time and yet present facts which are of particular importance to engineers and allow them to get preliminary information, at least, on the class of drier they would require for the particular problem at hand.

THE MINE SAFETY APPLIANCES CO., Pittsburgh, Pa., has issued a new circular describing the Burrell Gas Mask for the commercial needs in the chemical, dye, paint, paper, etc. industries. It describes the various types of masks for various gases. There has also been published by the same company a circular describing particularly the Burrell Ammonia Gas Mask.

THE DELAVAL STEAM TURBINE CO., Trenton, N. J., has issued a folder on De Laval equipment for the Marquette Cement Co. and another on equipment in the Crown Willamette Paper Mill. It has also published two bulletins. "Plants and Product" is the title of one booklet, which briefly describes the single and multi-stage steam turbines, centrifugal pumps, blowers and compressors and speed-reducing gears in which that concern has specialized since its establishment in 1901. The other booklet is on small single-stage centrifugal pumps for motor or belt drive. These pumps are made in 1½ and 2-in. sizes, and are designed for capacities ranging from 5 gal. per minute against 10 ft. head up to 130 gal. per minute against 150 ft. head. They contain few and simple parts, which are manufactured to limit gages to insure interchangeability. The booklet gives complete tables and instructions for selecting pumps for different conditions, and explains how to determine the proper speeds, and how to select piping, valves, fittings and driving pulley or motor to secure an efficient and satisfactory installation.

THE INTERNATIONAL COMBUSTION ENGINEERING CORP., New York, in a condensed pamphlet describes all its products.

SKINNER, SHERMAN & ESSELEN, INC., 248 Boylston St., Boston, 17, Mass., has issued a booklet entitled "An Introduction. Mr. Banker, Meet Old Man Chemistry." This is a reproduction of an article by James H. Collins published in a recent issue of *Forbes' Magazine*.

H. S. B. W. COCHRANE CORP., Philadelphia, Pa., has issued a booklet entitled "Feed Water Heaters in Their Relation to Steam Plant Efficiency." It informs us that "The text matter is not primarily descriptive of apparatus, but rather a presentation of the theory and practice of boiler feed water heating. After showing that the most efficient steam cycle is the one in which the feed water is heated from hot well temperature to boiler temperature by the use of steam withdrawn during expansion, various practical forms of apparatus and their uses are taken up, including vacuum deaërating heaters, back pressure heaters, heaters in conjunction with make-up water evaporators, feed water heating by stages, different methods of control for obtaining continuous heat balance, heaters in connection with exhaust steam heating system, heaters in conjunction with hot water heating and service systems, including heaters operated at temperatures below 212 deg. F., combined heaters and softeners and combined heaters and feed water meters. The feed water temperature best for plant efficiency is not a sharply defined quantity, as it is found that the temperature can vary through quite a wide range without seriously affecting overall economy. With the vacuum deaërating type of heater, this becomes entirely practicable—that is, the temperature of the feed water rises and falls according to the relative supplies of condensate and auxiliary exhaust steam or bled steam, without requiring close control by the attendant. The pamphlet should be of lively and timely interest to designers, managers and operators of steam plants."

THE LOUIS ALLIS CO., Milwaukee, Wis., has issued Bulletin 406, describing and giving full information with regard to the L. A. Type H. D., heavy duty motor.

THE ALEXANDER MILBURN CO., Baltimore, Md., calls attention to a miniature catalog covering the Milburn line of welding and cutting equipment, ranging from the smallest torch to a large compressing plant. Copy will be supplied upon request.

DOMESTIC LAUNDRY EQUIPMENT CORP., New York City, announces a new catalog illustrating and describing superdrying equipments for extracts, logwood, fustic, gambier, etc., vegetables, fruit and foods (dehydrating), aniline dyes and pigments, papier mache forms and products, oxblood and packing house materials, drug extracts, candy, glue, silks, enamels, white lead, etc.

HERMAN A. HOLZ, New York City, is distributing a catalog entitled "The Holz Thetascope," which describes an apparatus for the reliable and convenient measurement of the characteristic "angle of contact" ("theta") between liquids and solids and is particularly useful for the determination of the "lubricating efficiency" of oils and greases based upon their adhesive forces to metal surfaces.

THE FULTON CO., Knoxville, Tenn., in a 16-page booklet illustrates and describes Sylphon temperature regulators for automatically and accurately regulating temperature of liquids.

New Companies

THE MONROE PAPER CO., Monroe, Mich., has been incorporated with a capital of $50,000, to manufacture paper specialties. The incorporators are E. A. Mitchell, Toledo, O., and Frank L. A. Mitchell, 211 South Washington St., Monroe.

STANSHOFFERS' CHEMICAL LABORATORIES, INC., Brooklyn, N. Y., care of E. A. Deutschman, 44 Court St., Brooklyn, representative, has been incorporated with a capital of $15,000, to manufacture chemical products. The incorporators are C. G. Unger, M. Kupler and M. L. Nathanson.

THE GENERAL PRODUCTS CO., 306 South Sharp St., Baltimore, Md., has been incorporated with a capital of $100,000, to manufacture laboratory glassware and other laboratory products. The incorporators are Roland R. and Edward W. Harmon, and O. R. Benson, Jr.

THE CENTURY VARNISH REMOVER CO., 3830 Indiana Ave., Chicago, Ill., has been incorporated with a capital of $25,000, to manufacture chemical and affiliated specialties. The incorporators are John Stone, P. C. Pack and Frank Tomsak.

THE BIG STONE GAP BRICK & TILE CO., INC., Big Stone Gap, Va., has been incorporated with a capital of $100,000, to manufacture brick, tile and other burned clay products. The incorporators are W. W. and J. C. Taylor, Big Stone Gap, who will act as president and secretary, respectively.

THE FIRE ZONE LUBRICATING CO., College Point, L. I., care of Guernsey & Guernsey, Jamaica, L. I., representatives, has been incorporated with a capital of $20,000, to manufacture oil products. The incorporators are T. H. Doremus, G. S. Miller and G. A. Guernsey.

THE RAPAH CHEMICAL CO., Philadelphia, Pa., has been incorporated with a capital of $110,000, to manufacture chemicals and chemical byproducts. L. H. Gerhold, 668 North 19th St., Philadelphia, is treasurer and representative.

THE SOUTHWEST TANNING CO., Springfield, Mo., has been incorporated with a capital of $100,000, to manufacture leather products. The incorporators are W. R. Wolfe, E. M. Mitchell and W. E. Ogston, all of Springfield.

THE REUTHER FOUNDRY CO., Harrison, N. J., has been incorporated with a capital of $500,000, to manufacture gray iron castings. The company will take over the foundry heretofore operated under the name of Reuther Brothers, 7th and Bergen Sts. The incorporators are Frank, Frederick and Francis Reuther.

THE KORNOFF CHEMICAL CO., 22 West Quincy St., Chicago, Ill., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. The incorporators are Morris Honorof, S. Ruthstein and George J. Teller.

THE BUCKEYE TILE CO., York, Pa., care of the Delaware Registration Trust Co., 900 Market St., Wilmington, Del., representative, has been incorporated with a capital of $650,000, under Delaware laws, to manufacture tile and other ceramic products. The incorporators are M. W. Elesser, C. J. Grove and J. C. Strayer, York.

THE MAJOR OIL & REFINING CO., Indianapolis, Ind., has been incorporated with a capital of $100,000, to manufacture refined petroleum products. The incorporators are Fred Cline, E. E. Perry and John Elliott, all of Indianapolis.

THE CHESTER BRICK CORP., Chester, Pa., has been incorporated with a capital of $50,000, to manufacture brick, tile and other burned clay products. Edward C. Burton, 415 East 13th St., Chester, is treasurer and representative.

Coming Meetings and Events

AMERICAN ASSOCIATION OF CEREAL CHEMISTS will hold its ninth annual convention at Hotel Sherman, Chicago, June 4 to 9.

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual convention in Norfolk, Va., May 7 to 9.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York.

AMERICAN FOUNDRYMEN'S ASSOCIATION will hold a meeting in Cleveland, O., April 28 to May 4.

AMERICAN GAS ASSOCIATION will hold its annual convention the week of Oct. 15 at Atlantic City. An elaborate exhibition of gas-making and gas-utilization equipment is planned.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its summer meeting June 20-23 at Wilmington, Del.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W. Va., June 7, 8 and 9.

AMERICAN OIL CHEMISTS' SOCIETY will hold its annual meeting at the Eastman Hotel, Hot Springs, Ark., April 30 and May 1.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold its spring meeting May 28 to 31 in Montreal, Canada.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

CANADIAN INSTITUTE OF CHEMISTRY will hold its annual meeting in Toronto, May 29 to 31.

ENGINEERING SECTION of the National Safety Council will hold a mid-year safety conference April 17 in the auditorium of the Western Society of Engineers.

IRON AND STEEL INSTITUTE (London) will hold its annual meeting May 10 and 11 at the House of the Institution of Civil Engineers, London, S. W. 1.

NATIONAL ASSOCIATION OF MANUFACTURERS OF THE UNITED STATES OF AMERICA will meet in annual conference May 14 to 16, inclusive, at the Waldorf-Astoria, New York City.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (NINTH) will be held in New York Sept. 17-22.

NATIONAL FOREIGN TRADE COUNCIL has postponed its annual conference from April 25, 26 and 27, to May 2, 3 and 4. It will be held in New Orleans, La.

NATIONAL LIME ASSOCIATION will hold its fifth annual convention at the Hotel Commodore, New York City, June 13 to 15.

NATIONAL SYMPOSIUM ON COLLOID CHEMISTRY will be held at the University of Wisconsin, June 12 to 15.

SOCIETY OF CHEMICAL INDUSTRY, Canadian Section, will meet in Toronto, May 29 to 31.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY FOR STEEL TREATING — Eastern sectional meeting will be held June 14 and 15, in Bethlehem, Pa.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

A PAPER INDUSTRIES EXPOSITION will be held in Grand Central Palace, New York City, during the week of April 9, 1923, by the International Exposition Co.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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Economic Statesmanship

FROM some quarters comes the comment that the preliminary report of the Committee on Business Cycles and Unemployment just off the press is merely an attempt to lock the stable door after the mare is gone. These critics are ill advised, we believe, even though in many industries unemployment has long since given way to labor shortage. The fact remains, as Secretary HOOVER points out in introducing the committee's report, that "the slumps are in the main due to wastes, extravagance, speculation, inflation, overexpansion and inefficiency in production developed during the booms." The strategic point of attack, therefore, is during a period such as the present when rising markets and rapidly expanding operations threaten to precipitate us into another trough of depression and hard times.

This report is from a committee of prominent business men and economists, appointed in September, 1921, during the President's Conference on Unemployment. For over a year it has been engaged in a most exhaustive investigation into the underlying causes of periodic business depression. Its conclusions, therefore, are of more than passing importance, even though the committee proposes no startling new remedies or economic panaceas.

The suggested measures fall into two classes—those designed for the control of excessive expansion during the boom periods and those that will reduce the extent of the subsequent decline. In the former category are the recommendations for measures which will impress the business executive with a better understanding of the business cycle. This implies a knowledge of the fundamental data of business—the intimate and complete statistics of production, stocks, consumption and employment. Stress was also laid upon checking credit expansion by the banks and the possible control of inflation by the judicious exercise of power already held by the Federal Reserve system. But of basic importance, it would seem, is the recommendation that the individual should conduct his own business so as to avoid dangerous overextension of inventories and fixed capital—the two primrose paths to business failures and unemployment. Stabilized operation on the part of all industries is, of course, the keynote of the whole program.

The committee finds several methods for breaking the fall during the decline in the business cycle. It points out that construction can act as a sort of balance wheel on the ups and downs of business. A large program of governmental and public utility construction in times of depression is a well-known remedy of recognized effectiveness, and we are now reaching a period when the opposite policy of retardation is perhaps in order. Other suggestions applying more directly to unemployment during depression refer to the use of unemployment reserve funds, and the expansion of federal, state and farm employment bureaus.

Apart from its conclusions and recommendations the report is significant in that it forms a part of a vast program of national issues that we like to place in the category of economic statesmanship. The guiding influence in this movement is Secretary HOOVER, to whom the public is indebted for his efforts to replace politics with business judgment and constructive economics.

Scrap the Obsolete

WHEN the comedy financier buys into a manufacturing concern, votes himself onto the board and into authority, he requires, first of all, something to boast about. Most of us grow vain with success, and we should not begrudge vanity in others; it is therefore natural and to be expected that such a new authority "wallah" should feel his oats and step high. The chances are that he knows practically nothing of the business and he will be quick to declare that he does not propose to address himself to "details." There is but one thing he can do besides drawing the salary that he provides for himself, and that is to cut out what he calls "dead wood." Stockholders love to hear of the elimination of expenses, because expenses inhibit dividends. Something must be cut out to enable him to announce his slogan, and if the scientific adviser does not beware, the research laboratory will be the first thing to go. Indeed, it is up to the scientific adviser to find something that he can spare without the sequel of commercial tragedy; something that the new dictator can call dead wood, and cut out to heart's content.

But there is another side to this problem that old manufacturers who know their business, and experienced technologists as well, all too often neglect for fear of the venture. This is to scrap important parts of a plant as they become antiquated. Apparatus ceases to be *perfectly* good as soon as it is improved upon. The mere fact that an apparatus functions as well as it did several years before does not suffice if something to produce a better yield or a better quality has been invented in the meantime. Soon other apparatus is likely to show the same defect, and when a whole plant is out of date it usually requires an issue of bonds to save it—provided always, first that the bonds may be sold, and second that the banking house that sells them does not want a perpetual grip on a large part of all possible profits in the future.

In one important industry in the United States the average life of a layout is from 15 to 20 years. In Germany it has been the custom to renew the same type of plant about once every 5 years.. Now, how on earth

can an old works of 20 years' standing compete with an establishment that has been renewed three times during the same span? It is out of the question. It takes both courage and understanding to scrap an apparatus that is unimpaired by wear. What to put on the scrap heap is one of the hardest decisions to make in industry. Results are likely to be fatal if ignorance enters into the discussion. It takes a real man to choose.

Apropos of this very problem let us quote a sentence from a late address on education by Dr. STEARNS of Andover before a group of newspaper and magazine editors and writers. We think it fits "It is the very abyss of error," he exclaimed, "to hold that the purpose of education is to teach boys to obey. Our business is to teach them to choose!"

"The Heathen Chinee Is Peculiar"

"WHEN I lived in China," said a companion at dinner lately, "I had very little difficulty in getting things done. That is, I had practically no more difficulty after I learned how to give instructions. This consisted in announcing what I wanted or the thing I desired done, and saying no more about it Trouble came whenever I attempted to tell a Chinaman *how* to do a thing. That invariably confused him, because in every possible way the East differs from the West. The carpenter draws his plane toward him instead of pushing it away; he draws his saw up instead of forcing it down, and the saw-teeth are adjusted to this practice; the new-born infant puts the flat of his hands up to his eyes when he cries, and not his knuckles the way our babies do; indeed every method seems to be as different from ours as it can be made to be. Tell a Chinaman what you want, and he will get it or do it for you in his own way, but do not undertake to tell him how. He is competent and practical, but also in his own way."

This brought to mind a little 94-page book, called "Inorganic Chemistry," by Z. C. DAZE, paper-covered, printed in English in China. Mr. DAZE is now teaching chemistry in his native country, but a number of years ago he was a student under Prof RALPH H. MCKEE, now of Columbia University but then stationed at the University of Maine, at Orono. It was Professor MCKEE who showed us the little books of his erstwhile pupil.

The "Inorganic Chemistry" steps right into the subject by means of a case system, very like the method of teaching law which is current at some of our universities. Standard text-books are recommended, but no reference is made to them. The first chapter deals with general principles and contains 100 questions. Anyone who can answer 100 questions correctly has the very groundwork in chemistry that we want him to have. They are for beginners, but they are fundamental. The student has no chance to learn his lesson by rote.

Let us cite a few of them to indicate this scope. "Compare," says Question 23, "the energy contents, pressure, volume and rate of molecular action of gaseous ammonia with liquid ammonia." Question 26 wants to know if balanced reactions are of any value to a chemical manufacturer. "What conditions favor him?" is asked, and "Define chemical manufacture in terms of equilibrium," is demanded. "What relative positions do silver and gold occupy in the e.m.s., and give reasons for your answer," is Question 32. Under 9, "According to Hess' law of constant heat summations does the law of mass action hold good for matter and energy as well?" And so on. Chapter II is given over to calculations, and they are fair slices out of a chemist's life. Chapter III is devoted to carbon. Then come experiments, and after that a list of remarkably good definitions.

It is an excellent book, designed for young men who are resolved to master the subject, and it is also an effective discourager to those who would like to pass for chemists without paying for the privilege in thought and work. It is cheaply printed and bound; we doubt if it sells for over a quarter in China, but it has the stuff in it.

Professor MCKEE showed us three other booklets by Mr. DAZE, printed in Chinese. These we hesitate to expound for reasons that would attack the theory of editorial omnipotence to acknowledge. They are little works on technology that sell for about 10 cents each. One is on Pigments and Lakes with references up to date of publication in 1922. Another is on Paints and Varnishes of the same year. One was the second of two volumes called Talks on Oils, dated 1920, also containing references. The two former are illustrated with drawings. The drawings are curious, but they are all right.

"The heathen Chinee is peculiar," said BRET HARTE. He is indeed peculiar. He is also intelligent and worth while. He has imagination and the gift to do things in his own way. We believe that when our Chinese neighbors get themselves established in the science and the art of chemistry, their contributions will be immense.

Patents, Patenting And Publicity

A DISCUSSION of patents and patenting with an industrial chemical engineer recently brought out several important aspects of the question. In the first place, he emphasized that he secured patents covering processes in operation in his plant for no other purpose than to prevent the unwelcome attention of pirate "inventors"—individuals or companies whose tactics indicated a disregard of professional ethics, who made it a practice to study the patent records and, when possible, to file claims for an idea that another person had evolved and put into practical operation but which was apparently not covered by existing patents. These crooks would then forbid the original inventor from operating his own process, or allow him to do so only after payment of royalty. Disorganization in industrial work that follows such reprehensible practices is deplorable; the pirate usually has no difficulty, if the court demands it, in detailing his own researches. Only a simple outline is necessary, and the secrecy usually surrounding research is used as a camouflage. Disproof of his statement is difficult.

Science in industry is on a firm foundation, however, and our informant cited more than one instance in which, after being thus deprived of its moral right to benefit from its own initiative, a company had set to work and developed an alternative process. This was promptly patented, and technical progress was not delayed.

If the story can be made to point a moral, it is that emphasis should be paid to the necessity for corporations employing technical processes to see that future

developments are not hampered by fruitless patent litigation. The importance of adequate legal protection to permit continuous use of processes and equipment that have been developed within the organization cannot be overemphasized. The fascination of scientific achievement sometimes overshadows the need for commercial caution, but it is essential that the chemical industries, especially those in process of change and development, should take advantage of the best legal talent available for their patent problems.

Classroom Specialists

IT IS truly amazing how many things a modern engineer—even a metallurgical engineer—must know, if you listen to everybody. He must first of all have a well-rounded education in order to be an ornament to society. He must know business and business law, because he should be fitted for executive positions. He must be well trained in economics, because his opinion may be asked on the desirability of competing for foreign trade, and it certainly takes an economist and an expert mathematician even to compute the values of common articles in European currency. Oh, yes, accountancy would help here.

So it is. The engineer must be littérateur, financier, business man, accountant, lawyer, economist. And the funny part of it is that eminent educators who are advocating these things in one breath are in the next bewailing the pressure brought to bear on them by neighboring factories, making spinning tops or carpet tacks, to turn out students who have specialized on the problems of manufacture of spinning tops or carpet tacks. What we need, says the manufacturer, is a carpet tack engineer. Oh, no, says the educator, what you need is a human engineer, a management engineer!

It is hard to tell which is the more absurd. Every one has met all kinds of men appropriating to themselves whatever virtue may accrue with the use of the word engineer, like "efficiency engineer," or "sales engineer," or "management engineer," or "carpet tack engineer." The other day a big van passed by with the sign "Finnerty & Glattwitz, Moving Engineers." Moving, indeed!

These thoughts lead up to the observation that the education of the metallurgist should be more on fundamentals and less on specialties. It is impossible to become a specialist by studying in college—it is even impossible to predict what specialty a student will need in after life.

We might cite the history of a good friend. Educated as an electrical engineer, he was associated for several years with a traction company, but as an avocation he investigated many problems in magneto design and operation. When the war came he enlisted in the British army, was assigned to technical service, and spent 4 years in the air service on developmental, test and instruction work. When he was in school, what crazy person would have predicted the importance of flying machines?

Then when the war was over, there appeared to be little demand for aviation experts, so he got a job with a Cleveland engineer as an ordinary draftsman. The first task given him was to work up a machine for the manufacture of automobile license tags. It would have been absolutely impossible for either the student or the instructor, during the days when that man was in school and when there were a few two-lung Cadillacs chugging about the streets, to have conceived by the wildest stretch of the imagination the day when Fords, trucks, and automobiles would be so numerous that they have to be licensed, and that by the million.

Engineering, after all, is the application of the laws of mathematics, chemistry and physics through machines and structures for the benefit of man. What more obvious, then, that a great effort should be made toward instructing the student in these laws, and, what is equally important, by well-directed experiments teaching him how these laws are applied through various machines and instrumentalities—in other words, instructed not only in the laws themselves, but given enough practice so he can use these laws as tools? If there is any spare time, let him specialize in the literature of the Italian Renaissance or the art of the early Sumerians.

One Way to Finance New Ventures

ON A main thoroughfare of the Biggest City a relative of our old friend Mr. QUICKTURN CAPITAL is doing his bit for progress and humanity. A big sign on the door in 1,000 point type shouts "RADIUM" to the passing world. "Free exhibit of radium ores" is the gist of another poster. Sure enough, there is a table and pieces of minerals thereon. After you have gazed your fill you notice a small electric train going into a tunnel and around a track to show you how the ore is brought to the surface. Next there are some pictures of the Rocky Mountains, apparently all owned by this radium company, which, you begin to realize, must be quite an organization. There follows a more modern appeal: charts. What things do we get from our ore? Lead, silver, uraninite (sic, hic or hick?), radium! Each word printed in pink and lavender to emphasize perhaps the unique property of the ore. Pink lead and lavender radium! And yet another chart which says that according to government reports railroads, industrials and other stocks bring in from 4 to 14 per cent, whereas mining stocks pay 162 per cent! Think of it! That being the end of the exhibit, we turn to go out and are faced with an imposing line of desks each bearing the nameplate of an alert, intelligent looking young man seated behind it. We could not help cursing ourselves for being suspicious of the whole thing. It was a well-conceived and interesting sales effort.

Yet even if the project is honest and the men behind it capable and trustworthy, there is a point in the ethics of such selling that is bad. If we might borrow from P. T. BARNUM, it is a "sucker" appeal which is made. It is not an effort to interest intelligent investors nor to satisfy those who do invest of the soundness of the venture. The casual passerby is lured into the store out of curiosity. A certain percentage of these will by the law of probability have money to invest. Some of them can even be persuaded by Mr. QUICKTURN CAPITAL'S cousins to part with their money by the use of meaningless technical phrases that lend an air of substantiality and by means of glowing pictures of large profits. The cupidity of the investor does not excuse the method. There is no question of legality, but of ethics. For this reason the practice will most probably continue—for it seems to be successful wherever the sky is blue.

Readers' Views and Comments

An Open Forum for Subscribers

The editors invite discussion of articles and editorials in *Chem. & Met.* or on other topics of pertinent interest

"The Modification" of Aluminum-Silicon Alloys

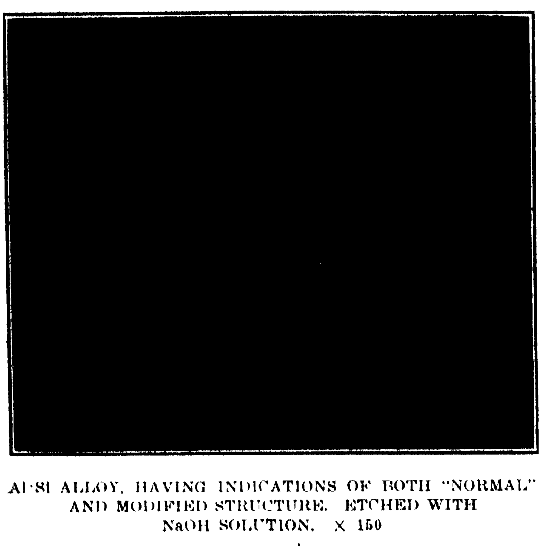
To the Editor of Chemical & Metallurgical Engineering

SIR: —In an article, "'Modification' of Aluminum-Silicon Alloys," by James J. Curran, published in *Chem. & Met.*, Aug. 23, 1922, it is stated that alloys containing from 5 to 10 per cent of silicon "may possess either one of two entirely dissimilar structures."

This opinion is concurred in by the above writer and, as stated, by the writers of three other articles. It is stated that the difference in the two dissimilar structures is due to the presence of sodium in one of them. The photomicrographs and experimental evidence given appear to bear out the above contention. However, no data were given as to the difference in physical properties produced by the addition of sodium, a deficiency supplied later by Dr. Edwards (*Chem. & Met.*, Sept. 27, 1922, p. 654).

While examining an aluminum-silicon casting the writer obtained the accompanying photomicrograph. The composition of the casting was as follows: aluminum 87.09 per cent, copper 0.18 per cent, silicon 10.68 per cent, iron 1.79 per cent, manganese 0.26 per cent. My alloy had a structure like the one described by Jeffries (April 19, 1922), containing 10 per cent silicon and 1 per cent iron, made by direct electrolytic reduction. There is seen the needle-like structure supposed to be obtained in the absence of sodium as well as the structure obtained by the introduction of sodium.

It is possible that the structure shown is a transition stage between the two "dissimilar structures." However, it is probable that the presence of sodium is not sufficient to account for the differences in structure. Small amounts of iron give a needle-like structure (Hoyt, "Metallography," Vol. II, p. 77), which might possibly account for the needles shown. However, with a structure, supposed to be due to the presence of sodium, such needles should not appear, according to Curran's article, since the sample used in his experiment contained 0.70 per cent of iron.



AL-SI ALLOY, HAVING INDICATIONS OF BOTH "NORMAL" AND MODIFIED STRUCTURE. ETCHED WITH NaOH SOLUTION. X 150

The specimen used was repolished and re-etched with NaOH solution. Each time the resulting structure was as shown.

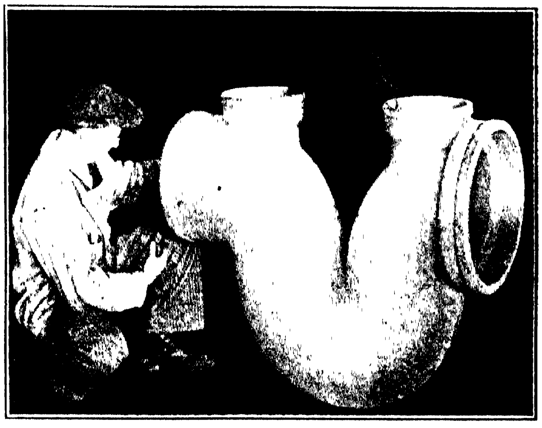
G. W. WALKER.

Chemist Hupp Motor Car Corp.
Detroit, Mich.

Mammoth Acid Drain Pipe In Yale's Sterling Laboratory

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have read with considerable interest the very excellent article that appeared in your issue of Feb. 28 on the Sterling Laboratory of Yale University, and while it may seem meticulous to point out any detail so far removed from the casual inspection of this great laboratory as the main acid drain, my attention was attracted by the statement in the article that "a drainage system has been installed entirely of chemical stoneware."



DURIRON 14-IN. RUNNING TRAP FOR STERLING LABORATORY, YALE UNIVERSITY

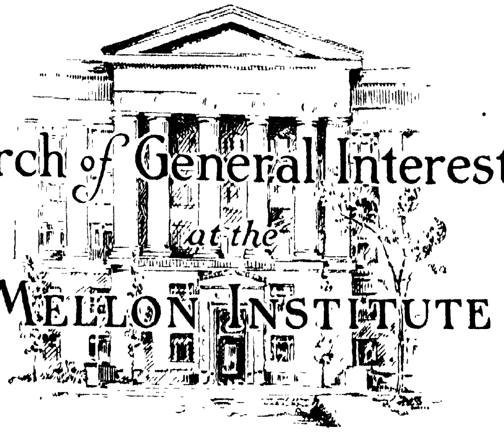
The fact that the Duriron Co. furnished the main drain pipe and fittings for the Sterling Laboratory is particularly recalled by me, inasmuch as these lines were of 10- and 14-in. size, the largest drain pipe that had been produced in Duriron at that time.

This one detail of the construction problems serves to emphasize the immensity of this building, inasmuch as the main drain pipe from an educational laboratory rarely exceeds 6 in.

The accompanying photograph of one of the Duriron 14-in. fittings will aid in visualizing the scale on which the Sterling Laboratory is built.

THE DURIRON CO., INC.
P. D. SCHENCK, President.

Dayton, Ohio.



Some Research of General Interest in Progress at the Mellon Institute

Outline of Present Status of Investigations Being Conducted in Fellowships Covering Bread, Carbon Dioxide, Coke, Corrosion, Fiber Containers, Gelatine, Insecticides, Insulation, Laundering, Magnesia Products, Mundacizing, Nickel and Monel, Refractories, Vitrified Tile, and Wood Chemicals

BY ALAN G. WIKOFF

TEN years ago the Industrial Fellowship system, formulated by Dr. Robert Kennedy Duncan in 1906, placed in experimental operation at the University of Kansas in January, 1907, and inaugurated at the University of Pittsburgh on March 1, 1911, was established on a permanent basis as the Mellon Institute of Industrial Research. During this first decade, the steady growth of the system has been attended with results of such economic importance to a variety of industries that the fame of the Institute and its work has spread throughout the technical world.

In this connection it is interesting to note that out of 350 Fellowships, 300 have been entirely successful. Of the remainder, 26 were of doubtful success, 11 unsuccessful and 13 were not completed. While in many cases the Fellowships are maintained by a company for its exclusive information, the volume of data which has been made available through publication is really surprising. Indeed, a mere enumeration of the books, bulletins, journal contributions and patents by members of the Institute during the period 1911-1922 forms a pamphlet of 37 pages.[1]

At the present time, 80 Industrial Fellows are conducting research on 50 Fellowships, covering the following subjects:

Asbestos, bread, byproduct recovery, carbon dioxide, chrysotile, cleaning, coke, corrosion, dental alloy, emulsion, flavoring, enameling, esters, fertilizer, fiber, food container, gelatine, glue, heavy chemicals, inks, insecticides, insulation, laundry, magnesia products, medicinals, metallic oxides, metal ware, natural gas, nickel, oil, organic synthesis, perfumes, pharmaceuticals, protected metals, refractories, roofing, salt, silicate, slag, smoke, steel, stove, synthetic acids, synthetic resins, textile finishing, varieties, varnish, vitrified tile and wood chemicals.

The complete list of Fellowships and personnel is given in Table I.

While it is obviously impossible to attempt to present a complete picture of current activities at the Institute, the writer feels that a résumé of some of the research in progress may serve to give a clearer conception of the workings of this great organization. At the same time he doubts whether it is possible to convey by means of the written word even a small measure of the spirit of enthusiasm and co-operation which is at once evident to the visitor at the Institute and which permeates its every undertaking.

Through the courtesy and co-operation of the executive staff and the Fellows themselves, general information regarding recent research on sixteen topics is presented in the following pages. In some cases the earlier status of the work has been outlined in a previous article by Savage.[2]

It will be noted that a number of Fellowships are maintained by associations of manufacturers. This is a phase which is becoming increasingly important, as the Institute thereby renders service to a whole group instead of to an individual, and it is possible to conduct the investigations on a more elaborate scale, because the expense is distributed. Most of the results in association research are of such a nature that they may be published without reservation. In the extension of uses for materials, a type of pioneering which is being carried out on a number of Fellowships, the concerted action which is possible through associations is very helpful.

Contact with the Institute and the Fellow is maintained as a rule by a research advisory committee appointed by the association and consisting of three or four officers of company members who are recognized specialists in the field under study. Through their co-operation, the work is planned and the Fellow supplied with necessary materials and all technological information. As in the case of all Fellowships, progress reports are made weekly to the administration. These are summarized into monthly reports for the information of the donors, followed by annual reports if the Fellowship is extended for more than one year. At the termination of the research a monograph is prepared.

[1]Copies of this list, which is Bibliographic Series, Bulletin 1, may be obtained from the Director, Mellon Institute of Industrial Research, Pittsburgh, Pa.

[2]Wallace Savage, "Industrial Research at the Mellon Institute," *Chem. & Met.*, vol. 22, p. 249, Feb. 11, 1920.

Table I—List of the Industrial Fellowships in Operation at Mellon Institute on March 1, 1923

No.	Names of Industrial Fellowships	Industrial Fellows Names and Degrees	Date of Expiration
181	Synthetic resins	C. B. Carter (Ph.D., University of North Carolina), senior fellow, A. E. Coxe (B.S., University of Chicago)	April 1, 1923
309	Glue	A. M. Howald (Ph.D., University of Pittsburgh)	April 1, 1923
324	Textile	E. R. Clark (B.A., Yale University)	May 1, 1923
326	Enameling	R. D. Cooke (M.S., University of Wisconsin)	April 1, 1923
327	Varnish	Marc Darrin (M.S., University of Washington)	May 1, 1923
328	Steel	B. B. Wescott (Ph.D., University of Pittsburgh)	June 15, 1923
329	Stove	J. F. Hansen (B.S., University of Illinois)	June 22, 1923
330	Bread	H. A. Kohman (Ph.D., University of Kansas), senior fellow, Roy Irvin (M.S., University of Kansas), E. S. Stateler (M.S., University of Pittsburgh)	June 1, 1923
331	Protected metals	J. H. Young (Ph.D., Ohio State University), senior fellow, P. D. Gephart (B.Ch.E., Ohio State University)	June 1, 1923
332	Food container	W. F. Henderson (Ph.D., University of Pittsburgh), senior fellow, H. E. Dietrich (A.B., University of Kansas)	July 12, 1923
333	Corrosion	C. R. Texter (B.S., Pennsylvania State College)	July 1, 1923
334	Gelatine	T. B. Downey (Ph.D., University of Pittsburgh)	Sept. 1, 1923
335	Ester	J. J. Fitzpatrick (B.Chem., University of Pittsburgh)	Aug. 5, 1923
336	Oil	W. F. Faragher (Ph.D., University of Kansas), senior fellow, W. A. Gruse (Ph.D., University of Wisconsin), R. W. Henry (B.S., University of Oklahoma), S. P. Marley (B.S., University of Pittsburgh)	Sept. 1, 1923
337	Metallic oxides	G. F. Seil (Ph.D., University of Pittsburgh)	Sept. 1, 1923
338	Slag	Tracy Bartholomew (E.M., Colorado School of Mines), senior fellow, H. C. Goover (A.B., Ursinus College)	Sept. 21, 1923
339	Gas	J. B. Garner (Ph.D., University of Chicago), senior fellow, Gertrude E. Price (A.B., Goucher College), assistant	Sept. 15, 1923
340	Wood chemicals	R. F. Remler (B.Chem., University of Pittsburgh)	Nov. 1, 1923
341	Perfumes	L. E. Gilson (Phar.B., University of Southern California), E. H. Balz (Ph.D., University of Pittsburgh)	Oct. 1, 1923
343	Pratt	L. H. Cretcher (Ph.D., Yale University), senior fellow, F. W. Hightower (B.A., University of Texas)	Dec. 15, 1923
344	Inks	F. F. Rupert (Ph.D., Massachusetts Institute of Technology)	Nov. 1, 1923
345	Chrysotile	Henry Joseph (Ch.E., Columbia University)	Jan. 1, 1924
346	Laundry	A. F. Shupp (Ph.D., University of Pittsburgh), senior fellow, Alice L. Wakefield, (B.S., Carnegie Institute of Technology), Mary M. Danley (B.S., Carnegie Institute of Technology)	Nov. 1, 1923
347	Emulsion flavors	Melvin DeGroote (B.Ch.E., Ohio State University)	Nov. 15, 1923
348	Heavy chemicals	E. E. Marbaker (Ph.D., University of Pennsylvania)	Dec. 1, 1923
349	Fiber	M. C. Walsh (Chem.Eng., Columbia University)	Nov. 15, 1923
350	Salt	T. E. Williams (B.S., University of Michigan)	Nov. 1, 1923
351	Nickel	O. B. J. Fraser (B.S., Queen's University), senior fellow, H. E. Searle (B.S., Queen's University)	Dec. 1, 1923
352	Silicate	J. I. Crawford (B.S., University of Illinois)	Dec. 1, 1923
353	Medicinal	C. C. Vogt (Ph.D., Ohio State University)	Jan. 1, 1924
354	Varieties	J. R. Harding (M.A., Leland Stanford University), senior fellow, F. J. Murphy (B.S., University of Pittsburgh)	Jan. 1, 1924
355	Fertilizer	H. H. Meyers (B.S., University of Pennsylvania), senior fellow, W. T. Nichols (B.Chem., University of Pittsburgh)	Jan. 5, 1924
356	Insulation	R. H. Heilman (E.E., University of Pittsburgh)	Jan. 1, 1924
357	Coke	F. W. Sperr, Jr. (B.A., Ohio State University), advisory fellow, W. J. Huff (Ph.D., Yale University), H. W. Rose (B.A., Yankton University), J. A. Shaw (B.S., Pennsylvania State College), G. G. Dosy (B.S., Worcester Polytechnic Institute)	Jan. 1, 1924
358	Byproducts	Walther Riddle (Ph.D., University of Heidelberg), H. F. Gill (Ph.D., University of Pittsburgh), assistant	Jan. 1, 1924
359	Insecticides	O. F. Hedenburg (Ph.D., University of Chicago)	Feb. 1, 1924
360	Asbestos	G. H. Katz (B.S., Ohio State University)	Feb. 1, 1924
361	Metal ware	W. G. Imhoff (M.S., University of Pittsburgh)	Feb. 16, 1924
362	Organic syntheses	J. G. Davidson (Ph.D., Columbia University), senior fellow, C. J. Herrly (B.S., Pennsylvania State College), A. R. Cade (M.S., University of Minnesota), J. T. Baldus (B.Chem., University of Pittsburgh), assistant	Jan. 1, 1924
363	Synthetic acids	R. B. Trusler (B.S., Syracuse University)	Feb. 1, 1924
364	Dental alloy	J. W. Harsch (B.S., University of Illinois)	March 1, 1924
365	Roofing	I. S. Ross (M.S., New Hampshire College)	Feb. 1, 1924
366	Refractories	M. C. Booze (B.S., University of Illinois), senior fellow, S. M. Phelps (University of Toronto), R. F. Ferguson (B.S., University of Pittsburgh), Jules Labarthe (B.S., University of California), W. R. Kerr (University of Pittsburgh), assistant	March 1, 1924
367	Magnesia products	H. W. Greider (M.S., University of Kansas)	March 1, 1924
368	Pharmaceuticals	A. W. Harvey (Ph.D., University of Pittsburgh)	March 1, 1924
369	Smoke	A. R. Powell (Ph.D., University of Illinois)	March 1, 1924
370	Vitrified tile	H. G. Schurecht (B.S., University of Illinois), senior fellow, G. R. Pole (B.S., University of Washington)	March 1, 1924
371	Vitrified tile	H. G. Schurecht (B.S., University of Illinois), senior fellow, G. R. Pole (B.S., University of Washington)	March 1, 1924
372	Cleaning	L. F. Jackson (B.S., University of Kansas), senior fellow, Helen E. Wassell (B.S., Carnegie Institute of Technology)	March 1, 1924

At present, the following Industrial Fellowships are maintained by associations of manufacturers:

Name	*Company-Members in Association*
Carbon dioxide	7
Edible gelatine	7
Fiber	25
Insecticides	5
Laundry	2066
Magnesia products	2
Metal ware	15
Mundacizing	10
Refractories	90
Stove	15
Vitrified tile	44
Wood chemicals	68

Vitaminous Bread

Henry A. Kohman, Roy Irvin and E. S. Stateler, on the Bread Fellowship, have been aiding the Ward Baking Co. laboratories in developing a bread, now on the market, which is a complete food.

By feeding tests on laboratory animals using the best white breads obtainable by the usual methods of manufacture, it was ascertained that, as exclusive articles of diet, these breads could not provide either growth or increase in body weight and that the animals under observation could not exist on bread alone. Whole wheat bread was also found deficient. With the addition of vitamines and mineral salts from wheat germ and bran, the animals under test showed improved condition and better development, although they still did not reveal normal growth. It then developed that the proteins in the bread were not properly balanced and that milk proteins were needed. Making the bread with milk instead of water and adding extra milk solids solved this particular problem. Addition of the new wheat germ extract was also necessary in order to balance the mineral salts. Indeed, the addition of many substances was tried and by eliminating all nonessentials and retaining the necessary and vital substances, the growth of the experimental animals was improved step by step.

Finally there resulted a bread on which the animals under observation grew to maturity and remained in a healthy condition. More important still, these animals were able to reproduce and rear their young, which had not been possible with previous breads. As many as six generations of animals have been raised on this new bread as the sole source of food, only city water being supplied in addition to the bread in all the concluding animal tests.

In making this new bread, which is already on the market in a number of cities, the vitamines and mineral salts recovered from the byproducts from milling wheat are restored to the white flour, and, with the additional vitamines and proteins provided by the use of rich whole milk, without any water whatever, a loaf of bread is produced which is a balanced food, complete in itself.

This work presents an almost ideal answer to the oft-repeated question, "Does research pay?" since one of the factors essential to successful research—benefit to the public as a whole—is more clearly evident than in the average instance.

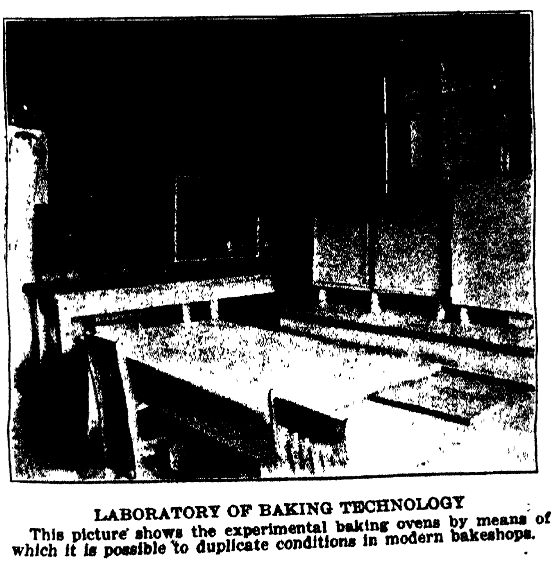
Uses for Carbon Dioxide

For the purpose of classifying, investigating and extending the uses of carbon dioxide, particularly liquid carbon dioxide, the Liquid Carbon Dioxide Division of the Compressed Gas Manufacturers' Association has established an individual Fellowship, C. L. Jones being the present incumbent. Data of unusual interest have been accumulated, some of which will be treated in more detail in an article on the uses of liquid carbon dioxide to be published in a subsequent issue. Mr. Jones is now according research attention to the use of liquid carbon dioxide in extinguishing mine and electrical fires.

Coke Fellowship

Although only five names appear under the multiple Industrial Fellowship on coke, the Koppers Co., which maintains the Fellowship, has a chemical research force which averaged about twenty members for the year 1922. F. W. Sperr, Jr., chief chemist of the Koppers Co., is senior advisory Fellow.

Owing to the wide interests of this organization, the Fellowship activities may be divided into two classes: Research problems; and necessary testing work required for the construction of byproduct coke and gas-oven plants with complete byproduct recovery, and tar-distilling and liquid purification plants. This testing work also includes the examination of coals for yield and nature of coke and byproducts, to be used as basis of plant guarantees; the examination of tars, etc.



LABORATORY OF BAKING TECHNOLOGY
This picture shows the experimental baking ovens by means of which it is possible to duplicate conditions in modern bakeshops.

In regard to the research problems, the most noticeable recent accomplishment has been the commercial development of the liquid purification process for removal of hydrogen sulphide and also hydrogen cyanide from the gas. Over twenty liquid purification plants are in operation or under construction, and the process is also being exploited in foreign countries. A plant is being started at the present time in England.

Purification of ammonia-still waste is rapidly becoming necessary for many plants and methods for carrying out this purification have been developed through research.

Another important line of investigation has been the study of coke from the standpoint of physical characteristics, with special reference to its performance in the blast furnace. Of most immediate interest is the combustibility of coke.

These three phases—gas purification, ammonia-still waste purification, and study of coke—are the most important lines of investigation in progress at the present time and work will be continued thereon during the coming year.

The investigation of new uses for byproducts from coke plants is always under consideration. This is especially true of coke-oven tar and light-oil products.

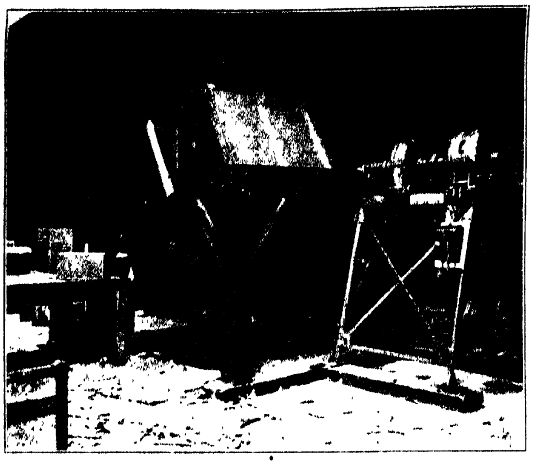
The various members of the organization have over eighty United States and foreign patents issued or favorably acted upon, covering various phases of the work. Among the research accomplishments of the past (mostly during the period of the war) are the recovery of benzene and toluene from carburetted water gas, the manufacture of coumarone and other resins, and motor fuels.

Corrosion

One of the well-known manufacturers of steel pipe is the donor of a Fellowship on corrosion, the work of which is being carried on by C. R. Texter. This Fellowship is devoted to a study of the effect of different kinds of water upon the internal corrosion of pipe lines, and of practical means for the prevention thereof. It has been found that, in natural waters, one of the most important factors influencing the corrosion of steel and iron pipes in hot water supply systems, boiler economizer tubes, etc., is the amount of oxygen carried in solution by the water. Another large factor is the chemical composition of the water itself, upon which depends the tendency of the water to form or not to form a self-healing protective film upon the surface of metal containing the water. This question is being investigated in a practical way upon as many different waters as possible.

Increasing the Service Rendered by Fiber Containers

Within recent years the partial replacement of wooden boxes and crates by fiber containers has become increasingly important. In addition to such advantages as lower first cost and reduced shipping weight, the use of the fiber products aids in conserving a natural resource which is being depleted at an alarming rate. Much of the progress toward the present highly satisfactory container is the result of investigational work



DRUM TESTER

Used in the tests made by the industrial Fellowship maintained by the Container Club, an association of manufacturers of solid and corrugated fiber boxes

conducted under the Fellowship maintained by the Container Club, an association of corrugated and solid fiber box manufacturers. Standardization and improvement of raw materials, manufacturing processes and finished products have been the aims of this work, which is at present carried out by Maurice C. Walsh.

Some of this work was summarized in the previous report.[5] For the purpose of determining resistance to handling and rough usage, there has since been installed a revolving 7-ft. hexagonal drum with various baffles, in which the containers receive in a brief period more severe treatment than would result from a transcontinental shipment. This drum has been of immense utility in determining the values of different box designs and the worth of proposed improvements and changes.

Recently a series of 500 fiber cases, consisting of 5-case lots of each product which a prominent food manufacturer packs in glass, was run in the drum tester to the point of breakage of the first bottle. Physical tests of the bottles were also made in four different ways and it was shown in a hearing before the Interstate Commerce Commission that there is no relation between the fragility of glass bottles and breakage in shipment when packed in fiber containers.

Stacking qualities of the boxes are determined by hydraulic-press tests, and it is interesting to note that fiber boxes have now been developed which will stand, when empty, a pressure of over one ton without collapsing.

Service facilities of the laboratory are available without charge to the general public for the benefit of the industry and a great deal of the work is done for shippers and manufacturers not members of the Container Club. A report on work done is made every 2 months at the meetings of the Container Club, and frequent visits are made to plants of box manufacturers and shippers, so that their problems may be studied at first hand.

Determining the Food Value of Edible Gelatine

Thorough investigation of the food value of edible gelatine is being conducted by T. B. Downey, in a Fellowship established by the Edible Gelatine Manufacturers of America, Inc. Through feeding experiments on albino rats, an effort is being made to get definite information on the real food value of gelatine as well as its supplementary action when used in conjunction with other food products. Its uses in confectionery and in ice cream present specific problems to be studied. In the case of milk it has been found that gelatine acts as a protective colloid, preventing the development of hard curds, and thus making the milk easier to digest. Gelatine functions in a similar way to make ice cream easier to digest, in addition to acting as a stabilizer. Dr. Downey has completed arrangements with medical specialists for thorough study of gelatine in infant feeding.

Enthusiastic personal interest in the progress of the work is taken by the donor of the Fellowship. It has been determined to establish and to make public the true facts as to just what gelatine does in all of its present uses and just what is its real food value.

Research and the Power Laundry

In 1914 a small group of Pittsburgh laundry owners, realizing that they were beset by technical problems beyond the comprehension of laymen and that the then recently organized Mellon Institute was equipped to solve them, established an Industrial Fellowship for the investigation of problems in laundering. About 18 months later the financial obligations were assumed by the Laundryowners National Association, making the services of the laboratory available for about 2,000 laundry members throughout the country. In the present multiple Fellowship, Dr. A. F. Shupp is assisted by Alice L. Wakefield and Mary M. Danley.

Standardization of supplies constituted the first work of the Fellowship, for many of the preparations used in the laundries were sold under trade names and it was necessary to ascertain the merit of each product. Attention was then directed to standardization of procedure, work on these two phases culminating in the publication of a "Manual of Standard Practice for the Power Laundry Washroom." In this treatise standard formulas for washing all types of fabrics are given, together with discussions of water, soap, soda and other supplies. Before making these recommendations, the possibility of disease being spread through laundries was carefully considered. Bacteriological tests showed that a treatment at least 20 minutes at a temperature between 140 and 160 deg. F. destroys all pathogenic non-spore-bearing organisms, while the dry rooms, tumblers and ironing process complete the sterilization.

During the past year the question of low-titer versus high-titer soaps has been under consideration. It has been shown that solutions of high-titer soaps exhibit lowest surface tension at about 140 deg. F., while the

VIEW IN MAIN RESEARCH LABORATORY OF THE LAUNDRYOWNERS NATIONAL ASSOCIATION

[5]See footnote 2.

corresponding temperature for low-titer soaps is around 90 deg. F. Since maximum emulsifying power obtains at the point of minimum surface tension, this would indicate that low-titer soaps should be more efficient for washing in cold or lukewarm water.

Although standard procedures have been worked out, it must be remembered that it is not possible for the laundry to standardize the goods which are sent to it. Adjustment of claims for damage is an important item in laundry management and studies of this phase soon developed the interesting fact that in many cases the fabric itself and not the laundry was at fault. While only four fibers are in general use—cotton, linen, wool and silk—improper manipulation during spinning, weaving, bleaching, dyeing, etc., often introduces defects which may not be evident until the finished goods are wet or washed, when they disintegrate or distort in a manner which would seem to indicate very rough treatment by the laundry. For instance, cloth may be finished and dried with some of the threads under greater tension than others. As long as the goods remain dry, they appear satisfactory; but when wet, the threads assume a normal tension and the piece shrinks unevenly or gets completely out of shape. Other examples were given in the previous article.

This aspect of the work has become so important that the entire time of one of the incumbents is devoted to it. It is realized that the solution of these problems lies in educating the buyers of textiles to discriminate between the well-made product of a reputable manufacturer and the clever but inferior imitation which often brings a higher price. This is an undertaking of considerable magnitude, but an excellent start has been made through the publication of a treatise on "The Conservation of Textiles," in which, for the first time, the faults of textiles are discussed in detail. It also includes a plea for a pure fabric law. The interest and co-operation of many of the larger textile mills have been secured and it is planned by the Laundry-owners National Association to carry on the campaign through distribution to the public of a series of educational leaflets covering the selection and care of textile products.

Insecticides

As noted in the previous article,[4] important research on the manufacture of lead arsenate and calcium arsenate has been conducted by Dr. Oscar F. Hedenburg, Industrial Fellow for the Rex Spray Companies, an association of manufacturers of insecticides of all types. More recently there has been developed through this research work a new and valuable household insecticide which is very effective against flies, mosquitoes, moths and other insect pests. This new material, "Fly-Tox," is a clear, amber-colored liquid of a pleasing odor and is applied by spraying.

[4]See footnote 2

Heat Insulation

Until the present Industrial Fellowship year the work on heat insulation was supported by the Magnesia Association of America. By special arrangement the association gave permission to the present donor—an individual manufacturer of heat-insulating materials—to subsidize the investigations.

At the present time, R. H. Heilman is conducting a series of tests for the purpose of determining the merits of insulations for superheated steam and of developing new coverings to keep pace with the growing demand for higher pressures and superheat.

The electrical method of testing is employed in the laboratory and pipes of various sizes are used in order to derive formulas whereby the losses from pipes of any size and operating under any condition of steam pressure can be readily and accurately calculated.




EXECUTIVE STAFF

Edward R. Weidlein — William A. Hamor — E. Ward Tillotson — Harry S. Coleman

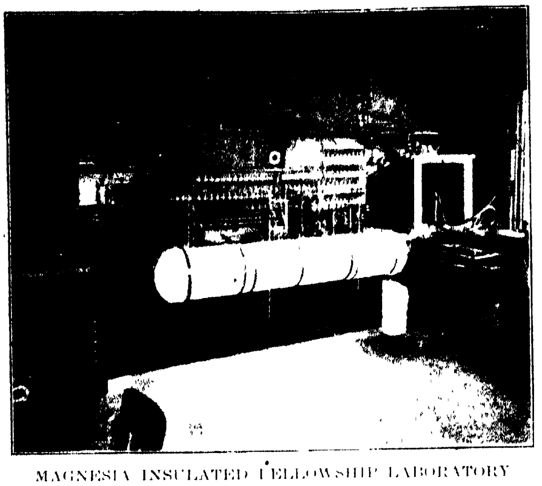
Many tests are being conducted in the laboratory to determine the thermal conductivity of various insulations and the laboratory tests are frequently checked by field tests, so as to obtain not only the thermal efficiency of the coverings but also their practicability as heat insulators under actual operating conditions.

For a paper entitled "Heat Losses From Bare and Covered Wrought Iron Pipe at Temperatures up to 800 Deg. F.,"[5] presented before the American Society of Mechanical Engineers in 1922, Mr. Heilman was awarded one of the society's junior prizes.

New Uses for Light Magnesium Carbonate

Light magnesium carbonate, the chemically precipitated basic hydrated carbonate of magnesium, possesses properties which would indicate the possibility of extending some of the present applications and of developing new ones, while modification of certain physical properties would make it better adapted for

[5]Abstracted in *Chem. & Met.*, vol. 27, p. 63, July 12, 1922. *Mechanical Engineering*, vol. 44, p. 435, July, 1922.



MAGNESIA INSULATED FELLOWSHIP LABORATORY

many uses. This, in brief, is the purpose of the magnesia products Fellowship, maintained by two prominent manufacturers of this material.

Convinced by a preliminary survey that the rubber industry afforded one of the most promising fields, H. W. Greider made a study of some physical properties of rubber compounded with light magnesium carbonate and with other pigments. The magnesium carbonate was found to act as a typical reinforcing pigment, increasing the tensile strength, hardness, stiffness and resilient-energy capacity of the compounded rubber. Only gas black exceeds it in reinforcing power. However, owing to the crystalline character of the present product, it tends to give a high permanent set, which is not generally desired. Work in progress includes a study of particle size with the object of increasing the uniformity while decreasing the size of the particles and also of increasing the ease of dispersion in rubber and other materials in which it is used as a filler.

Abrasion resistance is another property of vulcanized rubber which has received careful attention. In this connection it is interesting to note that the eminent English authority Dr. Philip Schidrowitz, commenting in the *India Rubber Journal** on Mr. Greider's report entitled "The Resilient Energy and Abrasion Resistance of Vulcanized Rubber," says that as a whole it "is a notable contribution to the literature of the subject."

Reducing Losses in Galvanizing

Many problems of economic importance to the galvanizing industry are being studied by Wallace G. Imhoff on the Fellowship maintained by a group of sheet metal ware manufacturers. The work is planned to aid the industry in producing goods of higher quality and also in developing economies in practice.

The principal loss of zinc in galvanizing results from the formation of dross, zinc ashes or sal ammoniac flux skimmings. Any reduction which can be made in this loss will have a direct effect upon the cost of production. When, for example, it is considered that every 5 lb. of iron that enters the bath will render unavailable 95 lb. of zinc, the importance of the possible savings will be readily appreciated.

Spent pickle is another byproduct that is receiving attention, with a view to possible recovery or utilization. The whole subject of pickling has been studied systematically in order to determine the pickling time and the method of handling which will give the maximum efficiency for different classes of ware.

Similar studies on the galvanizing operation itself have been conducted to develop the best coating for the purpose intended; in other words, to get the right coating in the right place.

Engineering recommendations covering such topics as most economical design for galvanizing plants, comparative values of different fuels, and kettle design also form an important part of the service which is being rendered by this Fellowship.

Mundacizing

For several years a multiple Industrial Fellowship on dry cleaning has been maintained by the International Technical Society of Cleaners and Dyers, an organization of nine of the largest and most progressive firms in the business. Recently it was desired to adopt a name which would better express the action of cleaning both dry and wet, and at the suggestion of W. A. Hamor, the Latin *mundo*, to rehabilitate, was chosen as the root for a series of new terms. Thus, the society becomes the Mundatechnical Society of America, the technical men in the industry are mundatechnologists, the master cleaners are mundicians, the operation of cleaning will be known as mundacizing, etc. Cleaning is thus differentiated from laundering.

Lloyd E. Jackson and Helen E. Wassell have obtained some very interesting results in studying the problems confronting the cleaning or mundacizing industry. As in the case of the laundry work, it was first necessary to establish specifications for dry-cleaners' soap, cleaners' naphtha and benzol. Motor gasoline is not satisfactory, as the light portions result in high evaporation loss, high-boiling fractions remain in the goods, and unsaturates give odors difficult to remove.

In a plant of any size the investment in gasoline or benzol is a considerable item, and the recovery of the solvents in a condition for re-use is consequently a problem of importance. It can be accomplished by distillation, of course, but work in progress on this Fellowship indicates the possibility of economically removing dirt and color by suitable chemical treatment.

Rendering garments mothproof at the same time that they are mundated is another phase of the investigations which offers attractive possibilities. It has already been determined that mundacizing is very efficient in destroying bacteria and larvæ.

Since gasoline or benzol is the only solvent used, there are frequently found on mundacized garments stains which require for their removal treatment with other solvents or agents. Many special problems arise and the laboratory is frequently consulted regarding the best procedures for removing particularly obstinate spots and for renovating unusual goods.

Nickel and Monel Metal

Certain mysterious failures of Monel metal tie-rods, pins, etc., in pickling tanks led to the establishment of a multiple Fellowship for the purpose of investigating the cause. Corrosion was found to be the result of a concentration-cell effect set up between points at which the pickle had penetrated the wood and was in contact with the metal as a stagnant solution and other points where the metal was exposed to a free wash of solution, as at cracks. The subject of atmospheric corrosion was next taken up, and this is being continued

*Vol 64, page 845, Nov 18, 1922.

by the present incumbents, O. B. J. Fraser and H. E. Searle. Projected uses for both Monel and nickel are also being studied. Pickling equipment, valves in superheated steam lines, dyeing, laundry and dairy machinery, hospital equipment, equipment for cafeterias and restaurants, meat slicers, drying screens for glue and gelatine, filter cloth and a variety of chemical engineering apparatus may be mentioned as some of the typical uses for Monel. Plugs for Burton-process stills are being made from cast Monel.

Refractories

The matter of tests for refractory materials and products has been the basis of a considerable portion of the work carried on at the Mellon Institute of Industrial Research by the multiple Fellowship established by the Refractories Manufacturers Association.

The test for spalling or disintegration under abrupt temperature changes has required the accumulation of a large amount of data, in order that the test, as finally used, may be applicable in a practical way.

A new test for determining the action of various slags or fluxes upon refractories has been evolved. This in conjunction with tests previously in use makes possible the obtaining of definite results.

A furnace has been developed for the hot crushing of highly refractory specimens, in which very high temperatures may be maintained while the specimens are under extreme loads. Four tests may be run at one time. It has proved to be valuable in the development of bonds for chromium and magnesite refractories and in research on silica brick.

All other standard tests are made upon refractories in addition to those named, many of them being made in such large number that excellent practice has been established.

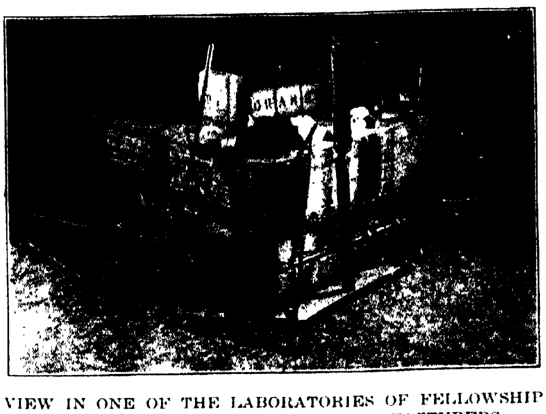
Special tests have been applied from time to time for comparative purposes. These have been particularly valuable in the accumulation of data on the unstudied physical and chemical properties of refractories.

The application of these tests has resulted in a decided improvement in the quality of refractory products. The manufacturers have recognized the value of work carried on in a well-organized laboratory and have employed it very fully in control of the quality of their products as well as in the development of new products and in the bettering of their manufacturing methods.

The true value of such work to the manufacturers and consumers of refractories can be appreciated only when it is realized that the product is ordinarily made from naturally occurring materials which are heterogeneous mixtures and often vary to the extreme. Without control tests, a deficiency in the product is not recognized until failure occurs in a furnace wall.

A number of failures of refractories have been investigated and the data gathered have led to better practice in furnace construction. A notable example is the investigation of various refractory cements on the market. This has resulted in an educational campaign against the use of cements of poor quality and has produced gratifying results.

With the development of tests covering the various properties of refractories has come the tendency to specialize. It is no longer common for a manufacturer to supply one or two classes of product for a great variety of uses. On the contrary, the particular requirements of a consumer are now met by a product designed to meet his needs. The economies of such practice are readily apparent.



VIEW IN ONE OF THE LABORATORIES OF FELLOWSHIP SUPPORTED BY METAL WARE MANUFACTURERS

This picture shows an experimental gas-fired galvanizing kettle in which all the operations of galvanizing are duplicated on a small scale. This is a typical illustration of hot galvanizing, or pot galvanizing.

Problems in the Manufacture of Vitrified Tile

Two associations of manufacturers of vitrified tile, the Clay Products Association and the Eastern Clay Products Association, jointly maintain a multiple Fellowship for the purpose of improving their product. Problems at present under investigation by H. G. Schurecht and G. R. Pole fall into three groups: Removal of iron-bearing minerals from the clays; glazing, and heat distribution in kilns.

Iron produces small dark lumps on the surface of the tile, so that a rough surface is presented by the interior of the pipe instead of the desired smooth finish. Elimination of iron will also reduce manufacturing losses and improve the appearance and glaze of the ware.

Relation between composition of clays and their ability to take salt glaze has been established by making a series of clay test-bars with variable amounts of the constituent under study. These were then fired and salt-glazed along with regular ware in a commercial kiln. A highly siliceous lime-free body seems to give the best results. The work is being extended to determine the influence of magnesium, potassium and sodium.

Since more uniform strength of ware as well as economy in fuel would result from more even distribution of heat in the kilns, a study of this factor is being undertaken for the various types of kiln and designs of flues in common use.

That such a commonplace commodity as drain tile should present problems for research quite as attractive as any in more highly developed fields may come as a surprise to many, but it is a fact that it has been found to be rich in opportunities of economic importance.

Extending the Uses for Wood Chemicals

About sixty-eight companies, manufacturers of methanol, calcium acetate and charcoal, comprising the National Wood Chemical Association, maintain a Fellowship, on which R. F. Remler has been studying the commercial applications of acetone and methanol.

During the past year Mr. Remler completed an investigation of the solvent properties of acetone. Solubility data were obtained for the following classes of materials: Oils, fats and greases, mineral lubricating oils; asphalts and bitumens; essential oils; rosin, copal

resins, coumarone resins; water gums; shellacs; waxes; cellulose acetate and cellulose nitrate. These results show its efficiency as an industrial solvent. Owing to the low boiling point, when used for extraction purposes the fuel cost is low and there is less danger of decomposing the final product than when higher boiling-point solvents are employed. Frequently, where used as a lacquer or varnish solvent, the vapors of acetone can be recovered by absorption, followed by fractional distillation. Acetone is less flammable than benzene, toluene ethyl ether, petroleum ether, gasoline or pentane. It is completely miscible with water and with many other solvents. A homogeneous liquid can be produced in some instances by the addition of a small amount of acetone to two immiscible solvents.

Work has also been done on acetone as a motor fuel. Some of the results may be summarized as follows:

Acetone alone is an excellent fuel, easy to start, does not freeze at the coldest winter temperature, and will not detonate under 180-lb pressure. It is not only miscible in all proportions with the various fuels used in motor cars, but produces a uniform mixture where added in various amounts to a number of immiscible liquids. Where added in small amounts to high-hydrocarbon fuels, it minimizes the deposition of carbon and prevents "fuel knocks." Acetone is the most economical solvent for acetylene, and, if saturated with this gas and added to composite motor fuels, produces a smoother running mixture, facilitates starting, and permits operating on a leaner mixture.

A study of the action of acetone and methanol on various metals is now in progress.

Mr. Render is prepared to serve as a clearing house of general information concerning products of wood distillation and to furnish advice regarding industrial applications of acetone, methanol, and acetic acid. He has collected all facts reported in the literature and this information is available to anyone interested in the subject.

Hazards in Gas Compression

Temperature Control Through Proper Lubrication and Cooling Is Essential—Different Gases Require Special Precautions

APPLICATION of the principles of safety engineering to problems of gas compression is discussed by A. D. Risteen in the April, 1923, number of *Mechanical Engineering*.

The outstanding factor in safe compression is temperature. This must be carefully controlled in the case of every gas through proper lubrication of the cylinder of the compressor and by cooling this cylinder by proper circulation of cold water in the jacket. Intercoolers in cases where several stages are employed are likewise essential.

For explosive gases such as hydrogen, valves on the compressor should be locked to prevent leakage. The precaution of removing every possible source of ignition is general. Wiring should be inclosed, switches and fuses placed at a distance; all bulbs should be inclosed in vapor-proof globes; no motors should be running in proximity to any place where gas may escape. Ample ventilation of rooms where gas is handled is of the utmost importance. Ease of exit must also be provided. In the cases of various common gases certain specific precautions become necessary.

In compressing air, water rather than oil should be used as a lubricant wherever high pressures are to be obtained. If oil is used on lower stages, the quantity and quality must be very carefully regulated. Removal of excess oil accumulated in receiver, piping or discharge valves must be provided for.

Oxygen must be absolutely free from combustible impurities at the time of compression and must be stored in strictly clean containers. Presence of grease, oil, organic dirt or red lead involves an extreme hazard. Water must be used in lubricating compressor.

Explosion through leakage is the chief danger in handling hydrogen. Admixture of oxygen makes the gas very unstable. Small amounts of oxygen may be removed by palladium pumice.

Nitrogen, argon, carbon dioxide and similar inert gases require comparatively few precautions. The toxic effect of CO_2 must be guarded against. Usually N is required free from hydrocarbons. This requires water lubrication.

Common Gases Cause Trouble

Chlorine is easy to see and its odor is readily recognized. Cooling caused by expansion of the gas in case of an explosion causes so much chilling that gas is dispersed only slowly. To prevent corrosion of containers, this gas must be absolutely dry. This drying may be effected in towers packed with pumice wet with concentrated sulphuric acid. The chief difficulty in compression is maintenance of gas-tight apparatus. Special packings of alternate hard and soft rings may be used. Compressed chlorine should be stored in clean cylinders to avoid hazard of chemical combination with foreign substances which might be present.

Since heat is absorbed when acetylene is formed, this gas is unstable under many conditions. The piston should move at low speed to avoid heating, and several stages should be employed. Apparently acetylene becomes unstable on standing, especially at high pressures. This gas should not be stored in an otherwise empty cylinder at a pressure over 30 lb. per sq.in. absolute. To store acetylene safely the compressed gas is dissolved in acetone. Cylinders used for this gas must never be used for any other purpose.

Ammonia Forms Explosive Mixtures

Contrary to the usual assumption that ammonia gas is not explosive, it has been found that an air mixture containing 16 to 27 per cent ammonia can be exploded. For this reason arc lights or other means of ignition should be guarded against wherever the concentration of ammonia gas may build up. Because of its solubility in water, a sprinkler system is recommended as a means of reducing its effect in case of an emergency. The compression of ammonia involves another source of danger. If the gas is allowed to become unduly hot during the process, a readily combustible gas is formed. Decomposed oil presumably forms part of this gas. The ammonia itself dissociates somewhat into its components. To avoid the danger of explosion during compression it is necessary to use a special lubricant and to keep the gas cool during the process.

A safety valve on compressing apparatus is recommended as a means of relief in case of trouble. To avoid danger of release of gas into surrounding atmosphere it is recommended that the safety valve discharge be into the low-pressure main or outside the building.

Distribution of Sulphur in Petroleum Products*

Particularly With Reference to the Primary Products Resulting From Cracking Distillation of a Hydrocarbon Oil—Found to Be Closely Analogous to Distribution of Nitrogen in Destructive Distillation of Shale Oil

BY GUSTAV EGLOFF AND JACQUE C. MORRELL
Research Laboratories, Universal Oil Products Co., Chicago, Ill.

CRUDE petroleum and the commercial cuts distilled from this substance as a general rule contain some sulphur. The forms into which this sulphur occurs may be briefly summed up as follows:

(a) Free sulphur.

(b) Hydrogen sulphide.

(c) Organic sulphur compounds.

Separation and identity of the last-named class of compounds is a very difficult problem. However, the following classes of compounds have been found in crude petroleum or its distillates:

Thiophenes[1], hydrothiophenes[2], sulphonic acids, alkyl sulphates[3], alkyl sulphides or thioethers[4], and mercaptans, or alkyl hydrosulphides[5]. The last two classes of compounds can be looked upon structurally as hydrogen sulphide or hydrosulphuric acid, in which either both hydrogens or one hydrogen has been replaced by alkyl groups.

SOME OF ITS DELETERIOUS EFFECTS

The presence of sulphur in the various commercial cuts of petroleum has a marked bearing upon the use to which these products may be put. In gasoline or motor fuel the presence of sulphur, either in the elementary form or as certain of its compounds, affects the metallic parts of the internal combustion engine in such a way as to cause serious damage, especially where the percentage is very high. In burning oils, such as kerosene, the presence of sulphur compounds beyond a certain limit is objectionable because of the bad odors produced by the use of these oils. Lubricating oils containing a high percentage of sulphur are also apt to have their usefulness impaired by the presence of sulphur or its compounds which might cause corrosive action.

In the cracking of various types of oil for the production of gasoline, the problem of the distribution of sulphur in the primary products of cracking is a very important one. The use of a charging stock with a high content of sulphur is apt to give a motor fuel which may defy treatment for the removal of sulphur compounds or the reduction of the amount present.

No work as yet has been published upon the distribution of sulphur in such cracked products, and it is with this end in view that this investigation is undertaken.

Beilby[7] has carried out some very interesting experiments with regard to the distribution of nitrogen in the various products resulting from the destructive distillation of nitrogenous organic material. He finds that albumin, gelatine and corresponding vegetable matter yield on thermal distillation: (1) ammonia, (2) oil rich in alkaloidal bodies, (3) carbonaceous residue containing a large proportion of the original nitrogen.

When more or less altered deposits of peat, coal, shale, etc., are distilled, a similar redistribution of the nitrogen takes place. A distribution of the nitrogen in shale is shown after distillation as follows:

	Per Cent of Nitrogen
Ammonia and water distillate	17.0
Oils as alkaloidal tar	20.4
Coke residue	62.6

Beilby showed that the nitrogen in the shale upon retorting distributes itself with a higher percentage in the higher boiling point fractions, reaching a maximum in the residue. Further redistillation of the tar into ten fractions also indicates a distribution of nitrogen as shown above—that is, higher percentages in the higher boiling point fractions, reaching a maximum in the residue. The formation of ammonia is a function of the conditions of temperature, time, retort and other factors. Slow distillation results in a decomposition of the alkaloids, producing more ammonia. For example, the total nitrogen in the shale was 0.7 per cent and redistribution took place in the following manner, calculating on a basis of total nitrogen as 100:

	Per Cent of Nitrogen
Ammonia (in water distillate)	32.8
Alkaloids (in oil)	20.0
Coke (N_2)	45.7
Loss	1.5

The work of Bielby indicates, therefore, that the nitrogen present in the original bituminous material increases in the latter fractions during retorting, reaching a maximum in the residue, and furthermore that during distillation of the shale only the more volatile alkaloids come off, and that the residue still contains the less volatile or pitchy nitrogenous bodies. It is probable that there is a series of unbroken continuity from the volatile alkaloids up to pitchy or cokelike nitrogenous bodies.

Perkins[8] has shown that, in working with an American and a Canadian crude oil, when distilled under atmospheric pressure, the percentage of sulphur increases as a function of increasing boiling point fractions. Some of his results are summarized in Table I.

It may be mentioned here that the finding of the present investigation regarding the distribution of sulphur in the primary products from the cracking of oils is closely analogous to the work of Beilby, with regard

[1]Edeleanu and Filiti, *Bull. Soc. Chem.*, *Series* 3, vol. 23, p. 384 (1900)

[2]Mabery, *J. Soc. Chem., Ind.*, vol. 19, p. 508 (1900)

[3]*Veith Dingl. Pol. J.*, vol. 277, p. 567 (1890)

[4]Heusler and Dennstedt, *Z. angew. Chem.*, vol. 17, p. 264 (1904)

[5]Mabery and Smith, *Am. Chem. J.*, vol. 13, p. 232 (1888).

[6]Höfer, "Erdöl," 2nd Edition, p. 82 (1906).

[7]*J. Soc. Chem. Ind.*, vol. 3, p. 216, (1884). See also Morrell and Egloff, *Chem. & Met.*, vol. 19, No. 2, pp. 90-96.

[8]*J. Inst. Petroleum Tech.*, vol. 3, p. 239 (1917)

TABLE I—SULPHUR CONTENT OF FRACTIONS OF AN AMERICAN CRUDE OIL, ORIGINALLY CONTAINING 0 727 PER CENT S

Fraction, Deg C	Per Cent of Sulphur	Specific Gravity
To 90	0 02	
110 150	0 10	0 7282
152 220	0 38	0 7669
220 257	0 41	0 7940
257 300	0 37	0 8138
300 350	0 37	0 8242
Residue	0 54	0 8976

to the distribution of nitrogen in the destructive distillation of organic bodies containing nitrogen.

The starting materials in this work were the primary products resulting from the cracking of a Mexican gas oil by the continuous liquid-gas phase process covered by the Dubbs patents. The quantity of oil operated upon and that of the primary products is shown in Table II and the principal characteristics of these materials will be found in Table III.

The oil was cracked under a pressure of 120 lb. with a liquid transfer temperature of 800 deg. F.

Methods of Determining Sulphur

A great variety of analytical methods exist for the determination of sulphur in petroleum products. Each of these methods has its particular virtues and drawbacks. Although in general by most of the methods reasonable checks may be obtained, the variation in results using different methods is very great.

With the exception of the determination of sulphur in the uncondensible gas the four methods used in the present investigation were as follows:

(1) The lamp method for the determination of sulphur in pressure distillate.

(2) Nitric acid oxidation method, usually known as the Rothe method.

(3) Sodium peroxide bomb method

(4) The oxygen bomb calorimeter method.

In the determination of the sulphur in the uncondensible gases the usual procedure of determining hydrogen sulphide and carbon dioxide was carried out. A modification of the Burrell apparatus for gas analysis was used, the amount of gas absorbed in sodium hydroxide being taken as the sum of the percentage volumes of carbon dioxide and hydrogen sulphide. The sum of these substances averaged 8 0 per cent. The average carbon-dioxide percentages in a large number of analyses of the uncondensible gas from various types of charging stocks containing no hydrogen sulphide was less than 1 per cent. This would give by difference a volume of hydrogen sulphide equal to 7.0 per cent.

The percentage of hydrogen sulphide given above is only an estimate, although the probable error is very small. However, in order to obtain the true percentage a method was devised whereby the gases were drawn through an absorption bulb containing a solution of approximately normal cadmium chloride. The hydrogen sulphide was absorbed by this solution, with the resulting precipitation of cadmium sulphide. The increase in weight of the bulb is assumed to be the weight of the

TABLE II—MATERIAL AND PRODUCTS INVESTIGATED

	Quantity	Bé Gr	Sp Gr	Weight of Total In Lb
Charging Stock				
Mexican gas oil	1,966 bbl	26 2	0 8973	617,225
Pressure distillate	1,004 bbl	44 8	0 8026	289,609
Residuum	855 bbl	17 4	0 9503	284,299
Coke	6 795 lb		1 27	6,795
Gas	368,900 cu ft (corrected to 0 Deg C and 760 mm)		0 887 (air as standard)	

TABLE III—GENERAL ANALYSIS OF MATERIALS UNDER CONSIDERATION

Mexican Gas Oil

Bé gr	26 2 deg	Sp gr	0 8973
Fired	1 45 p.m over 2 05 p m	Time to distill	2 hr 55 min.
Initial b p	363 End point (90 per cent) 710 deg F	Range	347 deg F
		Color before	Black
Charge	800 cc	Color after	Yellow
Flash	210 deg Cleveland	Universal Saybolt Viscosity 100 deg F	50 sec
Fire	240 deg open cup		

Condenser Running Water to Dry

Per Cent Over	Temp, Deg F	Bé Gr (In Deg)	Remarks
10	479	38 0	1 5 per cent at 410 deg F
20	513	34 1	0 35 per cent water
30	542	31 2	0 4 per cent loss
40	571	29 1	
50	591	27 4	Sulphur, 3 11 per cent
60	620	26 2	
70	658	24 7	
80	686	23 7	
90	710	24 1	
98	690	19 4	

Pressure Distillate From Mexican Gas Oil

Bé gr	44 8 deg	Time to distill	3 hr 4 min
Fired	1 58 p m over 2 a m	Range	338 deg
Initial b p	88 End point 426	Color before	Yellow
Charge	1,000 cc		

Condenser 57 Deg

Per Cent Over	Temp., Deg F	Bé Gr (In Deg)	Sp Gr	Remarks
2½	122	87 7	0 643	Off color at 158 deg
5	134	84 4	0 653	
7½	158	80 2	0 666	410 Deg F cut
10	188	72 9	0 690	52 5 per cent 54 2 gasoline
12½	216	66 9	0 711	46 1 per cent 31 8 gas oil
15	233	62 0	0 729	1 4 per cent loss
17½	256	58 9	0 741	Initial b p , 126 End point 422 deg
20	263	56 7	0 750	424 cut
22½	282	54 7	0 758	57 8 per cent 58 1 gasoline
25	296	52 5	0 767	40 8 per cent 31 3 gas oil
27½	310	50 6	0 775	1 4 per cent loss
30	323	49 0	0 782	Initial b p , 120 deg F
32½	334	47 4	0 789	End point, 437 deg
35	348	46 1	0 795	
37½	354	45 4	0 798	
40	367	44 1	0 804	
42½	375	42 4	0 812	
45	386	41 6	0 816	
47½	395	40 5	0 821	
50	400	39 9	0 824	
52 5	410	38 9	0 829	
55	418	38 3	0 832	
57 5	425	37 5	0 836	
57 8	426			

Cracked Residuum From Mexican Gas Oil

Bé gr	17 4	Cold test	—45 deg F
Fired	2 06 p m over 2 11 p m	Time to distill	24 min
Initial b p	382 deg End point, 775 deg	Range	43 deg F
		Color before	Black
Charge	100 cc	Color after	Brown
Flash	190 deg	Universal Saybolt viscosity 100 deg F	66 sec
Fire	270 deg		

Per Cent Over	Temp , Deg F	Remarks
5	487	0 5 per cent at 410 deg
10	510	
15	524	5 3 per cent coke
20	545	
25	557	0 2 per cent loss
30	569	
35	580	Conradson carbon
40	595	Residue 4 1 per cent
45	605	
50	620	
55	638	
60	655	
65	680	
70	695	
75	720	
80	741	
85	760	
94 5	775	

Gas Analysis of Uncondensible Gas

	Per Cent
Carbon dioxide + hydrogen sulphide	7 8
Unsaturated hydrocarbons	8 0
Oxygen	0 1
Carbon monoxide	0 3
Hydrogen	2 3
Saturated hydrocarbons (by difference)	81 5
Specific gravity (air = 1)	0 887

Coke

	Per Cent
Soluble in carbon bisulphide	27 4
Ash	0 93

TABLE V—PERCENTAGE DISTRIBUTION OF SULPHUR IN THE PRIMARY PRODUCTS ON A BASIS OF TOTAL SULPHUR PRESENT

	Sodium Peroxide Bomb Method Wt in Lb	Sodium Peroxide Bomb Method Per Cent	Oxygen Bomb Calorimeter Method Wt in Lb	Oxygen Bomb Calorimeter Method Per Cent
Total weight of sulphur in products	18,862	100	17,586	100
Coke	370	1 96	355	2 01
Residuum	12,168	64 51	10,917	62 08
Pressure distillate	4,055	21 49	4,055	23 05
Gas	2,269	12 02	2,269	12 90
Total		99 98	..	100 04

TABLE IV—DISTRIBUTION OF SULPHUR ON THE BASIS OF PERCENTAGE IN THE PRIMARY PRODUCTS

	Nitric Acid Oxidation Method		Sodium Peroxide Bomb Method		Oxygen Bomb Calorimeter Method		
	Per Cent of Sulphur by Wt	Total Wt of Sulphur in Lb.	Per Cent of Sulphur by Wt	Total Wt of Sulphur in Lb.	Per Cent of Sulphur by Wt	Total Wt. of Sulphur in Lb.	Wt of Total In Lb.
Raw oil (Lamp method of analysis in all oils)	2 19	13,517	3 11	19,196	2 90	17,899	617,225
Pressure distillate	1 40	4,055	1 40	4,055	1 40	4,055	289,609
Residuum	2 95	8,387	4 28	12,168	3 84	10,917	284,299
Coke	4 48	304	5 45	370	5 22	355	6,795
Gas (cadmium chloride absorption analysis)	8 5	2,269	8 5	2,269	8 5	2,269	26,420
Total weight of sulphur in primary products		15,035		18,862		17,586	
Difference in per cent of sulphur in raw oil and in primary products		+10 9		—1 6		-1 7	

hydrogen sulphide in the gas. The change of volume is also noted. In actual practice two Wetzel bulbs in series were used as absorption vessels in order to insure complete absorption. The volume of hydrogen sulphide in the gas as calculated from the determination by this method is 6.8 per cent, which checks very closely the above approximated amount. Under the circumstances it seems that very little if any absorption of the carbon dioxide takes place.

It is to be noted here that for very small amounts of hydrogen sulphide in gases the method making use of absorption in a solution of iodine and back titration with sodium thiosulphate is in all probability the most accurate.

Discussion of Methods

There is no doubt that the results as obtained by the oxygen bomb and the sodium peroxide bomb method give consistent results, as well as results which are of the same order of magnitude. The oxygen bomb method is preferable from the viewpoint of accuracy, since a cleaner precipitate is obtained.

The results obtained by oxidation with nitric acid are not favorable to the use of that method. Comparison of the sum total of sulphur in the primary products with that of the raw oil would seem to indicate losses in the latter, probably by volatilization during digestion of the oil with the acid.

In a critical examination of the data it must be recalled that the operations of measuring large quantities of liquids, gases and solids by meter, gage or scales are a function of the final comparisons as well as the analytical methods. There is also to be considered the possibility of some sulphur reacting with the metal parts of the system.

Conclusions

From the results set forth in Tables IV and V it should be pointed out that on a basis of the actual percentages of sulphur in the primary products of cracking hydrocarbon oils, the content of sulphur increases with the density of the liquid and solid products, but is higher in the gas than in any of the products. This is very closely analogous to the distribution of nitrogen in the destructive distillation of oil shale.

On a percentage basis with regard to the total amount of sulphur present the analogy does not hold for the coke, owing principally to the relatively low percentage of this product, although there is an increase in the percentage of sulphur with increasing density for the liquid and gaseous products when calculated on this basis.

Increase in Output of Aluminum for 1922

The value of the new aluminum produced in the United States during 1922 is reported as $13,622,000, an increase of about 25 per cent over the value in 1921. During the first half of the year domestic aluminum was quoted at 20 cents a pound for 99 per cent grade. In August the price rose slightly and on the passage of the tariff act rose to 23 cents a pound, where it remained during the rest of the year.

Exports of aluminum from the United States during 1922 included 1,538,079 lb. of ingot and scrap aluminum and alloys containing aluminum, 2,808,946 lb. of plates, sheets, bars, strips and rods and 4,548,939 lb. of manufactured articles, which represents a very large increase over the amount exported during the previous year. Imports, on the other hand, also increased to 31,482,983 lb. during the early part of 1922, as compared to 26,177,852 lb. for the corresponding period in 1921. This includes aluminum in crude form, scrap and alloys of any kind in which aluminum is the material of chief value.

Electrically Sintered Magnesite

Electrically sintered magnesite, a material having the highest melting point of any commercial refractory, is now being produced in quantity by the Carborundum Co. It is made from carefully selected California magnesite and is thoroughly fused in an electric furnace. It contains about 95 per cent MgO and less than 1 per cent of iron oxide and has a melting point of about 2,600 deg. C.

The material is especially resistant at high temperatures to iron or iron oxide. This makes it most valuable for lining metallurgical furnaces, either in the form of bricks or in granular form, tamped in. A further unusual feature of electrically sintered magnesite is that it does not contract when subjected to conditions encountered in industrial installations.

Some Notes on Quicksilver

The production of quicksilver in the United States in 1922, from the reports of the United States Geological Survey, amounted to 6,497 flasks of 75 lb. net, as compared with 6,339 flasks in 1921, which was the smallest annual output in 72 years of recorded production of domestic quicksilver. Of the total amount produced in 1922, California produced 3,494 flasks, Texas 2,725 and Nevada and Oregon 278. The average price of quicksilver in 1922 per flask of 75 lb. is reported as $58.95 in New York and $57.78 in San Francisco. However, the tariff act of 1922 placed a duty on imported quicksilver of 25 cents a pound, equivalent to $18.75 a flask. At the end of the year, the directors of the great Almaden mine in Spain reduced the price at the mine to about $45 per flask. No important additions to the known resources of domestic quicksilver were made during 1922, but the effect of the new import duty will probably result in a moderate increase in production for 1923.

Silicate of Soda In the Ceramic Industries*

Its Properties Depend Upon Ratio of Na_2O to SiO_2—What Grades Are Most Suitable for Various Purposes

BY JAMES G. VAIL
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CONSIDERATION of silicate of soda in the ceramic industries or, for that matter, in any industry must be predicated on an understanding of what is meant by the term silicate of soda. In a commercial sense silicate of soda is not more definite a term than clay. Its connotation is generic rather than specific. Attention must be called to this fact, because in spite of a voluminous literature there are still many technical men who think of a definite sodium silicate when they see the sirupy liquid of commerce.

Sodium metasilicate has been studied by several workers, notably Erdenbrecher, who has prepared three crystalline hydrates of Na_2SiO_3 with four, six and nine molecules of water, respectively. These may all be prepared at ordinary atmospheric temperatures. They all melt in their water of crystallization to liquids of low viscosity relative to the commercial preparations on the American market.

The ratio of Na_2O to SiO_2 is the usual index of the type of a commercial silicate solution. As the percentage and molecular ratios are so nearly alike, custom has chosen the more convenient percentage ratio. This may vary between the 1 : 1 of the metasilicate up to 1 : 4 or even higher. The properties of the products at the two ends of the scale are very different, and any intermediate composition can be produced in general without sharp breaks in the curves which represent the changing characteristics. Although it is likely that a compound of the ratio 1 : 2 does exist, its presence in the familiar solutions of this composition has not been completely proved. It is important then when you hear or read about silicate of soda to think, Which silicate of soda?

USE IN MENDING SAGGERS

Perhaps the use of silicate of soda for mending saggers is more widely applicable in the ceramic industries than any other. Where the break is a simple one, the process of repair is so simple as to be a marked economy. For this purpose a silicate which dries in the air to form a firm joint and retains its bonding quality as the temperature rises should be selected. All air-dried silicate solutions, even when they develop a bond strength above 1,000 lb. per sq.in., are hydrous. They can be completely dehydrated only at kiln temperature. During the removal of the last few per cent of water the bond strength of most silicate solutions is much reduced. At temperatures near 2,000 deg. F. sintering begins and the silicate again is sticky and has holding power. The ratio which we have found most suitable for this sort of work is about $Na_2O:SiO_2 :: 1:2.4$. If a grade containing more silica is used, its strength will decline earlier with advancing temperature. If a more alkaline type be selected, the cement will have a lower melting point and will set too slowly at atmospheric temperature. Silicate of soda should be mixed with a refractory clay to make the sagger mending cement. A mixture of calcined and raw clays is best, though not essential. A wide variety of clays can be used. The silicate of ratio 1:2.4 is usually sold as a solution of about 47 per cent solids testing 52 deg. Bé. About two parts by weight of this and one part of powdered clay should be used. A little water may be added to permit mixing the cement to a smooth, thick, creamy consistency. It is best to paint both broken surfaces of the sagger with the cement, taking care to apply enough to prevent a premature set due to absorption of water from the wet cement by the porous body of the sagger. This would occur only when the cement is spread very thin. Enough should be used to allow the cement to remain sticky for 5 minutes if exposed to the air. The broken parts should be pressed together so that a little is squeezed out and allowed to stand undisturbed over night. A joint formed in this way is usually stronger than the body of the sagger.

Cements made with clay and silicate of soda are also useful in making gas-tight brickwork in kilns, boiler furnaces, coke ovens and the like.

DEFLOCCULATING CLAY SUSPENSIONS

The influence of electrolytes on the suspension of clay in water as applied to refining and casting has received a great deal of attention and is the subject of a fairly voluminous literature. Beginning with a discussion of Acheson's paper on Egyptianized clay before this society in 1904, when W. D. Gates called attention to a similar effect of silicate of soda on clay, members of the American Ceramic Society have made numerous contributions to our knowledge. Bleininger and Schurecht should be especially mentioned in this connection. It is worthy of note that much that has been written is either not clear or entirely silent as to the kind of silicate employed. All solutions of silicate of soda will indeed assist in the suspension of clays and up to an optimum concentration make the separation of other minerals easier. In each case amounts beyond the optimum concentration produce a lesser effect or cause the flocculation of the suspended clay.

The work of Schurecht has shown that the effect of silicate is not merely the effect of a given amount of sodium oxide which may be added in any convenient form. A unit of Na_2O as sodium silicate has a larger effect in reducing the viscosity of a clay slip than the same amount of Na_2O added either as hydroxide or carbonate. The silica must enter into the reaction, and it appears that a study of the various types of silicate with different ratios of $Na_2O:SiO_2$ would be a valuable contribution to our knowledge of the art. The hydrogen-ion concentration is certainly an important factor in the effect of electrolytes on clay suspensions; the different types of silicate provide a convenient means for securing the concentration suited to the manipulation of each particular clay and the buffer effect of the silica should make it more easy to control the characteristics of the slip or the suspension in the refining process.

EFFECT ON DENSITY SHRINKAGE

The varieties of silicate of soda should also be studied with reference to their effect on the density shrinkage and strength of the ware. If one form of sodium silicate added to a clay in amounts of less than 2 per cent based on a 40 per cent solution can cause differences of more than 100 per cent in the dry strength or the

*Presented before the Terra Cotta Division, American Ceramic Society, at the Pittsburgh meeting, Feb. 12-16, 1923.

fired strength of clays, it is a matter of concern to know whether the form arbitrarily chosen for the study was in fact the most suitable. We have abundant evidence that the various forms do not behave alike.

Bonding Abrasive Wheels

One of the oldest uses of silicate of soda is to form a bond for abrasive materials in the manufacture of grinding wheels and abrasive stones. The process is widely used and has numerous advantages, important among which is the possibility of forming a wheel on one day and putting it into service the next. The silicate bond easily produces masses having a tensile strength of 2,000 lb. per sq.in. and the loss in process is very small. The silicate ordinarily employed for wheel manufacture has a ratio of 1 : 2 and is concentrated to a very sticky solution containing about 54 per cent solids. This solution is mixed with approximately an equal weight of a finely pulverized mineral such as clay or silica. The chemical characteristics of this powder can be varied considerably and good results secured, but its fineness and the thoroughness with which it is mixed with the silicate solution and the abrasive grains are important. The tamping of the mixture into molds calls for experience and skill to produce a uniform body. The wheels are first air dried at temperatures below the boiling point of water for a length of time dependent on the size of the wheel and then baked at about 450 deg. F. for several hours. The chemistry underlying this process is not fully understood, although a large amount of practical experience has developed a technique which gives good results. It is not, for instance, known that there is any reaction between the mineral filler and the silicate solution, and yet wheels are made sufficiently resistant to water to be run wet.

The water resistance of some mixtures is, however, improved by the addition to the inert mineral of small quantities of oxides capable of reacting with the silicate at the temperatures used in the process. One of these is zinc oxide. Fundamental research on the reactions of the silicate abrasive wheel process is needed to understand what has been empirically found to be good practice and to point the way to improvements. We already know that a silicate of very different character from those used for adhesive purposes is required.

Whether it be the making of silicate cements for mending saggers and setting brick with gas-tight joints, or the regulation of the flowing and suspension characteristics of mixtures of clay and water with small additions of silicate solutions, or the manufacture of quick process silicate abrasive wheels, the fact is worth remembering that the various forms of silicate have different properties. The grade best suited for one process may be quite unfit for another and many a process can be perfected by choosing a silicate solution adapted to the peculiarities of the clay with which it comes in contact and the conditions of its use.

Increase in Automobile Production

The Department of Commerce in Washington reports that automobile production increased in January and was the highest on record with the exception of last June. The output of passenger cars increased from 223,706 cars in January to 254,415 in February. Truck production amounted to 21,354 cars in February, as against 19,376 cars in January. Reports came from approximately 90 passenger car and 80 truck manufacturers.

Increasing Profits Without Increasing Sales

Dr. E. B. Lathrop has made a very good point in an article under the above title which appeared recently in the Philadelphia Chamber of Commerce *News Bulletin.* He points out first that the normal reaction of the executive is to urge an increase in sales in order to increase profits. On the other hand, in industries where the market saturation point is nearly reached or in which production will vary considerably from year to year due to an uncertain demand, it is much easier to save on the cost of purchases and better technical control. Suppose, for example, a firm makes $1,000 saving per month by better buying and better technical work, and suppose too that the firm is making a 10 per cent net sales profit. This monthly saving of $1,000 would be equivalent to a total yearly increase in sales of $120,000. Viewed from this standpoint, what might be termed "intensive cultivation" is very highly profitable.

Importance of Technical Purchasing of Raw Material

Take, for example, the purchasing of a common raw material such as ordinary salt. If we study different industries in which this material is used, the importance of technical purchasing can at once be made evident. For example, sodium chloride is used in ice cream manufacture. It is well known that different grades of salt give different results in the speed of making the ice melt. This of course is due to the calcium and magnesium chloride impurities in the salt, and yet the ice cream manufacturers have taken no advantage of this very common observation. They have not attempted to balance the relative corrosion which their salt may give against the more rapid freezing which is obtained.

In producing soap, salt is used to separate boiled soap from the excess of free alkali. The sodium soaps are all soluble, but calcium, magnesium and barium soaps are insoluble and have no value as cleansing agents. Obviously, then, the impurities in common salt will become invidious impurities in the soap itself.

Purchasing Department Should Wage an Aggressive War With Technical Implements

Again, in the manufacture of hydrochloric acid, which is prepared from common salt with either sulphuric acid or niter cake, the sodium sulphate thus manufactured is used in glass and paper making. Naturally the impurities which appear in the salt will become impurities in the salt cake. Examples in which the impurities in the raw material vitally affect the subsequent technology could be multiplied almost indefinitely. Here is a problem in which technical knowledge can play as important a rôle as it does in technical selling. The sales engineer has come to stay. His function in industry and his utility have been demonstrated. How about the purchase engineer? Is it not just as logical to make use of technical knowledge in purchasing as it is in sales? Instead of waging what might be termed a defensive war, why should the purchasing department not wage an aggressive war, using the modern implements of technical knowledge to carry it out? The purchase engineer and the sales engineer go hand in hand. They are twin positions, and in fact in many companies the same department, and the same engineers would adequately fill both functions. A least here is room for constructive thought and constructive action.

Heat Salvage in Small Furnaces

Thirty Per Cent Fuel Saved on Even a Small Tool-Room Furnace by a Simple Recuperator—Heat-Resisting Pipe Offers Ideal Medium With Which to Build Heat Interchanger

By W. C. Buell, Jr.
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Increasing interest in fuel conservation in recent years, coupled with the higher cost of fuel for industrial operation, has forced the recognition that waste heat, heretofore not considered an item of value, can be utilized, and by simple methods made to do useful work, even on small heating furnaces. In units of larger size, the value of waste heat has long been known and reclaimed to a considerable degree in blast, open-hearth, large billet heating and reverberatory furnaces, glass tanks, pot furnaces and others.

Reclamation of waste heat in these larger units was due not to a desire to save fuel, but to the necessity for increasing the flame temperature. High furnace temperatures for heating operations where the metal or compound must be raised to 2,700 deg. F. or more is accomplished by adding, to the fuel itself, appreciable quantities of sensible heat in the air required for combustion. Thus, Pittsburgh natural gas, containing 1,130 B.t.u., has a maximum flame temperature, when burned in the correct amount of cold air, of approximately 3,760 deg. F. At this temperature all the heat liberated during combustion is carried away by the products of combustion. If the air is preheated by any method to, say, 1,200 deg. F., that air will bring in 250 B.t.u. of sensible heat, which, if added to the original value of the gas, will give a total calorific value of the mixture of 1,130 + 250, or 1,380 B.t.u. per cu.ft.

This gas, with a calorific value of 1,380 B.t.u. per cu.ft., will have a theoretical flame temperature of approximately 4,280 deg. F. The increase comes entirely from the preheated air, and naturally, with higher flame temperature, a heating operation will be carried out

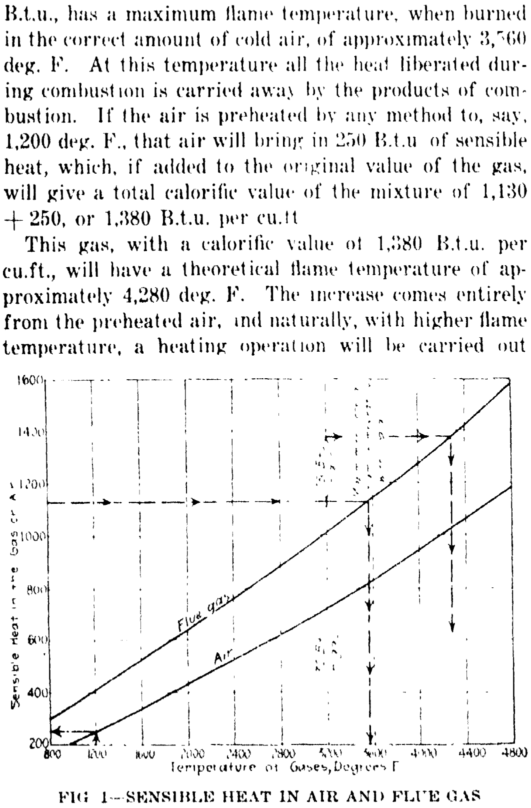


FIG. 1—SENSIBLE HEAT IN AIR AND FLUE GAS
Assumptions: Pittsburgh natural gas burned in theoretical amount of air.

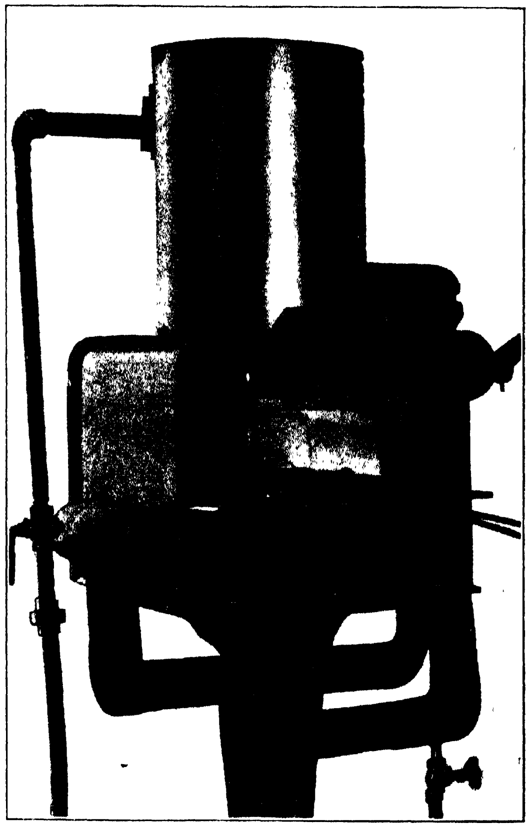


FIG. 2—AUTHOR'S FIRST RECUPERATOR, MOUNTED ON TOOL-ROOM FURNACE

with considerably greater rapidity than with lower flame temperature. Other similar problems in maximum flame temperatures on Pittsburgh natural gas may be solved graphically as shown in Fig. 1.

Waste heat may be salvaged in three general ways:

1. By placing a steam boiler in the waste gas flue between furnace and stack to generate steam.

2. By use of the regenerative furnace. This has two sets of reversing chambers in the waste gas flue between furnace and stack. The flue gas passing out gives up its heat to the brick checkerwork of one chamber and on reversing incoming air picks up this heat.

3. By recuperators. These are tubes placed in the waste flue, between furnaces and stacks, and through

which air for combustion is passed, thereby absorbing heat.

For obvious reasons heat-salvaging apparatus of the first classification is out of the question for small furnaces.

Regenerators of the second classification are relatively great in first cost, upkeep and labor cost, and require careful operation to accomplish good results.

Recuperators appear to offer the best solution of waste heat recovery in smaller furnaces. Once installed, they require no operating attention and if properly designed, upkeep cost is a relatively small item. Within certain limits, recuperative elements may be of tile or metal and inclosed in brick-lined containers. Tile recuperators are subject to the very severe criticism that, being of firebrick mixture, they resist the flow or transfer of heat to a very much greater degree than does silicon carbide or metallic elements. Accordingly, to secure an equivalent heat transfer from hot flue gas to colder air, it is necessary that the transfer area of tile recuperators vary directly as its thermal conductivity. To obtain equivalent results, then, the specified transfer area of tile recuperators must be at least five times as great as with silicon carbide elements; and from five to twenty-five times as great as when metallic elements are used as the medium of transfer. In addition to the foregoing basic objection to the use of tile recuperator elements, tile is fragile and hard to lay up with joints that remain tight enough to prevent escape of air into the flue gas compartments.

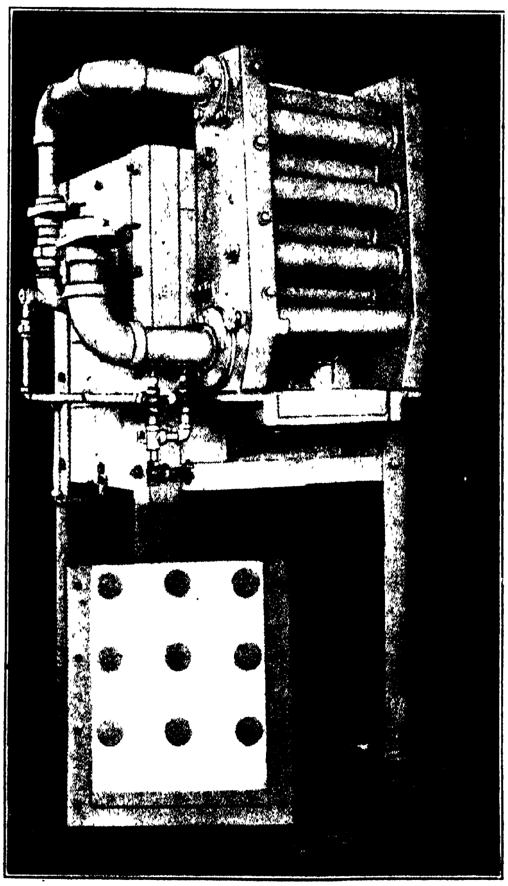


FIG. 3—W. S. ROCKWELL CO.'S "ECONOMIZER FORGE" (FRONT REMOVED)

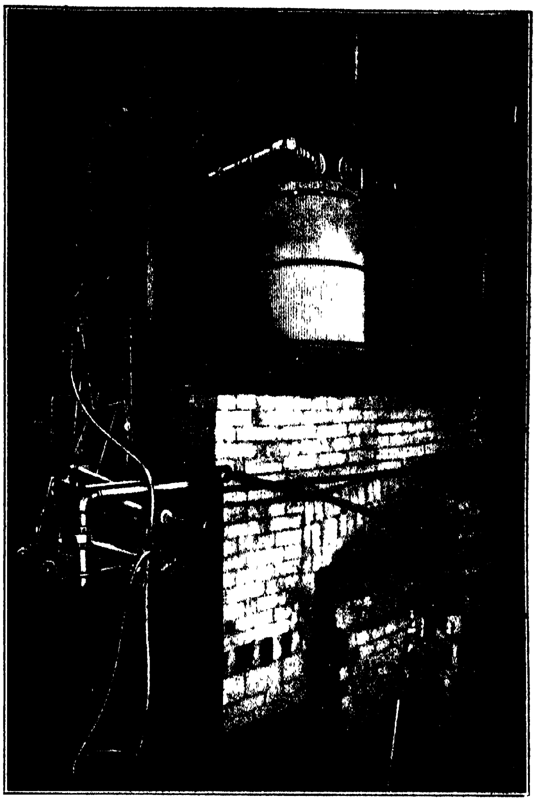


FIG. 1—EXPERIMENTAL RECUPERATOR ON FORGE FURNACE

As the scope of this article includes relatively small furnaces, metallic recuperators only are considered, for in such practice, limitations of the tile recuperator prevent its successful use. Tile recuperators have a fairly well defined field of application in larger furnaces.

While silicon carbide is a much better medium for recuperator elements than fireclay tile, on account of its greater conductivity, it is open to the objections of high first cost, fragile nature and the same difficulty of making tight joints. With their high thermal conduction and relatively low cost, metallic elements without doubt are the best elements to use in recuperators. But if satisfactory results are to be secured, a thorough understanding must be had of their properties, reaction under the working heats, and a knowledge of the engineering principles of recuperator design.

A consideration of the metals available for recuperators of this kind may be interesting. Certain of the nickel-chromium alloys on account of their high melting points and resistance to gases under high temperatures would make ideal recuperator elements. The high first cost of these alloys and difficulty of securing sound castings with thin walls are severe drawbacks to their general use, but even so, these alloys are the only metals available which will stand temperatures of the metal walls reaching 2,000 deg. F. or more.

Cast iron has long been used in heat exchangers—recall the original blast-furnace stoves made with cast-iron pipe elements. Cast iron was fairly satisfactory for that service as long as the temperatures encountered were relatively low. Cast iron is reasonably satisfactory for recuperator elements where the final temperature of the air does not exceed a few hundred degrees,

but it has the disadvantages of requiring a heavy wall section and relatively great weight.

It is desirable to bring air and flue gas into as close and continuous contact as possible throughout the entire length of the heat exchanger. Based on present experience, it appears that relatively small pipes, say 4 or 6 in. diameter, manifolded so as to secure proper area, offer the best available conduit. In the writer's practice, it is customary to force air to be heated through cylindrical containers which are surrounded by the hot flue gas. The air passes counter-current to the gas, both going at relatively high velocity. For low-temperature work (where the flue temperatures do not exceed 1,000 deg. F. and final temperature of the air 300 or 400 deg. F.) wrought-iron pipe gives excellent results. But when the flue gases are from 1,000 to 2,200 deg. F. and final air temperatures 300 to 1,200 deg. F., untreated wrought-iron or steel pipe does not last long.

TABLE I HEAT BALANCE
Figured in B.t.u. per hour

	Non-Recuperative	Recuperative
Total in fuel	119,645	82,350
Returned in preheated air	0	8,668
Total to furnace	119 645	91,018
Radiation loss		
Combustion chamber	25,331	30,911
Heating chamber	36,542	23,028
To recuperator	0	37,079
Vent loss	57 772	0
Total	119,645	91,018
To recuperator		37,079
Returned to heated air		8,668
Radiation loss in recuperator		15,208
Final vent loss		13,202
Total		37,079
Fuel saving		31 3%

If steel pipe is impregnated with aluminum (Calorized after the method of the Calorizing Co of Pittsburgh), pipe recuperator elements will give an economical performance in waste heat recovery within the temperature limits just mentioned. The life of calorized pipe is from five to ten or more times the life of untreated pipe. The cost of the special treatment is quite low. A calorized pipe has the added advantage of maintaining the same high rate of thermal conductivity at all times, for it does not scale.

The design of thermal recuperators should not be attempted by those not thoroughly versed in the art, for many factors must be co-ordinated to produce economical results; otherwise an installation that is neither economical nor satisfactory will result

A considerable number of furnaces employing the recuperative principle of salvaging waste heat by use of metallic recuperators are in general use. The writer believes that he developed in 1913 and arranged to have placed on the market one of the first commercial recuperators for small furnaces. This consisted merely of mounting on top of a small tool room furnace a brick-lined chamber containing a coil through which the air was forced (Fig. 2). That the use of even this small device was worth while is indicated from the heat balance (Table I) of one furnace operating without a recuperator and one furnace with recuperator, both furnaces being of exactly the same size and operated under identical temperatures in the heating chamber (2,450 deg. F.).

It is interesting to note that less than 10 per cent of the total B.t.u. required in an average hour was represented in the heat returned in the air. The recuperator effected a total saving of 31 per cent; less than 10 per cent was represented in actual heat returned, while over 20 per cent was had through increased flame temperature, less weight of furnace gases and other contingent economies that generally enhance the value of recuperative devices.

The idea exemplified by Fig. 2 may be applied, of course, in many ways. Fig. 3 shows an especially neat and compact recuperator built alongside a small forge furnace (designed by the W. S. Rockwell Co.). It has the front removed in order to show the calorized preheater pipes.

Beginning early in 1915, and extending over a period of more than 2 years, in collaboration with John W. Griswold, the writer made a series of tests on recuperative forge furnaces. The first experimental furnace, as constructed in the laboratory of Tate-Jones & Co., Inc., is shown in Fig. 4. This recuperator was designed along the lines of a Junker calorimeter: Flue gases were drawn through the recuperator by an exhauster mounted above, while air for combustion was forced through by a positive pressure blower (not shown in the figure). Much trouble was at first encountered with the heat exchanger elements. While only about 30 in. in diameter with 45 in. effective height, they had an interior transfer surface of over 100 sq.ft. and at times reduced the gases of combustion from 2,000 to 400 deg. F., and raised air temperatures from atmospheric to 1,700 deg. F.

The results secured were so very favorable that a second experimental furnace and recuperator was built for drop forge work in a large manufacturing plant at Toledo, Ohio. In this furnace forty to fifty steel bars 3 in. diameter, 40 in. long were heated per hour to about 2,000 deg. F. to be forged into six-throw automobile crank shafts. In one 24-hour period of ordinary shop operation it used 3,300 cu.ft. of coke-oven gas per ton of forgings. This is equivalent to less than 15 gal. fuel oil per ton—a very remarkable performance.

FIG. 5—CAR TYPE FURNACE WITH SIX RECUPERATORS

Fig. 5 shows a Car Type Annealing Furnace utilizing the same principle, but where the waste gas flues are brought outward into individual small stacks, instead of following the usual practice of passing upward through the furnace walls. Surrounding each of these stacks is a metal jacket through which air for combustion is forced and part of the heat of the waste gas is thus transferred to the air and reclaimed.

Recuperative forging furnaces of large size have been designed, patented and constructed by the Heppenstall Forge & Knife Co., one of that company's installations being shown in schematic outline in Fig. 6. Recuperators in this furnace are calorized U tubes, suspended in a chamber beyond the heating furnace proper, and into which the waste gases are directed. Air is forced through these tubes, where it is heated and thereupon

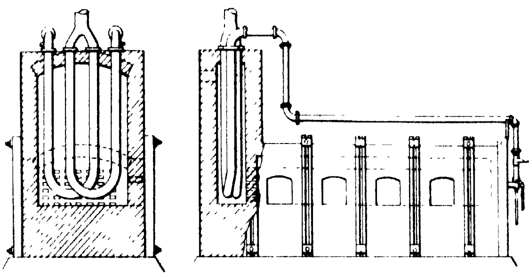


FIG 6—RECUPERATOR TUBES ON OIL FIRED FORGING FURNACE

led to the oil burners at the front end. Remarkable operating economies are shown by this installation. Temperatures from the recuperative effect are relatively low (600 to 700 deg. F.) and only about one-half of the total air required for combustion is preheated.

Interesting experiments are now being conducted on calorized pipe blast-furnace stove elements, with a view toward determining to what extent calorized air pipes can replace the regenerative brick chambers. Complete data on these experiments are not now available for publication, but extremely satisfactory results are shown from the preliminary figures. A consideration of blast-furnace stoves is beyond the scope of this article; but it is mentioned to show that the subject is of sufficient interest to cover all phases of industry wherever the use of heat is of importance.

Economies From Recuperation

Naturally the question will be asked, "How much can we save by the use of recuperative devices?"

There are at least twenty variable factors which will have a bearing on the ultimate over-all saving. Saving will be less where the existing non-recuperative furnace practice is very good. Poor or indifferent furnace practice is vastly improved by the use of recuperation; when provision is made for the installation of recuperative elements and the furnace placed in the hands of competent engineers, they will frequently so change the existing design of the furnace itself as to produce a still greater economy.

It is possible to design the recuperator to salvage almost any amount of waste heat that may be arbitrarily named. The higher the temperature of the waste furnace gases the greater the percentage that can be economically recovered. In forging practice it is economical to premise a design on a 50 per cent recuperative efficiency; for low-temperature heat-treating practice in small furnaces it is seldom economical to carry recuperation beyond a maximum of 30 or 40 per cent. On the other hand, recuperators operating on relatively low recuperator efficiencies will be found to produce material over-all savings. A chart is shown in Fig. 7 giving: (a) the fuel saving possible with waste gases at any temperature, (b) combustion conditions within the ordinary range of furnace practice, and (c) the saving with recuperators of varying effectiveness. This chart shows, for example, that gases which leave a furnace at 1,400 deg. F. and have entrained 10 per cent excess air carry out a total heat equal to that produced by 38 per cent of the fuel fired. If a recuperative device having a 40 per cent thermal efficiency is connected to the furnace, then over 15 per cent of the total heat fired will be returned to the furnace as sensible heat in the air for combustion.

The theoretical fuel saving itself is of considerable interest, but in every case the actual saving will be found much greater than the theoretical; for, as explained before, the addition of sensible heat to the fuel gives the equivalent result of increasing the calorific value of the fuel and thus increasing flame temperature. How this works out in theory and practice may be seen by re-examination of the chart Fig. 1, which shows the heat in the products of burning 1 cu.ft. of Pittsburgh natural gas, containing 1,130 B.t.u. per cu.ft. If we read down from this curve on the vertical ordinate, we shall find the theoretical flame temperature a trifle less than 3,600 deg. F. If the air is preheated by recuperation to 1,200 deg. F., that air will contain 250 B.t.u., which, added to the 1,130 originally in the gas, will give a total calorific value of the fuel of 1,380 B.t.u. Reading through as before, Pittsburgh natural gas with 1,380 B.t.u. will have a theoretical flame temperature of 4,280 deg. F. Thus, by increasing the calorific power of the fuel 18 per cent, we increase flame temperature over 20 per cent.

It seems wise to point out the advisability of entrusting the design of recuperative devices only to com-

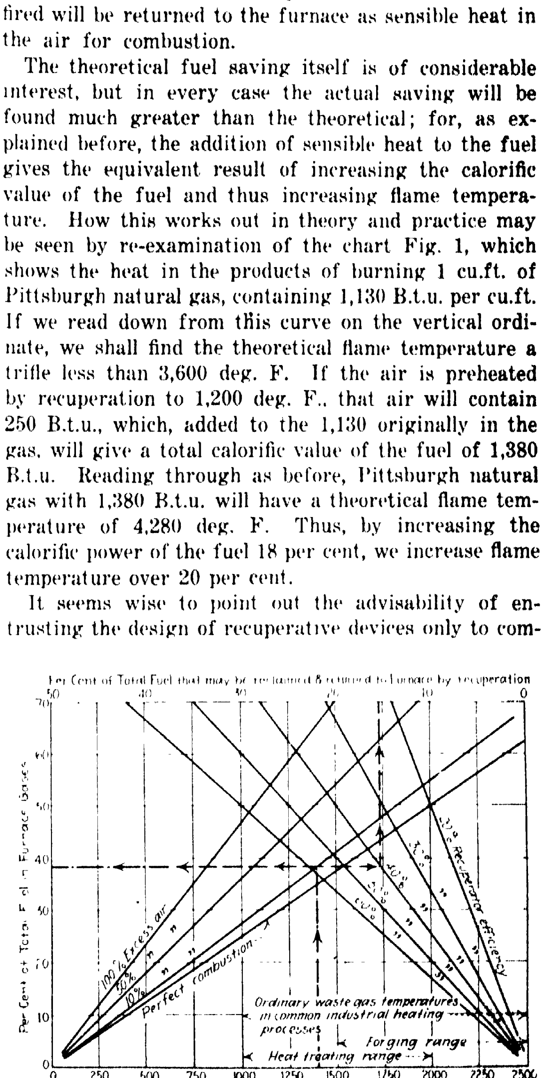


FIG 7—FUEL LOSSES AND POSSIBLE SAVINGS

petent engineers. The mass of variables affecting actual results can be only roughly evaluated from such data as are at present available. This points to the likelihood of obtaining only mediocre results by those who do not have available the necessary experimental data as yet unpublished.

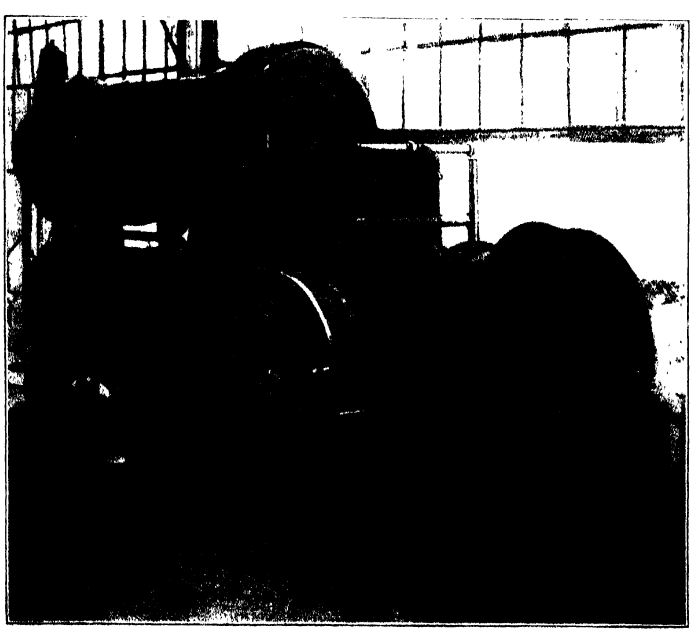
Although this article presents data which cannot be classified as conclusive, yet they are sufficiently indicative to call attention to the possible savings of our natural resources. Fuel savings and other economies are now possible by making comparatively inexpensive alterations in furnace installations. The era we are now facing promises to be one of the most severely competitive that manufacturers have as yet experienced. Many plants operating on narrow margins should find such basic savings of vital significance.

Automatic Furnace and Quencher

The W. S. Rockwell Co., of New York, manufacturer of industrial furnaces, has had on the market for some time an automatic rotary heating furnace and an automatic rotary quenching tank. It has recently effected a combination of these two units so that they may be operated as one; and heating and quenching can be carried on as a continuous, automatic unit process. The accompanying photograph shows the set-up of the combined units.

The operation of these units separately is well known to those interested. When operated together the procedure is as follows: After the material has been slowly brought up to temperature and discharged from the furnace, it slides into the submerged end of the quenching tank, where it is automatically picked up in small batches by the internal thread of the rotating tank and conveyed through the quenching fluid as it is raised to the final discharge.

This combination provides, then, a continuous unit giving individual and uniform treatment in both heating and quenching. By its use, as against that of the elements separately, chances for trouble with the product are largely eliminated. A real advantage is also gained through the reduction of labor required to operate and the elimination of dependence on the human element.



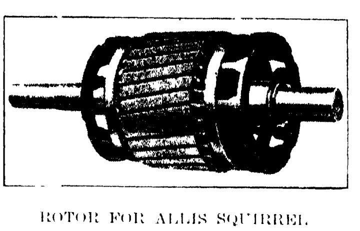
AUTOMATIC ROTARY FURNACE AND QUENCHING TANK

Heavy Duty Motor

Of recent years there have been few innovations of great novelty in the field of electrical motors, which adds particular interest to the new line of heavy duty, polyphase squirrel-cage motors recently placed on the market by the Louis Allis Co., of Milwaukee, Wis.

In the usual design of this type of motor, the rotor winding is formed with the bars individually joined to the end rings. This makes a multiplicity of joints and is a source of delays for repair when loose bars occur.

In the L-A Type H. D. motor, the new Allis type, the entire winding of the rotor consists of an integral sheet of copper, punched and formed by a special mechanical process. This one-piece winding is machine wrapped around the rotor core, the copper bars being expanded into the core slots by swaging, as indicated in the accompanying illustration. The single joint that extends through the two end rings is silver welded, after which the metal at both connections is processed by means of a contracting operation that rehardens the copper at the point where the heat, applied during the welding, softened it. This treatment results in a lapped,



ROTOR FOR ALLIS SQUIRREL CAGE MOTOR

silver-welded joint of maximum strength. The rotor winding, except for the joint in the two end rings, is electrically and mechanically as substantial and indestructible as a piece of pure copper pipe.

On account of being fabricated of comparatively thin copper stock, a material that has a high thermal conductivity, this rotor winding readily conducts the heat generated in it toward the ends of the rotor bars, where the heat is dissipated through the action of malleable iron fans. The rotor bars themselves also constitute a very efficient blower, thus materially increasing the ventilation.

The rotor core is a self-contained unit, and may be pressed on and off the shaft readily, as it has a straight keyway. Otherwise it is largely conventional except that it employs open slots without the usual overhanging tooth tips. Experience has shown that so long as a suitable relation is maintained between the air gap and slot width the performance does not suffer as regards power factor and efficiency and that a rotor core of this construction, with a suitable winding, results in exceptionally high starting and running torques. These

abnormally heavy starting and running torques have led the manufacturers to increase the shaft size above the usual practice for a given rating, which, in combination with the liberal bearings, fabricated from a phosphor bronze, insures exceptionally long life in service.

While great stress has been laid on the mechanical ruggedness of this new line of motors, the electrical characteristics have received equally careful attention. In addition to the exceptional starting and running torques, all motors are guaranteed to carry their full rated load continuously with a temperature rise not exceeding 40 deg. C., and after their ultimate temperature has been reached, to carry 25 per cent overload for 2 hours with a temperature rise not exceeding 55 deg. C. These motors are made in standard industrial sizes, voltages and frequencies

Thermal Conductivity

Interesting researches have been carried out by the Feather-Stone Inulation Co., of Los Angeles, on the thermal conductivity of what is known as the Feather-Stone insulating brick, manufactured by the company from material obtained from its deposit at Covina, near Los Angeles. The weight per brick is little more than 2½ lb., or 37 lb. per cu.ft. Compressive strength has been calculated at 36 tons per sq.ft. Thermal conductivity amounts to about 1 B.t.u. per sq.ft. per hour per deg. F., which is about one-tenth that of ordinary firebrick. Charts showing the comparative thermal conductivities of Feather-Stone

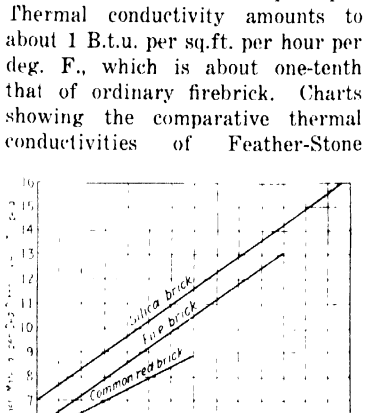


FIG. 1—GRAPH SHOWING THERMAL CONDUCTIVITIES OF VARIOUS TYPES OF BRICK

brick, common red and refractory brick are shown in Fig. 1. Fig. 2 illustrates graphically the relative heat losses through the insulated and uninsulated walls of a furnace.

Thermolith Cement

A new fire cement has been developed by the Harbison-Walker Refractories Co. The trade name given it is Thermolith. It is claimed for this cement that it sets hard and bonds fireclay brick firmly without heat. Fireclay and many other fire cements are incapable of bonding firebrick at ordinary temperatures. Thermolith remains a bond at all working temperatures—extreme heat

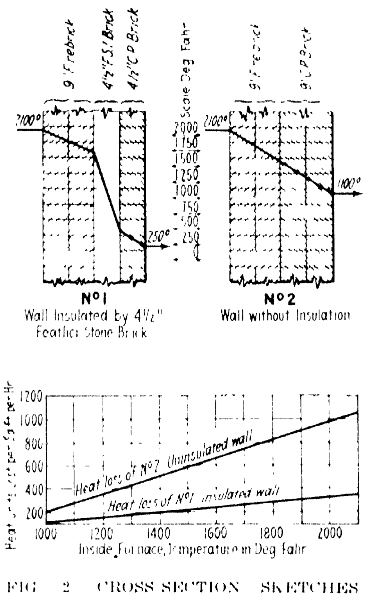


FIG 2 CROSS SECTION SKETCHES AND GRAPH SHOWING HEAT LOSS THROUGH INSULATED AND UNINSULATED WALLS

conditions neither fuse it nor crumble it. It is a high-temperature cement and a low-temperature cement. It is also claimed for this cement that it does not flux the brick at any working temperature, because it is chemically neutral. This same quality also enables it to resist the action of slags and clinkers, no matter whether acid or basic. It is mechanically strong. It withstands abrasion, either of furnace charge or mechanical equipment.

Thermal tests which have been conducted show this cement unfused at even the highest working temperatures, and in abrasive tests it has been impervious to sand blasts of sufficient force to wear down fireclay brick. It comes in dry powdered form. It is applied with a trowel after simple mixture with water. It does not require covering with water to prevent deterioration when not in use after the package is opened. It is packed in 200-lb. air-tight metal drums.

The cement is recommended by its manufacturers for use in laying up fireclay brick in blast-furnace and blast-furnace stove linings; boiler settings and firebox arches, heating, forge and welding furnaces; copper, lead and zinc furnaces; cement, lime and pottery kilns; gas regenerator linings; glass pot furnaces and glass leers; brass furnaces, and other miscellaneous uses. It is also of great value in patching and repairing fireclay brick construction, such as in boiler and gas-generating practice, where rapid and effective repairs are a requisite for uninterrupted service. This cement is also effectively used as a coating on refractory surfaces for protection against abrasive, corrosive and chemical attack.

Catalogs Received

POWER SPECIALTY CO., New York, N. Y.—Catalog EC 100 Descriptive catalog of the Foster Economizer for use in connection with steam boilers

COOPER HEWITT ELECTRIC CO., Hoboken, N. J.—Various leaflets as follows: Quartz glass apparatus for photophysics and photochemistry, the Lab-Arc, a high tension quartz mercury arc for polarimetry, interferometry, photomicrography, spectrometry, etc The Uviarc lamp in the laboratory, the ultra-violet lamp, the Uviarc test for dyes, inks, textiles, leather, prints and paper and Bulletin 105 on Uviarc and Ultra-violet lamps

NEW JERSEY FOUNDRY & MACHINE CO., 90 West St., New York, N. Y. Catalog 103, describing a new portable elevator.

GRINNELL CO., Providence, R. I.—Booklet on the Grinnell type tray drier

SAWYER SPECIALTY SCALES CO., Jacksonville, Fla Booklet on an accurate system of filling barrels with exact quantity.

QUIGLEY FURNACE SPECIALTIES CO., 26 Cortlandt St., New York, N. Y.—Bulletin 53—Uses of Hytempite Bulletin 70, the application of Mono-line, a cement for repairing and lining work in foundry practice.

HARDINGE CO., New York.—Bulletin 13. The Hardinge mill for grinding and pulverizing This bulletin describes new developments in pulverizing and grinding practice and a new type of conical mill put out by this company.

BLAW-KNOX CO., Pittsburgh, Pa.—Catalog on the Batcherplant A catalog on this company's so-called Batcherplant which is an overhead bin for the storing, measuring, and delivering of materials which are to be used in measured batches

TRUSCON LABORATORIES, Detroit, Mich.—Leaflet. A quotation from Samuel T. Very's article in a recent issue of *Architecture* on integral waterproofing descriptive of the application of Truscon products

DE LAVAL STEAM TURBINE CO., Trenton, N. J.—Leaflet Description of the installation of centrifugal pumps in the Baltimore plant of the American Sugar Refining Company

Catalogs Wanted

James H. Apps, consulting engineer, 205 Scripps Bldg., San Diego, Calif., desires to receive catalogs covering filters, drying and dehydrating apparatus, cooking kettles—steam jacketed and otherwise—oil-burning apparatus and pressure and exhaust fans.

Cama, Norton & Co., 11 Elphinstone Circle, Bombay, India, invite the receipt of correspondence and catalogs on engineering subjects for which they may have openings in Bombay and India in general.

Synopsis of Recent Literature

World Paper Production

From a recent article in *Paper* we learn that the total production of the existing 2,825 paper mills all over the world in 1913 amounted to approximately 9,750,000 tons and in 1920 the total output of paper and boards was about 14,500,000 tons. The average production of paper per meter-width of paper machines by countries has been estimated as follows: Germany, 540 tons; France, 660 tons; Sweden, 895 tons; England, 910 tons; Norway, 1,000 tons; Finland, 1,240 tons; Japan, 1,630 tons; United States, 1,845 tons; and Canada, 2,200 tons per year. The tons are to be understood as metric tons.

In 1921 the daily capacity of the United States mills was 7,825 tons mechanical, 5,700 tons sulphite, 904 tons sulphate and 1,846 tons soda pulp. During 1921 there was also converted into paper 3,550,000 tons of wood pulp and an unknown quantity of rags. However, the production of 1921 was much less than that of 1920, judging not only from the reported decrease of 846,000 tons of wood pulp but also from the fact that imports were lessened by 206,000 tons as against 1920. This decrease was not confined to the United States alone, as all over the world the same lessened production for 1921 occurred as compared with 1920 and even 1922 did not reach the production of 1920.

Zinc Dust and Its Uses

A. Billaz, in *L'Industrie Chimique*, Aug. 18, 1922, p. 193, notes that those chemical properties of zinc to which it owes its extended use in the powdered state are: (*a*) Reducing properties, which are utilized particularly in dye manufacturing—for example, in the reduction of nitro compounds to organic amines, and in the preparation of sodium hydrosulphite for the reduction of the vat colors; (*b*) the property of precipitating metals, such as copper, cadmium, lead, silver and gold from their solutions. It is used in the purification of zinc sulphate solutions destined for electrolysis or for the manufacture of lithopone, and precipitating gold and silver from their cyanide solutions; (*c*) the property of combining with dry oxygen only at a high temperature, and of giving with moist air a basic carbonate or with sea water an oxychloride which protects the bulk of metal from further alteration. These properties have led to the following applications: Painting iron objects; galvanization by cementation (sherardizing, which consists essentially in immersing iron objects in zinc dust at a temperature of 300 deg. C.); cold or electrolytic galvanizing of cast-iron objects; and metallization, or deposition by projection of a layer of zinc on the surface of the metal to be protected. The industries which use powdered zinc obtain the material from different sources, in accordance with the chemical rôle it has to play. One of these sources is from zinc smelters in which the zinc dust is but a byproduct. It is also made by blowing a stream of gas against a trickle of liquid zinc, and by a little-known pulverization (grinding) process. Zinc dusts are far from being pure zinc; they contain varying amounts of foreign materials, more or less undesirable to the user.

Up to recent years the presence of carbon in zinc dusts was explained solely by mechanical entrainment of the element volatilized from the charge or from the electrodes. Lemarchands (*Revue de la Métallurgie*, December, 1920) drew attention to the relation between the carbon in the dust and the carbon monoxide in the distilling gases, and proposed a chemical origin, depending upon the reduction of the carbon monoxide by the zinc, to the carbon. The main reaction is $Zn + CO = ZnO + C$, but this is modified by two other reactions, $ZnO + CO = Zn + CO_2$ and $CO_2 + C = 2CO$.

The oxidation of the zinc vapors by air is the most general and widely appreciated cause of the formation of zinc oxide contained to the extent of from 6 to 50 per cent. Air exists in the retorts and condensers, from the very commencement of the distillation, and cannot be avoided either in the ordinary furnaces or in the electric furnace. Zinc nitride, Zn_3N_2, the proportion of which in a zinc dust may vary from 0.16 to 0.42 per cent, is also formed from reaction with atmospheric gases.

Microscopic examination shows that grains of zinc dust are metallic globules coated with ZnO crystals; a circumstance which prevents the metallic droplets from wetting each other and uniting with the main body of liquid condensate.

Heated in air, zinc dust, owing to the concentration of oxygen on the surface of the metallic particles, ignites before melting.

Important Articles In Current Literature

More than fifty industrial technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem & Met* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers Those that are of unusual interest will be published later in abstract in this department but since it is frequently impossible to prepare a satisfactory abstract of an article this list will enable our readers to keep abreast of current literature and direct their reading to advantage The magazines reviewed have all been received within a fortnight of our publication date

EFFECT OF PULSATION ON FLOW OF GASES Horace Judd and Donal B Pheley *Mechanical Engineering*, April, 1923, pp 223-228

DEGREE OF SWELLING AND BEATING Dr C G Schwalbe *Paper*, March 14, 1923, pp 7 10

DEVELOPMENTS IN PULP AND PAPER INDUSTRY W G MacNaughton. *Paper Trade Journal*, March 22, 1923, Tech Sec , pp 49-53

TRANSFORMATION OF COLOR EQUATIONS FROM ONE SYSTEM TO ANOTHER. H E Ives *Color Trade Journal*, March, 1923, pp 102-107

OBTAINING LARGE BLAST-FURNACE PRODUCTION D T Croxton *Iron Age*, March 29, 1923, pp 897-900.

EFFECT OF GAS QUALITY ON QUANTITY USED BY CUSTOMERS Harold Davies, presidential address, Manchester District Institution of Gas Engineers *Gas Journal* (London), Feb 28, p 517.

EXPERIENCE WITH VERTICAL RETORTS. C F. W Rendle *Gas Journal* (London), Feb. 28, p. 529.

SAFETY ENGINEERING IN THE COMPRESSION OF GASES A. D Risteen. *Mechanical Engineering*, April, 1923, pp 242-245

SOLVING THE REFRACTORIES PROBLEM OF THE NAVY G. M. Galvin. *Jour Am Soc of Naval Engineers*, February, 1923, pp. 146-152.

FURTHER DATA ON THE EFFECTIVE VOLATILITY OF MOTOR FUELS Robert E Wilson and Daniel P Barnard, 4th *Jour. Soc Automotive Engineers*, March, 1923, pp. 287-292.

NEW INTERPRETATION OF EXHAUST-GAS ANALYSIS E H. Lockwood *Jour Soc Automotive Engineers*, March, 1923, pp. 299-301.

THE GERMAN BROMINE INDUSTRY. M. Debussy. *Chimie et Industrie*, February, 1923, pp. 245-258.

Temperature Control in Steel Making

Charles Clausel de Coussergues presented a paper on "The Influence of Temperature in Steel Production" before the Liége Congress, June, 1922 (*Revue de Métallurgie*, 1922, pp. 639-644), in which he notes that for a long time one of the desiderata of steel-melting practice was to get the highest possible temperature. However, one now begins to question this statement and to wonder whether a maximum temperature is always to be considered as the best condition for the molten bath.

Consider the basic open-hearth process; it is well-known that an increase in temperature will accelerate the formation of basic slag with a relatively high melting point and will also tend to maintain the slag in a fluid state. Therefore it may be considered advisable to reach a high temperature as rapidly as possible—say above 1,600 deg. C. Such a high temperature will also aid the oxidation of various impurities in the steel, as this is done largely by iron oxide and as the solubility curve of the oxide of iron in iron rises sharply with the temperature, being practically nil at 1,400, about 1 per cent at 1,700 and 3 per cent at 1,800 deg. C.

Such high temperature will, however, hinder dephosphorization. It has been demonstrated some time ago that phosphorus might act as a deoxidizer in presence of carbon if the temperature is not very high. Such, for instance, was the practice of the Décazeville

plant in France in 1902 and 1903 and of the Tsaritzyne works in Russia. The same fact was also pointed out by Howe in his work on steel when referring to the Creusot practice with basic bessemers. It has been said sometimes that on theoretical grounds such a process will prove impossible above the inversion point of the reaction

$$P_2O_5 + 5C = 2P + 5CO,$$

i.e., above 1,100 deg. C. That is, however, in contradiction with practice, and the error seems to lie in the fact that phosphorus does not occur in the bath as phosphoric oxide, but as phosphate.

As it is often advantageous to dephosphorize the bath in the presence of carbon, the process should be conducted at that stage which makes dephosphorization possible—i.e., at a relatively low temperature. Incidentally the lower temperatures will assist in getting rid of iron oxide, as its solubility at lower temperatures is very small.

It follows from these two series of considerations that the molten bath should be superheated first and then somewhat cooled down. Final deoxidation will be effected then at a relatively lower temperature, a smaller amount of oxides will have to be reduced, less deoxidizers will have to be used and a saving in costs obtained.

A New Material for Permanent Magnets

The performance of a permanent magnet depends upon both the remanence and the coercive force. The product of the remanence (R') as determined in a yoke by the coercive force K, as measured by a magnetometer, is considered to be a measure of the quality of the magnetic material. It has been shown[1] that, by the addition of manganese to iron, the coercive force was increased to double that of the ordinary chromium or tungsten magnet steel, but that this was accompanied by the reduction of the remanence to a point where the alloy was useless as a permanent magnet. In the present investigation[2] the addition of cobalt, with its known beneficial effect upon the saturation value of iron, was studied by Gumlich. First, three series of alloys with carbon ranges of 0.7 to 0.8 per cent, 1.0 to 1.1 per cent and 1.2 to 1.4 per cent containing from 3 to 11 per cent Mn, and with Co about 35 per cent, were made up. It was soon found that there was no advantage in going over 4 per cent in Mn. The best alloys of these series were found to be (H max. 500):

	%C	%Mn	%Co	R'	K	$R' \times K \times 10^{-3}$
(1)	0 83	4 8	35	9530	158	1505
(2)	1 12	4 7	35	9580	156 3	1497
(3)	1 24	4 0	35	9720	132 3	1285

The best heat-treatment was found to be quenching in ice-cooled oil from 850 deg. C.

The addition of cobalt in any lower proportion than 33 per cent caused rapid falling off in both R' and K.

In another series chromium was added to determine in what degree this element could be used as a substitute for the expensive cobalt. It was found that 5 per cent Cr could be substituted for 10 per cent of cobalt without appreciably altering the magnetic properties, provided the carbon was kept around 1.1 per cent. If, however, the Co was kept at 35 per cent and 5 per cent Cr added, very much better results were obtained, as, for comparison (H max. 500):

	%C	%Mn	%Co	%Cr	R'	K	$R' \times K \times 10^{-3}$
(2)	1 12	4 7	35		9580	156 3	1497
(4)	1 11	5	20	5 1	9430	155 0	1460
(5)	1 11	3 5	36	4 8	9130	203 8	1863

In these higher coercive force alloys it is necessary to use higher magnetizing forces than in ordinary magnet steels. Fields up to 1110 H max. were tried and gave increasingly good results. R' and K were boosted to 9310 and 227 respectively, as compared with 9130 and 203 at H max. = 500.

With high Cr, Co and C (alloy 5), it was necessary to increase the hardening temperature to 875 deg. C. Under aging, hammering and heating tests these alloys showed little change, the maximum being 3½ per cent due to heating to 100 deg. C. The temperature coefficient (20 to 100 deg. C.) was found to be 204×10^{-6}, which is about the same as our present Cr and W steels.

[1]*Electrotech. Zeitschrift*, vol. 40, p. 26 (1919).

[2]G. Gumlich, *Electrotech. Zeitschrift*, vol. 44, pp. 147-51, Feb. 15, 1923.

Corrosion of Metals by Refrigeration Brine

Results of a study to determine causes and methods of overcoming corrosion in refrigeration brine systems by Emerson P. Poste and Max Donauer, of the Research Laboratories, Elyria Enameled Products Co., are summarized in *The Mills Dealer* for February.

Three types of brine were found in commercial use: Natural calcium chloride, soda byproduct calcium chloride, sodium chloride. The latter is not used to any extent, as it is of a severely corrosive nature, probably due to an induced oxidation. Analyses of the two types of calcium chloride are as follows:

	Natural Per Cent	Soda Byproduct, Per Cent
Calcium chloride	73 59	74 07
Sodium chloride	1 45	0 51
Magnesium chloride	0 00	0 00
Total solids	75 11	74 66
Water	24 89	25 34

To determine the effect of acidity and alkalinity on rate of corrosion, tests were made with a brine of commercially pure calcium chloride treated with lime and acid to produce a range of from the equivalent of 0.5 per cent free calcium hydroxide to 0.3 per cent free HCl. The curve indicates that to keep corrosion at a minimum the alkalinity must be greater than 0.1 per cent. Brines originally alkaline will turn acid gradually, and a curve showing the rate in days plotted against original alkalinity was also determined. As in the first curve, the break in the curve comes at a free lime content of 0.1 per cent. Rate of corrosion was also found to decrease with the density of the brine.

These and other findings may be summarized as follows: Essentially pure calcium chloride brine is alkaline when first made, but it soon turns acid on exposure to air, due to absorption of carbon dioxide. With this acidity comes a marked increase in corrosive action. The activity is materially increased in the presence of magnesium chloride as a result of the earlier development of acidity and the formation of corrosive ammonium chloride in the case of ammonia leakage. Contact of unlike metals or the presence of stray electrical currents increases the rate of corrosion of a pure brine and the presence of the above impurities accelerates these electrical tendencies. The corrosive action of brine decreases with increasing brine density. Chlorides are on the market which are contaminated with magnesium chlorides, though first-class materials are available, both soda byproduct and natural chlorides. Corrosive brines free from magnesium chlorides may be corrected by treatment with lime if the alkalinity produced is maintained above 0.1 per cent. This is readily done by keeping a supply of lime in a bag hung in the brine tank.

Wear on Rails

According to M. J. Gouttier, in *Revue Universelle des Mines*, vol. 11, p. 524, the Sandberg sorbitic process of improving rails--used to a certain extent in England--has been lately applied by a traction line in Paris. Owing to the increase of the volume of the traffic and of the weight of the cars, the rails were being subjected to a more severe strain and are wearing down more rapidly than ever before. Investigations were set on foot to find a remedy. First it was thought best to alter the section of the rail. Another line of research was the question of using nickel steels, but their price proved prohibitive. The manganese and high-carbon steels were also studied.

Steel rails containing 0.5 per cent C, 0.3 per cent Si and 1.1 per cent Mn, treated by the Sandberg process, gave very good resistance to wear and were not expensive.

The Sandberg sorbitic process is applicable to the treatment of all similar articles where hardness and toughness are required. There are obvious objections to hardening rails by quenching. It is only necessary that the rails should be tough and hard. Therefore the rails, when still at a temperature above the critical range, are cooled by a blast of air or atomized fluid so as to cool them with a moderate speed through the critical range and obtain finally a sorbitic structure. By this treatment an increase of 10 to 15 per cent of tensile strength and of 20 to 25 per cent of elastic limit is easily had. Elongation is, of course, a little reduced and the Brinell hardness increased by 20 to 25 per cent. Resistance to abrasion is also raised very considerably.

The process has been developed to the treatment of rails *in situ*, by drawing a high temperature flame along the surface of the rail and then flooding the hot surface by a water jet.

Review of Recent Patents

Gas-Flow Meter—Charles W. Hinman has been granted a patent for a gas-flow meter which uses the heat interchange system for indicating the rate of gas flow. The method and apparatus are patented. The method consists of abstracting from the gas the quantity of heat resulting from the fixed diminution of temperature of the gas between inlet and outlet, producing in the abstracting fluid (water) a fixed temperature difference between inlet and outlet. The water flow is thus indicative of the rate of gas flow, due account being taken of the specific heats and temperature differences involved. (1,446,461. Feb. 27, 1923.)

Process for Treating Paper Mill Waste—J. E. Plumstead has assigned to the Jessup & Moore Paper Co., of Philadelphia, a process for recovering the soluble salts and the combined carbon in pulp mill waste liquor. This is done by passing first through an incinerating evaporator that takes off all the water, some of the chemicals and gases formed and reduces the combined carbon to a char. The resulting mixture of carbon and chemicals is treated with water in a dissolving tank, ground up finely and filtered. The carbon sludge which is thus obtained is dried and ground again and finally used as pulverized fuel. The hot gases are treated in a scrubbing system to remove any valuable products before allowing them to escape. (1,442,494. Jan. 16, 1923.)

Electrical Precipitation of Flocculent Material—This invention is concerned with the electrical precipitation of suspended materials from gases, when the suspended materials are of a light, flocculent nature such as soot or carbon smoke. In order to overcome the difficulty of precipitation of such materials, a solid, pulverulent material of a coarser, heavier nature than the material which it is desired to precipitate is distributed into the gas. This heavier material serves to form with the light, flocculent material a compact and granular mass easy of precipitation.

In operation, a suitable weighting and granulating medium, such as finely divided clay, fullers earth, soapstone, sand, cement, kiln flue dust or finely divided rock or earth of any kind which is heavier and more compact than the deposit which would be formed by precipitation of the material suspended in the gases is injected into the stream of gases passing to the electrical precipitator so as to become thoroughly distributed throughout the body of gases. This may be effected by injecting such finely divided solid material into the gas stream by blowing it in with a current of air, or steam, or other gas, or a mechanical distributing apparatus.

As the gas is then passed through the electrical precipitator and is subjected to the action of an electrical field produced between discharge and collecting electrodes, the material suspended in the gases, including the weighting and granulating agent aforesaid, is deposited on the collecting electrodes, and is removed from such electrodes from time to time by jarring, brushing or otherwise. By reason of the weighting and granulating effect of the material added to the gases and deposited along with the material originally suspended in the gases, the material so precipitated will remain on the electrodes instead of being carried along by the gases.

This is of especial importance in the case of gases where the precipitated material includes more or less soot. It has been found that in the precipitation of such material there is a tendency for the light, flocculent soot particles to be carried along by the

American Patents Issued March 20 and 27, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem & Met* readers. They will be studied later by *Chem & Met's* staff and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,448,846—Process for Making a Composition for Purifying Liquids. Walter L. Jordan, New York.

1,448,847—Sizing Composition. Reuben Kaiser, New York, N. Y., assignor to T. M. Duché & Sons, New York.

1,448,869—Varnish. Pincus Rothberg, Summit, N. J., and Albert Parsons Sachs, New York.

1,448,901—Gas-Analysis Machine. Frederick A. Moreland, Chicago, Ill.

1,449,067—Manufacture of Ink. Walter O. Snelling, Allentown, Pa.

1,449,102-113—Processes for the Manufacture of Yeast. Friedrich Hayduck, Wilmersdorf, Germany, assignor to the Fleischmann Co., New York.

1,449,114—Foam Destroying Device. Friedrich Hayduck, Wilmersdorf, Germany, assignor to the Fleischmann Co., New York.

1,449,121—Process of Producing Carvacrol and Thymol. Ralph H. McKee, New York.

1,449,127—Process for Producing Yeast. Martin Nilsson and Norman S. Harrison, Peekskill, N. Y., assignors to the Fleischmann Co., New York.

1,449,131—Method of Treating Molasses. Alfred Wohl, Danzig-Langfuhr, free city of Danzig, assignor to the Fleischmann Co., New York.

1,449,135—Method of Washing Compressed Yeast. Alfred Wohl, Danzig-Langfuhr, free city of Danzig, assigner to the Fleischmann Co., New York.

1,449,156—Solvent Composition. Herman F. Willkie, Baltimore, Md., assignor to U. S. Industrial Alcohol Co.

1,449,157—Enameling Composition. Herman F. Willkie, Baltimore, Md., assignor to U. S. Industrial Alcohol Co.

1,449,169—Apparatus for Producing, Separating, and Feeding Powdered Coal. Ernst H. Elzemeyer and Paul S. Knittel, St. Louis, Mo.

1,449,226-227—Process of Cracking Hydrocarbon Oils Under Pressure to Produce a Low-Boiling-Point Oil or Fraction. Richard W. Hanna, William D. Mason and Walter G. Hamilton, Richmond, Calif., assignors to Standard Oil Co., San Francisco.

1,449,330—Cleaning Composition. Sever P. Killy, Kansas City, Mo., assignor to John O. Lytle and Charles G. Edgerton, Sugar City, Colo.

1,449,373—Corrosion-Resistant Alloy. Wesley J. Beck and James A. Aupperle, Middletown, Ohio, assignors to the American Rolling Mill Co., Middletown, Ohio.

1,449,379—Lubricating Compound. Samuel A. Bullock, New York, N. Y., assignor to Ally Co., Inc., New York.

1,449,380—Manufacture of Threads, Filaments, Strips or Films of Cellulose. Michel Teodor Callimachi, London, England, assignor to Courtaulds, Ltd., London.

1,449,388—Paint and Varnish Removing Composition. Ida A. Ferrell, Staunton, Ind.

1,449,423—Production of Naphthylamines. Alexander Lowy and Arthur Mark Howald, Pittsburgh, Pa.

1,449,493—Process of Treating Rubber and Product Obtained Thereby. Sidney M. Cadwell, Leonia, N. J., assignor to the Naugatuck Chemical Co., Naugatuck, Conn.

1,449,603—Method of Separating Granular Solid Material. Martin Hokanson, Duluth, Minn.

1,449,613—Wool Cleaning. Hiram Young McBride, Denver, Colo.

1,449,681—Sulphur Dye. Erwin Kramer, Dentz, near Cologne, and Ludwig Zeh, Wiesdorf, near Cologne, Germany, assignors to Farbenfabriken vorm Friedr. Bayer & Co., Leverkusen.

1,449,718—Art of Rendering Paper Material Greaseproof. Wilbur L. Wright, Fulton, N. Y.

1,449,793—Glass and Process of Making Same. William Chittenden Taylor, Corning, N. Y., assignor to Corning Glass Works.

1,449,875—Apparatus for Hydrogenating Carbonaceous Material. Titus Ulke, Washington, D. C.

1,449,892—Sizing Composition and Process of Preparing the Same. Phillip W. Codwise, Dalton, Mass.

1,449,930—Machine for Treating Rubber and Other Heavy Plastic Material. Fernley H. Banbury, Ansonia, Conn., assignor to Birmingham Iron Foundry, Derby, Conn.

1,449,976—Oil Product and Process of Making Same. Henry V. Dunham, Mount Vernon, N. Y.

1,449,981—Method of Indigo Dyeing. Edward T. Garsed, Charlotte, N. C., assignor to Alexander & Garsed, Inc., Charlotte, Inc.

1,450,026—Process for the Manufacture of Lubricants From Low-Temperature Tar. Egon Eichwald and Hans Edgar Richard Vogel, Hamburg, Germany.

1,450,078—Valve for Corrosive Liquids. Charles F. Haunz, Buffalo, N. Y., assignor of one-half to Theodore Krug, Buffalo.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

gas stream because they do not form a compact adherent deposit on the electrodes, but either fail to adhere, or adhere only loosely to the electrodes, and are easily swept along by the gas stream. The dust, clay or other solid finely divided material, when precipitated along with the soot, forms a heavy more or less compact and granular deposit which adheres to the electrodes sufficiently to prevent being swept along with the gases, but can be readily dislodged by jarring or brushing, and when so dislodged will fall by gravity into the collecting means in the bottom of the precipitator. (1,446,-778. Gustav A. Witte, assignor to International Precipitation Co., of Los Angeles, Calif. Feb. 27, 1923.)

Process for Making Sulphates—Harry Pauling, of Berlin, Germany, has developed a process for making sulphates. It consists essentially in treating the metal with nitric acid, about 50 per cent strength. The acid is slightly warmed in order to start the reaction and a rapid evolution of nitric acid takes place. These gases are absorbed in suitable absorption towers, which may be operated in such a manner that the nitric acid is regenerated to the same strength at which the operation started. At the end of the reaction a solution of the nitrate of the metal is treated in another vessel with sulphuric acid. The nitric acid set free in this reaction is also recovered in the absorption chamber. Air is forced through the solution in order to free it from nitric acid. The resulting solution of copper sulphate may be crystallized by cooling.

The distinct advantages of this process lie in the fact that a very rapid reaction is effected with no loss of the intermediate agent—nitric acid. Formerly, sulphuric acid was run down through towers over copper or zinc, or nickel, or whichever metal was to be used, and the solution collected at the bottom This particular method is much more rapid and gives the material a high purity. (1,446,578. Feb. 27, 1923.)

Calcium Carbide Production—In U. S. patent 1,327,736 a claim was made for a process of producing calcium carbide from coking coal and lime mixed in proportions to form a cokelike mass and then subjected to the action of heat to convert it into carbide. It was stated in the specification that calcium oxide or calcium carbonate may be used with the bituminous coal when calcium carbide is the ultimate product desired. In a later patent (1,396,058) a cemented mixture of oxide and carbon made by the intimate mixture of lime and bituminous coal, heated to form a homogeneous mixture, was used as the raw material. It is stated in the present patent that a satisfactory product is obtained by intimately mixing equal parts by weight of calcium carbonate ground to about 40 mesh fineness with bituminous coal ground to about 8 mesh fineness. This mixture is subjected to heat sufficient to distill the coal. The heating may be performed in an ordinary gas retort or furnace. At about 600 deg. F. the tarry products are liberated and as the heating proceeds further, these bubble through the mass of material, thereby coating and impregnating each lime particle with hydrocarbon, which, under the influence of heat, is converted into coke or carbon. The action of the tarry products and the presence of an excess of carbon prevents the conversion of the calcium carbonate into the oxide (assuming the lime ingredient used is the carbonate). At the conclusion of the operation, a cemented mass of coke and limestone is obtained, which is of uniform composition throughout and which forms an ideal resistor to the passage of electric current in a carbide furnace. This raw material will not deteriorate, even though it is exposed to the action of the water. Hence it can be stored indefinitely and handled with convenience in the shipping. Furthermore, the limestone supplies not only the necessary calcium oxide, but has a fluxing effect which enables the reaction to be realized in a particularly efficient manner. (1,445,644. James H. Reid, assignor to International Nitrogen Co., Cleveland. Feb. 20, 1923.)

Organic Arsenic Compound—A new arsenic compound having the formula $As(OH)_2OCH_2COOH$ can be obtained by the interaction of chloracetic acid with arsenic oxide, As_2O_3, or its derivatives, provided the reaction takes place in the presence of an alkali. An example of how the material is produced is as follows: 198 parts of arsenic oxide (As_2O_3) are dissolved in 330 parts of sodium hydroxide and 700 parts of water. Subsequently 273.5 parts of chloracetic acid ($ClCH_2COOH$) are dissolved in a cold solution of 130 parts of caustic soda in 130 parts of water. The latter solution is then added while stirring to the solution of arsenic. After the reaction is complete the mixture is neutralized with acetic acid and rendered alkaline with a surplus of ammonia. By the addition of calcium chloride the calcium salt of the acetic arsenic acid is precipitated, filtered off and dried. The resulting compound is said to have therapeutic value. Johann Huismann and Jurgen Callsen, assignors to Farben-Fabriken vorm. Friedr. Bayer & Co., of Leverkusen, Germany (1,445,685. Feb. 20, 1923.)

Production of Cellulose Ethers—The present process in the manufacture of cellulose ethers is considerably accelerated by a method patented by Leon Lilienfeld, of Podhajce, Poland. Instead of washing out the alkali from the alkali cellulose, which is formed as an intermediate product in the ordinary process of manufacture, by this method the agent for conversion of the alkali cellulose to the ether is added before getting rid of the caustic. This does away with the pressing, centrifuging or like operations which have previously been necessary. The alkylating, aralkylating or arylating agent is added immediately after the caustic solution has acted upon the cellulose. (1,441,989. Jan. 9, 1923.)

British Patents

For complete specifications of any British patent apply to the Superintendent British Patent Office, Southampton Buildings Chancery Lane, London, England.

Pickling—In order to avoid brittleness in pickled iron or iron alloys, organic bases containing nitrogen rings, especially the quinoline nucleus, are added to any usual pickling bath, which may comprise sulphuric acid of 5 per cent strength for hot pickling, or hydrochloric acid of 10 to 20 per cent strength for cold pickling, and 1 to 2 per cent of the nitrogen compound. Extracts from the distillation products of coal tar or fractions of coal-tar distillates which contain the bases, or synthetic products may be used. Specification 158,768 is referred to. (Br. Pat. 188,713. British and Foreign Chemical Producers, Ltd., London. Jan. 10, 1923.)

Refining Lead—Oxidizable impurities such as arsenic, antimony, tin and zinc, are removed from lead by bringing the molten lead into contact with an oxidizing agent such as alkali nitrate, nitrite, chlorate or hypochlorite, or a peroxide, in suspension or solution in molten caustic alkali, or caustic alkali and a fusible chloride. The molten metal is preferably passed through the reagent by means of the apparatus described in specification 142,398 or 184,-639. The temperature and the proportion of oxidizing agent may be so adjusted that different impurities are removed in succession. (Br. Pat. 189,-013. H. Harris, London. Jan. 10, 1923.)

Artificial Silk—For purifying viscose and similar cellulose solutions to be used in the manufacture of artificial silk, the solution is emulsified with an organic liquid such as paraffine, which does not dissolve in the solution; on standing, the emulsion separates into layers, and the organic liquid carries with it the suspended particles and a portion of the resinous and coloring impurities of the viscose solution. Separation may be accelerated by passing the emulsion through a centrifugal separator. Subsequent filtration is unnecessary. (Br. Pat. 189,114; not yet accepted. J. R. N. van Kregten, assignor to Naamlooze Vennootschap Nederlandsche Kunstzijdefabriek, Arnhem, Holland. Jan. 17, 1923.)

Activated Carbon—Decolorizing carbon is produced from carbonaceous material of vegetable, animal or mineral origin, by dry distillation in presence of activating gases or other substances with or without a preliminary distillation together with inert or slightly active gases. The gases, which may be chlorine, volatile chlorides, air, steam, carbon dioxide or monoxide, flue or generator gases, or mixtures of these gases, are passed through the charge in a direction opposite to that of the charge itself. The other activating substances specified are calcium or magnesium carbonates and chlorides, slaked or unslaked lime or "liquids or gases." The raw materials such as wood waste, peat, waste cellulose, lignite, briquetted coal, etc., is charged into a retort, preferably

vertical or inclined, and the active gas, preferably at 100 to 600 deg. C., is introduced at the other end. The temperature of the retort is controlled by means of the gases so that it rises to a maximum and then decreases. Various temperatures are specified for the activation by the different gases. The retort gases produced are preferably removed at a short distance from one end of the retort, to obviate the choking of the conduit by the cooled products, and may be utilized to heat the retort. The product may be ground and purified by treatment with hydrochloric acid or "other chemicals." (Br. Pat 189,148; not yet accepted. General Norit Co., Ltd., Amsterdam. Jan. 17, 1923.)

Ammonia Recovery—Ammonia is recovered from producer gas, distillation gases and other gases containing a small amount of ammonia. The gas is passed through carbonaceous material containing organic acids such as soft lignite or peat, and the invention may be carried out in conjunction with the manufacture of producer gas from peat, lignite or similar material. The ammonia is liberated by means of alkali and the absorption material is regenerated by treating with an acid such as hydrochloric and removing the excess acid. (Br. Pat. 191,741. Industrial Research, Ltd., London. March 7, 1923.)

Insulating Varnish—Fatty acids are heated with either the gelatinized product formed by heating a vegetable oil with or without resin, or a mixture of glycerine and resin with or without vegetable oil. The heating is continued until the ingredients are thoroughly mixed and are on the point of gelatinizing. The compositions, with or without dilution with solvents such as kerosene, are used as varnishes and are further heated after application to cause them to solidify. Suitable fatty acids are those obtained from drying and semi-drying oils such as linseed, Chinese wood, corn, cottonseed, soya bean, peanut, sesame, rapeseed, castor oil and tung oils. Suitable resins are shellac and Congo copal. The products are particularly applicable for japanning or enamelling electric conductors and other metallic surfaces for insulating and protective purposes. (Br. Pat. 191,422; Western Electric Co., Ltd., Norfolk House, Victoria Embankment, Westminster March 7, 1923.)

Men in the Profession

Dr. FRANK APP has resigned from the staff of the Agricultural College and Experiment Station of Rutgers College to become vice-president of the Minch Brothers Co., at Bridgeton, N. J.

HENRY H. BUCKMAN, formerly head of Buckman & Pritchard, Inc., New York, producer of zircon, etc., will operate as a chemical engineer in raw materials and manufactures, with headquarters at Jacksonville, Fla.

WILLIAM I. BURT, formerly sales engineer of the Bristol Co., is now chief chemist of the Dolomite Products Co., Maple Grove, Ohio.

Dr. ARTHUR HOLLY COMPTON, head of the department of physics in Washington University, has been appointed professor of physics at the University of Chicago.

Dr. CECIL H. DESCH, professor and dean of the faculty of metallurgy in the University of Sheffield, delivered recently the "Second Sorby Lecture" on "The Services of Henry Clifton Sorby to Metallurgy." The Sorby lectureship has been instituted by Sheffield engineering associations to commemorate the work of Dr Sorby, who rendered signal service to metallurgy and to microscopy.

W. A. DUNKLEY has resigned his position as gas engineer at the Urbana Station of the Bureau of Mines to become superintendent of the gas department of the Memphis (Tenn.) Power & Light Co.

EDWARD CURTIS FRANKLIN, president of the American Chemical Society and professor of organic chemistry in Leland Stanford University, addressed the Pittsburgh Section of the society in the auditorium of the U. S Bureau of Mines on March 26. His subject was the "Ammonia System of Compounds," although it might be termed as a discussion of the analogy of ammonia to water. A number of interesting experiments were made.

CHARLES W. FRANCIS is now superintendent of the Lennox Chemical Co., Euclid, Ohio.

JOHN HAYS HAMMOND has endowed a scholarship in engineering at Yale University for a Mexican student. The scholarship is for a 4-year course and covers expenses of tuition, dormitory, meals, books, etc., and also transportation from and to Mexican border.

Dr. A. P. HOLLEMAN of the University of Amsterdam, Holland, will lecture, April 13, at 4 p.m. in the Doremus Lecture Theater, Chemistry Building, College of the City of New York.

Dr. IRA N. HOLLIS, for 10 years president of Worcester Polytechnic Institute and previously professor of engineering at Harvard University, has offered his resignation to the board of trustees.

A. C. HOUGHTON, who for the past 18 years has been associated with the Semet Solvay Co., has entered the employ of the Bakelite Co., of New York City. Mr. Houghton will erect and operate a phenol plant for that company near Cleveland, Ohio.

FRANK HOYER, formerly with the General Chemical Co., Buffalo, N. Y., has become an instructor in chemistry at the Hutchinson High School, Buffalo. Mr. Hoyer will spend part of his vacation with the General Chemical Co.

Dr. J. C. KARCHER of the sound laboratory, Bureau of Standards, has resigned to accept a position as technical adviser to the production manager of the Western Electric Co., Chicago, Ill.

CHESTER H. PENNING accepted an appointment as special expert with the chemical staff of the U. S. Tariff Commission, and assumed his duties in Washington about the middle of March.

HARRY STEBBINS, of Powers-Weightman-Rosengarten Co., has accepted the chairmanship of the fine chemicals division in the forthcoming Home Service Appeal of the Salvation Army for a fund to maintain and extend its activities in Greater New York.

E. T. STOTESBURY has been elected president of the Temple Iron Co., Reading, Pa.

Obituary

SIR JAMES DEWAR, the famous British chemist, who was the co-inventor with Sir Frederick Abel of cordite, the smokeless powder adopted by the government, died on March 27, in his eighty-first year. He also brought forward the Dewar flask, popularly known as the thermos flask. Sir James Dewar was born in Kincardine-on-Forth, prepared for college at the Dollar Academy and went to Edinburgh University, where he specialized in chemistry. On his graduation he became the assistant to Lord Mayfair, then occupying the chair of chemistry at Edinburgh University. Devoting himself to research the greater part of his long life, Sir James Dewar's investigations in the field of chemistry covered a wide range. Especially well known were the following among his investigations: Physiological action of light; problems of spectroscopy; liquefaction of gases; the scientific use of liquid oxygen, air, fluorine and hydrogen. For a time he was director of the Davy-Faraday Research Laboratory, and he held professorships at St. Peter's College, Cambridge, and was also Jacksonian professor of experimental philosophy at Cambridge. He was knighted in 1904.

GUSTAVUS DETLEF HINRICHS, formerly professor of physical science at the State University of Iowa and of chemistry at the St. Louis College of Pharmacy, is dead, at the age of 77.

CHARLES M. MACNEILL, president of the Utah Copper Co. and the Chino Copper Co. and vice-president of the Replogle Steel Co., died of pneumonia on March 17, at his home in New York, at the age of 52. He was ill less than 2 days. When 33 years of age he was elected president of the Utah Mining Co. and had been prominent in the copper industry since that time.

The Week in Industry and Trade

Current News and Market Developments

News Section

April 9, 1923
CHEMICAL & METALLURGICAL ENGINEERING
Tenth Avenue at 36th Street, New York
H. C. PARMELEE, *Editor*

Market Section

The Summary of the Week

The advance in phenol, together with prospects for a higher contract market, has stimulated the trade to such an extent that new production is under consideration in several quarters.

The Salesmen's Association of the American Chemical Industry has appointed a committee to draw up a uniform contract to govern transactions in chemicals.

Soap makers absorbed more than 1,000,000 lb. of extra tallow at 9c. per pound.

Heavy arrivals of arsenic from Japan reached the market during the week, but were readily absorbed.

Muriate of potash is very firm due to difficulty in securing stocks from Germany, and other potash salts are firm as a result.

Higher average price for tin caused advances in tin products at the beginning of the month, but tin oxide eased off in price during the week

Reports from Germany say that American buyers of chemicals are no longer active in German markets owing to the unsatisfactory result of previous business.

The Interstate Commerce Commission has refused to allow Western transcontinental railroads to reduce freight rates on oils from the Pacific coast to Chicago.

Permanganate of potash attracted considerable interest, but actual business was not heavy, as stocks are limited.

Bleaching powder has been finding a good outlet in consuming trades, and some producers are sold up.

Completing the Circle

THIS is the first issue of *Chem. & Met.* which contains this new department, "Industry and Trade." It is a new effort and will be a permanent addition to our service.

This department is built for every man in the chemical engineering industries. Whether his work be executive, operating, purchasing or selling, this department is his. He will naturally use it with different emphasis depending on his needs, but he will use it. Behind this constructive effort is a desire to serve all phases of the chemical engineering industries—production, management and marketing. The prestige that *Chem. & Met.* has earned as the leading technical paper in the field is a promise that its effort in marketing will be constructive and distinguished.

It has been more than a year since Herbert Hoover, acting as a spokesman and a critic of industry, said that the greatest effort of business in the next decade would be to diminish the slack and waste in distribution. That is the job of every business man. How is he to undertake it? What manner of effort must be made? Will it be accomplished by the single act of a genius? Probably not. It is a task for every one of us.

Distribution efficiency or marketing efficiency must be based first on a knowledge of markets. This includes current prices, and these *Chem. & Met.* will give you weekly. Accurate prices they are, compiled by men with long experience and a wide acquaintance, men who know accurate prices and who know where to get them.

Knowledge of markets must also include an understanding of the price changes that are likely to occur. Whether these changes are cyclical and dependent on seasonal demand or whether they are due to some unusual factors, they must be anticipated and interpreted by experts in that work. This *Chem. & Met.* will do through "Industry and Trade."

Again, knowledge of markets must include acquaintance with the trends of business. The post-war deflation taught us that lesson. The economics of business, the general movements toward depression or boom are not apparent from the day's work and can be sensed only by those who can get a perspective on conditions. In *Chem. & Met.* it is possible for us to focus the statistics from hundreds of sources into a balanced point of view on business conditions.

Imports and foreign prices are indications of the severity of foreign competition, and these will both be covered. Notes on corporations and industrials, reports of decreased or increased production, personal items indicating a greater or smaller emphasis on various phases of a company's business—all of these things paint a composite picture of business during the week.

This department will be *Chem. & Met.'s* contribution to better efficiency in marketing.

There is yet another side of this work that is important. In this department will be a record of important events in industry and trade. Not only is this department a market service to the industry but it is the newspaper of the industry. Able editors in New York, Chicago, Washington and San Francisco, constant editorial contact with industrial centers through trips and scores of correspondents in larger centers of activity make possible a news service that is unique.

H. C. Parmelee

Technical Societies and Trade Associations

News of the Week

Current Events Legislative Progress

Chemistry by radio is one of the latest wrinkles in popular education. Certain A.C.S. sections have already broadcast entertaining programs of chemistry with success. The New York Section is now planning a series of five or six lectures of popular interest which are to be wirelessed from the New York station WEAF. Subjects and speakers will be announced in the near future.

Gold and silver data are ready to be laid before the special Senate committee investigating the status of these industries. Various agencies have been active in assembling these data; the committee representing the mining congress expresses hope that the outcome of the investigation may greatly benefit the entire nation.

Prohibition of naval stores exportation from France is urged by various of her manufacturing syndicates which claim that the low stocks now in hand are fast being depleted by foreign purchasers. Rosin and turpentine are the commodities most affected.

New York's garbage problem is becoming serious. A study is being urged to find an improved method of disposing of the 3,700,000 tons of waste which has to be removed annually. Present methods involve both waste and a menace to health.

Education in leather is the aim of a campaign just launched, which is to be financed by the American Sole & Belting Leather Tanners, Inc. Various organizations are co-operating in this campaign to show the public what factors enter into leather manufacture and so influence costs to consumer.

The Austrian glass industry is tottering. Its wares cannot be placed on home or foreign markets. German and Czechoslovakian competitors are underselling Austrian firms by 40 to 50 per cent.

Soap going into Cuba from other countries than America is liable to new duties if a movement now on foot is carried through. Cuba makes most of her laundry and floating soap using much imported raw material, but has in the past imported toilet and perfumed soaps from Europe. The new measure would effectively stop this importing.

French metal industry is slowing down. An order has just been received here for 1,000,000 tons of American coal. The present supply of coke is very low. Almost none comes from the Ruhr. Several concerns are facing the suspension of all operations.

A unique service to paint men is being rendered by Spencer Kellogg & Sons, Inc., of Buffalo, N. Y. This firm, manufacturer of vegetable oils and oil products, is offering the services of an expert on linseed oil to speak before any master painters' association in the United States.

Calendar

The following important technical meetings are scheduled for the immediate future:

AMERICAN ASSN OF ENGINEERS Norfolk, May 7-9

AMERICAN ELECTROCHEMICAL SOCIETY New York City, May 3-5

AMER SOCIETY MECHANICAL ENGRS. Montreal, May 28-31

AMERICAN FOUNDRYMEN'S ASSOCIATION Cleveland, O., April 28-May 4

AMERICAN OIL CHEMISTS' SOCIETY Hot Springs, Ark., April 30-May 1

AMERICAN WELDING SOCIETY New York, April 24-27

AMERICAN ZINC INSTITUTE St. Louis, May 7-8

CANADIAN INSTITUTE OF CHEMISTRY Toronto, May 29-31

INTERSTATE COTTON SEED CRUSHERS ASSN Hot Springs, Ark., May 2-5

SOCIETY OF CHEMICAL INDUSTRY Canadian Section Toronto, May 29-31

SOCIETY OF INDUSTRIAL ENGINEERS Cincinnati, O, April 18-20

SOCIETY OF CHEMICAL INDUSTRY New York, joint meeting with other societies, April 13

Six million cords of pulpwood was consumed by United States pulp mills in the banner year, 1920. A recent report of O. M. Porter of the American Pulp and Paper Association states that last year fires destroyed enough wood to keep our mills running for 18 months at this rate. Budworms are destroying an average of 10,000,000 cords a year in Quebec alone.

The sisal inquiry of the government has been placed in charge of P. L. Van Buren Bell, who has been appointed by Secretary Hoover. Mr. Bell is to look into the situation on the ground with especial reference to the control of the Yucatan crop.

Colombia and Brazil urge American investigation of their rubber resources The Ministers of these countries have issued statements in which co-operation in a study of the situation is promised. Willingness on the part of these countries to have the United States develop its own rubber industry within their bounds seems manifest.

Acetylene and oxygen, purified and mixed, roughly 40 per cent of the former to 60 per cent of the latter, constitute a new anæsthetic. Its discoverer, Prof. K. Gaus, has named the mixture narcylene. The objectionable odor of the acetylene is overcome by the addition of pine oil.

Federal Phosphorus Co. Not to Produce Arsenate

The Federal Phosphorus Co. is not to engage in the manufacture of calcium arsenate. Theodore Swann, president of the company, has notified *Chem. & Met.* that the statement appearing in last week's issue to the opposite effect is in error.

Tariff Investigation Organized

Schedules asking information regarding costs of production and other data have been mailed by the Tariff Commission to domestic producers of the seven chemicals regarding which the commission has undertaken investigations looking toward changes in duties under the flexible tariff section of the new act.

The commission has approved plans by which F. W. McSparren, of the chemical section, and an accountant not yet selected will sail for Argentina April 14 to investigate costs of production and other competitive conditions of casein in the South American republic, which is the largest exporter to the United States, and by which C. R. DeLong, chief of the section, and M. G. Donk, an assistant, and an accountant will sail for Europe about May 1 to investigate costs of production there of oxalic acid, diethyl barbituric acid, barium dioxide, potassium chlorate and sodium nitrite. Dexter North, another chemist, will join the European party later. Investigation into foreign costs of production of logwood extract will be made, in the Caribbean islands principally, at a somewhat later date.

Casein Investigation Under Way

Chief DeLong and Mr. Donk spent several days in New York and vicinity recently conferring with producers of casein regarding the tentative cost schedule. As a result several changes were made in this schedule before it was sent out. There are about seventy producers of casein in the United States. Schedules for the other chemicals, each of which involves a smaller number of domestic producers, were sent out without consultation. While in New York the representatives of the Tariff Commission also arranged with importers for letters of introduction to their foreign connections.

The schedules, in most cases, will be compiled in the office of the Tariff Commission before experts and accountants visit the domestic plants to check the returns and observe conditions, and in others will be filled by the manufacturers and held until the commission's representatives call.

Franklin Discusses Ammonia

Thirty A.C.S. sections throughout the country are to hear Dr. E. C. Franklin, president of the society, lecture on "The Ammonia System of Compounds." His first delivery of the talk was before the Southern California Section on March 16 at Los Angeles.

Dr. Franklin illustrated his remarks by a large number of experiments with liquid ammonia. He stressed the similarity that existed in many of the physical and chemical properties of ammonia and water. Although water was accepted as the universal solvent, ammonia was equally effective. A parallelism existed between the water of crystallization of some compounds and the ammonia of crystallization of others. Pure water is a non-conductor of electricity; liquid ammonia is equally resistive. An experiment was made of attaching to electrodes in the liquid a circuit containing a source of power and an ordinary electric bulb. Insufficient current passed to cause the filament to glow. After the addition of a minute amount of silver nitrate, however, the liquid ammonia became a conductor, and incandescence resulted.

Pure liquid ammonia is neither acid nor base; acids and bases react with it as they do with water. High degrees of concentration are practicable with many salts when dissolved in liquid ammonia; crystallization usually occurs with much greater facility from an ammonia solution than from a water solution. A distinct analogy is traceable between hydrolysis and, to coin a term, ammoniolysis.

Motor Fuel Development Encouraged by France

French importers of gasoline must purchase motor alcohol from the government. Recent legislation in France makes it compulsory for those who import motor gasoline to purchase from the government each month a quantity of motor alcohol equal to one-tenth of the volume of gasoline imported during the previous month. A cablegram to the Department of Commerce from Commercial Attaché C. L. Jones explains that this measure will become effective in July, 1923. The Department of Commerce states that apparently this measure is aimed to utilize the large stocks of alcohol held by the French Government and likewise to assist in the development of a "national motor fuel," using alcohol as a base.

Naval Stores Data Sought

The Bureau of Chemistry is making the necessary preparations to collect annual statistics on turpentine and rosin in the hands of the consuming industries and also statistics showing the stocks of rosin and turpentine at the primary ports and chief marketing centers. Figures will be made public jointly by the Bureau of Chemistry and the Bureau of the Census and will be available some time in May.

Paper Exposition Program Announced in Detail

Large Attendance Expected — Many Exhibitors Have Taken Space— Technical Meetings Planned

Many features both in exhibits and programs mark the opening of the Paper Industries Exposition at Grand Central Palace, New York, on April 9. Ticket demand has been very heavy for the exposition. Only four spaces remain unoccupied; the total number of exhibitors is twice that of the first Chemical Exposition. Every phase of the industry is represented.

The program for the week follows:

Monday, April 9—Opening Day. Formal opening, 2 p.m. Afternoon and evening, motion pictures.

Tuesday, April 10—Clean Food Packaging Day. Afternoon, program of notable addresses; official visit by Salesmen's Association of the Paper Industry; evening, motion pictures.

Wednesday, April 11—Executive Day. Executives of paper-manufacturing plants to be shown through the exposition. Afternoon and evening, motion pictures.

Thursday, April 12—Technical Paper Manufacturing Day. Afternoon, special technical program; official visit by American Paper and Pulp Association and the National Paper Trade Association; evening, motion pictures.

Friday, April 13—Printers, Publishers and Advertisers Day. Afternoon, program of notable addresses; evening, motion pictures.

Saturday, April 14—Consumers Day. Afternoon, special features of interest to paper consumers; afternoon and evening, motion pictures.

CO_2 Consumption Grows

Carbonated beverages now are being consumed in this country at a rate in excess of four billion bottles per year, J. W. Sale, chief of the Water and Beverage Laboratory of the Bureau of Chemistry, estimates. An indication of the growth of the carbonated beverage industry is had in the fact that the membership of the bottlers' organization, the American Bottlers of Carbonated Beverages, although formed only 3 years ago, now has a membership of more than 1,800. The 1923 convention of the organization is to be held in Providence, R. I. The exact date has not yet been set.

To Make Alloy Steel in Canada

The formation of the Dominion Alloy Steel Corporation, Ltd., by a number of iron- and steel-producing experts of wide experience is one of the latest and most interesting developments in the Canadian iron and steel industry. Today all the steel used in the manufacture of motor cars is being purchased from the United States. Canada now ranks as the second largest maker and user of automobiles among the nations of the world. Approximately $600,000,000 is invested in this industry.

Feiker Heads Material Survey

At the request of Secretary Hoover, of the U. S. Department of Commerce, F. M. Feiker, assistant to the president of the McGraw-Hill Co., Inc., has undertaken the organization and general direction of the world surveys of raw material supplies, rubber, sisal hemp and nitrates, for which Congress recently made an emergency appropriation of $500,000.

California Uses Own Resources in Pottery Making

With the exception of English china and ball clays, and English cliftstone whiting, the new plant of the Homer Knowles Pottery Co., Santa Clara, Calif., will utilize almost exclusively Pacific coast raw materials in the production of chinaware. The flint and feldspar will be taken from California properties; the borax and boracic acid will come from Death Valley, Calif.; the oxide of cobalt from California and Nevada; and the oxide of zinc and white lead from other points in this district. Operations at the pottery have been commenced and it is expected to develop the plant to the greatest extent. Homer Knowles is president and L. S. Reading vice-president.

Canada Provides Paper School

Plans are being made by the government of the Province of Quebec, Canada, for the establishment of a pulp and paper-making school and a bureau of scientific research in connection with the forest industries of the province. In this regard the Minister of Lands and Forests is working in conjunction with the Canadian Pulp and Paper Association.

Of importance also to the forest industries is the forthcoming conference between the provinces in the matter of forest protection. This is to extend to all the provinces and it is being hoped also that it will be possible to interest the United States, principally in regard to the Maine forests. The idea that the Minister of Lands and Forests, Honore Mercier, has in mind is that there should be a certain uniformity of laws for the prevention of forest fires.

To Discuss Cement Constitution

The Portland Cement Association, at its forthcoming meeting, is to hear P. H. Bates of the Bureau of Standards discuss the problems of the cement industry. Particular emphasis is to be laid upon the constitution of cement. It is expected that Mr. Bates' talk and the discussion of it will bring out the more important points that will be investigated by the association in the research which has been recently authorized, and which, it is hoped, will be carried out by the association in close co-operation with the National Bureau of Standards.

Commercial and Business News

German Chemical Companies Unable to Fulfill American Contracts

French Occupation Prevents Securing Raw Materials From the Ruhr —Tariff Difficulties Encountered by American Buyers— Poor Containers and Adulterated Products Factors in Demoralizing Trade

THE German chemical market, particularly at Hamburg, has a gloomy outlook which can be attributed to various reasons, among which is the difficulty of obtaining materials from the Ruhr owing to the French occupation.

There are many instances where chemical concerns at Hamburg are unable to fulfill their contracts with American houses owing to the impossibility of getting materials from manu facturers in the Ruhr area. In a number of instances, American firms have found it impossible to obtain delivery on products ready for shipment which are in the hands of manufacturers in the Ruhr and are in a quandary as to what to do in cases of revolving contracts for materials which they have contracted to deliver to American buyers.

Certain American buyers are frantic in their efforts to fill contracts falling due in the United States, and except in cases where the Germans have a speciality chemical which can be obtained from no other country, are rushing to buy the materials in the American market in order not to lose customers and are therefore forced to take losses on some deliveries.

Steady Decrease of American Buyers

American buyers have ceased buying promiscuously in the German market. American buyers in the German market have had unfortunate experiences with the operation of the new American tariff in the payment of duties on some commodities, especially those which were not clearly specified in the new law, the duties on which in certain instances are said to have run so high as to make the value of the commodity three times the wholesale market price in the United States.

Tariff Causes Mixup

In one case a firm which purchased a salt not specifically provided for in the new tariff and which sold for 25c. a pound in the New York wholesale market was requested to pay a duty of 75c. per pound in accordance with the category under which it fell, and finding this impossible, endeavored to cancel contracts for delivery of the commodity with German manufacturers. He was finally forced by court action to take another consignment ready for shipment, resulting in a terrific loss which had its effect in both the German and the American market. A number of other instances of like character might be cited.

High Prices for Containers

Prices for good containers for chemicals have soared to such height that it is almost impossible to obtain a good barrel or jute bag in which to ship materials. Barrels, in some cases, cost more than the materials, and often cheap barrels or used barrels are provided which break before they arrive at their destination or are so dirty inside as to spoil the materials for practical use.

Certain American importers of chemicals state that often when a consignment of salts has reached New York from Germany, after unloading a cargo, there is more salt in the ship's hold and on the dock than in the bags.

Inferior Quality of Chemicals

So many complaints are made as to the quality of German chemicals and so many cases are pending in the German courts between concerns on account of chemicals not coming up to specifications that it has driven the American buyer to other markets. The impurities in epsom salts and glauber salts shipped from Germany are such that they do not come near the U.S.P. specifications, although the German analyst assures the buyer that the product will meet the U.S.P. specifications. This is more noticeable in the dealings with new concerns which have originated since the war than with old established firms, the latter still being careful in all dealings in order to uphold the reputation of their houses. Recently the percentage of sand and iron and other impurities found in certain chemical salts has been very noticeable. One American firm dumped 50 tons of epsom salts into the river after their arrival in this country due to the fact that they contained such a large percentage of such impurities.

High Prices

Prices have in most cases now exceeded gold values and German firms are now importing commodities which they were recently exporting to the United States. Caustic soda, sodium sulphide and sal ammoniac are among the materials which are being purchased from the New York market.

Imports of Chemicals for December Fall Sharply

Chemical Imports for the Calendar Year, However, Show Good Gain Over Those of Previous Years

A decided decrease in the imports of chemicals and allied products is shown by the December figures which just have been compiled by the Department of Commerce. In December the value of chemicals and allied products brought into the country free of duty were valued at $4,738,819. The value of the imports on the dutiable list was $2,809,166. This compares with $10,731,795, the total imports of free and dutiable chemicals and allied products in November. There was a notable falling off also in the imports of coal-tar chemicals. In December the value of all coal-tar chemicals brought into the country was $687,972. In November those imports were valued at $1,055,523.

The imports of paints, pigments and varnishes were valued at $275,514, an increase of $75,000 over the imports in November. It also is noteworthy that the imports of paints, pigments and varnishes in December of 1922 exceeded the value of the imports in December of 1921.

Imports of Fertilizers Decline

Imports of fertilizers in December were only slightly more than half as great as those brought into the country in November. The total value of fertilizers imported during December was $3,851,619. These imports, however, are greater than those of December, 1921, when the value of all fertilizers imported was $569,512. Most of the increase is accounted for by larger imports of nitrate of soda. The increase applied, however, to all the nitrogenous phosphates and to potash fertilizers.

Imports for the Calendar Year 1922

With a compilation of the December figures a review of the imports of the entire calendar year now is possible. Throughout 1922 chemicals and allied products valued at $63,126,239 were imported, about $10,000,000 more than the value of imports during the calendar year of 1921. Imports of coal-tar chemicals throughout 1922 were valued at $11,012,769, slightly less than the value of imports of 1921.

Colors Again Coming In

The year 1922, however, saw the upbuilding of a considerable import of colors, dyes, stains, coal acids and coal bases. The value of these products imported in 1922 was $1,006,924. There were no imports of these commodities during 1921. Paints, pigments and varnishes to the value of $3,673,139 were imported during the 12 months of 1922. This is an increase of a million

and quarter dollars over imports in the calendar year of 1921.

Fertilizers to the value of $45,183,574 were imported during 1922. This is an increase of nearly $15,000,000 over the value of the 1921 imports. The largest single item entering into that total is $26,152,723. The value of Chilean nitrates imported during 1922 was about $9,000,000 more than were imported during 1921.

Comparative figures showing the imports of certain chemicals during December, 1922, with revised chemical figures for December, 1921, are as follows:

	1921	1922
Carbolic acid (lb.)	.....	24 510
Other intermediates (lb.)	99,114	111,052
Synthetic indigo (lb.)	336,979	. .
Alkalis and alkaloids (lb.)	1,049,861	
White arsenic (lb.)	.....	699,697
Oxalic acid (lb.)	......	488,950
Sulphuric (lb.)	......	432,000
Tartaric (lb.)	.....	98,387
Muriate of ammonia (lb.)	151,969	....
Perchlorate (lb.)	..	259,938
Bleaching powder (lb.)	1,998,069	76,800
Crude iodine (lb.)		10,734
Cyanide of potash (lb.)	.. ..	236,363
Sodium nitrate (lb.)	.	333,919
Calcium cyanamid (tons)	1,582	6,751
Sulphate of ammonia (tons)	295	..
Muriate of potash (tons)	14,229	8,318
Kainite (tons)	10,777	10,520

Coal-Tar Survey Being Made by Tariff Commission

A thorough survey of production, importation and world conditions of coal-tar dyes and chemicals is being prepared by W. N. Watson, color expert of the chemical section of the Tariff Commission. The work probably will not be completed for several months.

The survey probably will not be published, being intended for the information of Congress, but the data will be made available to the trade on request. This is the first comprehensive survey of coal-tar finished products undertaken by the Tariff Commission, the work heretofore having been confined to an annual census of production and importations, with notes on occasional items for the benefit of committees of Congress. The survey will include chapters on dyes, pharmaceutical ingredients, synthetic tanning materials, flavors and perfumes, phenolic resins and synthetic indigo. It will embrace world production and distribution, domestic conditions and competitive conditions generally.

Washington News

Reduce Rate on Sesame Seed

The Interstate Commerce Commission has upheld the contention of the Globe Cotton Oil Mills that a rate of 55 cents on sesame seed from San Francisco to Los Angeles is unreasonable. The commission finds that the rate was unreasonable to the extent that it exceeded 25 cents per 100 lb. In its opinion the commission held that sesame seed is comparable with flaxseed and rapeseed.

Research Work to Aid in Increasing Arsenic Production

The recent agitation regarding white arsenic and the insecticide of which it is the principal ingredient, calcium arsenate, has served to stimulate research and prospecting for arsenious ores. Beyond these factors, however, there has been no definite result reported, byproduct smelter plants apparently awaiting a more definite demand before going into heavy production of arsenic.

The Geological Survey is engaged in an informal check of estimates of 1923 production of white arsenic, and while there is no report in shape for official announcement, it is said that indications point to a production of 21,000 to 22,000 tons, instead of the approximately 18,000 tons which was estimated in a report given Congress several months ago. Minimum domestic requirements for purposes other than insecticide manufacture are estimated at 9,000 tons.

Research work along the lines of improved methods of recovery of arsenic from smelters and a redistribution of refining plants if demand justifies and also along the lines of less costly and more efficient means of direct recovery of arsenic from ore is progressing actively, being the outstanding result of the recent agitation.

Increased Movement of Nitrate of Soda to This Country

While import figures covering February business are not available, the traffic through the Panama Canal during February indicates a very material increase in the movement of nitrate of soda from Chile to the United States. During February 183,344 tons of that commodity passed through the Canal. While it is known that all of this tonnage did not come to the United States, it does indicate the very much larger volume in which nitrate is moving. It can be said that imports into the United States are greater in proportion than the increases in the shipments to other countries.

Bright Outlook for American Chemical Products

Trade prospects are particularly bright for practically every chemical product that the United States is in a position to export, chemical specialists in Washington point out. The fact that German exports to this country are continuing in larger volume than had been expected should not lead to the conclusion that Germany is exporting in the same volume to other countries or that shipments to America will continue at the present rate. Germany is particularly anxious to secure business where payment is made in dollars. The uncertainty of the situation at home and the way in which the mark is being manipulated at this time are causing Germany, it is believed, to rob her own consumers to fill American orders. To the economic reasons for such procedure must be added the powerful influence to that end which is being exerted by American importers. Some are of the opinion that Germany must almost have given up dyeing at home in her effort to build up dollar credit and hold on to her American market. All reports being received from Germany, however, are to the effect that the volume of new production is low and continues to diminish.

Imports of Coal-Tar Dyes in 1922

Imports of coal-tar dyes in 1922 totaled 3,880,811 lb., valued at $5,600,163, according to premilinary figures from the records of the Commerce Department. Of the total, 1,738,753 lb. valued at $2 533,581, came from Germany; 1,476,715 lb., valued at $2,326,391, from Switzerland; 177,293 lb., valued at $229,608, from England; 145,989 lb., valued at $175,436, from Italy; 168,201 lb., valued at $197,383, from the Netherlands; 57,541 lb., valued at $56,848, from France, and the remainder from Belgium, Canada, Japan and Czechoslovakia.

The total compares with imports of 3,914,036 lb., valued at $5,156,779, in 1921. In 1914, before the domestic dye industry gained a foothold, imports totaled 46,000,000 lb., and only 6,000,000 lb. was produced in the United States, practically all of this from intermediates imported from Germany.

Competition From Moroccan Phosphate Rock

No actual measure is possible as yet of the character of competiton which may be expected from Moroccan phosphate when the railroad is completed between Casa Blanca and Oued-el-Zem. It is known, however, that the Moroccan product is of high grade and will displace Florida phosphate in certain markets. Due to the isolated location of the deposits and the care with which those interested in the development are guarding information as to the probable extent of their output, no accurate data are available. It can be said, however, that the potentialities of this competition are causing concern on the part of those interested in American phosphate properties.

Chemical Company Expands

The Hanovia Chemical & Manufacturing Co., of Newark, N. J., has purchased a large plot of ground adjoining its factory. This purchase was made in order to provide for future expansion of the company.

Heavy Demand Forces Linseed Oil Prices Upward

Record Shipments of Argentine Seed Readily Absorbed—Foreign Oil Bought by Crushers

IN the latter part of last year estimates on the Argentine linseed crop indicated an exportable surplus of 62,000,000 bu. Later these estimates were revised and trade opinion now places the exportable at 40,000,000 bu up to 52,000,000 bu. with many well-informed seed men inclining toward the higher figure. Granting that the lower estimates are correct, there was good reason to believe that the world's supply of linseed was large enough to insure a relatively low price level for linseed oil in all markets. Crop prospects in India were generally favorable and a minimum exportable of 12,000,000 bu. is expected from that country. Moreover, the Continent was regarded to be in a position where its consuming requirements for seed would be less than normal.

Seed Movement Satisfactory

The movement of seed from producing sections has been all that could have been expected. From Oct. 1 to March 31 receipts at Western terminals in this country were about 7,600,000 bu. Imports during the same period swelled the total to such an extent that crushers have had a supply of approximately 17,000,000 bu. This is at the ratio of 34,000,000 bu. for the year—a total which, with the exception of last year, never had been consumed in any year in the history of the domestic industry. Shipments from the Argentine during the first 3 months of this year reached the record volume of 20,744,000 bu. Of this amount 12,926,000 bu. went to the United Kingdom and the Continent, thus showing that the supply in all consuming markets was unusually large.

Reasons for the High Prices

Prices for seed and oil, however, have gone steadily upward and at present these commodities are selling at levels higher than have been in effect since 1920. Various reasons may be assigned for the strong position of the markets. In the first place, it is evident that former standards of consuming needs in this country must be discarded in favor of standards more in accord with the progressive growth of the paint, varnish and other industries whose manufactures include linseed oil as a necessary raw material. In a recent address before the Paint, Oil and Varnish Club of New York one of the most experienced linseed men in the trade stated that this country was consuming seed at the rate of 40,000,000 bu. per year.

Furthermore, Europe has upset all calculations by the extent of its seed purchases and especially by its prominence as a competitor in Argentine markets. As an incidental cause for high prices, it may be recalled that the early promise of a record yield in the Argentine inspired heavy speculative trading on the short side of the market, and the covering of these short sales helped to start the trend of values upward. Briefly summarized, current values for seed and oil may be explained by the natural workings of the law of supply and demand. There appears to be nothing fictitious or inflated about present values, and lower prices can hardly be looked for until the balance swings more in favor of supply.

Interest in Foreign-Made Oil Revived

One of the important developments growing out of the sharp rise in prices is found in the revival of interest in foreign-made oil on the part of American importers. When the new tariff law went into effect last September, it provided for an import duty on linseed oil, of 3.3c. per pound, equal to 24¾c. per gallon. This was generally regarded as an effective barrier and it was freely predicted that foreign oil would not be able to compete in our markets as long as this tariff remained in operation. Yet last month more than 1,500,000 gal. of oil were reported to have been bought in European markets by American interests, with domestic crushers credited as being the largest purchasers.

Western Railroads Can't Lower Rates on Vegetable Oils

The Interstate Commerce Commission has refused permission to Western transcontinental railroads to reduce freight rates on vegetable oils from Pacific coast points to Chicago and adjacent territory. Transcontinental railroads by schedules filed to become effective Dec. 5, 1922, proposed the 10c. cut. Protest was immediately made by the importers, dealers and manufacturers and the Eastern trunk lines, and the commission suspended the schedules pending an investigation.

Russian Far East Restricts Imports of Chemicals

Advices just received from the Russian Far East state that a law has been passed prohibiting the importation of various commodities. Among the items specified on the prohibited list are many chemicals and allied products, including: glauber salts, phosphates, alcohol, carbonate and bicarbonate of soda, caustic soda, chlorine, lime, resin, tar, asbestos, magnesium, talc, manganese ore, potato flour, fertilizers, varnish, paints, candles, sheet glass, textile raw materials except cotton, inks, except copying and fountain pen ink.

Mills Oppose Move to Lower Vegetable Oil Duties

J. A. Arnold, vice-president of the Southern Tariff Association, has filed a petition signed by 160 cotton oil mills. This petition is in the form of a protest against any move to lower duties on vegetable oils. Edward Woodall, chairman of the Vegetable Oil Division of the Southern Tariff Association, in a memorandum accompanying the petition gives notice that, if the vegetable oil schedule is reopened, he will apply for an increase of 50 per cent in the duties on vegetable oils, based on cost of production in this country compared with similar cost in the Far East.

Trade Notes

Charles J. Roh, vice-president and sales manager of the Murphy Varnish Co., of Newark, N. J., returned last week from an extensive business trip throughout the West, including the Pacific coast.

At the last meeting of the Paint, Oil and Varnish Club of New York, three new members were admitted. They were: H. F. Kleinfeldt, of the Abbe Engineering Co.; R. G. Jackson, of the Kentucky Color & Chemical Co., and W. Buxbaum, of the Winchester Arms Co.

J. C. Smith, for several years secretary of the Oil Seeds Co., of New York City, has formed a new company under the name of the Smith-Weihman Oil Co., with offices at 19 Moore St. Mr. Smith is secretary of the Oil Trades Association of New York.

Charles W. Mixter, of Brookline, Mass., has accepted an appointment as tariff economist on the Tariff Commission.

E. W. Jayne, of Jayne & Sidebottom, left New York last week on a business trip to the Middle West.

The world's production of tin in 1921 was only 109,704 metric tons, the lowest annual output since about 1908 and a decrease of about 16,000 tons from that of 1920.

Dr. J. W. Jenks, of the Alexander Hamilton Institute; W. F. Gephart, of the First National Bank of St. Louis, and A. C. Kains, president of the Federal International Banking Co., New Orleans, will be speakers at the Foreign Trade Convention to be held at New Orleans, May 2, 3 and 4.

Exports of quebracho extract from the Argentine from March 1 to March 23 were 31,000 tons, which compares with 20,000 tons exported in the corresponding period of 1922.

The steamship Stuart Dollar arrived at San Francisco on April 2 from the Far East with 192 packages of arsenic and 352 barrels of china wood oil.

R. B. French, manager of the New York office of the Harshaw, Fuller & Goodwin Co., is on a buisness trip to Buffalo and surrounding territory.

Facts and Figures That Influence Trade in Chemical Products

Market Conditions

Current Prices Imports and Exports The Trend of Business

Steady Contract Deliveries Feature Market for Heavy Chemicals

Antimony Products Advance in Price—Cream of Tartar and Tartaric Acid Firmer—Arsenic Stronger for Spot and Nearby—Tin Oxide Lower—Permanganate of Potash in Light Supply

GOOD call is reported for contract deliveries of most heavy chemicals and in some cases producers are using their entire output to take care of existing orders. New business during the week showed a falling off as compared with the preceding week. German chemicals have attracted attention following reports that difficulty was found in securing supplies. In many cases stocks already contracted for are not coming to hand and importers who had resold their German contracts have been trying to protect their buyers by securing the goods from sources outside the original sellers. The freight situation is still unfavorable for moving materials from some sections of this country and this is causing some delays in deliveries.

Permanganate of potash was actively sought during the period but offerings are small as domestic goods are sold ahead and imported material is not coming in freely enough to relieve the spot stringency. Large amounts of arsenic reached the local market during the week but most of this went direct to consumers and the balance was sold while afloat so the spot situation was not bettered. Cream of tartar and tartaric acid are feeling an increased seasonable demand and brought higher prices in the local market. Antimony oxide and other antimony products likewise were firmer. Tin oxide lost the advance reported at the beginning of the month and showed a decline of 3c. per pound. Hydroquinone was offered at $1 per pound, which represents a decline of 5c. per pound. Hyposulphite of soda also was offered at prices more in buyers' favor. Formaldehyde was unchanged in price as far as producers were concerned, but second hands were shading.

Fertilizer Chemicals Active

The fertilizer trade has had a very active season and a correspondingly active call for many chemicals has come from that source. While the season is now well advanced, there still is heard a good inquiry for many fertilizer chemicals. It is significant to note that imports of fertilizer materials for the last calendar year reached a valuation of $45,183,574, which represents a gain of nearly $15,000,000 over the total for 1921. Of this increase about $9,000,000 was credited to nitrate of soda. Imports of all chemicals for the year ending December 31 were valued at $63,126,239, or about $10,000,000 more than in the preceding year.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	**181.61**
Last week	181.44
April, 1918 (high)	286.00
April, 1919	231.00
April, 1920	261.00
April, 1921 (low)	140.00
April, 1922	158.00

The moderate advance in the index number was caused chiefly by the uplift in linseed oil. Chemicals showed but little average change.

Acids

Acetic acid—Consumption of acetic acid continues in a satisfactory way and there appears to be no likelihood of an easing off in prices for some time to come. The corroders have been absorbing large quantities. The 28 per cent held at $3.17½ per 100 lb., while the 56 per cent was nominally unchanged at $6.35@$6.37 per 100-lb. Glacial closed at $12.05@$12.85 per 100-lb.

Citric acid—There was a seasonable increase in the volume of business and with foreign markets tending higher prices here were quite firm at the close. The imported was raised to 51c. per pound in more than one direction and talk of even higher prices than this was heard in the local trade. Domestic material held at 49@50c. per pound. Several shipments came through from abroad in the past week.

Formic acid—The 85 per cent was available at prices ranging from 14½@17c. per pound, according to quantity, delivery, etc. The market was a little unsettled in some directions.

Boric acid—The market was steady on the basis of 11c.@11½c. per pound. Some traders were not disposed to shade 11½c. per pound, immediate delivery.

Muriatic acid—Production is well taken care of and a firm undertone features the market. Nominal quotations range from $1.00@$1.10 per 100 lb., on the 20 degree in tanks.

Oxalic acid—There was a firm undertone to the market for oxalic acid and makers recently advanced prices to the basis of 12¾c. per pound, f.o.b. works. Spot material settled at 13¼c.@13½c. per pound. The fact that competition with foreign goods, temporarily, has been eliminated, brought out a much better feeling here. Imported costs from 13¼c.@13½c. to import, according to advices received here late in the week.

Sulphuric acid — Consumption has been good for some time past and with stocks reduced in nearly all directions a strong undertone features the market. The 66 degree variety closed at $15@$16 per ton, in tanks, f.o.b. works. On the 60 degree the nominal quotations range from $9.50@$10.50 per ton, f.o.b. works. Oleum was raised to $18.50@$19.50 per ton.

Tartaric acid—Producing costs have advanced and this combined with good consuming demand has strengthened the market. Sellers now hold imported at 34c. per lb. and domestic makes are held at an inside price of 35c. per lb.

Potashes

Bichromate of potash—Some reports credited sales of moderate sized lots at 10¾c. per lb. but the general asking price showed 11c. per lb. as the inside price. Stocks have been moving freely and the market appears to be in a strong position with much depending on future developments in the market for muriate.

Carbonate of potash—Buyers have shown considerable interest in hydrated but offerings are so meager that trading has been held down to small volume. Prices are little better than nominal at 7½c. to 7¾c. per lb. Shipments are quoted at the same level as spot but guaranteed deliveries are hard to locate. Calcined 80-85 per cent likewise were practically taken off the market and in most quarters prices meant nothing in the absence of offerings. Calcined 96-98 per cent sold in a small way with asking prices at 8c. per lb. and upwards according to seller.

Caustic potash—Inquiry for spot and prompt shipment was not heavy but offerings are light and prospects are more favorable for an advance rather than a decline in price. Sales of 88-92 per cent on spot were reported at 8¼c. per lb. and as high as 8½c. per lb. was asked by some holders. Shipments are firm at 8¼c. per lb.

Permanganate of potash — Domestic producers are busy taking care of orders

in hand and have little if any surplus for new business for April delivery. Imported goods have sold freely and it is difficult to locate round lots for prompt delivery. Spot prices are given at 25½c. per lb. and upwards, according to seller. Goods afloat are said to have sold at 25c. per lb. April shipments were offered at 22c. to 22½c. per lb.

Sodas

Bichromate of soda—Small lot transactions have predominated throughout the week, although round lots have passed against contracts. Producers are maintaining values at 7½c. per lb. at the works and spot trading is going through at prices ranging from 7¾c. to 8c. per lb. depending on quantity and seller. Chrome ore is quoted at $20.50 per ton for Indian, c.i.f. Atlantic ports. Rhodesian and New Caledonian are held at $21 to $24 per ton.

Caustic soda—Reports on export business vary but it seems certain that considerable business has been transacted for shipment abroad at prices ranging from 3.45c. to 3.50c. per lb. f.a.s. Domestic buyers have been taking on stocks in a large way and a firm tone is evident in the market. Producers offer at $2.50 per 100 lb. at the works, basis 60 per cent, with the usual premiums for less carlot quantities. Second hands offer solid 76 per cent at $3.45 to $3.65 per 100 lb. in the spot market, the range varying according to quantity and make.

Chlorate of soda—Some offerings of inferior grades have been on the local market and have been quoted under the open market price. Domestic producers report a good call for their product both in the way of new business and in ordering material out on old contracts. Prices are firm and unchanged at 6½c. to 7c. per lb. at the works. Imported grades are not pressing on the market and are held at 6½c to 7c. per lb.

Hyposulphite of soda—There was a general reduction in the market, establishing the price at $2.50@$2.75 per 100 lb. Demand has been rather inactive and with offerings of foreign material very much in evidence the situation has favored buyers for some weeks past.

Nitrate of soda—Activity in the fertilizer trade has been noted for some time and large amounts of nitrate of soda have been delivered at Southern ports. Buying orders are still prominent and it is evident that many consumers are not covered up to their full requirements. It is probable that demand will not continue active much longer, as the fertilizer season is too far advanced to permit of trading in the volume recently noted. Revisions in the prices of producers in Chile have been expected but so far no announcement has reached the domestic trade. Importers say the amount held in this country is small and this has a sustaining effect on values. Nitrate is quoted at $2.65 per 100 pounds ex vessel, Atlantic ports.

Nitrate of soda—The market has picked up a little in activity but the improvement has not been sufficient to describe trading as active. Some consuming trades are in the market constantly while others are hardly taking their normal requirements. Sellers are offering freely but are not cutting prices in order to stimulate buying. Foreign grades are offered in numerous directions and prices vary from 8¾c. to 9c. per lb. according to quantity and seller. Domestic grades also are in good supply with prices holding on an unchanged basis of 10c. to 10½c. per lb.

Silicate of soda—Different consuming trades have been in the market and sellers report a very satisfactory volume of business. Considerable quantities of silicate are said to be used in the sealing of paper cartons. Producers quote the 40 degree at 75c. to 85c. per 100 pounds at the works. The 60 degree is held at $1.60 to $1.70 per 100 pounds works.

Soda ash—New business continues to hold up well but the bulk of the business passing is against old contracts. Consumers are calling for deliveries promptly and more than normal amounts are being taken off the market. With the large production well taken care of and producing costs holding at relatively high levels the market is working into a very strong position although no price changes seem in immediate contemplation. Some producers are not eager to enter into new contracts calling for extended deliveries. Contract prices for light ash, basis 48 per cent, are quoted at $1.20 in bags and $1.40 in barrels. Dense ash is quoted at $1.25 in bags and $1.45 in barrels. Dealers were offering carlots of light ash at $1.75 in bags and $1.95 in barrels.

Miscellaneous

Antimony oxide—White oxide guaranteed 99 per cent has been firm with higher prices in effect due to higher cables from China and limited offerings on spot. Demand has been quiet, but this had no influence as a market factor. Quotations are now held at an inside figure of 9c. per lb. Standard powdered needle antimony is held at 8c. per lb., with lump nominal at 7¾c. per lb.

Arsenic—Fairly large amounts of white arsenic reached the market in the past week coming from Japan. Nearly all arrivals, however, were sold ahead and there still is a scarcity of spot material. Quotations in the spot market vary from 15½c. to 16c. per lb., according to seller. Sales of March-April from Japan were reported at 14½c. per lb. June shipment from Japan was quoted at 12½c. per lb. and some reports were heard to the effect that contracts covering shipments over the last half of the year could be placed at 11c. per lb. Sales of material afloat were put through at 15¼c. per lb.

Bleaching powder—Steady withdrawals are being made against contracts with active interest in spot and nearby goods. Some producers are sold up to capacity and there are no heavy surplus stocks in any quarter. A firm undertone features prices and large drums are held at $2.40@$2.55 per 100 lb. at the works. Spot cars at the works are quoted at $2.20 per 100 lb. The contract price remains at $1.90@$2.00 per 100 lb.

Borax—The market has maintained a steady position with a seasonable movement to consumers. Granulated and refined, crystals or powdered are offered at 5¼c. per lb. in bags, carlots. The price for goods in barrels was 5½c. per lb. Boric acid was quiet but steady at 11c. per lb.

Copper sulphate—Demand has been fairly active and a firmer feeling was in evidence. Cables again reported a higher market abroad and it was doubtful whether $5.70 could have been shaded on May-June shipment from the other side. Domestic makers quote the market at $6.25@$6.50 per 100-lb. on the large crystals, the inside figure obtaining on round lots only.

Cream of tartar—Consumers have been in in the market in an active way and with producing costs increasing the tendency of prices has been upward. The inside price is now given as 25½c. per lb. and asking prices range up to 26½c. per lb.

Formaldehyde—An easy tone has featured trading in this chemical. In the first place buyers are reserved and are interested only when price concessions are granted. First hands are keeping their quotations nominally unchanged at 16c. per lb. but resale offerings have changed hands as low as 14½c. per lb.

Lead acetate—With no important change in pig lead and the demand for the chemical fairly active prices ruled firm so far as the leading producers were concerned. White crystals, in casks, held at 13½c. per pound. White powdered was offered at 14¼c. per pound, in casks, and 15¼c. per pound, in kegs. The brown, broken, in barrels, settled at 12½c. per pound.

Lead arsenate—With the demand holding up well on the approach of the season of large consumption prices ruled steady, but closed the week unchanged at 12@12½c. per pound for the paste and 21½@22c. per pound for the powdered.

Nickel sulphate—Leading sellers were asking 11½c. per lb. as the inside price. Nickel ammonium sulphate was firm at 10½c. per lb. and upwards, according to quantity.

Sal ammoniac—Several shipments from abroad were landed here last week, but this failed to shake the market. The undertone was firm in all directions, reflecting higher replacement cost. Imported white on spot settled at 7@7½c. per pound. Imported gray was raised to 8½@9c. per pound. Domestic white granular held at 7¾@8c. per pound, carlots, f.o.b. works. Lump was firm at 14½@15½c. per pound, immediate delivery.

Salt Cake—Resale lots are very difficult to locate and only occasional sales of small lots are reported. First hands also have very little to offer, as they are using their output to fill contracts. Consumers are interested in taking on fresh commitments but under the circumstances trading is naturally restricted. Quotations hold at $25 to $27 per ton for bulk lots.

Sulphate of Aluminum—Quiet conditions have prevailed, as most consumers are covered ahead. Contract withdrawals are of good volume and prevent any accumulations in the hands of producers or sellers. Prices have held steady and unchanged at $2.50 to $2.75 per 100 pounds for iron free and $1.50 to $1.60 for the commercial.

Tin oxide—There was a reduction of 3c. per pound in tin oxide, following closely upon the easier situation in the metal. Leading makers now offer tin oxide at 52c. per pound, in barrels, immediate delivery. Trading was moderate throughout the week.

Coal-Tar Products

Active Demand for Phenol—Production Inadequate—Benzol Offerings Increase—Crude Naphthalene Higher Abroad—Solvents Scarce

INTEREST centered in the strong situation which has arisen in the market for phenol. The inquiry was fairly active, but business in spot and nearby material was restricted for want of offerings. Talk in the trade of new sources of domestic production did not change the attitude of sellers. Large handlers of phenol have no faith in the prospects for increasing the output so far as the immediate future is concerned and when old contracts expire there is a strong possibility that new prices will show a higher range. Demand for benzol has not yet opened up and this accounts for the slightly easier undertone for this commodity. Solvent naphtha was scarce, owing to the sold-up position of the market. Crude naphthalene was higher abroad and this stiffened prices here. Several parcels of cresylic acid arrived from the other side, despite the high duty, but there is much dissatisfaction over the tariff and traders believe that something will have to be done so that consumers not protected with contracts for the domestic material may continue manufacturing without resorting to a change in formulas. Owing to the inability of German makers to make shipments without encountering all sorts of difficulties because of the Ruhr situation, American manufacturers have been in a position to compete for foreign business. Reports of some large orders in dyes for shipment to China were current in trade circles. The Department of Commerce has announced March imports of coal-tar dyes as 312,809 lb., valued at $301,436, of which 66 per cent came from Germany, 18 per cent from Switzerland and 12 per cent from Italy, the latter representing reparation dyes which were re-exported. March imports compare with 191,709 lb., valued at $199,640, for February, and approximately the same amount for January.

Coal-Tar Crudes, Etc.

Benzene—Offerings were freer and the market presented an unsettled appearance. Traders expect that business will soon open up, as a spell of good weather would bring about increased consumption in the motor fuel field. The 90 per cent was nominally unchanged at 27c. per gallon, in drums, carload lots, contract basis.

Cresylic Acid—Domestic producers have nothing to offer, production being sold up on the basis of 70c. per gallon. In the outside market scattered lots of imported, on spot, sold at $1.40 for the 97 per cent, in drums, and $1.30 for the 95 per cent, in drums. Owing to the tariff situation importers were disposed to offer this material for shipment "in bond" and late in the week the general quotation on nearby material was 85c.

Phenol—Demand was fairly active, but spot business was restricted because of the sold-up condition of the market. Second-hands reported sales in U.S.P. phenol, immediate delivery, in lots of 1 to 3 tons at prices ranging from 52c. to 53c. per pound. Foreign material for shipment was available around 50c. A report was current in the trade that a new factor would soon be in a position to offer phenol. The high prices, in the opinion of traders, will stimulate production. The surplus stocks purchased from the government are disappearing at a surprising rate.

Naphthalene—Importations of crude were reported, but this made no impression upon the market. Cables reported a firmer situation in crude and this resulted in steadying prices in the New York trade. Crude, a little off in quality, brought 2⅝c. per pound. On standard material asking prices now range from 3½c. to 3¾c., as to quantity and seller. Demand for balls was good and the prices were raised to 10¾@11c. per pound. Flake held at 9½c., immediate delivery, and 9c. for June-July. On distant futures prices were considered too vague to quote.

Solvent Naphtha—Production appears to be well sold up and rumors of some re-selling were without foundation. The water-white, in drums, was merely nominal at 37@40c. per gallon. Demand was fairly active.

Toluene—Trading was slow and the market was a featureless affair. Production is limited because of the quiet state of the market. Nominal quotations range from 30@35c. per gallon, contract basis.

H Acid—Offerings were scanty on spot and prices of 80@85c. were considered wholly nominal. Producers say that they have enough orders on hand to take care of their output for some little time to come.

Alpha-naphthylamine—Small parcels sold at 38c. per pound, immediate delivery. The supplies available were moderate only and it was doubtful whether 35c. could have been shaded on a round lot for nearby delivery.

Aniline Oil—The market was inactive, but offerings were not pressing for sale and leading handlers continued to quote from 16c. to 16½c. per pound, as to quantity.

Beta-naphthol—There were offerings at 22c. per pound, round-lot basis, with smaller quantities changing hands at 25c. per pound. The market was barely steady in some directions.

Dimethylaniline—A firmer feeling was reported in this intermediate reflecting improvement in the demand. At the close traders were asking 42@43c. per pound.

Para-cresol—A cable from England quoted para-cresol for immediate shipment at 35d. per pound, c.i.f. New York terms.

Para-toluidine—With offerings scanty the market ruled firm at the recent advance, prices holding at 95@97c. per pound. The inquiry was fair.

Pyridine—The market was entirely nominal, traders experiencing difficulty in obtaining supplies. Recent business in small lots went through at $2.40 per gallon.

N. & W. Acid—Inquiry was moderate only; but with no accumulation in supplies prices for Neville and Winthers acid held at $1.25 per pound.

Xylene—The commercial variety was offered in a moderate way at 30@32c. per gallon. The pure was nominal at 45@50c. in drums.

Propose Uniform Contract for Chemical Trade

The Salesmen's Association of the American Chemical Industry has taken up the question of formulating a uniform contract to be used by the trade in transactions involving heavy chemicals.

The following committee has been appointed to draw up the contract:

Chairman—John A. Kienle, vice-president, in charge of sales, Mathieson Alkali Works, Inc.; P. S. Tilden, sales manager acid and heavy chemical division, E. I. du Pont de Nemours & Co.; E. J. Barber, manager chemical department, White Tar Co., Inc.; Ralph F. Durland, manager, N. Y. sales office, Dow Chemical Co.; William Haynes.

Vegetable Oils and Fats

Linseed at New High for Season—Cottonseed Steadies in South—Coconut Quiet—Good Call for Soya

Linseed oil—The feature in the vegetable oil trade last week was the sharp uplift in prices for linseed oil. Crushers had warned the consumers repeatedly of the impending crisis in the matter of spring deliveries, but it is safe to say that few gaged the market correctly and the fact that several producers would consider less than carlot business only, covering April-May deliveries, proved conclusively that their tanks must be very nearly dry. Spot oil closed at $1.14 per gallon, car lot basis, which compares with $1.10 a week ago. One lot of 1,000 barrels of June oil sold early in the week at $1.06, but the price for this position at the close was $1.10 asked. July oil settled at $1.09, with August forward at $1.07@$1.08 per gallon, carlots, cooperage included. The flaxseed markets established new highs for the season on light offerings of nearby material. There was no important change in the world's flaxseed situation. Crushers in New York territory apparently have enough seed on hand, but are handicapped by insufficient press capacity. Production could not be augmented in time to help the market. Foreign oil was active and well-informed members of the trade say that more than 1,500,000 gallons have been purchased for shipment to this country in the past month or so. At the close bids of $1.14 per gallon, duty paid, were turned down for oil afloat. April shipment from the other side settled at $1.10, with May-June at $1.07@$1.08, c.i.f. terms. Linseed cake was offered at $35 per ton, in bags, summer positions. Demand for cake for export was dull. A parcel of 3,000 tons of Argentine flaxseed afloat sold at $2.31, c.i.f. New York.

Cottonseed oil—The recovery in lard in the West, together with favorable news on the distribution of cottonseed oil and products, brought out a recovery in prices for the options. Estimates on March consumption were optimistic and trade leaders expect that the disappearance will exceed 200,000 barrels. April business has opened up well and should the rate of consumption be maintained the supply situation may become tight before new oil is available. Crude settled nominally at 10½c., f.o.b. mills.

Coconut oil—Business fell away and prices at the close were barely steady, both here and on the coast. Ceylon type oil was offered freely at 9c. coast, sellers' tanks, with intimation that this figure could be shaded on a firm bid. The market here settled at 9½@9⅝c. per pound, tank car basis. Copra ruled firm around 5½c. per pound, c.i.f. Pacific coast ports.

China wood oil—The offerings were meager, despite the fact that several parcels reached United States ports. Spot oil held at 35c. a pound in the "outside" market. On futures, traders were reluctant to quote pending a freer movement of oil from the interior of China. A nominal price for July-August shipment oil was 24½c.

Palm oil—Nearby oil was firm on moderate offerings, but some traders regarded the more forward positions as a little unsettled. Not much new business was placed last week. Lagas for shipment held at 8.55c. per pound, with Niger at 8.20@8.25c. per pound, c.i.f. New York.

Sesame oil—Refined imported oil sold at 12¼c., c.i.f. New York, nearby positions. May shipment was traded in at 12c., c.i.f. terms.

Soya bean oil—Bids at 10¼c. per pound for seller's tanks, April shipment from the coast were turned down. The asking price at the close on nearby material was 10½c., duty paid, f.o.b. coast. Demand was fairly active.

Menhaden oil—Trading in new oil on the "if made" basis has set in and it is estimated that more than 10,000 barrels of crude sold at 50c. per gallon, f.o.b. point of production.

Tallow—Sales during the week reached the total of 1,000,000 pounds, the bulk of the business passing being in extra special on the basis of 9c. per pound, loose, ex-plant.

Greases—Offerings were limited and prices ruled firm. Low acid yellow held at 8½@8¾c. per pound.

Miscellaneous Materials

Barytes—Demand for the white floated was fairly active and with no change in the position of crude prices ruled firm on the carlot basis of $28 per ton, containers included, f.o.b. St. Louis. Crude held at $8@$10 per ton, f.o.b. point of production. Off color, wet ground, was offered at $15@$16 per ton, f.o.b. works.

China clay—There was a steady call for this material and prices were firmly maintained. Crude was nominally unchanged at $7@$9; powdered, $13@$20, f.o.b. Virginia points. Imported lump $15@$20 f.o.b. American ports; powdered, $45@$50.

Pyrites—Imported lump, 1 in. diameter and up, 12c. per unit; fine, 12c. per unit, ex ship, Atlantic ports. Market steady.

Lithopone—Several shipments arrived at New York from Antwerp. Domestic makers reported a good volume of new business on the basis of 7c. per pound, in bags, carlots, April-May-June delivery. The market was firm.

White lead—The market for the metal was a shade easier, but this did not influence corroders and prices for the pigments were unchanged. The official quotation for pig lead held at 8.25c., New York. Trading in the pigments was fairly active. With stocks of unsold material subnormal and as there appears to be little likelihood for a sudden change in the metal situation, producers hold out no encouragement in the way of lower prices. Standard dry white lead, basic carbonate, closed the week at 9¾c. per pound, in casks, carlots. Red lead, dry, was offered at 11.40c. per pound, in casks.

Zinc oxide—A firm undertone featured the market. Producers report steady gains in the volume of business, and, with the metal showing no important change, they regard the market as favoring sellers so far as the future is concerned. American process, lead free, held at 8c. per pound, carlot basis, with the leaded grades commanding from 7@7¼c. per pound. French process, red seal, was available at 9¾c. per pound.

Glycerine—Several refiners announced a reduction of ½c. per pound in the chemically pure grade, establishing the market at 18c. per pound, in drums. The reason for the decline could be traced to the unsettled market for crude. Business was inactive during the past week and competition was more of a factor. Dynamite sold at 16½c. per pound, carlot basis. The arrival of several shipments of foreign crude was noted. Soap lye crude, basis 80 per cent, loose, carlots, closed nominally at 11@11¼c. per pound. Recent business in the Middle West went through at 10¾c. Saponification was offered sparingly and quotations of 12¾@13c. were considered nominal.

Naval stores—The shrinkage in spot holdings brought out a general advance in prices. Turpentine sold as high as $1.53 per gallon in the Savannah market. In the New York trade the nominal quotation toward the close was $1.61 per gallon. In rosins prices ruled firm on the basis of $6.20 per barrel for the "B" grade. Demand for rosins was good. Pine tar pitch held nominally at $6.00 per barrel.

Shellac—Cables from Calcutta reported a steady market toward the close, with the result that operators here were no longer anxious to discount futures. The importations were not large enough to bring out any real change for the better in the market for spot goods. The inquiry was satisfactory. T. N. on spot settled at 76c. per pound. Bleached, bone dry, held at 90c. on spot, with futures available around 86c. Superfine was traded in at 80@81c. per pound. Calcutta offered T. N., April shipment, at 72c. c.i.f. New York.

Alcohol—A fair trade was reported in denatured alcohol and prices ruled steady. The No. 1, 188 proof, was offered at 39c. a gallon, with the No. 5 at 38c. a gallon. Methanol, 95 per cent, was maintained at $1.19@$1.21 a gallon; 97 per cent close at $1.21@$1.23 a gallon. The situation in ethyl was unchanged, quotations holding on the basis of $4.75@$4.85 for the 190 proof.

Imports at the Port of New York

ACIDS—200 kegs tartaric, Bremen, Order, 100 cs. tannic, Shanghai, East Asiatic Co., 100 csk. citric, Rotterdam, Order, 456 bbl. citric, Palermo, Order; 4 bbl. tartaric, Palermo, Order; 157 bbl stearic, Rotterdam, M. W. Parsons; 41 drums phosphorus, Hamburg, Hummel & Robinson, 78 dr. cresylic, Hamburg, Caldwell & Co., 60 pkg. phosphoric, Bremen, Order; 10 csk. oxalic, Antwerp, Brown Bros. & Co.

ALBUMEN—54 pkg, Hamburg, Cooper & Cooper.

ALCOHOL—25 bbl den't'd, San Juan, M Fiegel Bros.; 115 bbl. do., San Juan, C Esteva.

ALIZARINE—6 csk., Hamburg, Kuttroff, Pickhardt & Co.; 4 csk., H. A Metz & Co

AMMONIUM—60 csk. muriate, Glasgow, Nat'l. City Bank, 100 cs. bromide, Hamburg, Nat'l Am. Bank, 549 csk nitrate, Hamburg, Kuthroff, Pickhardt & Co., 70 csk. muriate, Bristol, C de P. Field & Co, 40 pkg. carbonate, Liverpool, Brown Bros., 112 csk. phosphate, Antwerp, Globe Shipping Co.

ANTIMONY SALT—20 bbl., Hamburg, J D. Lewis.

ANTIMONY OXIDE—335 bags, Hankow, Java Handelsvereeniging

ARSENIC—100 bbl. red, Hamburg, Brown Bros. & Co.; 200 csk, Hamburg, Pfaltz & Bauer; 338 bbl., Antwerp, Order, 109 csk., Rotterdam, Lunhan & Moore; 496 cs, Kobe, China Am. Tobacco Trading Co, 150 cs, Kobe, N. Y. Trust Co.; 579 cs., Kobe, Takata & Co.; 360 cs, Kobe, Nat'l Shawmut Bank of Boston; 200 cs., Frazar & Co; 100 cs, Kobe, Order; 120 cs, Yokohama, Am. Trading Co.

BARYTES—500 bags, Bremen, Order.

BARIUM NITRATE—29 csk, Hamburg, Industrial Trust Co.

BARIUM CARBONATE — 130 bags, Bremen, Hummel & Robinson.

BLANC FIXE—48 bbl., Hamburg, A. Murphy Co.

BARIUM BINOXIDE—64 cyl., Havre, Mallinckrodt Chem. Works.

BARIUM CHLORIDE—71 csk, Hamburg, A. Klipstein & Co.; 52 csk., Antwerp, Order.

CALCIUM CHLORIDE—166 dr., Hamburg, Order.

CASEIN—85 sk., Rotterdam, T M. Duche & Sons; 128 bags, Hamburg, A. Klipstein & Co.; 751 bags, Buenos Aires, Bank of America; 998 bags, Buenos Aires, Brown Bros & Co; 2,083 bags, Buenos Aires, Order.

CHEMICALS—3 cs., London, Order; 42 c., Antwerp, J. E. Dockendorff & Co.; 31 bbl., Hamburg, Arco Trading Corp.; 45 csk., Jungmann & Co.; 35 dr., Hamburg, F. Boehm, Ltd; 135 dr., Hamburg, Hummel & Robinson; 400 pg, Bremen, A. Klipstein & Co.; 92 pkg., Hamburg, Superfos Co; 10 cs., Hamburg, Order; 200 csk., Antwerp, Guaranty Trust Co.; 400 bags, Antwerp, C. B. Richard & Co.; 500 csk., Antwerp, Order; 422 pkg., Liverpool, Monsanto Chem. Works; 50 cs., Bremen, Merck & Co

CHALK—75 csk. precipitated, Bristol, H. J. Baker & Bro.; 1,000 bags ground, Antwerp, Cooper & Cooper; 400 bags, Antwerp, Irving Nat'l Bank; 2,215 bags, Antwerp, Order; 200 bags, Antwerp, Order; 500,000 kilos, Dunkirk, J. W. Higman & Co.; 990,000 kilos, Dunkirk, Taintor Trading Co.; 1,000 bags, Antwerp, Bankers Trust Co.

COPPER SULPHATE—77 csk., Liverpool, E. M. Sergeant & Co.; 200 csk., Liverpool, Order; 98 csk., Swansea, Order; 201 csk., Antwerp, Order; 400 csk., Liverpool, Order.

COLORS—5 bbl. aniline, Hamburg, Carbic Color & Chem. Co.; 2 csk. aniline, Hamburg, Kuttroff, Pickhardt & Co.; 13 csk. aniline, Genoa, Irving Nat'l Bank; 6 csk aniline, Genoa, Ladenburg Thalmann & Co.; 8 csk. aniline, Genoa, Am. Exchange Nat'l Bank; 29 bbl. black, Kobe, American Trading Co.; 20 cs. dry, London, Downing & Co.; 9 kegs aniline, Liverpool, Textile Alliance.

COPRA—13,514 sk., Cebu, Order; 119 bags, Morant Bay, Franklin Baker Co.

DEXTRINE — 500 bags, Rotterdam, Stein, Hall & Co.; 500 bags, Rotterdam, J. Morningstar Co.

DIVI-DIVI — 1,481 bags, Maracaibo, Huth Gillespie & Co.; 334 bags, Puerto Plata, Cordilleras Comm. Co.

EPSOM SALT—750 cs., Hamburg, Brown Bros. & Co.; 6,000 bags, Hamburg, Superfos Co.; 160 csk., Hamburg, Order.

FLORIUM NITRATE — 3 cs., Hamburg, Order.

FULLERS EARTH—250 bags, London, C B. Crystal Co., 350 bags, Bristol, L. A. Salmon & Bro.

FLUORSPAR—300 bags, Rotterdam, L. A Salmon & Bro

GUMS—125 bags Persian, Bombay, Guaranty Trust Co., 469 bags karaya, Bombay, Brown Bros. & Co., 266 bags do., Bombay, Chatham & Phenix Nat'l Bank; 90 bags do., Bombay, Irving Nat'l Bank, 1426 bags do., Bombay, Order; 106 pkg. tragacanth, Bombay, Order, 375 cs. gum, Calcutta, Balfour, Williamson & Co., 150 cs tragacanth, London, Thurston & Braidich, 205 pkg damar, Singapore, Order, 525 pkg arabic, Port Sudan, Thurston & Braidich, 2,758 pkg. arabic, Port Sudan, Order, 260 bags arabic, Port Sudan, Nat'l Bank of Egypt, 420 bags arabic, Port Sudan, Thurston & Braidich, 350 bags arabic, Port Sudan, Caracando Bros; 2,030 pkg. arabic, Port Sudan, Order, 400 bags copal, Antwerp, Brown Bros & Co; 25 bags, copal, Antwerp, Order, 294 pkg copal, Antwerp, Order, 15 bbl sandrac, Marseilles, G Lincks, 24 bags copal, London, S Winterbourne & Co, 50 pkg. damar, Batavia, Balfour, Williamson & Co., 200 cs. damar, Padang, Smith & Schipper; 100 cs. damar, Padang, Order, 8 cs. damar, Tandjong Priok, Order, 2,293 pkg. copal, Macassar, Order; 75 cs. damar, Port Said, Order.

GALLNUTS—250 cs, Hankow, Arnhold Bros

GLAUBERS SALT—500 bbl., Hamburg, E. M Sergeant & Co., 35 bbl., Hamburg, Schutz & Rulckgarber; 122 bbl, Hamburg, Order

GLYCERINE—40 dr, Antwerp, N Y. Trust Co.; 54 dr., Melbourne, Marx & Rowolle

HEXAMETHYLENETETRAMINE 38 cs., Hamburg, Industrial Trust Co.

HYDROGEN PEROXIDE—61 pkg. Antwerp, Order.

IRON SULPHATE 57 csk., Antwerp, E M Sergeant & Co., 311 bbl., Antwerp, Order.

LOGWOOD EXTRACT—131 bbl., Cape Haitien, Logwood Mfg Corp, 15 bbl. crystals, Cape Haitien, Logwood Mfg. Corp.

LITHOPONE—120 csk, Bremen, Pfaltz & Bauer; 1,500 csk., Antwerp, Benj. Moore & Co; 200 csk, Antwerp, A Klipstein & Co.

MYROBOLANS — 4,312 bags, Bombay, Order; 4,410 bags, Calcutta, Nat'l City Bank, 6,880 pkts., Calcutta, Order.

MANGANESE—22 csk., Bristol, Lamson A. & C Co. Magnesia, chloride, 70 dr., Brown Bros. & Co., 138 dr, Hamburg, Brown Bros & Co.; Magnesite, calcined, 295 bbl., Rotterdam, Innis Speiden & Co.

NAPHTHALENE — 886 bags, London, Irving Nat'l Bank; 1,740 bags, Hamburg, Holder of B. L.; 150 bags, Hamburg, L. Martin Co; 500 bags, Hamburg, Order; 270 bags, London, Irving Nat'l Bank.

NICKEL SULPHATE—47 csk., Swansea, Order.

OILS—Cod—225 csk., St. Johns, R. Badcock & Co.; 60 bbl., St Johns, Bowring & Co, 200 csk, St. Johns, Job Bros. & Co.; 160 bbl., London, Order. **Coconut**—710 tons, Manila, Order, 816 tons, Manila, Order. **China wood**—306 csk., Hankow, Cook & Swan; 1,000 bbl., Hankow, Order. **Fusel**—29 dr, Rotterdam, Credito Italo; 33 dr., Hamburg, Order; 31 bbl., Hamburg, Order; 24 dr, Antwerp, Guaranty Trust Co.; 50 dr, Rotterdam, Caldwell & Co.; 6 dr., Rotterdam, Order; 12 bbl., Dunkirk, Guaranty Trust Co. **Olive, sulphur**—350 bbl., Milazzo, Banca Comm. Italiana; 300 bbl., Milazzo, Order; 200 bbl., Palermo, Brown Bros. & Co.; 200 bbl., Palermo, Order. **Palm**—64 csk., Liverpool, African & Eastern Trading Co.; 8 csk., Liverpool Order; 250 csk., Hamburg, African & Eastern Trading Co; 174 csk., Hamburg, Order; 32 csk, Liverpool, Order; 80 csk., Liverpool, D Bacon; 61 csk., Liverpool, Order. **Peanut**—400 bbl., London, E. F. Drew & Co. **Perilla**—500 dr., Kobe, Am. Express Co.; 525 bbl., Dairen, Int'l Banking Corp.; 400 bbl., Dairen, Bank of N. Y. **Rapeseed**—125 bbl., London, Order. **Sardine**—2,000 cs., Kobe, Bank of America; 200 cs, Kobe, Lee, Higginson & Co.; 2,000 cs, Yokohama, Order. **Linseed**—286 bbl., Rotterdam, J. C. Francesconi & Co. **Sesame**—569 bbl., Rotterdam, Nat'l City Bank.

PHOSPHATE, BONE—304 bags, Rotterdam, H. J. Baker & Bros.

PLUMBAGO—308 bbl., Colombo, Goldman, Sachs & Co, 100 bbl, Colombo, H. W. Peabody & Co, 564 bbl., Colombo, H. P. Winter & Co, 308 bbl., Colombo, First Fed. Banking Corp.

POTASSIUM SALTS 29 csk, nitrate, Hamburg, Order 50 cs. caustic, Gothenburg, Mallinckrodt Chemical Works; 5,317 pkg. muriate, Bremen, A. Vogel, 15 cs. carbonate, Bremen, P H. Petry & Co.; 32 dr bicarbonate, Rotterdam, Meteor Prod. Co., 100 cs. bromide 206 csk caustic, 107 pkg. actz. Hamburg, Roessler & Hasslacher Chem Co., 440 cs bromide, Hamburg, Superfos Co, 56 csk. product, Hamburg, A Klipstein & Co, 101 dr. caustic, Hamburg, A Klipstein & Co., 40 dr. caustic, Hamburg, A Klipstein & Co.; 44 csk. salts, Hamburg, Roessler & Hasslacher Chem. Co, 270 cs cyanide, Hamburg, Roessler & Hasslacher Chem Co., 100 cs. alum, Hamburg, A. Klipstein & Co; 322 csk. alum, Hamburg, Order, 16 csk bisulphide, Hamburg, Order, 310 bbl. chlorate, Hamburg, Order, 28 csk carbonate, Hamburg, Order; 3,164 bags muriate, Bremen, A. Vogel, 22 bbl perchloride, Swansea, Order; 5,500 bags muriate, 1,500 bags sulphate, Antwerp, Société Comm. des Potasses D'Alsace, 125 bbl. chlorate, 20 bbl. perchlorate, Marseilles, Nat'l City Bank; 250 bbl chlorate, Marseilles, Order, 4 csk. prussiate, Antwerp, Order; 46 csk. carbonate, Antwerp, Order

QUEBRACHO—20,997 logs, Santa Fe, Tannin Corp

SAL AMMONIAC 73 csk., Meteor Prod-phate, Antwerp, Société Comm des Potasses ucts Co, 36 bbl, Hamburg, J. A. Van Brunt & Co., 94 csk, Hamburg, Order; 76 bbl., Hamburg, Order

SEEDS—Castor—1,426 bags, Bombay, Folkart Bros, 10,245 bags, Cocanada, Order, 16,296 bags, Cocanada, Ralli Bros; 12,977 bags, Cocanada, Order. **Linseed**—22,430 bags, Rosario, Spencer Kellogg & Sons, 105,264 bags, Buenos Aires, Order; 30,294 bags, Buenos Aires, Merchants Nat'l Bank of Boston, 8,524 bags, Rosario, Order.

SHELLAC — 130 bags, Calcutta, Phil. Nat'l Bank; 100 bags, Calcutta, London & Liverpool Bank of Commerce, 100 bags, Calcutta, Arbuthnot, Latham & Co.; 600 pkg., Calcutta, Order, 100 bags, Hamburg, A. Murphy & Co.; 11 bags, Hamburg, Kasebier-Chatfield Shellac Co.; 50 cs., Bremen, Order, 100 bags, London, Order; 2,182 bags, Southampton, Order; 75 bags, Calcutta, Cont Comm Nat'l Bank; 319 pkg., Calcutta, Irving Nat'l Bank; 290 pkg., Calcutta, Lee, Higginson & Co.; 52 bags, Calcutta, First Nat'l Bank of Boston; 100 pkg., Calcutta, Brown Bros. & Co.; 100 pkg., Calcutta, London & Liverpool Bank of Commerce; 1,050 pkg., Calcutta, Order; 1,625 pkg refuse lac, Calcutta, Order; 141 pkg, Karachi, Order; 156 bags sticklac, Marseilles, Order

SODIUM SALTS—5,667 bags nitrate, Antofagasta, W R. Grace & Co.; 11,286 bags nitrate, Iquique, W. R. Grace & Co.; 500 csk. nitrate, Hamburg, Kuttroff, Pickhardt & Co; 20 dr. perborate, Hamburg, Bank of America; 122 csk sulph., Hamburg, Roessler & Hasslacher Chem. Co.; 43 dr. sulphide, Hamburg, Order; 81 dr. sulphide, Hamburg, Order; 180 cs. cyanide, Marseilles, Asia Banking Corp.; 99 bbl. hyposulphide, Antwerp, Cooper & Cooper; 128 dr. sulphide, Antwerp, J. D. Leis; 17 csk. prussiate, Liverpool, Guaranty Trust Co.; 35 csk. prussiate, Baker Bros.

STARCH, POTATO—1,250 bags, Rotterdam, Stein, Hall & Co.

STRONTIUM NITRATE—44 csk., Hamburg, Roessler & Hasslacher.

SUMAC—700 bags, Palermo, Equitable Trust Co; 300 bales, Palermo, Order.

TARTAR, CRUDE—16 pkg., Valparaiso, National City Bank; 668 bags, Marseilles, Tartar Chem. Works; 105 bags, Marseilles, C Pfizer & Co.

TALC—1,000 bags, Bordeaux, L. A. Solomon & Bro.; 500 bags, Bordeaux, Hammil & Gillespie; 800 bags, Bordeaux, Order; 62 cs., Bordeaux, Binney & Smith.

TALLOW, VEGETABLE — 500 pkg., Hankow, Arnhold Bros.; 500 pkg., Hankow, Am. Linseed Co.

TALLOW, ANIMAL—558 csk., 16 pipes, Melbourne, D. Bruce & Co.

WHITING — 500 bags, Bristol, L. H. Butcher & Co.; 90 bbl., Antwerp, Order.

WOOL GREASE—75 bbl., Manchester, Am. Trust Co.

ZINC OXIDE—10 bbl., Marseilles, Order; 300 bbl., Antwerp, Brown Bros. & Co.

ZINC WHITE — 100 bbl., Marseilles, Reichard, Coulston, Inc.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

General Chemicals

Acetic anhydride, 85%, drums	lb	$0 38 –	
Acetone, drums	lb	22 –	23
Acid, acetic, 28%, bbl	100 lb	3 17½ –	3 92
Acetic, 56%, bbl	100 lb	6 35 –	6 37
Glacial, 99½%, bbl.	100 lb	12 05 –	12 85
Boric, bbl.	lb	11 –	11
Citric, kegs	lb	49 –	50
Formic, 85%	lb	14½ –	17
Gallic, tech.	lb	45 –	50
Hydrochloric, 18° tanks,	100 lb	90 –	1 00
Hydrofluoric, 52%, carboys	lb.	12 –	12
Lactic, 44%, tech., light, bbl.	lb	11½ –	12
22% tech., light, bbl	lb	05½ –	06
Muriatic, 20°, tanks,	100 lb	1 00 –	1 10
Nitric, 36°, carboys	lb	04½ –	05
Nitric, 42°, carboys	lb	06 –	06½
Oleum, 20%, tanks	ton	18 50 –	19 00
Oxalic, crystals, bbl.	lb	13½ –	14
Phosphoric, 50%, carboys	lb	07½	08
Pyrogallic, resublimed	lb	1 50 –	1 60
Sulphuric, 60°, tanks	ton	9 00	10 00
Sulphuric, 60°, drums	ton	12 00 –	14 00
Sulphuric, 66°, tanks	ton	15 00 –	15 50
Sulphuric, 66° drums	ton	19 00	20 00
Tannic, U.S.P., bbl.	lb	65	70
Tannic, tech., bbl	lb	45 –	50
Tartaric, imp. crys., bbl	lb	34	
Tartaric, imp., powd., bbl.	lb	34 –	
Tartaric, domestic, bbl..	lb	35 –	
Tungstic, per lb	lb	1 00 –	1 20
Alcohol, butyl, drums, f.o.b. works.	lb	.27 –	.29
Alcohol ethyl (Cologne spirit), bbl	gal	4.75 –	4 95
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 188 proof No. 1, bbl	gal	39 –	40
Alum, ammonia, lump, bbl	lb	03½	03¾
Potash, lump, bbl	lb	03 –	03½
Chrome, lump, potash, bbl	lb.	.05½ –	05¾
Aluminum sulphate, com., bags	100 lb	1 50 –	1 65
Iron free bags	lb	02½ –	02¾
Aqua ammonia, 26°, drums	lb	.06¼ –	07¼
Ammonia, anhydrous, cyl	lb.	.30 –	30½
Ammonium carbonate, powd casks, imported	lb	.09½ –	10
Ammonium carbonate, powd domestic, bbl	lb	.13 –	.14
Ammonium nitrate, tech., casks	lb	10 –	11
Amyl acetate tech. drums	gal	3 50 –	3 75
Arsenic, white, powd., bbl	lb	15½ –	16
Arsenic, red, powd., kegs	lb	14½ –	15
Barium carbonate, bbl	ton	78 00 –	80 00
Barium chloride, bbl.	ton	90 00 –	95 00
Barium dioxide, drums	lb	18 –	18½
Barium nitrate, casks		08 –	08½
Barium sulphate, bbl	lb	04 –	04½
Blanc fixe, dry, bbl	lb	.04½ –	04¾
Blanc fixe, pulp, bbl.	ton	45 00 –	55 00
Bleaching powder, f.o.b. wks., drums	100 lb.	2 15 –	
Spot N. Y. drums	100 lb.	2 60 –	2 70
Borax, bbl	lb.	05½ –	05¾
Bromine, cases	lb	28 –	30
Calcium acetate, bags	100 lb	3 50 –	3 60
Calcium carbide, drums	lb	04½ –	04¾
Calcium chloride, fused, drums	ton	22 00 –	23 00
Gran. drums	lb	.01½ –	01¾
Calcium phosphate, mono, bbl	lb	06½ –	07
Camphor, cases	lb	91 –	93
Carbon bisulphide, drums	lb	07 –	07¼
Carbon tetrachloride, drums	lb	10 –	
Chalk, precip.—domestic, light, bbl	lb	.04½ –	04¾
Domestic, heavy, bbl..	lb	03½ –	03¾
Imported, light, bbl.	lb	04½ –	05
Chlorine, liquid, cylinders	lb	06 –	06½
Chloroform, tech., drums	lb	35 –	38
Cobalt oxide, bbl	lb	2 10 –	2 25
Copperas, bulk, f.o.b. wks.	ton	16 50 –	20 00
Copper carbonate, bbl..	lb	19	20
Copper cyanide, drums	lb	47 –	50
Coppersulphate, crys., bbl	100 lb	6 25 –	6 50
Cream of tartar, bbl	lb	25½ –	25¾
Epsom salt, dom., tech., bbl	100 lb	2 00 –	2 25
Epsom salt, imp., tech., bags	100 lb	1.10 –	1 25
Epsom salt, U.S.P., dom., bbl	100 lb	2 50 –	2 75
Ether, U.S.P., drums	lb	.13 –	15
Ethyl acetate, com., 85%, drums	gal	.80 –	85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal	.95 –	1 00
Formaldehyde, 40%, bbl	lb	.14½ –	.16
Fullers earth, f.o.b. mines	net ton	16.00 –	17 00
Fullers earth—imp., powd.,	net ton	30.00 –	32 00
Fusel oil, ref., drums.	gal.	3.55 –	4 05
Fusel oil, crude, drums.	gal.	2.30 –	2 40
Glaubers salt, wks., bags	100 lb	1.20 –	1 40

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available. In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

Glaubers salt, imp., bags	100 lb.	$1 00 –	$1 25
Glycerine, c.p., drums extra	lb	.18 –	.18½
Glycerine, dynamite, drums	lb	.16½ –	
Iodine, resublimed	lb	4 55 –	4 65
Iron oxide, red, casks	lb.	.12 –	.18
Lead			
White, basic carbonate, dry, casks	lb	.09¾ –	.10¼
White, basic sulphate, casks	lb	09½ –	
White, in oil, kegs	lb	.12½ –	14
Red, dry, casks	lb	.11½ –	12
Red, in oil, kegs	lb.	.13½ –	.15
Lead acetate, white crys., bbl.	lb.	13½ –	14
Brown, broken, casks	lb	12½	
Lead arsenate, powd., bbl	lb	23 –	24
Lime-Hydrated, bbl	per ton	16 80 –	17 00
Lime, Lump, bbl	280 lb	3 63 –	3 65
Litharge, comm., casks	lb	10¾ –	11
Lithophone, bags	lb	07 –	07¼
in bbl	lb	07¼	07½
Magnesium carb., tech., bags	lb	08 –	08½
Methanol, 95%, bbl	gal	1 21 –	1 23
Methanol, 97%, bbl	gal	1 23	1 25
Nickel salt, double, bbl	lb	10½ –	.
Nickel salts, single, bbl.	lb.	11½ –	
Phosgene		60 –	75
Phosphorus, red, cases	lb.	35 –	40
Phosphorus, yellow, cases	lb.	.30 –	.35
Potassium bichromate, casks	lb.	.11 –	.11¼
Potassium bromide, gran., bbl	lb.	.16 –	.23
Potassium carbonate, 80-85%, calcined, casks	lb.	.06 –	.06¼
Potassium chlorate, powd	lb.	.07 –	.08
Potassium cyanide, drums	lb.	.45 –	50
Potassium hydroxide (caustic potash) drums	100 lb	8 25 –	8 50
Potassium iodide, cases	lb.	3 65 –	3 75
Potassium nitrate, bbl	lb.	.06½ –	.07½
Potassium permanganate, drums	lb.	.25½ –	.25¾
Potassium prussiate, red, casks	lb.	.80 –	.85
Potassium prussiate, yellow, casks	lb.	.37½ –	.38
Salammoniac, white, gran., casks, imported	lb	.07 –	.07½
Salammoniac, white, gran., bbl., domestic	lb	.07¾ –	.08
Gray, gran., casks	lb	08 –	09
Salsoda, bbl	100 lb	1 20 –	1 40
Salt cake (bulk)	ton	26.00 –	28 00
Soda ash, light, 58% flat, bags, contract	100 lb	1.60 –	1.67
Soda ash, light, basis, 48%, bags, contract, f.o.b. wks.	100 lb.	1.20 –	1 30
Soda ash, light, 58%, flat, bags, resale	100 lb.	1 75 –	1.80
Soda ash, dense, bags, contract, basis 48%	100 lb.	1.17½ –	1.20
Soda ash, dense, in bags, resale	100 lb.	1.85 –	1.90
Soda, caustic, 76%, solid, drums, f.a.s.	100 lb.	3.45 –	3.70
Soda, caustic, 76%, solid, drums, contract	100 lb	3.35	3.40
Soda, caustic, basis 60%, wks., contract.	100 lb.	2.50 –	2.60
Soda, caustic, ground and flake, contracts	100 lb.	3.80 –	3.90
Soda, caustic, ground and flake, resale	100 lb	4 00 –	4.15
Sodium acetate, works, bags	lb	06 –	.06½
Sodium bicarbonate, bbl	100 lb	2 00 –	2.50
Sodium bichromate, casks	lb	.07¾ –	.08
Sodium bisulphate (niter cake)	ton	6.00 –	7.00
Sodium bisulphite, powd., U.S.P., bbl	lb.	.04½ –	.04¾
Sodium chlorate, kegs	lb.	.06½ –	.07
Sodium chloride	long ton	12.00 –	13.00
Sodium cyanide, cases	lb.	.20 –	.23
Sodium fluoride, bbl	lb.	$0.09 –	$0 10
Sodium hyposulphite, bbl	lb.	.02½ –	03
Sodium nitrite, casks	lb.	.08½ –	09
Sodium peroxide, powd., cases	lb.	.28 –	30
Sodium phosphate, dibasic, bbl	lb.	.03½ –	04
Sodium prussiate, yel. drums	lb.	.18½ –	19
Sodium silicate (40°, drums)	100 lb.	.80 –	1 25
Sodium silicate (60°, drums)	100 lb.	2.00 –	2 25
Sodium sulphide, fused, 60-62%, drums	lb.	.04½ –	.04¾
Sodium sulphite, crys., bbl	lb.	.03½ –	03¾
Strontium nitrate, powd., bbl.	lb.	.09½ –	.10
Sulphur chloride, yel drums.	lb.	.04½ –	.05
Sulphur, crude	ton	18.00 –	20 00
At mine, bulk	ton	16 00 –	18 00
Sulphur, flour, bbl	100 lb.	2.35 –	3 15
Sulphur, roll, bbl	100 lb.	2.00 –	2.50
Sulphur dioxide, liquid, cyl	lb.	.08 –	.08½
Talc—imported, bags	ton	30 00 –	40 00
Talc—domestic powd., bags.	ton	18.00 –	25.00
Tin bichloride, bbl	lb.	.13½ –	.14
Tin oxide, bbl	lb.	.52 –	.54
Zinc carbonate, bags	lb.	.14 –	.14½
Zinc chloride, gran, bbl	lb.	.06 –	.07
Zinc cyanide, drums	lb.	.37 –	.38
Zinc oxide, lead free, bbl.	lb.	.08 –	.08½
5% lead sulphate, bags	lb	.07½ –	....
10 to 35% lead sulphate, bags	lb.	.07 –	.
French, red seal, bags	lb	09¾ –	
French, green seal, bags	lb	.10¾ –	
French, white seal, bbl	lb	12 –	
Zinc sulphate, bbl..	100 lb.	2.75 –	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl	lb.	$0.80 –	$0.85
Alpha-naphthol, ref., bbl	lb	1 05 –	1.10
Alpha-naphthylamine, bbl.	lb	.35 –	36
Aniline oil, drums	lb.	.16 –	.16½
Aniline salts, bbl.	lb.	.24 –	.25
Anthracene, 80%, drums	lb.	.75 –	1.00
Anthracene, 80%, imp., drums, duty paid	lb.	.70 –	.75
Anthraquinone, 25%, paste, drums	lb.	.70 –	.75
Benzaldehyde U.S.P., carboys	lb.	1.40 –	1.45
Benzene, pure, water-white, tanks and drums	gal.	.32 –	.35
Benzene, 90%, tanks & drums	gal.	.27 –	.30
Benzene, 90%, drums, resale	gal.	.30 –	.33
Benzidine base, bbl	lb.	.85 –	90
Benzidine sulphate, bbl	lb.	.75 –	.80
Benzoic acid, U.S.P., kegs	lb.	.72 –	.75
Benzoate of soda, U.S.P., bbl	lb.	.57 –	.65
Benzyl chloride, 95-97%, ref., drums	lb.	.25 –	.27
Benzyl chloride, tech., drums	lb.	.20 –	.23
Beta-naphthol, subl., bbl	lb.	.55 –	.60
Beta-naphthol, tech., bbl	lb	.23½ –	.24
Beta-naphthylamine, tech.	lb.	.80 –	.90
Carbazol, bbl	lb.	.75 –	.90
Cresol, U.S.P., drums	lb	.25 –	.29
Ortho-cresol, drums	lb.	.24 –	.26
Cresylic acid, 97%, resale, drums	gal.	1 40 –	1.50
95-97%, drums, resale	gal.	1.30 –	1.30
Dichlorbenzene, drums	lb.	.07 –	.09
Diethylaniline, drums	lb.	.50 –	.60
Dimethylaniline, drums	lb	.42 –	.43
Dinitrobenzene, bbl	lb.	.19 –	.20
Dinitroclorbenzene, bbl	lb.	.22 –	.23
Dinitronaphthalene, bbl	lb	.30 –	.32
Dinitrophenol, bbl	lb	.35 –	.40
Dinitrotoluene, bbl	lb	.20 –	.22
Dip oil, 25%, drums	gal	.25 –	.30
Diphenylamine, bbl.	lb.	50 –	.52
H-acid, bbl..	lb.	.80 –	.85
Meta-phenylenediamine, bbl.	lb.	.95 –	1 00
Michlers ketone, bbl...	lb.	3.00 –	3.50
Monochlorbenzene, drums	lb.	.08 –	.10
Monoethylaniline, drums	lb.	.95 –	1.10
Naphthalene, crushed, bbl.....	lb.	.08 –	.09
Naphthalene, flake, bbl...	lb.	.09½ –	.10
Naphthalene, balls, bbl...	lb	.10½ –	.11
Naphthionate of soda, bbl	lb	.58 –	.65
Naphthionic acid, crude, bbl.	lb	.60 –	.65
Nitrobenzene, drums	lb.	.10 –	.12
Nitro-naphthalene, bbl...	lb.	.30 –	.35
Nitro-toluene, drums	lb.	.15 –	.17
N-W acid, bbl.	lb	1 25 –	1.30
Ortho-amidophenol, kegs.	lb	2.30 –	2.35
Ortho-dichlorbenzene, drums	lb.	.17 –	.20
Ortho-nitrophenol, bbl.	lb.	.90 –	.92
Ortho-nitrotoluene, drums...	lb.	.10 –	.12
Ortho-toluidine, bbl.	lb.	.13 –	.15
Para-amidophenol, base, kegs	lb.	1.15 –	1.20
Para-amidophenol, HCl, kegs	lb.	1.20 –	1.25
Para-dichlorbenzene, bbl	lb.	.17 –	.20
Paranitraniline, bbl.	lb.	.74 –	.75
Para-nitrotoluene, bbl...	lb.	.55 –	.65
Para-phenylenediamine, bbl.	lb.	1.45 –	1.50
Para-toluidine, bbl...	lb.	.95 –	.98
Phthalic anhydride, bbl......	lb.	.35 –	.38
Phenol, U.S.P., drums.......	lb.	.50 –	.55
Picric acid, bbl..	lb.	.20 –	.22
Pyridine, dom., drums........	gal.	nominal	
Pyridine, imp., drums.......	gal.	2.50 –	2.75

Resorcinol, tech., kegs	lb.	$1.50 - $1.55
Resorcinol, pure, kegs	lb.	2.03 - 2.10
R-salt, bbl	lb.	.55 - .60
Salicylic acid, tech., bbl	lb.	.47 - .48
Salicylic acid, U.S.P., bbl	lb.	.50 - .52
Solvent naphtha, water-white, drums	gal.	.37 - .40
Crude, drums	gal.	.22 - .24
Sulphanilic acid, crude, bbl	lb.	.18 - .2.
Thiocarbanilide, kegs	lb.	.35 - .38
Toluidine, kegs	lb.	1.20 - 1.30
Toluidine, mixed, kegs	lb.	.30 - .35
Toluene, tank cars	gal.	.30 - .35
Toluene, drums	gal.	.35 - .40
Xylidines drums	lb.	.40 - .45
Xylene, pure, drums	gal.	.45 - .50
Xylene, com., drums	gal.	.35 - .37
Xylene, com., tanks	gal.	.30 -

Naval Stores

Rosin B-D, bbl	280 lb.	$6 20 -
Rosin E-I, bbl	280 lb.	6 30 -
Rosin K-N, bbl	280 lb.	6 35 - 6 75
Rosin W G-W.W., bbl	280 lb.	7 00 - 8 00
Wood rosin, bbl	280 lb.	6 25 -
Turpentine, spirits of, bbl	gal.	1 60 - 1 62
Wood, steam dist., bbl	gal.	1 35 -
Wood, dest. dist., bbl	gal.	1.25 -
Pine tar pitch, bbl	200 lb.	- 6 00
Tar, kiln burned, bbl	500 lb.	- 12 00
Retort tar, bbl	500 lb.	- 11 00
Rosin oil, first run, bbl	gal.	.43 -
Rosin oil, second run, bbl	gal.	.47 - ...
Rosin oil, third run, bbl	gal.	.53 -
Pine oil, steam dist.	gal.	... - .90
Pine oil, pure, dest. dist.	gal.	... - .85
Pine tar oil, ref.	gal.	... - .46
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal.	... - .35
Pine tar oil, double ref., bbl	gal.	... - .75
Pine tar, ref., thin, bbl	gal.	... - .25
Pinewood creosote, ref., bbl	gal.	... - .52

Animal Oils and Fats

Degras, bbl	lb.	$0 03¾ - $0.04¼
Grease, yellow, bbl	lb.	08½ - 08¾
Lard oil, Extra No. 1, bbl	gal.	.92 - 94
Neatsfoot oil, 20 deg. bbl.	gal.	1.28 - 1 32
No. 1, bbl	gal.	92 - 94
Red oil, distilled, d.p. bbl	lb.	11½ -
Saponified, bbl	lb.	11½ -
Tallow, extra, loose	lb.	09 -
Tallow oil, acidless, bbl	gal.	96 - 98

Vegetable Oils

Castor oil, No. 3, bbl.	lb.	$0 13¼ - $0 13½
Castor oil, No. 1, bbl.	lb.	14 - 14½
Chinawood oil, bbl	lb.	32½ - 35
Coconut oil, Ceylon, bbl.	lb.	.10½ - .10¾
Ceylon, tanks, N.Y.	lb.	.09¾ - 09¾
Coconut oil, Cochin, bbl.	lb.	.10¾ -
Corn oil, crude, bbl.	lb.	.12¼ - ...
Crude, tanks, (f.o.b. mill)	lb.	.10½ - .10¾
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.10½ - 10¾
Summer yellow, bbl.	lb.	.12¼ - 13
Winter yellow, bbl	lb.	.13¼ - .13½
Linseed oil, raw, car lots, bbl.	gal.	1 14 -
Raw, tank cars (dom.).	gal.	1 09 -
Boiled, cars, bbl. (dom.).	gal.	1 16 - ...
Olive oil, denatured, bbl.	gal.	1.10 - 1.15
Sulphur, (foots) bbl.	lb.	.07¾ - 09¼
Palm, Lagos, casks	lb.	.08¼ - .08½
Niger, casks	lb.	.08¼ - .08½
Palm kernel, bbl.	lb.	.09¼ - .09½
Peanut oil, crude, tanks (mill)	lb.	.13½ - .13¾
Peanut oil, refined, bbl.	lb.	.17 -
Perilla, bbl	lb.	.15½ - 16
Rapeseed oil, refined, bbl.	gal.	.84 - 85
Rapeseed oil, blown, bbl.	gal.	.90 - 91
Sesame, bbl	lb.	13¼ - 13½
Soya bean (Manchurian), bbl	lb.	.12¼ -
Tank, f.o.b. Pacific coast	lb.	.10¼ - .10½
Tank, (f.o.b. N.Y.)	lb.	.10¾ - 11

Fish Oils

Cod, Newfoundland, bbl	gal.	$0.70 - $0 72
Menhaden, light pressed, bbl.	gal.	$0.70 -
White bleached, bbl.	gal.	.72 - .74
Blown, bbl.	gal.	.76 - .78
Crude, tanks (f.o.b. factory)	gal.	.50 - .52
Whale No. 1 crude, tanks, coast	lb.	.06½ - ...
Winter, natural, bbl.	gal.	76 - .78
Winter, bleached, bbl.	gal.	79 - .80

Oil Cake and Meal

Coconut cake, bags.	ton	$38.00 - $40 00
Copra, sun dried, bags, (c.i.f.)	lb.	06½ - .06¾
Sun dried Pacific coast	lb.	.05½ - 05¾
Cottonseed meal, f.o.b. mills	ton	40.00 - 41.00
Linseed cake, bags	ton	35 00 - 36 00
Linseed meal, bags	ton	38 00 -

Dye & Tanning Materials

Albumen, blood, bbl	lb.	$0.45 - $0.50
Albumen, egg, tech, kegs	lb.	.72 - .75
Cochineal, bags	lb.	.35 - 36
Cutch, Borneo, bales	lb.	04¾ - .05
Cutch, Rangoon, bales	lb.	.12 - .12½
Dextrine, corn, bags	100 lb.	3.39 - ......
Dextrine, gum, bags	100 lb.	3.74 - ......
Divi-divi, bags	ton	38.00 - 39.00
Fustic, sticks	ton	30.00 - 35.00
Fustic, chips, bags	lb.	.04 - .05
Logwood, sticks	ton	28.00 - 30.00
Logwood, chips, bags	lb.	.02½ - .03½
Sumac, leaves, Sicily, bags	ton	65.00 - ......
Sumac, ground, bags	ton	$55 00 - $60.00
Sumac, domestic, bags	ton	35.00 - ......
Tapioca flour, bags	lb.	.03½ - .05

Extracts

Archil, conc., bbl	lb.	$0 17 - $0.18
Chestnut, 25% tannin, tanks	lb.	02 - 03
Divi-divi, 25% tannin, bbl	lb.	04 - 05
Fustic, crystals, bbl	lb.	20 - 22
Fustic, liquid, 42°, bbl	lb.	08 - 09
Gambier, liq., 25% tannin, bbl.	lb.	08 - 09
Hematine crys., bbl	lb.	14 - 18
Hemlock, 25% tannin, bbl	lb.	04 - 05
Hypernic, solid, drums	lb.	24 - 26
Hypernic, liquid, 51°, bbl	lb.	14 - 17
Logwood, crys., bbl.	lb.	19 - .20
Logwood, liq., 51°, bbl.	lb.	.09 - .10
Quebracho, solid, 65% tannin, bbl	lb.	.04½ - .05
Sumac, dom., 51°, bbl.	lb.	06½ - .07

Dry Colors

Blacks-Carbongas, bags, f.o.b. works	lb.	$0 16 - $0 18
Lampblack, bbl	lb.	12 - 40
Mineral, bulk	ton	35 00 - 45 00
Blues Bronze, bbl	lb.	55 - 60
Prussian, bbl	lb.	55 - 60
Ultramarine, bbl	lb.	08 - 35
Browns, Sienna, Ital., bbl	lb.	06 - 14
Sienna, Domestic, bbl	lb.	03½ - 04
Umber, Turkey, bbl	lb.	.04 - 04½
Greens-Chrome, C.P. Light, bbl	lb.	32 - 34
Chrome, commercial, bbl	lb.	12 - 12½
Paris, bulk	lb.	.30 - 35
Reds, Carmine No. 40, tins	lb.	4.50 - 4 70
Oxide red, casks	lb.	10 - 14
Para toner, kegs	lb.	1 00 - 1 10
Vermilion, English, bbl	lb.	1 30 - 1 32
Yellow, Chrome, C.P. bbls	lb.	20 - 21
Ocher, French, casks	lb.	02½ - 03

Waxes

Bayberry, bbl	lb.	$0 28 - $0.30
Beeswax, crude, bags	lb.	.21 - .25
Beeswax, refined, light, bags.	lb.	34 - 35
Beeswax, pure white, cases	lb.	.40 - 41
Candellila, bags	lb.	.24 - 25
Carnauba, No. 1, bags	lb.	39 - .40
No. 2, North Country, bags	lb.	.23 - .23½
No. 3, North Country, bags	lb.	19½ - .....
Japan, cases	lb.	.14½ - .15
Montan, crude, bags	lb.	.04 - .04¼
Paraffine, crude, match, 105-110 m.p.	lb.	04½ - .04½
Crude, scale 124-126 m.p., bags	lb.	.03 - 03¼
Ref., 118-120 m.p., bags	lb.	.03½ - ....
Ref., 125 m.p., bags	lb.	.03½ - ...
Ref., 128-130 m.p., bags	lb.	.04 - .04¼
Ref., 133-135 m.p., bags	lb.	.04½ - 04¾
Ref., 135-137 m.p., bags	lb.	.05 - .05¼
Stearic acid, sgle pressed, bags	lb.	.14 -
Double pressed, bags	lb.	.14½ -
Triple pressed, bags	lb.	.16 -

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb.	$3.30 - $3 40
F.a.s. double bags	100 lb.	4 15 - 4 25
Blood, dried, bulk	unit	4 60 -
Bone, raw, 3 and 50, ground	ton	30.00 - 35 00
Fish scrap, dom., dried, wks.	unit	5 00 - 5 10
Nitrate of soda, bags	100 lb.	2.65 - 2.67½
Tankage, high grade, f.o.b. Chicago	unit	4.70 - 4 80
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$4 00 - $4 50
Tennessee, 78-80%	ton	8 00 - 8 25
Potassium muriate, 80%, bags	ton	35 00 - 36.00
Potassium sulphate, bags.	unit	1.00 - ......

Crude Rubber

Para—Upriver fine	lb.	$0 30 - ....
Upriver coarse	lb.	.26½ - ...
Upriver caucho ball.	lb.	.28½ -
Plantation—First latex crepe	lb.	.33½ - ...
Ribbed smoked sheets	lb.	.33½ - ...
Brown crepe, thin, clean	lb.	.32 - ..
Amber crepe No. 1	lb.	.32½ - ...

Gums

Copal, Congo, amber, bags.	lb.	$0.18½ - $0.19
East Indian, bold, bags	lb.	.22 - .23
Manila, pale, bags	lb.	21 - .22
Pontinak, No. 1 bags	lb.	.21 - .22
Damar, Batavia, cases	lb.	.31 - 32
Singapore, No. 1, cases	lb.	.34 - .35
Kauri, No. 1, cases	lb.	.62 - .66
Ordinary chips, cases	lb.	.18 - .20
Manjak, Barbados, bags	lb.	.09 - .09½

Shellac

Shellac, orange fine, bags	lb.	$0.80 - ..
Orange superfine, bags	lb.	.82 - .....
A. C. garnet, bags	lb.	.78 - .79
Bleached, bonedry	lb.	90 - ...
Bleached, fresh	lb.	77 - .78
T. N., bags	lb.	.76 - ......

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh. ton	$450.00 - $550.00
Asbestos, shingle, f.o.b., Quebec	sh. ton	$60.00 - $80.00
Asbestos, cement, f.o.b., Quebec	sh. ton	15.00 - 17.00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	16.00 - 20.00
Barytes, grd., off-color, f.o.b. mills bulk	net ton	13.00 - 15.00
Barytes, floated, f.o.b. St. Louis, bbl	net ton	28.00 - ...
Barytes, crude f.o.b. mines, bulk	net ton	10.00 - 11.00
Casein, bbl., tech	lb.	.11 - .12
China clay (kaolin) crude, f.o.b. Ga	net ton	7 00 - 9 00
Washed, f.o.b. Ga	net ton	8 00 - 9 00
Powd., f.o.b. Ga	net ton	13 00 - 20.00
Crude f.o.b. Va	net ton	8 00 - 12 00
Ground, f.o.b. Va	net ton	13 00 - 20.00
Imp., lump, bulk	net ton	15 00 - 20 00
Imp., powd	net ton	45.00 - 50 00
Feldspar, No. 1 pottery	long ton	6 00 - 7.00
No. 2 pottery	long ton	5 00 - 5.50
No. 1 soap	long ton	7.00 - 7.50
No. 1 Canadian, f.o.b. mill	long ton	25.00 - 27.00
Graphite, Ceylon, lump, first quality, bbl	lb.	.06 - .06½
Ceylon, chip, bbl.	lb.	.05 - .05½
High grade amorphous crude	ton	35.00 - 50.00
Gum arabic, amber, sorts, bags	lb.	.15 - .16
Gum tragacanth, sorts, bags	lb.	.50 - .60
No. 1, bags	lb.	1.75 - 1.80
Kieselguhr, f.o.b. Cal.	ton	40.00 - 42.00
F.o.b. N.Y.	ton	50 00 - 55.00
Magnesite, crude, f.o.b. Cal.	ton	14.00 - 15.00
Pumice stone, imp., casks	lb.	.03 - .05½
Dom., lump, bbl	lb.	.05 - .05½
Dom., ground, bbl	lb.	.06 - .07
Silica, glass sand, f.o.b. Ind	ton	2 00 - 2 50
Silica, sand blast, f.o.b. Ind	ton	2.50 5.00
Silica, amorphous, 250-mesh, f.o.b. Ill	ton	17.00 - 17.50
Silica, bldg. sand, f.o.b. Pa	ton	2.00 - 2.75
Soapstone, coarse, f.o.b. Vt., bags	ton	7.00 - 8.00
Talc, 200 mesh, f.o.b., Vt., bags	ton	6.50 - 9.00
Talc, 200 mesh, f.o.b. Ga., bags	ton	7 00 - 9.00
Talc, 200 mesh, f.o.b. Los Angeles, bags	ton	16.00 - 20.00

Mineral Oils

Crude, at Wells

Pennsylvania.	bbl.	$4 00 - $4.25
Corning	bbl.	2 ?0 - ..
Cabell	bbl.	2 76 - ..
Somerset	bbl.	2 55 - 2.80
Illinois	bbl.	2 ?7 - ...
Indiana	bbl.	2 ?8 - ...
Kansas and Oklahoma, 28 deg	bbl.	1 50 - 1 60
California, 35 deg. and up	bbl.	1.45 - ......

Gasoline, Etc.

Motor gasoline, steel bbls	gal.	$0.24½ - ......
Naphtha, V. M. & P. deod, steel bbls	gal.	23½ - ......
Kerosene, ref. tank wagon	gal.	.15 - .....
Bulk, W. W. export	gal.	.08 - ......
Lubricating oils:		
Cylinder, Penn., dark	gal.	.27 - .30
Bloomless, 30@31 grav.	gal.	.20 - .22
Paraffin, pale	gal.	.24 - .25
Spindle, 200, pale	gal.	.25 - .26
Petrolatum, amber, bbls	lb.	.05 - .05½
Paraffine wax (see waxes)		

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	ton	$45-50
Chrome brick, f.o.b. Eastern shipping points	ton	50-52
Chrome cement, 40-50% Cr_2O_3	ton	23-27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Ky wks.	1,000	40-46
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	36-41
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65-68
9-in arches, wedges and keys.	ton	80-85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48-50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	48-50
F.o.b. Mt. Union, Pa	1,000	42-44
Silicon carbide refract. brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N.Y.	ton	$200.00 - $225.00
Ferrochromium, per lb. of Cr, 6-8% C.	lb.	.11½ .11¾
4-6% C.	lb.	.12 - .13
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	115.00 - 120.00
Spiegeleisen, 19-21% Mn.	gr. ton	35.00 - 37.00
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb.	1.90 - 2.15
Ferrosilicon, 10-15%	gr. ton	38.00 - 40.00
50%	gr. ton	86.00 - 89.00
75%	gr. ton	150.00 - 160.00

Ferrotungsten, 70-80%, per lb. of W	lb.	$0.85 –	$0.90
Ferro-uranium, 35-50% of U. per lb. of U	lb.	6.00 –	......
Ferrovanadium, 30-40%, per lb. of V	lb.	3 75 –	4.00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$6 50 –	$8 75
Chrome ore, Calif. concentrates, 50% min Cr_2O_3	ton	22 00	23 00
C.i.f. Atlantic seaboard	ton	18 50	19 00
Coke, fdry., f.o.b. ovens	ton	8 25 –	8 50
Coke, furnace, f.o.b. ovens	ton	7 00 –	7 25
Fluorspar, gravel, f.o.b. mines, Illinois	ton	21 50 –	.
Ilmenite, 52% TiO_2	lb	01¼ –	01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	33 –	. .
Manganese ore, chemical (MnO_2)	ton	75 00 –	80 00
Molybdenite, 85% MoS_2, per lb. MoS_2, N.Y.	lb	.65 –	70
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb	06 –	08
Pyrites, Span., fines, c.i.f. Atl. seaport	unit	.11½ –	12
Pyrites, Span., furnace size, c.i.f. Atl. seaport	unit	.11½ –	12
Pyrites, dom. fines, f.o.b. mines, Ga.	unit	.12	
Rutile, 95% TiO_2	lb	12 –	.
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8 50	8 75
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	8 00 –	8 25
Uranium ore (carnotite) per lb. of U_3O_8	lb	3 50 –	3 75
Uranium oxide, 96% per lb. U_3O_8	lb	2 25 –	2 50
Vanadium pentoxide, 99%	lb	12 00	14 00
Vanadium ore, per lb. V_2O_5	lb	1 00 –	
Zircon, washed, iron free, f.o.b. Pablo, Fla.	lb.	.04½ –	13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	17½ 17⅝
Aluminum, 98 to 99%	23 24
Antimony, wholesale, Chinese and Japanese	9 9¼
Nickel, virgin metal	25 27
Nickel, ingot and shot	29 00
Monel metal, shot and blocks	32 00
Monel metal, ingots	38 00
Monel metal, sheet bars	45.00
Tin, 5-ton lots, Straits	46 75
Lead, New York, spot	8 25
Lead, E. St. Louis, spot	8 20
Zinc, spot, New York	7 85
Zinc, spot, E. St. Louis	7 50

Other Metals

Silver (commercial)	oz.	$0 67⅛
Cadmium	lb.	1.10
Bismuth (500 lb. lots)	lb	2 55
Cobalt	lb	2.65@2.85
Magnesium, ingots, 99%	lb	1.25–
Platinum	oz	115.00
Iridium	oz	260 00@275 00
Palladium	oz	79 00
Mercury	75 lb.	70.00–

Finished Metal Products

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20 75
Copper bottoms	30 75
Copper rods	20 50
High brass wire	19 50
High brass rods	17 00
Low brass wire	21 10
Low brass rods	22 00
Brazed brass tubing	24 25
Brazed bronze tubing	29 00
Seamless copper tubing	25.25
Seamless high brass tubing	23.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound

Copper, heavy and crucible	11 30@11.50
Copper, heavy and wire	11 25@11.50
Copper, light and bottoms	9.25@ 9.50
Lead, heavy	5 75@ 6.00
Lead, tea	3.50@ 3 75
Brass, heavy	6 25@ 6 40
Brass, light	5 35@ 5 75
No. 1 yellow brass turnings	6.30@ 6 50
Zinc	3.50@ 4.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.29	$3.14
Soft steel bars	3.19	3.04
Soft steel bar shapes	3.19	3.04
Soft steel bands	3.29	3.19
Plates, ¼ to 1 in. thick	3.29	3.14

Industrial

Financial, Construction and Manufacturing News

Construction and Operation

Alabama

HOLT—The Central Iron & Coal Co. has broken ground for the erection of its proposed new 1-story foundry for the production of cast-iron pipe, to be 150x364 ft., estimated to cost $85,000, with machinery.

Arizona

TUCSON—The Tucson Gas, Electric Light & Power Co. will make improvements and extensions in its artificial gas plant to cost about $200,000, including the installation of additional machinery.

Arkansas

FORT SMITH—The Fort Smith Cotton Oil Co., North 1st and G Sts., has plans in progress for the erection of a new fertilizer manufacturing plant, to be 1-story, estimated to cost $25,000, with equipment.

California

LOS ANGELES—The Los Angeles Pressed Brick Co., Frost Bldg., manufacturer of common and semi-vitreous face brick, has plans under consideration for the erection of a new plant with initial output of close to 100,000 bricks per day. A department will be installed for the manufacture of roofing. A tunnel kiln will be constructed. Howard Frost heads the company.

LOS ANGELES (San Pedro)—A 1-story foundry, 150x180 ft., will be constructed by the Walsh Automatic Coupling Co., estimated to cost about $25,000. Farrell & Miller, Western Mutual Life Bldg., Los Angeles, are architects.

LINCOLN—Gladding, McBean & Co. have work under way on extensions at their local clay products plant, to include the installation of additional machinery. A tunnel kiln is being constructed, to be used in connection with roofing tile manufacture.

Connecticut

MIDDLETOWN—The Benevue Co., recently organized, has leased feldspar properties of the Laurel Brick & Sand Co., at Laurel, near Middletown, and plans for the installation of a new plant for commercial feldspar production. Equipment will be provided for initial employment of about 100 operatives. The company also purposes to construct and operate a pottery in this section at a later date.

District of Columbia

WASHINGTON—The Washington Gas Light Co., 411 10th St., N. W., is arranging a construction program for new artificial gas plants, improvements in present plants and system to involve an annual amount of about $1,000,000 for a number of years. Plans for initial work are under consideration.

Illinois

CHICAGO—The National Wood Finishing Co., recently organized to manufacture oils, paints and varnishes, has leased the 2-story and basement building, 50x120 ft., at 2242 Belmont Ave., with option to purchase, for a new plant. An adjoining site, 75x125 ft., has also been secured for later expansion. Machinery will be installed and the plant placed in operation at an early date.

CHICAGO—Brenner, Monley & Morris, Inc., care of Fox & Fox, 38 South Dearborn St., Chicago, architects, has had plans drawn for the construction of a new copper rod and wire mill on Kedzie St., to be 1-story, 105x300 ft., and estimated to cost approximately $250,000, with machinery. Work will be placed under way at an early date.

ROCKFORD—The Sargent-Morse Paper Co., 315 Chestnut St., has tentative plans under consideration for enlargements in its plant, for the manufacture of paper and paper board products. The company was incorporated recently to succeed to an existing business.

CHICAGO—The National Fiber & Vulcanizing Co. has leased the 1-story plant at 2808-14 West Lake St., totaling about 10,000 sq.ft. of space, for a new works. Possession will be taken at once.

Indiana

INDIANAPOLIS—The Ideal Paint Co. has leased a building at 437 East 10th St. for enlargements in its plant. Equipment will be installed at an early date.

SOUTH BEND—A large foundry will be constructed at the plant of the Studebaker Corp., manufacturer of automobiles, estimated to cost close to $200,000. Plans have been drawn and bids called for the general erection.

INDIANAPOLIS—Eberhardt & Co., Greenbrier St., manufacturers of waterproofing compounds and kindred products, have plans nearing completion for the erection of an addition to their plant on Darwin St. and Hillside Ave.

Louisiana

YOUNGSVILLE—The Youngsville Sugar Co. has plans under way for extensions and improvements in its plant including the installation of additional machinery. Enlargements will be made in the power department. R. O. Young is general manager.

BASTROP—H. L. Brown, vice-president of the Yellow Pine Paper Mill Co., Orange, Tex., and associates have organized a new company to be known as the H. L. Brown Paper Co., Inc. Property has been purchased at Morehouse Parish, near Bastrop, and work will soon be commenced on a new paper mill, with an initial capacity of 50 tons of kraft paper and pulp per day. It is estimated to cost in excess of $1,750,000, with machinery. A power house will be built. George F. Hardy, 309 Broadway, New York, is engineer.

Maryland

NORTH EAST—The North East Porcelain Co., recently organized, has taken over the former plant of the Maryland Porcelain Co., on Broad Creek, near the city, and will soon commence the manufacture of porcelain products. The factory will be improved and additional machinery installed. E. Kirk Brown is president; Robert C. Reeder, treasurer; and Gustav Glocker, secretary and general manager. The last noted will be in active charge of the project.

Massachusetts

SPRINGFIELD—The B. & H. Paper Co., 65 Water St., has plans in progress for the erection of a new 2-story building, 50x90 ft., on Fulton St., estimated to cost about $25,000.

EVERETT—The Boston Electrolytic Oxygen Co., South Ferry St. and Revere Beach Parkway, manufacturer of industrial oxygen, etc., will commence the immediate erection of a new 1-story plant addition, 24x86 ft., estimated to cost about $14,000, exclusive of equipment. A general building contract has been awarded to the Hudson Construction Co., Everett.

HOLYOKE—The American Writing Paper Co. is perfecting plans for the electrification of its various mills in this section, to replace waterpower operation during certain periods of the year.

Michigan

MONROE—The Monroe Board & Lining Co., First National Bank Bldg., has tentative plans under consideration for the construction of a new local mill for the manufacture of paper and paper board products. William G. Gutman heads the company.

DETROIT—The National Lead Co., 1607 Howard St., is completing plans for the erection of a new 2-story building, 40x120 ft., at Howard and 10th Sts., for general works expansion. Western & Ellington, 1507 Stroh Bldg., are architects.

Missouri

INDEPENDENCE—The Faultless Pneumatic Tire Co., 414 Shuker Bldg., Kansas City, Mo., Frank Y. Allen, head, has preliminary plans under way for the remodeling and improving of a building at Independence, for the establishment of a new plant. An appropriation of about $50,000, is being made for the work and the installation of equipment.

KNOB NOSTER—Frank C. Nicholson, Kansas City, Mo., head of the Harrisonville Brick & Tile Co., Harrisonville, Kan., has leased a brick manufacturing plant at Knob Noster. Improvements will be made and additional equipment installed for brick production and affiliated manufacture. A new kiln will be installed. It is planned to place the plant in service at an early date.

KANSAS CITY—The Cook Paint & Varnish Co., 1319 Grand Ave., has awarded a general contract to Collins Brothers, 1600 Grand Ave., for the erection of a new 2-story and basement plant on Harrison Ave., between 14th and 15th Sts., North Kansas City. It will be 113x162 ft. Work will be placed in progress at an early date. Hans Von Unwerth, 509 Finance Bldg., is architect and engineer.

KANSAS CITY—The Kansas Portland Cement Co., Federal Reserve Bldg., a subsidiary of the International Portland Cement Co., Kansas City and New York, will operate the former plant of the Bonner Portland Cement Co., Bonner Springs, Kan., recently purchased by the parent organization. Plans are nearing completion for enlargements in the works to develop an annual production of 4,000,000 bbl., and operations will soon be commenced. H. Struckmann is president.

New Jersey

NEWARK—The Hanovia Chemical & Mfg. Co., 233 New Jersey Railroad Ave., manufacturer of liquid gold, luster colors, etc., has commissioned Fred A. Phelps, Union Bldg., architect and engineer, to prepare plans for enlargements in its plant for considerable increase capacity in different departments. The company has purchased property on New Jersey Railroad Ave., from Chestnut to Oliver St., for future extensions.

NEWARK — The Crepe Craft Paper Mfg. Co., 121-23 Jackson St., has leased space in an adjoining building for enlargements in its plant.

TRENTON—The Electric Porcelain Mfg. Co., New York Ave., has awarded a contract to Harry Faske, Trenton, for the erection of a 1-story addition to its plant to cost about $14,000 exclusive of equipment.

NEW BRUNSWICK — The American Clay Products Co. has leased the entire plant of the Atlantic Clay Products in East Brunswick Township at an annual rental of $50,000, and will occupy the factory at once. The works will be used for the manufacture of hollow tile products.

KEYPORT—The Architectural Tile Co. is negotiating with the city council for the purchase of municipal property in the vicinity of its plant, to be used for proposed additions.

New York

DEFERIET—The St. Regis Paper Co., Watertown, will soon take bids for the erection of a 1-story addition to its mill at Deferiet, estimated to cost about $60,000.

Ohio

AKRON—The Chemmitex Rubber Co., has leased the tire manufacturing plant of the Interlocking Cord Tire Co., at Mogadore, near Akron, and will take possession at once. The Interlocking company has plans nearing completion for the erection of a new factory in the immediate vicinity of the former plant, and will soon begin work.

ROSSFORD—The Edward Ford Plate Glass Co. has awarded a contract to A. Bentley & Sons, Toledo, for the erection of additions to its plant to cost about $2,000,000, with machinery. Work will be commenced immediately.

Oklahoma

SAND SPRINGS—Chestnut & Smith, operating the local Phoenix refinery, have plans nearing completion for extensive improvements and additions in the oil refining plant to increase the output to 8,000 bbl. per day. It is purposed to have the plant ready for operation in June.

WETUMKA—The Phillips Petroleum Co. is planning for the construction of a new gasoline refining plant on local site.

NEWKIRK—The local oil refinery of the Pirtle-Pittman Co. has been acquired by R. S. Ayres and associates, and a new company will be organized to operate the plant. Plans are under way for extensions and improvements, to include the installation of additional equipment including "cracking" stills for gasoline production. George Turner will act as assistant general manager.

ARDMORE—The Santa Fe Oil & Refining Co., recently organized, has taken over the local plant of the Chickasaw Refining Co., lately secured at a bankruptcy sale. The new owner will take immediate possession, and plans for extensions and improvements, including the installation of additional equipment. James A. Cotner heads the company.

Oregon

SALEM—The Oregon Pulp & Paper Co. has commenced work on enlargements to its local mill to double, approximately, the present capacity. Machinery to cost about $75,000 will be installed.

Pennsylvania

ALLENTOWN—The Coston Brick Co. has commenced the erection of a new plant on North Quebec St., near the Union Blvd., for the manufacture of concrete brick, tile and kindred products. The machinery installation will be started at an early date.

PHILADELPHIA—A 1-story foundry to cost about $25,000, will be constructed at the plant of the American Engineering Co., Wheatsheaf Lane and Sepviva St.

PHILADELPHIA—The R. E. Tongue & Brothers Co., Allegheny and Amber Sts., manufacturer of chimneys and other glass products, has plans in progress for the erection of a new plant addition to cost approximately $60,000, including equipment. The construction contract has been let to the William Steele & Sons Co., 16th and Arch Sts.

MACUNGIE—Bids are being taken by the East Penn Foundry Co. for the erection of a new 1-story foundry, 140x150 ft., for the manufacture of cast-iron pipe and brass castings. Facilities will be provided for the employment of about 100 men.

South Carolina

GREENWOOD—Fire, March 13, destroyed a portion of the fertilizer mixing plant of the Southern Cotton Oil Co., with loss reported at close to $25,000. It is planned to rebuild.

Tennessee

JOHNSON CITY—The Watauga Cement Products Corp. will construct a number of additions to its plant and install new equipment. It is purposed to double the present capacity. J. W. Warren is president and general manager.

ROCKWOOD—A. E. Venable is organizing a company to construct and operate a local plant for the manufacture of brick, tile and kindred burned clay products. It is expected to develop an initial capacity of 50,000 bricks per day.

Texas

BRECKENRIDGE—The Gulf Production Co. has perfected plans for the construction of six new gasoline plants, casinghead type, in this vicinity, estimated to cost approximately $1,500,000, with machinery. Work on the initial plant will be commenced at once, designed for a daily output of about 8,000 gal. of gasoline.

CORPUS CHRISTI—The city council is arranging for a bond issue of $350,000, for the installation of a municipal gas plant and system.

GAINESVILLE—George Brown and Joseph Curtis, Gainesville, have acquired the plant of the Gainesville Brick Co., near the city limits. A new company with capital of $75,000, will be organized to operate the property, and extensions and improvements made.

FORT WORTH—The Herbert Oil Co., Majestic Bldg., is arranging an appropriation of about $50,000, for extensions in its plant and the purchase of additional equipment.

FORT WORTH—The Helius Casinghead Co., Fort Worth, has plans under way for the construction of a new gasoline plant in the vicinity of Brownwood, Tex., estimated to cost close to $200,000, with machinery. It will be designed for an output of about 10,000 gal. per day.

Vermont

HARTFORD—The Hartford Water Co. has plans under way for the construction of a new water-purification plant in connection with its local waterworks. Weston & Sampson, 14 Beacon St., Boston, Mass., are engineers.

Virginia

ROANOKE—The Roanoke Tire & Rubber Co., Terry Bldg., is arranging a list of equipment for installation at its proposed new plant, and will take bids until about May 1. R. F. Mitchel, Seaboard Bank Bldg., is architect. Alfred Buck heads the company.

SUFFOLK—The Boll Weevil Exterminator Co., recently organized with capital of $500,000, plans for the operation of a local plant for the manufacture of insecticides. Thomas H. Debnam, Suffolk, is treasurer.

Washington

SEATTLE—The Associated Oil Co. has commenced the construction of a new storage and distributing plant on Railroad Ave., comprising a number of buildings, tanks, etc., estimated to cost $75,000.

Canada

FORT ALEXANDER, QUE.—The J. D. McArthur Co., Quebec, is perfecting plans for the construction of a new paper and pulp mill in this vicinity, estimated to cost close to $1,000,000, with machinery. B. W. Thompson is vice-president.

Industrial Developments

LEATHER—The American Hide & Leather Co., New York, will take possession of its new plant at Peabody, Mass., recently purchased, early in April, and will commence operations at once for the manufacture of leather specialties of various kinds. The plant has a rated capacity of 1,500,000 ft. of material per month.

The Castle Kid Co., Camden, N. J., is advancing production at its tannery and is now working on a night and day schedule. Employment is being given to a full force. Both cabrettas and kid in various colors are being produced.

The Texas Hide & Leather Co., Yoakum, Tex., has completed enlargements in its plant, and the new departments have been placed in service. The working force will be increased.

The Standard Kid Mfg. Co., Wilmington, Del., is running under heavy output and giving employment to additional workers.

GLASS—The Owens Bottle Co., Toledo, O., has placed all of its plants on a full 24-hour operating basis, giving employment to maximum working forces. Incoming orders insure the continuance of this schedule for an indefinite period.

Manufacturers of flint glass in all parts of the country have made an agreement with workers for the elimination of the usual "summer suspension" period during the present year, and practically all plants will be continued in operation, allowing employees vacation periods, with restriction that not more than 25 per cent of the shop force shall be absent during any particular period.

Bottle-manufacturing plants in New Jersey, at Millville, Glassboro, Bridgeton and vicinity, are running under heavy production schedules with large working forces. It is expected that this basis will be continued for an indefinite period.

PAPER—The River Raisin Paper Co., Monroe, Mich., is running on a full-time operating schedule, giving employment to a full working force of about 1,000 men. The company has heavy advance orders on hand.

The American Writing Paper Co., Holyoke, Mass., is maintaining production on a capacity schedule with full working forces at its different mills. This basis will be continued indefinitely.

The Eddy Paper Co., Three Rivers, Mich., recently acquired by new interests, has advanced production to about 80 per cent of capacity, and expects to advance this output in the near future.

CERAMIC—The Columbia Clay Products Co., Warrenton, Ore., which has been in financial difficulties for a number of months past, is arranging for the early resumption of operations at its plant.

The Illinois China Co., Lincoln, Ill., has placed its new 10-kiln plant in operation and expects to develop maximum output at an early date. The company specializes in the manufacture of vitreous chinaware, plain white and decorated. The new plant

replaces a works destroyed by fire some time ago.

The Fredonia Brick Co., Fredonia, Kan., manufacturer of face brick, has resumed production at its plant, and expects to maintain operations for an indefinite period. Additions are now in progress and new machinery will be installed in a number of departments.

The Knoxville Brick Co., Knoxville, Tenn., is running full on a basis of about 80,000 bricks per day. Plans are in progress for a number of additions, with new machinery to increase this output at an early date.

The B. Mifflin Hood Brick Co., Atlanta, Ga., is operating at full capacity at its various brick and tile plants, and reports orders far in excess of those at this same time a year ago. The plants will be continued on the present basis indefinitely, giving employment to full working forces.

RUBBER—The manufacture is advancing in the Akron, O., district, and total current production is now approximately 100,000 completed tires daily at all plants. Of this aggregate, the Goodyear Tire & Rubber Co. is running on a schedule of close to 30,000 tires per day, with the Firestone Tire & Rubber Co. maintaining about this same output. The Goodrich Rubber Co. is manufacturing more than 20,000 tires daily, the Miller Rubber Co., 8,500; the General Tire & Rubber Co., 2,200; the Seiberling Tire & Rubber Co., 2,000, the India Rubber Co. more than 700, the Swinehart and Mohawk Tire & Rubber companies, 1,000 each, and the American Rubber Co., 750 tires daily.

The Bourn Rubber Co., Providence, R. I., has closed its plant temporarily, pending the outcome of a strike of operatives, totaling about 500. The company has refused to meet a demand for a wage advance of 10 per cent.

C. H. Booth, receiver for the Republic Rubber Co., Youngstown, O., is arranging plans for a reorganization, with expectation of placing all mills of the company on the active list at an early date.

IRON AND STEEL—The Carnegie Steel Co. is arranging to blow in its blast furnace at Niles, O., following a 7-year idle period. The plant has a rated output of 300 tons of pig iron daily, and will give employment to about 275 men, of which 200 will operate on the day turn, and the remainder on night shift.

The Penn-Seaboard Steel Corp., Philadelphia, Pa., has advanced production at its Chester, Pa., mills to 100 per cent capacity and is said to have orders on hand to insure this schedule for at least 90 days. The plant has been running at from 80 to 90 per cent since last fall.

The Virginia Iron, Coal & Coke Co., Roanoke, Va., is arranging to blow in another blast furnace at its plant.

The Adrian Furnace Co., Du Bois, Pa., is planning to place the torch to its local blast furnace at an early date.

The Titusville Iron Co. and the Titusville Forge Co., Titusville, Pa., affiliated organizations, are running at full capacity, giving employment to about 1,300 operatives. Wages have been advanced at the plants 10 per cent, effective April 2.

The Kittanning Iron & Steel Mfg. Co., Pittsburgh, Pa., a subsidiary of the Carbon Steel Co., has blown in its Rebecca furnace in the Kittanning, Pa., district.

Following the adoption of an increased operating schedule with two extra shifts in the blooming mill, the Eastern Steel Co., Pottsville, Pa., is planning for third shift at an early date, making full 24 hour service. An increased working force will be employed.

The Newton Steel Co., Youngstown, O., is operating at 17 sheet mills under capacity output.

The Low Moor Iron Co., Low Moor, Va., is planning to blow in its local blast furnace at an early date.

Of a total of 117 sheet mills in the Mahoning Valley section, Youngstown, O., only 2 such plants are now inactive; 115 mills are running full with normal working forces.

MISCELLANEOUS—The American Smelting & Refining Co., New York, is operating its copper refinery at Chrome, N. J., at maximum capacity, on a basis of about 20,000,000 lb. of refined copper per month. A full working force is engaged.

The Air Reduction Sales Co., New York, has completed its new plant at Baltimore, Md., and will place the factory in service at once for the production of commercial oxygen.

The Sinclair Refining Co., New York, has resumed production at its Mereaux, La., oil refinery, and purposes to develop maximum output.

New Companies

HENRY LANGE, INC., Kearny, N. J., has been incorporated with a capital of $25,000, to manufacture glass products. The incorporators are C. Martens and Henry Lange, 177 Windsor St., Kearny. The last noted represents the company.

THE FEDERALOID CORP., Brooklyn, N. Y., care of John Bogart, 63 Park Row, New York, representative, has been incorporated with a capital of $40,000, to manufacture celluloid products. Incorporators: D. I. Michaelson, J. Levy and J. Rottiner.

THE VENEKLASEN CLAY PRODUCTS CO., Hamilton, Mich., has been incorporated with a capital of $30,000, to manufacture burned clay wares of various kinds. The incorporators are Benjamin J. and John H. Veneklasen, both of Zeeland, Mich.

THE SCOLLAY PAPER CO., Boston, Mass., has been incorporated with a capital of $100,000, to manufacture paper products. John J. Delany, president, and M. F. Boyle, Mattapan, Mass., treasurer. The last noted represents the company.

THE LAWRENCE MFG. CO., Washington, D. C., care of the Capital Trust Co. of Delaware, Dover, Del., representative, has been incorporated under Delaware laws with capital of $15,000,000, to manufacture chemical specialties, cleansing powders, etc. The incorporators are John H. Lawrence, Washington, John H. Watkins and Frank J. King, New York.

THE KEARNEY-DAILEY GLASS CO., 407 North Elizabeth St., Chicago, Ill., has been incorporated with a capital of $100,000, to manufacture glass products. The incorporators are James M. Dailey, Thomas S. Kearney and James J. McMahon.

THE TRANSLOID PRODUCTS CO., Danbury, Conn., has been incorporated with a capital of $500,000, to manufacture glue, isinglass, gutta percha, rosin and kindred products. The incorporators are Charles Hetzel, William F. Buzaid and T. A. Keating, 118 Liberty St., Danbury.

THE ZEMCO CHEMICAL CO., New York, care of J. J. Hanrahan, 7 East 42d St., representative, has been incorporated with a capital of $100,000, to manufacture chemicals and chemical byproducts. The incorporators are L. Hoffman, J. M. Habstedt and D. Currubi.

THE URADIA CHEMICAL CORP., Houston, Tex., has been incorporated with a nominal capital of $5,000, to manufacture chemical products. The incorporators are J. E. Hall, R. A. Barrett and O. D. Thomas, all of Houston.

THE PHILLIPS PETROLEUM PRODUCTS CO., Boston, Mass., has been incorporated with a capital of $650,000, to manufacture petroleum and refined oil byproducts. Ralph B. Phillips is president; and Thomas F. Thornton, 1207 Columbus Ave., Boston, treasurer. The last noted represents the company.

THE H. H. DIERKES CO., INC., Union Hill, N. J., has been incorporated with a capital of $25,000, to manufacture brick and other burned clay products. The incorporators are Otto H. Harting, O. Venion, Jr., and Henry H. Dierkes, 144 Bergenline Ave., Union Hill. The last noted represents the company.

THE ALCON CHEMICAL ENGINEERING CO., 308 Capitol Theater Bldg., Detroit, Mich., has been incorporated with a capital of $10,000, to manufacture chemicals, chemical byproducts, etc. The incorporators are J. Howard Smith, J. A. Miller and J. F. Williams, 414 Fourth Ave., Royal Oak, Mich. The last noted represents the company.

THE SOUTHERN ALPHA TILE CO., Tampa, Fla., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $100,000, to manufacture tile and other ceramic products.

THE WANNER MALLEABLE CASTINGS CO., 10 South La Salle St., Chicago, Ill., has been incorporated with a capital of 20,000 shares of stock, no par value, to manufacture iron and other metal castings. The incorporators are Harry C. Wanner, J. Fred Reeve and Bernard W. Vinissky.

THE CONCRETE BRICK & TILE CO., Wildwood, N. J., care of Leap, Sharpless & Way, Wildwood, representatives, has been incorporated with a capital of $100,000, to manufacture concrete products. The incorporators are Charles W. Craythorn, William H. and I. L. Austin, all of Wildwood.

THE F. T. PARSONS PAPER CO., Washington, D. C., care of the Capital Trust Co. of Delaware, Dover, Del., representative, has been incorporated under Delaware laws with capital of $200,000, to manufacture paper products. The incorporators are Frank T. Parsons, Washington; Benjamin F. Bond, Jr., and Bert Reid, Baltimore.

Coming Meetings and Events

AMERICAN ASSOCIATION OF CEREAL CHEMISTS will hold its ninth annual convention at Hotel Sherman, Chicago, June 4 to 9.

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual convention in Norfolk, Va., May 7 to 9.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York.

AMERICAN FOUNDRYMEN'S ASSOCIATION will hold a meeting in Cleveland, O., April 28 to May 4.

AMERICAN GAS ASSOCIATION will hold its annual convention the week of Oct. 15 at Atlantic City.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its summer meeting June 20-23 at Wilmington, Del.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W. Va., June 7, 8 and 9.

AMERICAN OIL CHEMISTS' SOCIETY will hold its annual meeting at the Eastman Hotel, Hot Springs, Ark., April 30 and May 1.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold its spring meeting May 28 to 31 in Montreal, Canada.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

AMERICAN WELDING SOCIETY will hold its annual meeting April 25 to 27 at the Engineering Societies Building, New York.

AMERICAN ZINC INSTITUTE, INC., will hold its fifth annual meeting at the Hotel Chase, St. Louis, May 7 and 8.

CANADIAN INSTITUTE OF CHEMISTRY will hold its annual meeting in Toronto, May 29 to 31.

ENGINEERING SECTION of the National Safety Council will hold a mid-year safety conference April 17 in the auditorium of the Western Society of Engineers.

INTERSTATE COTTON SEED CRUSHERS ASSOCIATION will hold its annual convention at Hot Springs, Ark., May 2 to 4.

IRON AND STEEL INSTITUTE (London) will hold its annual meeting May 10 and 11 at the House of the Institution of Civil Engineers, London, S. W. 1.

NATIONAL ASSOCIATION OF MANUFACTURERS OF THE UNITED STATES OF AMERICA will meet in annual conference May 14 to 16, inclusive, at the Waldorf-Astoria, New York City.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (NINTH) will be held in New York Sept. 17-22.

NATIONAL FOREIGN TRADE COUNCIL has postponed its annual conference from April 25, 26 and 27, to May 2, 3 and 4. It will be held in New Orleans, La.

NATIONAL LIME ASSOCIATION will hold its fifth annual convention at the Hotel Commodore, New York City, June 13 to 15.

NATIONAL SYMPOSIUM ON COLLOID CHEMISTRY will be held at the University of Wisconsin, June 12 to 15.

SOCIETY OF CHEMICAL INDUSTRY, Canadian Section, will meet in Toronto, May 29 to 31.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY FOR STEEL TREATING — Eastern sectional meeting will be held June 14 and 15, in Bethlehem, Pa.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: April 13—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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Highlights of The A.C.S. Meeting

ALTHOUGH perhaps a shade more academic than usual, the meeting at New Haven was nevertheless one of the most significant in the history of the American Chemical Society. Circumstances made it so. The presence of a distinguished group of world leaders in science and the university ceremonies attending the dedication of Yale's new chemical laboratory gave an international academic interest to the occasion. And, too, Dr. EDGAR F. SMITH'S historical address had a quality of scholarship and of the art of presentation which left its deep impression on all who heard it.

From the viewpoint of the society, however, the extended sessions of the Council and its studious reception of the important reports of the committee on society procedure marked real milestones of progress in the direction of a more unified and harmonious membership. A few knotty problems are still unsolved, but the Council, as well as the committee, demonstrated that it is awake to the society's shortcomings. Further progress rests largely with the sections. The discussion at the first Council meeting brought out clearly the fact that the committee's report had been carefully studied by certain of the sections and that some of the representatives had been given definite instructions on which they were able to base their actions as the different issues were decided. On the other hand, it was equally evident that a good share of the membership as such had had no opportunity to consider the matter or to instruct their councilors. Although the committee was discharged and graciously voted the thanks it so well deserved, the fact remains that progress in society procedure is not a dead issue. Both the majority and minority reports, together with the Council's discussion and action, are worthy subjects for further study by the sections and the membership at large.

The division programs, even though long, were not uninteresting, and they actively competed for the attention of the members and guests. The symposiums on catalysis and colloids and the important general papers by Prof. T. G. DONNAN and Dr. OSKAR BAUDISCH reflect the intense interest of American chemists in the fundamentals of their science. But that practice also vied with theory was indicated by the close attention given to the special programs on motor fuels, insecticides and fungicides and the materials of equipment construction. In the sessions of the Organic Division, which not so very long ago were rather slimly attended, there was at times standing room only, and not much of that. Industrial chemistry, on the other hand, lured into its conferences many men of pure science. This is as it should be, because industrial research has assumed its proper rank in the great procession of science, it marches with the Very Learned, and except among some of the laggards, it has ceased to be the Recipe Mill uninformed persons think it should be.

Next September the society will meet in Milwaukee and conditions there will likely favor a shading toward industrial rather than academic interests. Thus will come the balance that makes it possible for the society to steer an even course of progress.

Materials for Equipment Construction

A SYMPOSIUM is not unlike a dangerous drug from a journalistic point of view. It is splendid if used occasionally as a stimulant perhaps, but too frequent use brings immunity to stimulation. Then the drug loses its force. So in *Chem. & Met.* we have been careful to use the symposium in moderation and each time for a definite, constructive purpose.

In this issue we publish a series of notes and essays on Materials for Equipment Construction. To chemical engineers there is no question so ubiquitous, so puzzling or so imperative as "What material shall we use in this equipment?" Everyone can recall a process which failed or succeeded because of the clumsy or deft selection of materials. Yet with all its importance there is a surprising tendency in this problem to copy the practice of others without knowing whether this practice has brought success or failure or without being fully acquainted with conditions under which the material was used.

Periodically, therefore, we must wake up and devote an increased amount of intelligent attention to this phase of our work. We should ask questions such as, What is the latest practice in making pressure vessels? What new materials are there which will resist acid corrosion? or weathering? or high temperature? What have they been doing in the alloy field or with industrial glassware?

This symposium does not pretend to be complete. It is a stimulant and not a dictionary. By no means are all the materials of construction mentioned, nor is there any attempt to be exhaustive in the treatment of any of them. In most of the essays the modern practice or the modern tendencies in the use of a material or a group of materials are reflected. Sometimes a producer offers a word of advice to consumers. Sometimes a consumer reports his success or failure. The net result is, first, a picture of the most important activities in the materials of construction field and second, a reminder of a neglected opportunity on your part if you are not utilizing the best knowledge that is available in selecting your materials for equipment fabrication. Finally, it is a promise on our part to keep this problem before you, for we believe it lies at the foundation of production success.

Impressive Circumstances Connected With the Dedication of Yale's New Chemical Laboratory Feature Spring Gathering—Reports of General Sessions and Important Council, Division and Section Meetings

EDITORIAL STAFF REPORT

HISTORY records that on two other occasions the American Chemical Society met at New Haven. But never was a meeting held under such impressive circumstances nor before such a distinguished group as gathered for the sixty-fifth meeting during the week of April 2, 1923. In round numbers 1,500 members and guests were present—including such world leaders in science as Sir J. J. Thomson, Professors F. G. Donnan of London, A. F. Holleman of Amsterdam, Giuseppi Bruni of Milan, G. Urbain of the Sorbonne and Principal Irvine of St. Andrew's. The dedication of the Sterling Memorial Laboratory marked an event in the history not only of Yale University but of chemistry in America

Council Meetings

From the point of view of the society a great deal of interest attaches to the two important Council meetings held in Byers Hall on Monday and Wednesday afternoons. President E. C. Franklin presided at both. About 115 councilors were present at the first meeting and 60 to 75 at the second.

Prof. O. B. Tower of Western Reserve University presented a memorial note on the long and active life of the late Prof. Edward W Morley, concluding with appropriate resolutions of appreciation, which were adopted by a rising vote.

The secretary was instructed to turn over the society's collection of autographed letters from eminent men to Prof. Edgar Fahs Smith, in whose keeping they will be properly cared for and eventually made available to all chemists, along with the rest of his great store of historical papers.

A new section was chartered with headquarters at Erie, Pa., and the secretary was instructed to provide a charter for another section which shall include Rock Island, Davenport, Clinton and Moline, as soon as proper application has been made.

Dr. A. M. Comey, formerly of Wilmington, Del., but now of Cambridge, Mass., was elected to succeed Dr. George D. Rosengarten, whose term as member of the committee on national policy has expired.

Committee Reports Heard

A large number of committees handed in reports, of which the following were a few: The advisory committee to the War Department recommended the proper and authoritative study of color for uniforms, to provide for minimum visibility. The committee on employment recommended the addition of $2,400 to the budget to provide for employment information in the news edition of *Industrial and Engineering Chemistry*. The committee on industrial alcohol recommended an advisory committee, preferably of technical men, to look after the sales of industrial alcohol. It is believed that this will help rather than hinder the enforcement of prohibition, inasmuch as the present non-technical force with its police powers is more easily deceived than would be a group of informed men, whose business is to look after industrial sales. It should also help to diminish the confusion and disorder which now reigns in regard to the industrial uses of alcohol.

The secretary reported that 1,278 members of the society were dropped for delinquency in payment of dues on Jan. 1, 1922.

A little flurry of excitement followed a resolution in regard to the action of the advisory committee in connection with an amended Stanley bill in which the advisory committee, acting for the Council, expressed itself as favoring a provision in the patent law that would require foreign patentees or owners of patents under certain conditions either to produce or to license productions in this country. After a rather heated discussion on the propriety of the committee's action, its decision was supported. It brought out, however, a good story from Henry Howard of how German industrialists working with their government succeeded in making a treaty with the United States which would

not require them to make patented dyes in this country nor establish here the technique of making dyes. The story involved a most remarkable series of false scents and misleading trails, all carefully planned out beforehand.

The difficult work began with the majority and minority reports of the committee on progress in society procedure. At first it appeared that the problems were too big and too far-reaching to be decided by the Council at that late hour, and finally it was resolved to refer the majority and minority reports to the advisory committee with the request that they be digested and recommendations offered to the Council at the September meeting.

The session adjourned about 6 o'clock.

Society Policies

At a subsequent meeting of the advisory committee it was decided that the report had not received sufficient discussion by the Council and accordingly a special session was arranged for on Wednesday afternoon. At that time over 4 hours was devoted to a consideration of this important report on society policies and procedure. The committee, consisting of A. V. H. Morey, chairman; George L. Coyle, L. C. Drefahl, Graham Edgar, H. C. Parmelee, R. E. Swain and J. N. Swan, had given more than a year's study to basic problems connected with the management and policies of the American Chemical Society. A unanimous report, together with majority and minority discussion of society membership, publications and finances, was read by the chairman and considered by the Council while functioning as a committee of the whole. Later, the following significant action was taken on the committee's recommendations:

A general plan of regional representation of directors was approved and a committee authorized to report the necessary changes to be made in the constitution and bylaws.

By unanimous vote, an executive committee to consist of the president and secretary of the society, the editor of the *Journal of the American Chemical Society* and the editor of *Industrial and Engineering Chemistry*, the last past president and three councilors at large was authorized to replace the present advisory committee. Its powers were further extended to include those usually held by an executive committee.

Although it was generally agreed that the Council was too large to be an efficient governing body, none of the schemes proposed for reducing its membership could gain the meeting's approval, and the matter was laid on the table for later action.

Intersectional meetings of the American Chemical Society will probably be approved and extended as soon as a working plan is formulated by a committee to report at the next meeting of the Council.

After a discussion of the election of members and classified membership, the Council adopted the committee's recommendation that a special committee be appointed to study and report its findings in the matter of definite measures for enhancing the value placed on membership in the society.

The very intimately related subjects of the society's publications and its finances come in for a major share of the Council's discussion, especially since on certain matters there was a division of opinion within the committee. The Council appeared to be unanimous in its opinion that the financial condition of the society is fundamentally sound and no material economies are likely to be effected in the society's present management. The majority and minority reports pointed out that the society's advertising business was conducted on a satisfactory and reasonable basis, and in answer to a question from the floor, the editor of the *Industrial Journal* declared that an increase in the advertising rates in that publication was already under contemplation. Certain other technical considerations in connection with the production of the society's publications were also discussed, but without definite action by the Council.

A significant motion passed during the last few minutes of the meeting instructed the secretary to mail the final program to members 10 days in advance of the Council meeting. It also set the final date of acceptance of papers at least one month before the general meeting.

Chemistry and the Public

The purpose of the meeting in New Haven, in the words of Prof. Treat B. Johnson, chairman of the executive and program committee, was to bring together chemistry and the public. The fact that Woolsey Hall was crowded to capacity for the first general session was pleasing evidence of the society's success in this direction. In his introductory remarks Professor Johnson called attention to the fact that this was the third time the American Chemical Society has met in New Haven. The first meeting was in 1899, when the society's membership was 1,570; at the time of the second meeting, in 1909, the membership had increased to 4,136.

The society was then officially welcomed to New Haven by state, city and university, represented respectively by Lieutenant-Governor Hiram Bingham, Mayor David E. FitzGerald and President James R. Angell. Presi-

NATHAN HALE ENTRY, HARKNESS MEMORIAL
The J. Willard Gibbs entry is also in this court

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following year bold spirits erected a glass house in the woods and exported their product to England. They made beads also for trading purposes, and some of the beads they made exist today. By 1619 two or three blast furnaces had been blown in. Later the glass house and these furnaces were destroyed in an Indian massacre.

John Winthrop the younger was among the first members of the Royal Society and he was in frequent correspondence with his scientific friends in London. He made many contributions to the proceedings of the Royal Society. The notion of alchemy, of the transmutation of metals, still prevailed, and Winthrop had a sense of it. Indeed it lasted well into the eighteenth century. There was the Rev. Ezra Stiles, the seventh president of Yale, who was the first to teach chemistry at the college, and he surely would not acknowledge any addiction to this form of witchcraft or wizardry; for the practice of alchemy was considered no less than this. But the Rev. Ezra Stiles, who discussed the secular ways of matter by day, would experiment in secret at night, and who shall say how tempted he was or how far he resisted the temptation to consider the ways of Satan in the transmutation of base metals into gold? Stiles was a correspondent of Priestley, and that also would bespeak his favor with Dr. Smith, for Dr. Smith has a very tender spot in his heart for the memory of that rather cantankerous and obstinate old gentleman.

Then followed a short historical note of the life of Benjamin Silliman the elder, who, after graduating from Yale and studying law, accepted the call of his alma mater to teach chemistry.

Silliman began teaching chemistry at Yale in 1804 and for 15 years he worked 15 or 20 ft. underground in the cellar of the house of the president of the college. In 1805 he made a trip to Europe and met Sir Humphry Davy and others. In 1818 he established the *American Journal of Science*. His correspondence with Hare also shows him to have been an active producer, although his great work was teaching. "Those who smooth the road to science," said Dr. Smith, "are often more useful than the men of original research." Among the men inspired by his teaching were Dana the geologist, Brush, Brewer the geographer, Johnson of the Agricultural College, and J. Willard Gibbs, the first of physical chemists.

It was not alone what Dr. Smith said but also his manner of saying it that gave his address such rare distinction. Its literary beauty was a subject of frequent discussion throughout the meeting among those that heard it. In fact we shall probably have to wait for several generations before we shall have another great chemist with the finish, the wit and the subtle elegance of speech to match the ex-provost of Pennsy.

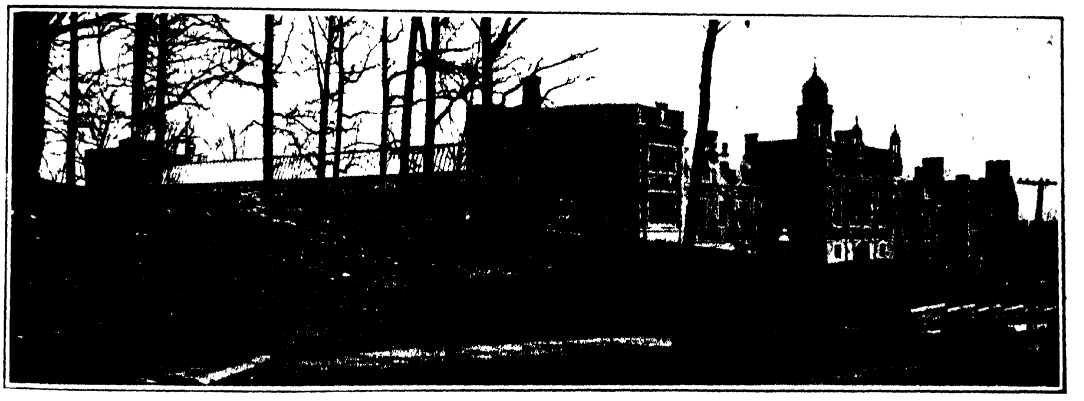
The Chemist in Industry

The sessions of the Industrial Section, which were held in the large lecture room of the Osborn Memorial Laboratory, enjoyed an attendance which varied between 30 and 300; there being, usually, between 50 and 75 members and visitors in attendance throughout the session. It is perhaps unfair to pick out only three outstanding features, for the general standard of articles was excellent and the discussions, for the most part, were intelligent and animated. There were three papers, however, of greater interest than the rest, possibly because of timeliness or some other unusual circumstance.

The first was a paper by L. V. Redman, entitled "Phenol Resins in Chemical and Allied Industries." It was not so much the utility of the phenol resins in chemical engineering industries that was novel or significant. As a matter of fact, the consumption of these is relatively insignificant.

Analyzing the distribution of these products, by industries, it was found that in 1917 the automobile industry took 65 per cent of the total production; that smoking articles took 20 per cent, and miscellaneous industries, mainly telephones, 15 per cent. In 1921, 50 per cent was used by the automobile industry; 15 per cent in the smokers' products; 15 per cent still in the miscellaneous, and 20 per cent in what might be termed mechanical products—buttons, pencil holders, handles, etc. In 1922, due to the remarkable development of radio, 34 per cent of the total business was radio; 30 per cent automobiles; 6 per cent smokers' articles; 10 per cent miscellaneous, and 20 per cent mechanical. The radio business is peculiar in that it utilizes a very large percentage during the months from January to April.

The industry has been on an insecure basis because of raw materials. Phenol has always been a foreign product. During the war a tremendous phenol capacity was created in the United States, but this rapidly dwindled until there is comparatively little produced at present. In order to make the industry more secure, the Bakelite Corporation is building a large phenol plant on the shores of Lake Erie, which will be in operation within a year. This will make the industry



STERLING LABORATORY, SHOWING SAWTOOTH CONSTRUCTION

a nationally contained industry, as is the case with one of the other great plastics, celluloid, which of the four great plastics is the only self-contained American industry; the others, rubber and fiber, are still dependent on foreign resources.

Progress in the Study of Corrosion

The second significant paper had to do with corrosion. It was presented by Professor Whitman, of Massachusetts Institute of Technology. Reviewing the work done in that field, Professor Whitman pointed out that the most important factors in corrosion were, actually, the removal of the hydrogen produced by the action of the hydrogen on iron. This removal can take place in two ways. The first method is by supplying oxygen to form water—and this is a straight diffusion problem. In other words, the rate of removal of hydrogen depends directly on the rate at which oxygen can get to the surface of the metal to remove the hydrogen atoms. Second, it can be removed by the evolution of hydrogen gas, as occurs in acid solutions. The experimental work of this problem consisted in suspending a steel shaft with a smooth surface in acids of varying concentrations, and rotating it at various speeds. The acid concentration was varied from less than $0.05N$ to $5N$ and the shaft was speeded up from zero to 4,000 r.p.m. Corrosion was measured by titrating the iron in the solution at the end of a given time. At rest, it was found that the corrosion in strong acids was much greater than that in weaker acids, but when rotation started it was found that the rate of corrosion diminished for a time and then increased rapidly, all concentrations approaching the same corrosion rate, so that at 4,000 r.p.m. there is practically no difference in the rate of corrosion in weak and strong acids. This shows pretty conclusively that there are two effects: one which depends on the hydrogen-ion concentration and the other which depends on the rate of diffusion of oxygen to the steel surface.

Experiments were then tried with oxygen, nitrogen and air as the atmosphere over the liquid, with increasing rate of revolution. It was found that the corrosion under oxygen was about 3½ times that under air, whereas that under air was considerably greater than that under nitrogen. This seems to show again, conclusively, that the oxygen diffusion is a primary factor at high speed.

The Plauson Mill Cornered at Last

The third high spot in the session was a discussion of the colloid mill, by W. J. Kelly, of the Goodyear Tire & Rubber Co., who has been in Germany and has watched the mill in operation. It was, for most of the audience, the first time that any accurate, first-hand data were presented on the colloid mill, and it was therefore exceedingly interesting. Mr. Kelly described clearly the design of the mill, it being a set of staggered teeth on a rotating drum, the teeth rotating between baffles on the side of the mill and the clearance being about 1 mm. The rotation does actually reach 12,000 r.p.m. and for those high speeds is direct connected with motor or turbine. It also is run with a belt when the speed is as low as 3,000 r.p.m.

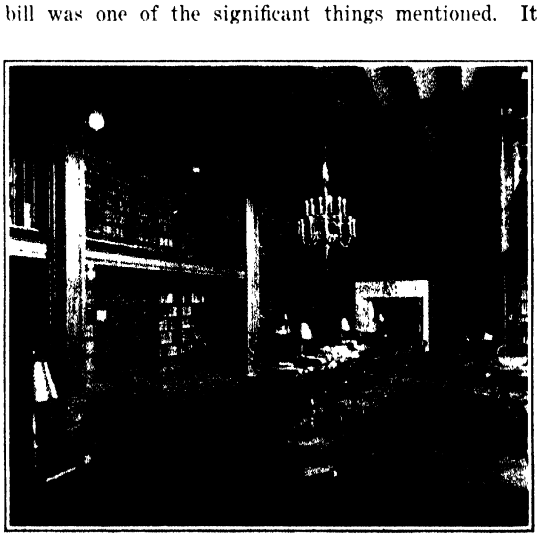
In answering questions with regard to the mill, Mr. Kelly pointed out that it was a batch mill and that the present size handles, roughly, 5 kg. of material, 1 kg. being the material to be ground and 4 kg. being water. It takes about 10 minutes to grind up this batch to a size of material which is almost colloidal. An appreciable percentage of the particles have a vigorous Brownian movement and go down to less than 1μ in diameter. The turbine-driven mill is almost vibrationless; the bearings are thoroughly protected and the packing is a compound of graphite and asbestos. Power consumption is extremely large, being, roughly, 28 hp. As yet it can hardly be called a commercial success—in fact, the commercial application is extremely limited. At the present time it cannot be applied to large-scale work, although there does not seem to be any reason why the difficulties cannot be overcome.

Mr. Kelly said, in answer to some criticisms of the Newport Company for not wanting to sell the mill in the American market, that the company had received its first mill last August and did not want to sell the mill until sure that it was reliable and until the limits of applicability were exactly known.

Considerable animated discussion occurred with regard to the mill, and it was altogether an ideal paper for a meeting. It developed out of a comprehensive survey of the industrial colloid field by Dr. Harry N. Holmes, of Oberlin University. Dr. Holmes discussed the colloid mill and then went on to other fields of colloid activity—silica gel, lignin, syneresis, smoke settling, lubrication, carbon and lamp black, glass and enamel, paper and paint. He urged the establishment of fellowships for the study of colloidal problems and believes that widespread application would follow from fundamental studies.

Some Materials of Construction Papers

At the first session Professor Boltwood, of Yale, described the Sterling Laboratory and some of the problems that had to be solved during its design. Prof. C. R. Hoover, of Wesleyan University, then discussed an elaborate series of experiments on laboratory table tops and reached the conclusion that, without counting the psychology of the situation—which often should be the determining factor—Alberene was the most suitable material for laboratory table tops. C. M. Strickland, of the American Rolling Mills Co., presented a paper on the resistivity of iron and its application to chemical industry. The importance of small amounts of impurities which reflect directly in the industrial corrosion bill was one of the significant things mentioned. It



LIBRARY IN STERLING LABORATORY

HARKNESS MEMORIAL QUADRANGLE

was stated that in 1921 pig-iron production was less than the rust loss to industry, this being probably due to the relatively large amount of impure iron produced during the preceding years of war activity.

The symposium on materials of construction in chemical industries was continued with a paper by Prof. C. S. Robinson of M.I.T. on the use of wood, pointing out the necessity of selecting the material with considerable care, as wood was not a standard material by any means, and further that wood from the same tree varied considerably, depending on the grain and the selection of the piece. In other words, two pieces of maple might vary more appreciably than maple and pine. In general, however, there seems to be an appreciable tendency toward the use of cypress and pine in the East and the redwood in the West. This paper was discussed ably by W. A. Peters, of the du Pont company, who reflected the experience of his company in regard to the action of various kinds of material on wood. W. Evans, of the B. F. Goodrich Co., gave an interesting discussion of the growth of the rubber industry, and, finally, of the use of all kinds of rubber, with the exception of hard rubber, in chemical engineering industries.

Hard Rubber an Increasing Factor

Mr. Buttfield, of the American Hard Rubber Co., then described some of the uses of hard rubber in industrial work, hard rubber being described as material containing between 15 and 50 per cent sulphur and varying considerably, depending upon the time of the cure as well as the mix. There is no limit to what might be called "hard rubber," however. One interesting recent development was the use of hard rubber for coating and lining metal objects, modern practice favoring the use of a soft rubber binder which sticks to the metal surfaces better.

In the beginning of the Friday session Dr. Charles H. Herty gave a talk on the trials and tribulations of the organic chemical industry during the past year, and he sounded a note of optimism for the future. Dr. Turrentine, of the Bureau of Soils, presented a paper on the extraction of nitrates from caliche, pointing out that poor chemical engineering was largely responsible for the inefficiency of the Chilean industry and that, in general, a recovery of 55 per cent was made on the caliche. The export tax, of course, represents about 41 per cent of the total cost, labor 19 per cent and fuel 11 per cent. Efficiencies in plant operation would naturally cut down the total cost per pound and even though the ratios might not be changed appreciably, the cost would be considerably improved. As a matter of fact, the investors are using all the surplus to pay dividends and there is therefore no surplus for developments. Dr. C. L. Reese commented on the report, stating that in some quarters greater efficiency was achieved by chemical control, although absolute chemical control was impossible because of the difficulty of sampling crude caliche.

Division of Organic Chemistry

The first morning was taken up with a symposium on catalysis. As there were twelve papers in all, there was scant time for proper presentation and less for discussion.

The effect of small quantities of iron in aiding the reduction of aldehydes in the presence of platinum black was strikingly presented by Roger Adams.

J. S. Reichert and J. A. Niewland described the catalytic combination of benzene homologs with acetylene to derivatives of diphenyl ethane.

H. S. Taylor brought out the fact in his talk on negative catalysis that one molecule of diphenylamine in 10,000 mols of benzaldehyde absolutely inhibits the oxidation of the aldehyde by oxygen.

There were almost as many varieties of theories as there were papers, and the indications were that the development of theories which will be capable of general acceptance is still far off. This subject of catalysis seems to deserve an individual section so that proper discussion would be possible without further encroaching on the time of the Organic or the Physical section, whose rosters are already overcrowded.

In the general program the papers by the foreign visitors excited considerable interest and were given with the lecture hall filled to capacity.

A. F. Holleman of the University of Amsterdam, Holland, presented a rather general paper reviewing the reactivity of various groups in the benzene derivatives, with particular reference to the effect of a substituent in determining the position taken in the molecule by groups entering later.

Many Interesting Papers

One paper of interest was that by James F. Norris and E. O. Cummings on "The Electrolytic Reduction of Various Organic Acids." The remarkable feature was brought out that fumaric acid in the form of its sodium salt could be almost quantitatively reduced to succinic acid without the use of a diaphragm, whereas with maleic acid a diaphragm was absolutely necessary to obtain suitable yields.

Thomas Midgley, Jr., together with C. A. Hochwalt and G. Calingaert, described the preparation of diplumbic hexaethide, a byproduct of their researches on anti-knock materials. This compound has not been previously prepared.

The chemical compounds present in coal tar were discussed by J. M. Weiss and C. R. Downs, who presented the picture of the compounds really present in appreciable amounts in American coke-oven tar, together with the proportionate amounts found. Phenanthrene was shown to be next to naphthalene the most abundant material present and, contrary to popular conception, only about thirty compounds are present in sufficient amount to be of even potential commercial importance.

A novel field of research was that of Elmer E. Brown

and Treat B. Johnson, who have collected large quantities of tubercle bacilli and subjected them to chemical analysis. The results presented were preliminary and the work is to be continued further.

Another paper, by J. J. Donleavy and T. B. Johnson, proposed the crystalline compounds formed by organic acids with pseudo thio-ureas as a means of identification. Various of these salts were exhibited and showed a fine crystalline appearance.

A rather novel feature for the organic section was the use of moving pictures to demonstrate various types of laboratory apparatus by H. T. Clarke of the Eastman Kodak laboratories.

Apart from the papers already mentioned, there was a very large number of other worthy contributions, the unfortunate part being that the number of papers on the program was so great that adequate time could not be given to either presentation or discussion.

Motor Fuel Symposium

The members of the Division of Petroleum Chemistry joined with the Section of Gas and Fuel Chemistry on Friday morning for a Motor Fuel Symposium under the chairmanship of Dr. Van H. Manning, director of research of the American Petroleum Institute. The purpose of this symposium was to bring out the important fundamentals of present-day knowledge of motor fuel supplies and requirements from a chemical point of view. The program consisted of five papers taking up five distinct phases of the subject.

Availability, usability and power-producing ability were three phases of fuel requirements discussed by S. W. Sparrow of the Bureau of Standards, who presented the first paper. In determining usability the explosive range, distillation range, latent heat of evaporation, flash point, freezing point, separation point, viscosity, detonation characteristics, spontaneous ignition temperature and corrosiveness were discussed. Great emphasis was laid upon the necessity of having a uniform viscosity of the fuel.

Available Petroleum Supplies

F. W. Lane and A. D. Bauer were the authors of a paper, "Economic Aspects of Motor Fuel Supply From Petroleum." They pointed out the steadily increasing percentage of the petroleum produced in the form of gasoline because of increasing temperature of cut and increasing cracking of lighter fractions into gasoline constituents. They believe that increases in production will be accomplished to a considerable extent by further recovery from abandoned wells, by improved working methods in old fields and by greater care in conserving the lighter fraction of oils after removal from the well. The greatest benefit for our future years will, however, come from more efficient utilization in the engine itself. It is to this possibility which these authors point with the greatest optimism.

Refinery Problems in Motor Fuel Supply

Frank A. Howard and N. E. Loomis of the Standard Oil Co. of New Jersey presented a discussion of important refinery problems bearing upon adequacy of motor fuel supply. Proper plant equipment, including countercurrent cooling methods, ample condensing equipment, comprehensive gas-tight vapor-recovery system and other modern plant facilities, were urged as the most important plant requirements. It was pointed out that loss of a gallon of light gasoline made the manufacture of several gallons of commercial gasoline less because the quantity of the commercial product is limited essentially by the amount of light constituents available for blending into a commercial mixture.

In view of this necessity for maintaining proper proportion among light, medium and heavy constituents the recovery of volatile liquid hydrocarbons from the refinery gases was suggested by the authors as second only to the importance of proper processing equipment. Of course, such recovery system requires particularly great care in having gas-tight vapor lines throughout the plant. And to supplement the equipment and the vapor recovery the authors pointed out that it is absolutely essential to protect storage tanks against evaporation losses. This phase of the subject was discussed with special reference to the use of Sealite, the compound recently described before the American Petroleum Institute. This patented compound is a mixture of glucose, cornstarch, glue, calcium chloride and other constituents in a liquid form that can be beaten up into a froth which is spread on the surface of the oil tanks. A layer approximately 1 in. thick is recommended by these speakers, as this quantity is found to be effective over a period of at least a year. With it the evaporation losses are only one-fifth that occurring in ordinary tank storage.

New Motor Fuels

Henry A. Gardner of the Institute of Industrial Research, Washington, reported briefly on work which he has been doing for the Bureau of Aëronautics of the U. S. Navy Department. The use of anhydrous alcohol, which is now available commercially, is particularly advantageous with aviation fuels. It is free from gum-forming constituents or corrosive agents and seems to have "anti-knock" characteristics, especially when used in mixtures of 30 per cent alcohol with 70 per cent gasoline. With such mixture extended tests by the navy are under way from which it is hoped that very complete information will be available as to performance under conditions of flight. Such fuel has one disadvantage in that it takes up moisture from the air when exposed to damp atmospheres, causing separation of the constituents under some circumstances. But with properly closed containers this difficulty can, in the opinion of the author, be avoided.

Wilbert J. Huff of the Koppers Co. discussed coal tar as a source of fuel for internal combustion engines, giving particular attention to the possibility of using naphthalene or oils which require different methods of burning in an engine than are used with gasoline. The author reviewed the history of the use of naphthalene in such engines and pointed out some of the limitations and some of the possible advantages which might be realized from this as a motor fuel.

Gas and Fuel Chemistry

In order to encourage coke-oven operators connected with steel plants to release the tar for refining instead of burning it, effort has been made by the Koppers Co. to develop methods for burning the soft pitches formed by partial distillation of coke-oven tars. One of the important problems involved is the design of equipment for pumping and burning these heavy tars or soft pitches which remain after the light oil constituents have been removed. Wilbert J. Huff discussed the fundamental data which he has obtained for the design of tar-handling equipment, particularly the relation of tem-

perature to viscosity of tars and soft pitches derived from them.

E. R. Weaver and P. G. Ledig of the Bureau of Standards described a simple device for determining the approximate concentration of water vapor in a gas. The operation of the device depends upon the change of conductivity of a thin film of hygroscopic material with changing moisture content of the atmosphere. The results reported indicate that a few parts per million of water vapor is sufficent to produce a definite indication on the device and that up to a partial pressure of 20 or 30 mm. the indications are significant and reliable.

The Burrell gas indicator for combustible gases in air was discussed by L. H. Milligan, who reported on changes in this device and tests he has made with it in the course of his work at the Bureau of Mines

HEAT BALANCES AND HEAT OF CARBONIZATION OF COAL

A brief report was made by D. W. Wilson and L. Evans of the Buffalo Station of the Massachusetts Institute of Technology regarding the fundamental principles which should be observed in striking a heat balance on industrial equipment. The authors bring out clearly the error frequently made in this sort of engineering calculation through failure to realize the necessary precautions for consistency of computation. Particular emphasis is laid upon difference in apparent efficiency or apparent loss that may result from different bases of calculation as to temperature of reference. Changing the reference temperature often changes by many per cent the apparent heating loss or the apparent efficiency of a system.

The thermal behavior of coal during carbonization has been studied experimentally in the laboratory at the U. S. Bureau of Mines, Pittsburgh station. J. D. Davis reported on this work. It is shown by this author that the heat of reaction depends very much upon the maximum temperature to which the carbonization of the coal is carried. Over the lower range of carbonization temperatures coals usually show endothermic reactions; but between 400 and 700 deg. C. the net heat of reaction is exothermic; whereas at still higher temperatures the overall effect is given as endothermic. In every case, however, the results show only a small heat of reaction for coals, usually less than 20 calories per gram on the curves presented.

Division of Petroleum Chemistry

A varied program including several papers of unusual importance attracted a record number of petroleum chemists to the sessions of this division. In the absence of Dr. T. G. Delbridge, who had been forced to resign from the chairmanship because of new responsibilities in the Atlantic Refining Co., and of Vice-Chairman R. R. Mathews, Dr. W. F. Farragher, of Mellon Institute, presided. Eleven papers were read and discussed at the first session of the division, which then joined with the Section of Gas and Fuel Chemistry for the joint symposium on motor fuel.

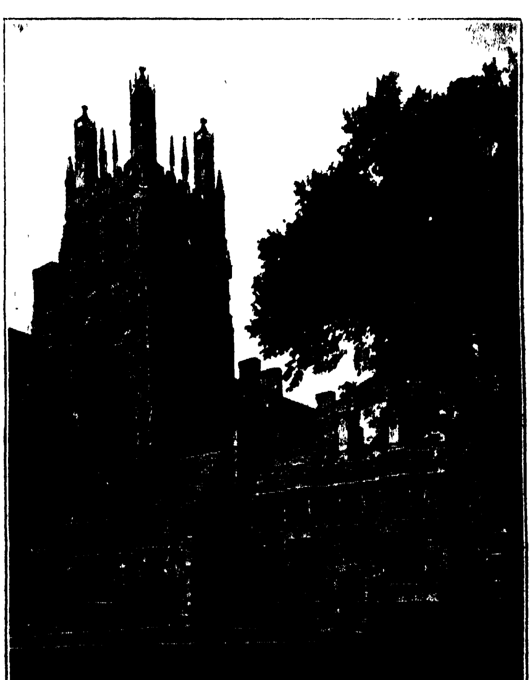
HIGHER ALCOHOLS FROM PETROLEUM OLEFINES

The production by the Standard Oil Co. of New Jersey of higher alcohols from petroleum olefines was described by W. W. Clough and Carl O. Johns, of the research division, development department, of that company. Dr. Johns, who presented the paper, pointed out that although the olefines were absent from crude petroleum, they were produced in considerable quantities during pressure still cracking. By reaction with concentrated sulphuric acid, alkyl esters are formed which are hydrolyzed with water to yield the alcohols. This is the basis of the present process which has been placed on a successful commercial basis, largely through the efforts of M. D. Mann, Jr., who is in charge of the company's alcohol plant.

It is significant that in all of these alcohols the hydroxyl group is on the second carbon atom of the straight chain molecule. No branch chains or OH groups in other than secondary positions have been observed. Of the various alcohols, isopropyl (2 - propanol) is perhaps the best known. It is a clear, colorless liquid, not definitely toxic but capable of producing peculiar physiological effects entirely different from those produced by ethyl alcohol. Its chloride is an excellent fat solvent. The secondary butyl alcohol (2 - butanol) was formerly only a laboratory curiosity, prepared by an expensive organic synthesis. However, it is now prepared in lots of thousands of gallons by distillation from the crude mixtures of higher alcohols. It forms at 87.5 deg. C., a constant boiling solution containing 72.7 per cent of alcohol by weight. The acetate is prepared by refluxing with acetic anhydride. The secondary amyl (2 - pentanol) forms a constant boiling solution at 119.1 deg.

The chlorides of all three alcohols are interesting organic compounds, and the fact that their use is not as dangerous as ether or benzol implies that they may become useful solvents for fat extraction.

The paper by Prof. C. W. Botkin of New Mexico A. & M. College was presented in abstract by C. L. Jones of Mellon Institute. The preliminary experiments described indicate that by pressure decomposition the yield of crude gasoline from shale oils may be increased to 45 per cent and that this treatment greatly improves refining qualities. The yield and quality of the crude motor fuel fraction, however, is not so high as obtained from the usual petroleum oils under the same conditions.



A CORNER OF THE HARKNESS MEMORIAL

The continued interest in viscosimetry and its importance to the petroleum industry was evidenced in three significant papers on this subject. Dr. W. H. Herschel of the Bureau of Standards discussed tests in which the actual temperature in the outlet tube of a viscosimeter of the Saybolt type was determined with a thermocouple in order to procure evidence in regard to proper bath temperatures. Prof. E. C. Bingham and G. R. Hood of Lafayette College and W. H. Fulweiler of the United Gas Improvement Co. reported on changes in the viscosity of mineral oils on standing. The question had been raised whether mineral oils maintain a constant fluidity suitable for use in calibrating viscosimeters. A sample of pale mineral oil measured by W. L. Hyden in 1921 and showing a validity of 0.9243 was redetermined recently with the same instrument under exactly the same conditions and an increase in fluidity of 1.36 per cent was obtained.

Dr. Fulweiler reported in his paper that a white medicinal oil examined by him had at first decreased in viscosity and then after a year started increasing. In the case of another oil that was being used in interlaboratory standardization of the Saybolt instrument an increase in viscosity of 0.9 per cent was noted within a few months. Another mineral oil showed a fair constancy for over a year. Lard oil, on the other hand, started decreasing and then suddenly increased to 17 per cent—obviously showing it to be unsatisfactory as a standard.

Contact Catalysts for Cracking

Contact catalysis in the vapor phase cracking of petroleum hydrocarbons was the subject of two papers presented by Thomas Midgley, Jr., of the General Motors Research Corporation and Prof. James R. Withrow of Ohio State University. In the first it was pointed out that selenium, the basis of powerful anti-knock materials, is also a contact catalyst for cracking oils when it is used in the form of ferrous selenide. As shown by the following results a very striking increase in the nitratable material and a corresponding decrease in the critical temperature of dissolution with aniline were obtained. A slight increase in gasoline yield is to be noted:

	Original Kerosene	With Pumice	With Fe_2O_3	With FeSe
H_2SO_4 Absorption (per cent)	4	20	22	28
Crit. temp. of dissol. with aniline (deg. C.)	60.5	53	55	46
Nitratable content (per cent)	23	17	18	43
Gasoline content (per cent)	0	25	30	40

The work reported by Professor Withrow was to extend Midgley's investigations to include other metallic oxides in order to see if there was any periodicity in the cracking effect. So far none has been noted. Elementary selenium proved the most effective catalyst. None of the other compounds was higher than metallic iron, whereas nickel and the sulphides of the iron group tend to decrease cracking.

Coloring Matter of Cracked Gasoline

Dr. B. T. Brooks and H. O. Parker of the Mathieson Alkali Works in a joint discussion of the coloring matter of cracked gasoline pointed out that the bright yellow color that sometimes comes from high-temperature cracking is probably due to conjugated di-olefine bodies. The authors proved that sulphur compounds were not the cause of this color by cracking a water-white pharmaceutical oil and obtaining a bright yellow-colored oil. This color was effectively removed by fullers earth. Midgley later pointed out that silica gel would accomplish the same purpose.

The last paper to be presented was that of the division's secretary, Dr. W. A. Gruse, and was of significance in that it suggested a direct means for the evaluation of motor fuels. The distillation test is not as reliable an index of the value of a fuel for the internal combustion motor as is the point of initial condensation (dew point). Accordingly an apparatus has been developed for the direct determination of this significant physical constant. The dew points determined in this apparatus were uniformly higher than those calculated by the method based on the 85 per cent point in the distillation tests.

Cellulose Division

The outstanding feature of the sessions of the Cellulose Division was the joint meeting with the Sugar Division at which J. C. Irvine, principal of St. Andrew's University (Scotland), spoke on "The Chemistry of the Polysaccharides." Professor Irvine's talk was a marvel for the way in which it made such a complex subject as the chemistry of the polysaccharides appear so very simple. Were it not for the glimpses of the extraordinarily painstaking technique required, one would have obtained the impression that this was one of the simplest fields of experimental chemistry. Professor Irvine expressed the opinion that the constitution of cellulose may be expressed in terms of molecular structure, but he pointed out that this did not tell us the mode of polymerization nor could it explain how these molecules are marshaled to give the cellulose fiber or the starch grain. In other words, while it would give us the constitution of the cellulose molecule, it would not in any way settle the chemistry of cellulose, which is almost entirely in the realm of the colloidal state.

Next in interest was the symposium on "Oxycellulose, Cellulose Hydrate and Hydrocellulose," which was the special order of business for Thursday afternoon. The symposium was opened by Professors L. E. Wise and Harold Hibbert and was participated in by a considerable number of those present. It was agreed that the term "hydrocellulose" was particularly unfortunate and that it would be advantageous if some means could be taken for abolishing it.

Dr. Alfred Tingle, of the E. B. Eddy Co., called attention to some products derived from sulphite waste liquor which have physical properties which render them easy to work with. He suggested their possible importance as starting materials for a new series of derivatives.

As a result of their further study of the chemistry of wood cellulose, Sherrard and Froehlke and also Sherrard and Gauger expressed the opinion that the cellulose of the woods which they have examined is not the same fundamentally as the cellulose from cotton.

According to Dr. L. F. Hawley of the Forest Products Laboratory it is not possible to obtain the methoxyl in wood charcoal in the form of methanol by distillation. Various catalysts were tried and also distillation with various gases. The same author, with L. C. Fleck, reported that there was in all woods examined a relation between the toxic effect of the water extract of the wood, when allowed to act on wood-destroying fungus, and the durability of the wood.

Hill and Hibbert have found that the stability of certain cyclic acetals related to the cellulose nucleus varies markedly from chains composed entirely of car-

bon atoms. Experiments are in progress involving the synthesis of members containing from 10 to 18 atoms in the chain. A number of interesting suggestions were offered by Professor Hibbert as to the ease with which the formation of unsaturated groupings such as aldehydes, esters and methoxyl groups may take place in plant growths.

The committee on standard cellulose presented a double report. The first part contained methods and specifications for preparing a standard sample of pure cellulose, while the second covered the analytical methods involved in the examination of cellulose.

Dye History in America

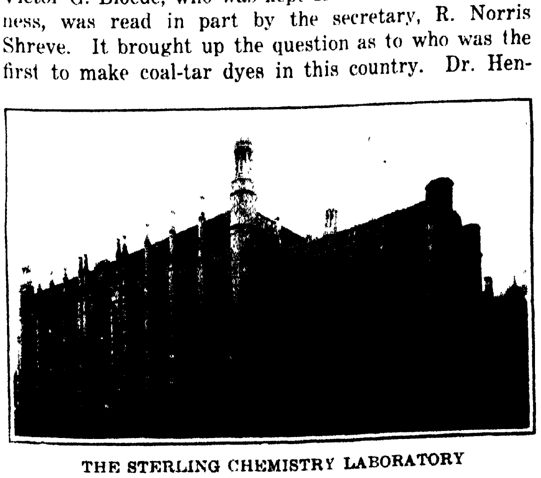
The symposium on the coal-tar dye industry in the United States prior to 1914 began with a paper by Dr. Ellwood Hendrick, giving a history of the Albany Aniline & Chemical Works, which was organized in 1868 by Arthur Bott at the suggestion of A. W. Hofmann. He gave his own experiences, and told of the various chemists engaged in the effort up to 1884, when the bond holders foreclosed. He concluded with a history of the Hudson River Aniline & Color Co., organized in 1882, and of the American Aniline & Color Co., the absorption of the two companies by the Bayer Company and record of their products up to 1914 and later.

George A. Prochazka told of his beginning in the industry in 1882, of the incorporation of the Central Dyestuff Co. in 1898, and of the manufacture of various dyes and intermediaries under the supervision of himself and his brother John up to 1914. He gave dates and tonnages in regard to the various products, which included the remarkable statement that the company with which he was associated made and sold 100,000 lb of eosine in 1897. This was before para-red succeeded it in paint.

Prof. Irving W. Fay, of the Brooklyn Polytechnic Institute, led the discussion on the teaching of dye chemistry along with the organic course, and suggested that it be taught by the case system, to make students think for themselves.

The paper by Dr. Charles E. Munroe and Miss Aida M Doyle was read in abstracted form by Miss Doyle. It presented the efforts made by the government at Washington at various times to foster the industry.

Other contributions by Eugene Merz, W. J. Stainton, Herman A. Metz and J. F. Schoelkopf, Jr., were read by title, but will be published with the others. That of Victor G. Bloede, who was kept from attendance by illness, was read in part by the secretary, R. Norris Shreve. It brought up the question as to who was the first to make coal-tar dyes in this country. Dr. Hendrick thought it was the Albany works in 1868 under Arthur Bott. In the paper of Dr. Munroe and Miss Doyle the date was given as 1866, but the name of the maker was not added. And Mr. Bloede remembered a German in Brooklyn who had a little plant on the Edwardes Canal, as far back, if we recall the date right, as 1864



THE STERLING CHEMISTRY LABORATORY

Section of Chemical Education

In the Section of Chemical Education George S. Counts made a plea for the needed research on the teaching of chemistry in secondary schools. W. H. Chapin reported on research problems which are fitting for teachers with limited time and equipment. Earl R. Glenn and Louis E. Welton presented a scientific study of the achievement of high school students in chemistry. Prof. R. A. Baker of Syracuse University gave a plan for grading large classes in chemistry.

Prof. E. G. Mahin of Purdue University proposed quantitative analysis as a study that replies to the instinctive questing within the minds of students as to what makes things go. Properly administered, it develops thinking and reasoning powers. Petty cheating, such as the manipulation of data and reports, are far tory than by rigid disciplinary measures. Prof. W. H. Chapin presented his method of teaching quantitative analysis, and Prof. H. R. Kraybill discussed the subject in relation to students of agriculture. Prof. Charles W. Cuno spoke of the need for more chemistry for engineers so that they may meet their problems in road building, electric furnace practice, metallography, etc. He wondered whether these subjects were not basically chemical. If they are, then how shall they be taught?

Prof. A. P. Sy of Buffalo University made a plea for a pedagogical scrap-heap in chemistry. Our concepts of chemistry are changing rapidly, and we should adjust our teaching methods to conform to modern ideas, especially to beginners.

The Chemical Education Section is becoming at once active and useful. The report presented by the committee on the correlation of high school and college chemistry did not meet with unanimous approval, which is natural, because the problem has not been solved as yet. But the discussion has got far beyond the old blame-shifting talk. That which is most earnestly sought is a better method of presenting chemistry to beginners, whether they are in high schools or colleges. It is generally recognized that the comparatively few high school pupils who go to college should not affect unfavorably the teaching of the large majority who do not go to college. It was clearly brought out, especially by Professor Sy, that we destroy the attractiveness of the study if we present features of the science to beginners that are not at all interesting to them then, while these same features become of intense interest later when the students come to learn their significance. It is not designed to make chemistry easy, or to use kindergarten methods. The purpose is rather to improve the order of teaching so that the sequence of things taught shall make the course in chemistry a living vital study, one that leads both to deductive and constructive habits of thought, and to the appreciation by the student of his greater understanding of the processes of nature.

Brief reviews of important papers presented before certain other divisions will appear in a subsequent issue.

Materials for Equipment Construction

A Symposium Reviewing the Field From the Standpoint of Present Practice in the Light of the Experience of Producer and Consumer

IT HAS seemed to us a good principle that the fundamentals upon which industries are built should be reviewed from time to time so that the milestones may be observed. Perspective changes The things that once seemed important are not deemed important now. So there must be a healthy checking up that we may all know at least the direction in which we are moving.

In this symposium we have tried to assemble and focus the changes that have come to pass in the use of materials of construction for chemical equipment. It would have given an erroneous perspective to record the changes out of relation to the general background and so these reviews will reflect modern practice.

In general, the topics have been reviewed by an engineer with an impartial predilection for technical facts. In some cases we have enlisted a maker and a user of such a material to bring the contrasting views into the picture. It should be of service to the whole industry to have assembled here authoritative articles on the most important materials of construction, together with the limits in the use of each and its outstanding characteristics.

Important Considerations in the Construction of Wood Tanks

Proper Selection of Stock, Careful Design and Skilled Workmanship Essential—Need for Frank Co-operation of Users

BY CONRAD PENNUCCI
Engineer, New England Tank & Tower Co., Everett, Mass.

WOOD, being more resistant to the action of many acids than are other materials of equal or greater cost, is used extensively in the construction of tanks for the chemical and allied industries. The large number of wood tanks required annually has resulted in the establishment of factories devoted exclusively to their manufacture. Space limitations preclude the presentation here of the details of the technique of tank building and of the uses and adaptation of wood tanks in the chemical industry, but the writer will endeavor to cover in a general way the points that are considered of greatest importance.

The life of a wood tank in industrial use is governed mainly by three factors—the selection of wood, the skill and care used in the construction and the design of the tank.

The importance of selecting stock to be used in making a tank cannot be overemphasized. Not only must the natural resistance of the wood itself be taken into account but also the question of the available supply of the proper uniform grades that are "right" in respect to their quality and condition of dryness must be carefully considered. Only stock that is dry and thoroughly seasoned should be used. In general the greater the number of years intervening between the stump and the tank the better the tank. Such stock undoubtedly costs more, but in comparison is worth more than it costs.


FIG. 1 WOOD TANKS AT PLANT OF CROWN WILLAMETTE PAPER CO.

The very definite constructional limitations of wood demand a close study of the design of the tank, and the importance of it cannot be disregarded.

Workmanship is the vital factor determining the life of the tank. A well-made tank of poor material will usually outlast a badly made tank of good material. While the equipment required in a tank shop is not generally extensive, it is of the greatest importance that the workmen be experienced in construction of this nature. Certain skill is required of tank builders that is peculiar to their trade and it has been found from experience that the most skilled wood worker in other lines cannot compete with the mechanic whose experience has been confined to the peculiarities of tank making.

NEED OF USER-MAKER CO-OPERATION

From the standpoint of both the user and the manufacturer, it is important to have information as to the purpose for which the tank is built.

There has been lacking between the users and the builders of wood tanks the frank co-operation absolutely essential to the development of the best possible equipment. This is a problem that cannot be finally worked out in the laboratory; such findings, while helpful, are often misleading and indicate doubtful preferences. Final decisions must rest on experience based on the service rendered by installations under actual operating conditions.

Very substantial savings would result to the chemical users of wood tanks by pooling their experiences with the manufacturers and frankly studying the problem together. Tank manufacturers have by years of experience acquired considerable knowledge of the varieties of wood and of the construction best suited to meet the different conditions of service.

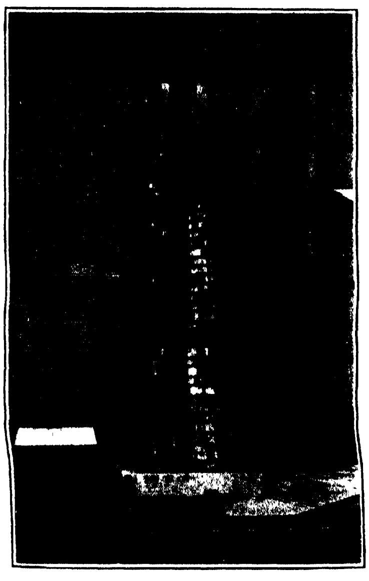
With such co-operation, ill-advised installations would be eliminated, material savings would be apparent at once, and in a few years the aggregate saving would be enormous.

Wood Pipe in Plant Construction

Its Wide Range of Utility in Chemical Engineering Industries Offers a Convenient Solution to Many Piping Problems

BY EUGENE H. SMITH
The Michigan Pipe Co., Bay City, Mich.

ALTHOUGH comparatively little wood pipe is used today in the strictly chemical industries, it is gradually finding a broadening field of application in the industries dependent upon chemical processes, particularly those involving the handling of acidic or other highly corrosive liquids. Thus in the sulphite paper mills wood pipe is used for conveying the sulphite liquor, which because of its sulphurous acid content is extremely corrosive to most metals. In some mills wood pipe is used to transfer the dilute solutions of sulphite pulp from one part of the plant to another. Oil refineries find wood pipe a practical means of handling sulphuric acid wash waters. In steel plants maintaining galvanizing and tin plate departments, corrosive acid solutions are encountered, and in many instances it has been found necessary to use wood pipe in handling them.



WOOD PIPE TOWERS FOR HYDROFLUORIC ACID

A rather novel application of wood piping is found in white lead factories, where it is used for conveying CO_2 required in the manufacturing process.

USE IN FERTILIZER PLANTS

Wood pipe construction is becoming rather general in the fertilizer industry in connection with the towers for the collection of hydrofluoric acid from acid phosphate manufacture. The accompanying illustration shows such a system of towers. The layout is composed of three vertical towers of 48 in. inside diameter, the acid gas main being 30 in. inside diameter and the special wood elbows and tees are also constructed of 30-in. pipe. The pipe may be made in any lengths desired up to 16 ft., being constructed of 3-in. thick Canadian white pine staves, double-tongued and grooved on the lateral edges and molded on the inner and outer faces to conform with the inside and outside diameter of the pipe.

Each section of pipe is mortised and tenoned so that it may easily be set in place. The towers are tightened by the ¾-in. rod placed 10 in. apart, excepting at the joints, where the spacing is 4 in. to provide extra strengthening.

Wood Tanks for the Paper-Making Industry

Details in Design and Construction of Special Equipment Developed to Meet the Needs of This Industry

BY L. E. LONG
Engineer, National Tank & Pipe Co., Portland, Ore

Proper selection of the variety and grade of lumber used, careful design and skilled workmanship and expert supervision are the essentials vitally important in the making of the best possible tanks for use in the chemical industry, and the users would profit by considering the tank from these four important viewpoints.

THE manufacture of wood tanks for the paper-making industry is not a new enterprise. During the past 7 years, however, a special effort has been made to develop equipment particularly adapted to this industry's greatest need—viz., a tank to hold the acid sulphite liquor used in the digestion of wood pulp. It is believed that a description of the design and construction of such a tank may bring out a number of features of interest to chemical engineers in other industries.

These tanks are manufactured from the best quality clear Douglas fir. Heads and bottoms are finished 7½ in. thick and staves 5¼ in. thick are hooped with ¾-in. round, soft-steel hoops, made in sections. Each section is fitted with a button head on one end, and 6-in. cold-rolled thread and hexagon nut on the other end. A specially designed malleable iron draw lug is attached to each hoop section to connect the various sections together and to tighten the hoops on the tank.

Figure 1 (page 676) shows sulphurous acid tanks at the plant of the Crown Willamette Paper Co., located at Floriston, Calif.

The blow-pit tanks, used for the discharge of the digesters, are manufactured from the same class of material, and have the same finished thickness of bottoms, heads and staves as tanks used for the storage of sulphurous acid. The blow-pit tanks, however, are supplied with a perforated false bottom. (See Fig. 2.) The holes in this false bottom are tapered ⅜ in. in diameter on the under side, and ⅛ in. in diameter on the upper side. The false bottom, made of 3-in. clear Douglas fir lumber and finished 2⅝ in. thick, is placed in the tank in the same manner as the bottom and head. The tank is also hooped with ¾-in. round, soft-steel hoops, having the same specifications as the sulphurous acid tanks.

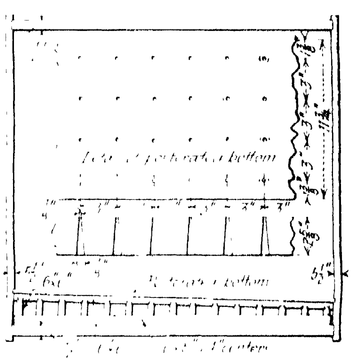


FIG. 2—ELEVATION AND DETAIL OF BLOW PIT TANK

Acid-Resisting Irons

The Composition, Properties and Uses of These Important Materials Reviewed in the Light of Modern Practice

BY PIERCE D. SCHENCK
President, The Duriron Co.

ACID-RESISTING IRONS, frequently referred to as ferro silicon or high-silicon irons, have become an important part of chemical plant construction. The composition of such irons is usually from 13 to 15 per cent silicon, with carbon, manganese, sulphur and phosphorous present in comparatively small amounts and the remainder iron. A better descriptive name for these irons would be iron silicides, as they probably consist of alloys of iron silicide and iron. Any elements outside of iron and silicon have a marked effect in diminishing the resistance to corrosion. The term "high-silicon iron" is indefinite and apt to be misleading. Comprehensive curves have been published proving conclusively that irons with silicon content of less than 12 per cent have little or no advantage over ordinary cast iron so far as resistance to corrosion is concerned.

Fig. 1 illustrates this point, although the curve is drawn to cover only the useful range of iron silicides. The resistance to corrosion increases with the silicon content,

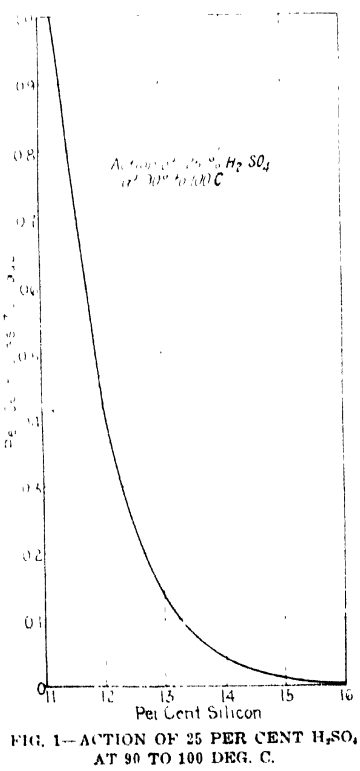


FIG. 1—ACTION OF 25 PER CENT H_2SO_4 AT 90 TO 100 DEG. C.

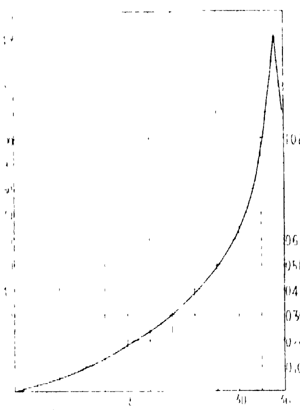


FIG. 2—EFFECT OF HYDROCHLORIC ACID AT DIFFERENT CONCENTRATIONS

but above 15 per cent the increased resistance of the alloy does not justify the higher cost of manufacture. Iron silicides, to give satisfactory results, must be manufactured under the most careful metallurgical control, as slight variations in composition, pouring temperature or cooling rate will have a marked effect on the acid-resisting qualities.

Where severe corrosive conditions are to be encountered a minimum silicon content of 14 per cent and a maximum carbon content of 0.80 per cent should be insisted upon. A higher graphitic carbon content has been found quite objectionable, as it not only lowers the resistance of the metal to corrosion but is apt to segregate and form pockets of pure graphite.

A lower silicon content, particularly if accompanied by an increase in carbon, will result in a rate of corrosion several hundred times as great as would be the case if the specifications mentioned were met.

Perhaps a more satisfactory method of determining the suitability of one of these alloys would be a depreciation test on a representative sample, made by keeping the sample in a 25 per cent sulphuric acid solution for 24 hours at a temperature of 90 to 100 deg. C. Great care should, of course, be used to maintain a uniform concentration of the solution. The loss in milligrams per square centimeter, under such a test, should not be over 0.08, an average of three such tests being advisable on very important work. Iron silicides that pass these specifications should be entirely satisfactory for use with nitric, sulphuric, acetic and, in fact, practically all commercial acids at any strength or temperature, with the exception of hydrochloric and, of course, hydrofluoric acids. Fig. 2 shows the effect of hydrochloric at different concentrations.

There are certain corrosives in the handling of which silicides should never be used, such as bromine, fused alkalis, hydrofluosilicic acid when concentrated, and the chlorides of sulphur. Others, such as caustic solutions, sulphurous acid solutions and certain sulphites, require careful consideration and possibly tests under specific conditions.

An important feature of these silicides is their almost universal resistance to chemicals under various conditions permitting standardization of apparatus. This advantage, together with the fact that apparatus of complicated form and considerable size suitable for high pressures and temperatures can be produced, has provided a construction material making possible on a commercial scale the use of processes which have been heretofore impracticable.

Several manufacturers, both abroad and in the United States, manufac-

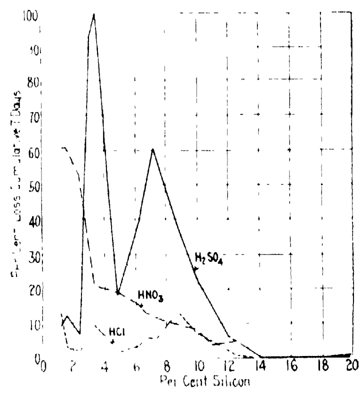


FIG. 3—VARIATION OF CORROSION WITH CHANGES IN PER CENT SILICON

ture standard apparatus such as valves, pumps, pipe, exhaust fans, etc., which are available in various sizes to meet general conditions. Unless the engineer is very familiar with the design and characteristics of silicides, the manufacturers' recommendations as to these points should be considered, as there are certain well-defined limitations of design which are peculiar to the material in question.

Large Containers

Stills and Tanks of Boiler Plate Are Usually Riveted—Welded Seams Have Certain Advantages, and May Now Be Made by Skillful Manufacturers With Dependable Joints Nearly as Strong as the Original Plate

By E. E. Thum

Associate Editor of *Chemical & Metallurgical Engineering*

LARGE containers, to operate at elevated temperature and pressure, are often needed by chemical engineers. At the present time, steel plate is the only structural material available in the necessary sizes, possessing the required strength and obtainable at a price. Naturally, a prerequisite to the use of large stills is that the contents will not react with commercial plate. The word "commercial" might be stressed, because the chemical engineer will find it impossible to obtain stills made of metal having special analysis or of alloy sheets, unless his order amounts to many hundreds of tons or he is justified in paying a very fancy price. Open-hearth firebox steel will ordinarily be found quite suitable. Some manufacturers of large tanks have pronounced ideas on the effect of small percentages of sulphur, phosphorus, copper or silicon, but the purchaser should bear in mind that the specific effect of these usual constituents of steel is far less than many unspecified factors which go to make up "best practice."

By their very nature, large containers must be fabricated of more than one piece. Riveting is the conventional method of jointing. Riveted joints have given satisfactory service in all classes of engineering structures for many years; their strength is easy to compute and has been proved by many tests; the shop practice is well standardized. Therefore a conservative engineer will often specify riveted joints, knowing that any reputable boilermaker can turn out a tight, workmanlike, dependable job. He will see to it, however, that the number of joints is kept to the minimum—each end should be "dished" of one piece; the entire bottom, inclosed in the firebrick setting, should be seamless. To meet such requirements, plate mills have been enlarged until it is now possible to obtain plates 15½ ft. wide and 40 ft. long—sheets which tax the railroad clearances for shipment.

However, riveted joints that easily resist water will develop leaks when handling light distillate. Even the tightest joint is hard put to remain tight when subjected to considerable temperature variations. Therefore much time may easily be lost with riveted connections through shut-downs to calk seams and redrive loose rivets.

If it is desirable to restrict the riveted seams to a minimum, why not dispense with them entirely? Such reasoning has led to the manufacture of "seamless" or "all-welded" containers. The American Society of Mechanical Engineers boiler code, however, does not permit the use of welded seams except for minor details, and then only allows the designer to figure a strength 55 to 65 per cent of that of the original plate. This specification tends to prevent many engineers from using perfectly safe welded joints having the highest efficiencies of any known method of joining metals.

Weld or Rivet?

The truth of the matter is that few engineers are able to give an intelligent answer to the question. Habit, precedent and even less reliable criteria are the bases of decision. Here the problem is discussed and a few axioms are laid down. It is a live, vital question and one that is constantly changing perspective as technological practice develops.

It would not be safe practice to give an ordinary repair man the job of welding up a pressure still. However, gas-, electric- and hammer-welding methods and practices have been highly perfected in quite recent times. A recent series of tests made by the Bureau of Standards on fifty large containers welded by gas flame or electric arc shows that if the seams are beveled both ways before welding (i.e., the welding is done from both sides and the added metal fills a "double V"), the welds may be conservatively figured at 80 per cent of the strength of the original plate. Low-carbon grades of boiler plate are recommended for such work, and the finished job should be tested at 50 per cent overload, hammering the weld during test.

Joint efficiencies as high as those in lap-welded pipe—90 per cent—can be expected in "hammer-welded" seams. This method merely adapts the methods of the blacksmith to very large pieces. Control is entirely automatic; heating is done by gas burners, and the hot seam is hammered together and worked down flat a short length at each operation. A strong joint is doubtless due in no small measure to the hammering which the heated metal receives.

However made, the completed still should be placed in a large furnace and carefully annealed—this to relieve any internal stresses due to the bending of plates or local heating. Not only does this practice allow the engineer to be assured that the metal is not laboring under high initial stresses before it is put to any useful work, but removes the liability for "season cracking"—a peculiar and dangerous brittleness rapidly induced by nitrate and other chemical solutions.

Six Kinds of Riveted Seams

E. E. Rohrer of the Coatesville Boiler Works suggested this listing to us:

In general there are six types of riveted joints: First, the lapped and single riveted seam is almost entirely used for storage tank work. The efficiency of this type of seam is approximately 50 per cent. Second, the lapped and staggered double riveted seam, used where medium pressure may be required. The rivets in this type of seam are usually about 1 in. greater pitch than for the single riveted seam. This type of joint has an efficiency of about 70 per cent. Third, the lapped and triple riveted seam is comparatively seldom used. Fourth, the butt strap double riveted seam (the butt strap seams here mentioned inside and outside butt straps) has an efficiency of about 82 per cent. Fifth, butt strapped triple riveted seam, having an efficiency of about 87 per cent. Sixth, the butt strapped quadruple riveted, having an efficiency of about 93 per cent; these latter two are used on larger diameters and for higher pressures.

Metals for High Temperature

No One Alloy Can Be Used as Standard—Each Has Its Limitations and These Must Be Appreciated in Order to Ward Off Failure

BY F. A. FAHRENWALD
Consulting Engineer, Cleveland, Ohio

MANY chemical processes require the use of metallic containers or mechanical units at high temperature. In such circumstances the degree of commercial success is measured by the degree of stability of these units under manufacturing conditions.

A score or more "heat-resisting" alloys have been offered to meet these requirements. The term "heat-resisting alloy" has come to be blindly used by the purchaser and so misused by the vender without regard to the kind of heat to be encountered or the nature of resistance required. As a consequence, the general effect is so unsatisfactory that the user or designer of high-temperature equipment has come to underrate the possibilities of heat-resisting alloys. The term "heat-resisting," like good or bad or high or low, is merely relative. Any material is heat resisting only to some particular set of requirements.

Therefore, it is no more feasible to make one heat-resisting alloy for all high-temperature uses than it is to make one single, all-purpose grade of steel for watch springs, cutting tools, bridge construction and gas pipe.

THE DIFFERENCE BETWEEN 25 AND 1,000°

It seems difficult to visualize conditions as they would obtain if our normal temperatures were around 1,000 deg. C. instead of 25 deg. C. (as it happens to be for perhaps only this one body in the universe), but this mental adjustment is necessary if the design and materials of equipment for use at the upper temperature are to be satisfactory. As a matter of fact, most failures in high-temperature equipment are not due to a lack of quality in the materials themselves so much as to an improper application due to this inability on the part of either the manufacturer or designer to think from any plane other than that established by the normal temperature and pressure of early courses in physics.

Many structures and devices designed for operation at 1,000 deg. C. are based on data and engineering conditions for ordinary temperatures. When put in operation they suffer the same fate as would the ether-plane of an aviator who from some cold planet attempted to make the trip to earth in a flying structure made up of materials which gave best service under his normal conditions. He would not, of course, use iron or steel, because these show a tendency to brittleness at his low temperatures and he would no doubt employ struts and braces of copper, aluminum or zinc, with perhaps castings of mercury for certain parts of his mechanism, and if he had made no greater allowances for thermal expansion or the weakening of his materials with increasing temperatures than do many of our mundane designers the wreck of his arrival would be no greater than those which happen here.

A timely caution from a very wise metallurgist! When users of metals at high temperatures are able to forget conditions at 25 deg. C. and the ordinary tests and think in terms of 1,000 deg., then there will be less failure. Perhaps then we shall not use an alloy in an oxidizing atmosphere which is of use only under carbon monoxide. Here at least is a prophet whom we should heed.

Corroded surfaces, warped, sagged and cracked structural members, and other types of failure at high temperature have been blamed on the alloy itself when the true cause is that the material and design was not fitted to the particular requirements, or the impossible attempted.

Any metal or alloy is heat resisting with reference only to some clearly defined set of requirements. Thus, tungsten is a very superior heat-resisting material in an atmosphere of nitrogen, argon, or in a vacuum, but tantulum, while nearly as refractory, cannot be used in nitrogen, and neither of these is as heat resisting as ordinary cast iron in open air. Platinum is very heat resisting in open air, but in an atmosphere of CO gas or metallic vapors or in contact with certain salts it is unstable at quite low temperatures. Lead is more heat resisting than nickel or iron when in contact with sulphuric acid, and iron is a better material than platinum for lead pots.

These perfectly obvious examples, which could be multiplied many times, are given merely to illustrate the fact that in so far as resistance to corrosion is concerned any given metal or alloy is "best" with reference to some one set of conditions only. Resistance to corrosion (scaling and oxidation), however, is not the only criterion to be used in selecting equipment for high-temperature operation. If this property alone were required, it would be a relatively simple matter to meet very rigid requirements. The real difficulty lies in combining chemical resistivity with the necessary physical or mechanical stability. As a matter of fact most failures observed in heat-resisting alloy units are due to cracking or warping and not to surface deterioration.

MECHANICAL PROPERTIES AT HIGH TEMPERATURES

It must be remembered here that the mechanical properties of iron, nickel or heat-resisting alloys at 1,000 deg. C. are not those revealed by ordinary physical tests and that these materials at high temperatures are very much like copper, lead or zinc at ordinary temperatures. A hearth plate of steel or heat-resisting alloy will, for example, flow or bend slowly at a temperature of 2,000 deg. F. just as a lead shingle will "creep" down the side of a roof in the hot (high-temperature really, for lead) sunshine. A tensile or bending test carried out at a temperature of 1,000 deg. C. on a typical heat-resisting alloy will show an apparent strength of 25,000 lb. per square inch under a quick pull, when as a matter of fact its effective strength under continuous dead load is only about 5,000. A structural unit may therefore vary five to one in cross-section, depending upon whether designed for intermittent service or to resist permanent stresses.

High-temperature stiffness, hardness or strength may be obtained by proper alloying, but usually at a sacrifice of some other property, just as in the parallel low-temperature example of hard lead for type metal. Again, it would be relatively easy to provide for the combination of a certain kind of chemical resistivity with some specific set of physical or mechanical properties for some definite narrow temperature range; but often one must provide for rapid fluctuations of 1,000 deg. temperature, with the accompanying tremendous forces of thermal expansion. One high-

temperature process, for instance, may require resistance to a certain type of corrosion and in addition, one other property to a maximum degree —such as high tensile strength, or stiffness, or resistance to cracking or abrasion while hot, or a high degree of machinability or ductility while cold to facilitate fabrication. Another process may require the combination of three or more special properties, and it is not difficult to think of only two which can hardly be combined in the same alloy. It is easy, for example, to combine resistance to scaling in open air or ordinary gases of combustion with a high degree of ductility, strength and machinability while cold, but it happens that if these surrounding gases contain a small percentage of sulphur, maximum resistance to corrosion has been found only in alloys which are quite brittle and non-ductile cold and not particularly resistant to warping and cracking at high temperatures. An alloy which has been found to be very resistant to molten lead is quite fragile cold, but machineable — a property not required for this purpose—while another alloy well suited to withstand abrasion in continuous furnaces of a certain type is too hard and so cannot be fabricated into the required forms. These examples are given to show that it is often necessary to accept certain seemingly objectionable features in an alloy which contains to a maximum degree the one particular type of high-temperature stability required and that alloys for use at high temperatures must not be judged by "standards" developed for ordinary conditions.

Practically all of the "heat-resisting" alloys at present on the market are composed of chromium together with one or more of the iron group metals, with minor additions of other elements to impart certain desired characteristics. Maximum operating temperatures — limited by the character of these constituents— are thus necessarily low, but it is not at all unlikely that super-refractory alloys will be available in the near future. It is unfortunate that one cannot go to a handbook for exact and detailed information concerning the behavior of such metals at high temperatures.

So without attempting to advise on specific cases, I would urge a proper consideration of those factors which make for success or failure in high-temperature equipment.

Corrosion-Resisting Irons and Steels

Interesting Discussion of the Corrosion Resistance of Pure Iron. Chromium Steels and Silicon Cast Irons

BY JAMES A. AUPPERLE
Chief Chemist, American Rolling Mill Co. Middletown, Ohio

AT THE outset, one must admit that only a service test will determine whether a metal will resist chemical reagents. This has been found true so often that at times the chemical engineer hesitates to guarantee the performance of any particular metal if he suspects that the operating conditions are slightly different from those with which he has been formerly dealing.

Consequently it is unnecessary to warn the experienced man not to rely too much upon laboratory tests. As ordinarily conducted, they give no more than a rough general indication of the service to be expected. So little is known about the mechanism and true nature of corrosion, and so much depends upon the kind of reaction product—whether loose or adherent, pervious or tight, inhibitive, accelerator or catalyzer—that it is hard to predict what will happen during the fiftieth day, for instance, based upon the results observed during the first day. A consideration of great importance in this connection is whether the salt solution in contact or formed by corrosion will hydrolyze easily with the concomitant formation of acid concentration at those particular regions. Aluminum sulphate is an instance. Impurities in the liquids to be handled sometimes give startling troubles; the amount of oxygen held in the solutions is also a very important factor. A recent test on coal mine waters of the Pittsburgh district containing a wide variety of sulphates gave very puzzling and inconsistent results for these very reasons.

Broadly speaking, in order to obtain a ferrous metal which approaches non-corrodibility it is necessary to render the iron, by suitable alloying, insoluble in the reagent in question, or to make the iron as pure and homogeneous as possible in order to avoid electrolytic or galvanic effects among the different micro-constituents.

Chromium is the element usually added to steel, and silicon is the element usually added to cast iron (in considerable percentages in both classes (to make the alloy insoluble in reagents. Thus we have many kinds of "stainless" steels and high-silicon irons on the market. Great purity in the iron has also been found to be very efficacious in resisting corrosion under many diverse service conditions, which include ground waters and very dilute solutions generally. This is the idea upon which "commercially pure ingot iron" is produced. Possibly the same reason underlies the remarkable preservation of many wrought-iron objects— the iron crystals in this material are quite pure, the so-called "impurities" in this material being concentrated in the slag inclusions.

It should be remembered that chromium steels and more complex steels will often give disappointing results when subjected to the action of acids. Table I illustrates this point by corrosion tests which were made at room temperature.

From these results it will be noted that there is a remarkable difference between the various grades of stainless steel, especially in the acid solutions. In the 5 per cent hydrochloric acid solution, one grade of stainless steel showed forty times as much corrosion as commercially pure iron. A great difference is also noted in the results obtained using 5 per cent acetic acid solution. One type of stainless steel lost practically nothing, while other types of stainless steel lost more than the commercially pure iron.

Commercially pure iron has been successfully employed to resist the action of 20 per cent aluminum sulphate solution and also to resist the action of boiling ammonia (sp.gr. 0.90).

Great strides have been made during recent years in the vitreous enameling industries, by which proc-

TABLE I LOSSES IN OUNCES PER SQ. FT

Material	5 Per Cent Hydrochloric A 100 Hr	5 Per Cent Acetic Acid 100 Hr	Distilled Water 100 Hr	3½ Per Cent Sea Salt 100 Hr	Moist Salt 300 Hr.
Commercially pure iron	0 211	0 034	0 019	0 021	0 075
Stainless steel "A"	8 118	001	002	002	005
Stainless steel "B"	188	046	001	001	004
Stainless steel "C"	2 534	055	006	008	.007

ess a glass-like coating having wonderful acid and alkaline resisting properties is fused onto the metal. Light gage sheet metal can be employed in the chemical industry when an enameled coating is used. The enameled coating is very light and approximately three times as thick as the average metallic coating on sheets. It has been found that utmost homogeneity in the base is necessary if the coating—either of metal or of enamel—is to be absolutely continuous. Included impurities in the base metal almost invariably mark the location of defects in the coatings.

It is obvious that a linseed oil paint should not be used on structural or other material where alkalis predominate, as alkalis would have a tendency to saponify the linseed oil in the paint and thus destroy its usefulness as a protective coating.

A very efficient protective coating which has been used successfully by sulphuric acid plants is coal tar of the consistency of molasses, thinned with the use of benzol if necessary and containing about 10 per cent by weight of dry portland cement. A coal-tar paint of this character can be made up cheaper than any other type of paint, and has been found very satisfactory. The cement will combine with the acids and water sometimes present in coal-gas tar and water-gas tar. The paint should be applied with the use of a sprayer, and the paint should be kept agitated while being sprayed.

Use of Copper and Its Alloys in Chemical Engineering

Easy Fabrication and Resistance to Corrosion Make Them Some of the Most Useful of Construction Materials Used by the Chemical Engineer

BY WILLIAM G. SCHNEIDER
Copper and Brass Research Association, New York City

COPPER has been in use so long that it is usually taken for granted that everybody knows all about copper. Perhaps that habit of thought explains why, in many instances, the broad, general utility of copper has been somewhat lost sight of behind an impressive series of laboratory tests, featuring "successors to copper." The final test of a metal's service value is actual use, and it is a matter of record that in many instances expensive apparatus built of, or using, materials whose reputations were made through special or laboratory tests failed because, in actual operation, conditions were present which could not have been comprehended in the laboratory. Accelerated corrosion tests have repeatedly demonstrated other metals as equally non-corrosive as bronze. Yet the engineer has made the bronze pump practically standard for the handling of acid mine waters, not only because bronze stands up well but also because the bronze pump is readily repaired on the job. To be sure, some of the newer alloys constantly coming to the fore are more resistant to certain forms of corrosion. In many cases, however, these are so difficult to machine, weld, forge or otherwise work that if a break occurs the entire plant or unit is thrown out of operation.

Since the major responsibility of the chemical engineer is quantity production at a profit, and his tools are pumps, coils, tanks, digester, condensers, evaporators, kettles and similar apparatus, his most valuable metal is that which possesses to the greatest extent a combination of the essential qualities of easy fabrication, heat conductivity, non-corrodibility and strength.

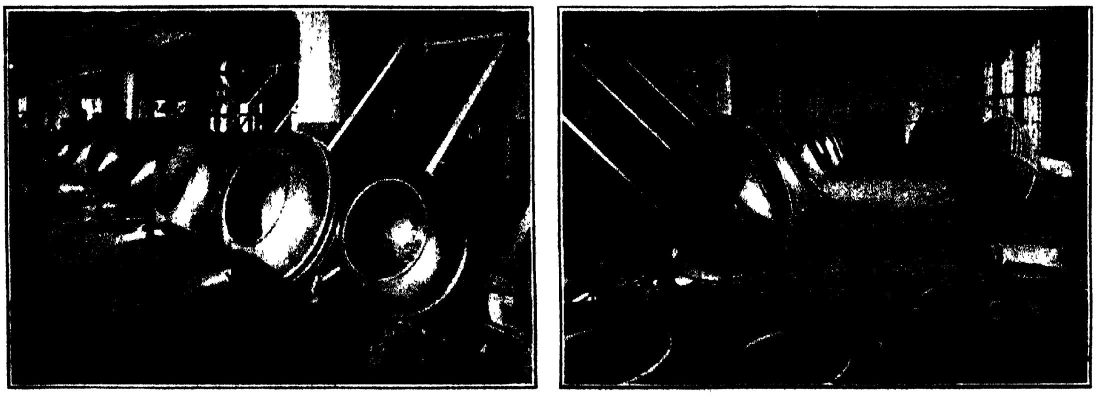
Easy fabrication and its non-corrosiveness are the reasons why copper has been selected for so many types of apparatus used in the chemical and allied industries. But the very ease with which copper is made into even intricate shapes has sometimes earned for it unjust condemnation and criticism.

The naturally close, homogeneous structure of copper has occasionally been weakened by careless manufacture, with the result that instead of developing the inherent valuable properties of copper, they have been destroyed at the expense of its serviceability.

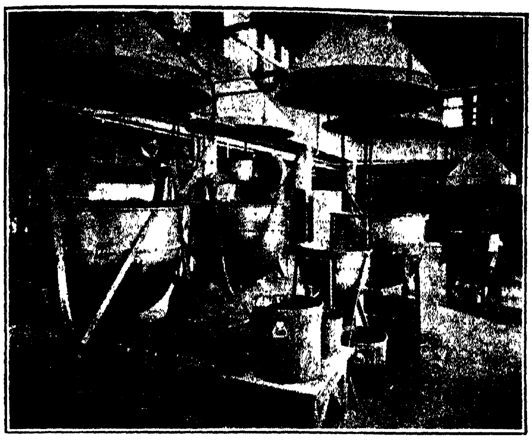
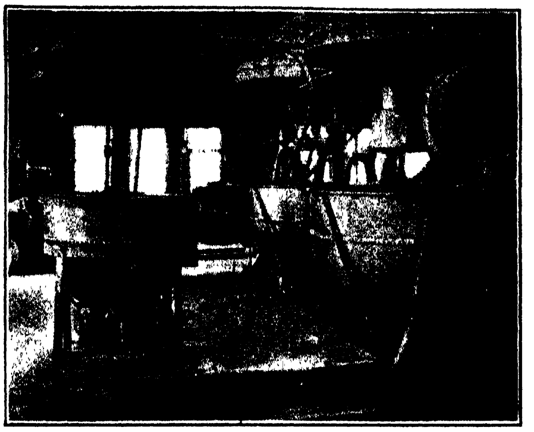
Copper varnish kettle bottoms, condensing equipment, candy kettles, milk evaporators, soup kettles, kettles in which sweet fillings for crackers are prepared, and other chemical equipment, carefully fabricated, are still in active service after 30, 40 and 50 years of continuous use.

A very desirable feature of copper, aside from its ability to withstand the abrasive and corrosive actions of the various materials used in the plant, is its factor of safety. Subjected to high pressures, if it fails copper does not "let go" at once but rather gives warning and time to get out of harm's way. Other metals of brittleness and rigidity which have their elastic limit too near or equal to the ultimate strength fail all too suddenly.

As extensive as the use of copper



REVOLVING PANS, FABRICATED OF COPPER, USED FOR SUGAR COATING CANDIES

COPPER JACKETED STEAM KETTLES, USED FOR COOKING "GUM" CANDIES, OPERATING UNDER 85-LB STEAM PRESSURE

already is, there are other uses, aside from apparatus, where it would seem logical and economical to use it. Copper, brass, bronze and other copper alloys have made good in condenser equipment for the handling of excessively corrosive fumes and liquids. Sheet copper ducts in ventilating systems, particularly in chemical plants, indicate an advantageous use for copper. The commonly used materials are, to be sure, cheaper, but the success with copper in outdoor service of a similar character is a strong argument in its favor.

In conclusion there is one consideration that cannot be overemphasized. Once the chemical engineer has selected copper or one of its alloys because of its resistance to corrosion or abrasion in connection with his particular problem, he would do well to consult with the experienced fabricator regarding the actual construction of his equipment.

Copper, brass, bronze or other copper alloys are not "cure-all" metals, but when they are properly used and installed they offer advantages in the chemical industry that cannot be surpassed by commercially practical metals

When Copper Should Be Used in Chemical Equipment

A Résumé of Some of Its Desirable Properties as Well as Definite Limitations as a Structural Material

BY JOHN A. STEFFENS
Consulting Chemical Engineer, Brooklyn, N. Y.

THE use of copper and its alloys in the chemical industry is dependent on the property of resistance to corrosion combined with good structural characteristics. Copper may be readily worked into requisite forms, although the methods of the coppersmith differ from those of the iron worker. Supplies of the metal are relatively abundant and cheap and when resistance to corrosion is necessary, the use of copper is usually most economical.

But copper does not universally resist corrosion. Substances containing ammonia and its derivatives in the presence of water, attack it quite vigorously, likewise nitric acid and some of its derivatives. Some sulphur compounds will cause the formation of copper sulphide, and if the surface be subject to fluid flow sufficient to erode the layer of the sulphide, progressive corrosion occurs. The usual practice of tinning the copper surface is no deterrent to this action.

Oxy-acids, such as lactic, tartaric and malic, have a variable action, apparently dependent on the concentration of water, temperature and presence of air. Maleic and fumaric acids attack copper and its alloys. A curious phenomenon is the solution of copper and tin in the anhydrous formic esters, stable crystalline compounds being formed. Further instances of specific corrosive action might be mentioned, but suffice it to say that each substance and process requires testing under working conditions.

USE IN ALCOHOL INDUSTRIES

Despite the instances of corrosion which have been given, the general usefulness of copper in the chemical arts is great and its use is increasing. In the alcohol industry, copper stills are standard equipment. Properly built, a life of at least 10 years may be expected. The small quantities of impurities in alcohol rapidly corrode steel and wrought iron. Cast iron is fairly resistant, but is more costly and cumbersome and, in addition, usually of smaller capacity than similar copper equipment.

In working the products of wood distillation, copper equipment finds extensive use. Methanol, acetone, methyl acetate, dimethyl acetal, aldehyde and other substances have less action on copper than they have on iron.

For the manufacture of esters, copper columns are most commonly used, and where kettles are used, they are usually of copper. Some of the rarer esters require enameled kettles. For the manufacture of ethyl acetate, copper is exclusively used. The acetic acid, except in the presence of air, has little action, and the dilute sulphuric acid practically none.

The use of copper in heating surfaces is extensive. Burnished copper kettles are a common sight in the food industries. Copper tubing in evaporators is common.

To sum up, copper is used to replace steel and wrought iron wherever it satisfactorily withstands the corrosive action of the materials to be processed. Further consideration of this general basis of choice of material leads us outside the field of chemical equipment.

Jacketed Cast-Iron Kettles

Certain Fundamentals Which Are Desirable Features When Cast-Iron Kettles Are to Be Used

BY R. C. BOGGESS
Manager, Dopp Sales, Sowers Manufacturing Co

THE extensive use of jacketed kettles in chemical industries is so well known that it hardly needs comment. The jackets are used for steam, for hot oil, for heating batches and cooling them quickly with cold water, for a thousand and one kinds of chemical reactions in liquid phase. Therefore a brief consideration of a few of the desirable features of jacketed kettle construction will be distinctly worth while. Quite naturally the problems which are considered in this paper are in general problems that we have encountered in the manufacture of the Dopp kettle, and it is perhaps pardonable therefore to mention the successful solution of some of them.

For example, there are many distinct advantages in casting the kettle, the jacket and the reinforcing connection between the outer and inner shell all in one piece. There are no rivets, bolts, seams or joints that work loose with the repeated contraction and expansion inevitably experienced in this type of apparatus. No leaks are possible such as occur frequently in two-piece kettle construction.

Again, the composition of the iron which goes into the kettles must come in for very serious consideration. In the first place, the tensile strength should be high, for in the larger type sizes of kettle the demands are rather severe on the metal itself, and second, the corrosion factors must be considered. As a matter of practice it has been found desirable in our works to use a special iron high in silicon and low in manganese and phosphorus, which has a tensile strength of from 35,000 to 40,000 lb. per sq.in. The silicon content must be balanced, of course, to avoid on the one hand brittleness, and on the other hand rapid corrosion.

RAPID HEAT TRANSFER DESIRABLE

It is worth while recording an interesting test that was made on one of the Dopp kettles and that illustrates a principle worth remembering. The inside of the kettle was coated with a thick grease and steam was turned into the jacket. In a short time the grease melted in around opposite of each of the stay bolts, showing conclusively that these bolts actually conduct the heat into the kettle at a more rapid rate than the surrounding iron. Thus it comes about that the stay-bolted construction and single casting which is standard practice in our fabrication has facilitated the heat transfer.

It is quite essential that kettles of this kind be tested to a high hydrostatic pressure before shipment, and it is safe practice to use twice the working pressure of the steam. This applies not only to the jackets but to the kettle itself if it is to be used for pressure or vacuum work. The use of high temperatures in jacketed kettles is, of course, possible now with heated oil, and temperatures of 575 deg. F. can be reached and maintained inside the kettle. With this kind of a process it is essential to have a leak-proof jacket. In such cases a welded steel jacket has no counterpart in cast-iron work except a one-piece cast construction. There the oil simply can't get out. There are other points which unfortunately have to be regarded as trade secrets and are, therefore, of less interest to the technical man in a symposium than to his other self when he acts as purchasing agent. For example, by specially controlling the casting process and keeping the metal away from the molding sand a smooth surface can be obtained on the iron and no machining or grinding is necessary. This process leaves a protective skin on the surface of the iron which acts as a protective coating.

Aterite

Its Interest to Manufacturers and Users of Chemicals Lies in a Combination of Resistance to Corrosion and to High-Pressure, High-Temperature Work

BY FOSTER MILLIKEN, JR
President of Aterite Co., Inc

RESULTS are usually achieved by effort, but on rare occasions by accident. When Aterite was first conceived, the idea in view was to produce an alloy of certain definite characteristics, and toward this end entire success was met. By a strange coincidence it was found that in addition the resultant alloy had properties more valuable than any originally contemplated, which automatically brought it into a field where previously far from satisfactory results had been obtained by the use of other metals.

Since its introduction in the early part of 1916, Aterite has been used with remarkable success for two primary services—in connection with chemicals and for high-temperature, high-pressure work.

CHEMICAL

To be of value in handling chemicals, a metal must possess certain primary attributes. First, of course, it must be resistant to corrosive action, and second, of almost equal importance, it must be resistant to erosive action. In addition it must be readily machinable, so that without the necessity of special equipment the average mechanic can make the necessary repairs. The metal must have a certain amount of strength and ductility in order to withstand the hard usage it is oftentimes called upon to bear at the hands of unskilled workmen. It must have all these characteristics as well as more minor ones and still be within a price which is not prohibitive.

While Aterite will not resist the corrosive action of all chemicals, still it is proof against those most commonly used, and in addition possesses all other attributes mentioned above.

A concrete example comes to mind. Probably one of the most severe cases is on an acid agitator used in oil-refining work, where during the course of operations the sulphuric acid is changed from strong to very dilute. In such a service a certain refinery had got a maximum service of only 42 days, whereas an Aterite valve has now functioned without interruption for over 6 years. This is only one of many cases and likewise applies to many other acids, such as acetic, hydro-

fluosilicic and chemicals such as aluminum sulphates, etc., to say nothing of kindred lines like vulcanizing.

TEMPERATURE

For high-temperature, high-pressure work a most careful study must be made of a metal's characteristics, as failure is apt to be of a most disastrous nature, both to property and life. To be of value the metal must have many well-defined attributes.

Too many engineers are prone to consider tensile strength as a deciding factor, when instead the yield point should be of main consideration. A metal for temperature work must not only have a high yield point but at the same time a good reduction in area and elongation. It must of necessity be dense, but at the same time exceedingly ductile, so as to give adequate warning before letting go. It should have a low coefficient of expansion and contraction, or if used with other metals, one which compares favorably. In addition the metal must have a high melting point and above all retain its properties at high temperatures.

Aterite possesses each of these requirements to a marked degree, making it an admirable metal for high-temperature, high-pressure work. For valve work in such a service it is particularly suited, being the only known metal of which an entire valve can be constructed, thus completely eliminating any difference in expansion or contraction of parts. Heretofore forged steel has been widely used, but after reaching temperatures of from 800 to 900 deg. F., it rapidly deterioriates. Aterite has been used in various forms, such as valves and fittings on superheated steam lines, even as high as 1,250 deg. F., 250 lb. pressure, without any deterioration.

And so, through a coincidence, the alloy Aterite has been found and proved successful for the handling of chemicals and also for high-temperature, high-pressure work.

Notes on Brasses and Bronzes

They Resist Mild Corrosion—More Severe Conditions Met by Alloying With Manganese or Nickel—Tin Forms Very Sensitive Compounds With Nitrates

BY HAROLD F. WHITTAKER

THE simple brasses and bronzes are not very widely used as corrosion-resisting metals in the chemical industry except under those conditions where relatively mild corrosive conditions exist. Each of these alloys resists normal atmospheric corrosion fairly well. Various bronzes have been used to a large extent in contact with sea water, where they are used in ship propellers and sheathing. In spite of the fact that serious corrosion difficulties were encountered by the United States and British navies during the war, brass is still considered to be far superior to steel for condenser tubes. Corrosion of brass condenser tubes has been divided into five classes. Various methods have been used to overcome the various kinds of attack, but the best method so far found has been a frequent, thorough cleaning of the tubes to remove all deposits or scale.

There are some places where brass and bronze give satisfactory service in the chemical industry. Either will withstand boiling 10 per cent sodium chloride satisfactorily, and bronze resists corrosion fairly well when in contact with warm sulphurous acid solutions. There is one place in the chemical industry where bronze is apparently superior to all other commercial metals as a structural material— manganese bronze resists 85 per cent formic acid exceedingly well; in fact, it lasts almost twice as long as pure copper under similar conditions. This alloy is also known satisfactorily to resist warm dilute sulphuric acid solutions ranging in concentration between 1 and 2 per cent and under such conditions will outlast brass about two and a half times.

There are several places in the chemical industry where brass or bronze must not be used. One of these is in connection with the handling or storage of ammonium nitrate. Although these alloys are not known to form explosive corrosion products, these products have a harmful effect upon the ignition point of certain explosives in which ammonium nitrate is used. Tin is thought to form sensitive compounds with ammonium nitrate, therefore tinned containers or bronze parts should not be exposed in any of the operations in connection with ammonium nitrate.

A rather unusual but interesting type of corrosion takes place between copper, brass or bronze and organic amino compounds such as aniline, toluidine, etc. The copper of these metals readily replaces one of the hydrogen atoms of the amino group, the corrosive compound forming a thick crust on the metal surface. This crust is neither adherent nor protective. The above reaction is usually considered to be a high-temperature reaction, although instances are known where 3 per cent solutions of aniline in hydrocarbons have readily attacked copper at ordinary temperatures.

It might be well to call attention to types of the complex bronzes which have been designed particularly to overcome corrosive conditions. Examples of these complex bronzes are Aterite, which is a nickel brass; Meco metal, a copper nickel zinc alloy, and Ampco, one of the aluminum bronzes containing principally copper, aluminum and iron. There are several similar alloys on the market, but in most instances their compositions are concealed by alloy numbers or trade names. Some of the above alloys have variable composition, hence a suitable composition may be selected for specific corrosive conditions. Most of the above alloys are usually subjected to some working or rolling process previous to their fabrication, since their resistance to corrosion is increased and they possess greater structural strength. The manufacturers recommend these alloys for use with superheated steam, hydrofluoric acid and the organic acids as well as some concentrations of sulphuric acid and sulphurous acids. They are not usually recommended for use with chromic, hydrochloric, nitric, picric or mixed acids nor for ammonium hydroxide. Pure copper is usually considered to be superior to any alloy for handling hot dilute acetic acid. Much better life is obtained from these alloys when arrangements are made to keep oxygen or oxidizing materials away from them when they are exposed to corrosive conditions. It may be of interest to note that one of the above alloys was designed for the purpose of eliminating the necessity of casting under pressure. As far as the writer has heard the alloy gives excellent results in the foundry without the use of a riser.

In any case, where brasses or bronzes are being considered, it is advisable to carry out corrosion tests as nearly as possible under operating conditions.

Aluminum for Chemical Construction

Properties That Favor Its Use for Equipment Fabrication and a List of Uses in Chemical Industries

By E. Blough
Aluminum Company of America

CHEMICAL ENGINEERS are always seeking for materials to improve their plant equipment. Each industry has its own problems in this respect, so a recital of some of the experience gained in the use of aluminum in chemical equipment may prove of use to those engaged in this profession.

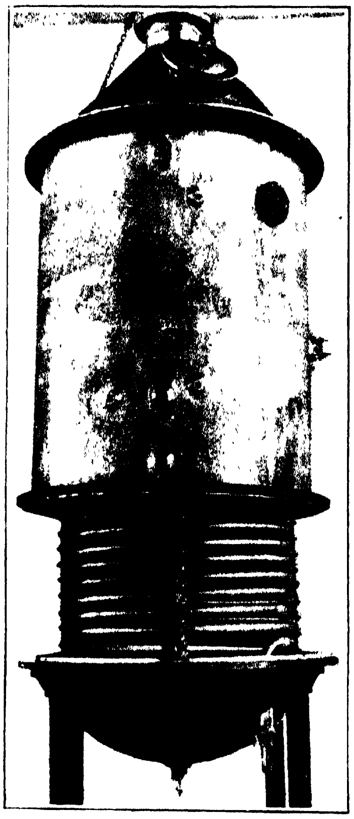


FIG. 1—STILL 11 FT. HIGH DESIGNED FOR INDIA REFINING CO.

Since the utility of the material is based, first, upon its chemical behavior and, second, upon its mechanical properties, it has been found by experience that pure aluminum is more generally applicable to chemical apparatus than its alloys (with an exception noted below). It is always desired that the chemical or product will react as little as possible with the container, and whenever the container is acted upon, the products of the reaction should be colorless.

Pure aluminum tanks, vats, tubing and coils fulfill this requirement. Since the metal is generally used in the soft or annealed condition, the tensile strength may be considered 12,500 lb. per square inch for purposes of design. This figure may also be used as the tubing strength.

It has been found more satisfactory to make pipe fittings of an alloy containing a small amount of manganese, as this alloy gives a casting which may be subjected to a high internal pressure without "sweating."

The shapes in which apparatus can be built are almost limitless. This is due to the fact that aluminum can be formed by drawing, spinning, beating, bending or by any other commercial method. The parts thus formed can be welded together autogenously so that a seamless (without rivets) vessel may be constructed of any size or shape to suit the particular needs of the chemical manufacturer.

A description of some of the uses to which aluminum has been put in the chemical industry may prove of interest and use to those engaged in the manufacture of chemicals.

With a few exceptions, as might be expected, the greatest success has been attained in the organic field. One exception is the use of aluminum tubing in sulphur wells in place of iron tubing. Another use in inorganic chemical manufacturing is for crystallizing pans for ammonium sulphate.

Aluminum is used for vinegar containers and also for piping. There are also several large installations where it is used as storage tanks for acetic acid.

In the forest product field it is used for turpentine stills, wood distillation stills and in this same general field for varnish kettles.

Formaldehyde shipping containers of aluminum have proved very satisfactory.

Gasoline fuel tanks of aluminum are widely used, particularly in aircraft. Similarly, aluminum parts in gasoline pumps for service stations have been approved by the Underwriters' Laboratories.

Aluminum wax cooling pans have an almost limitless life in the preparation of paraffine wax and do not in the least discolor the wax to the detriment of candles.

Condensers and deodorizers are made of the pure metal in the vegetable oil industry, as for example in connection with coconut oil.

Gelatine and glue manufacturers use aluminum for cooling pans.

Tartaric and citric acid manufacturers use aluminum crystallizing pans.

Rubber curing pans are made from aluminum.

The list might be extended and new uses are found each year. A typical apparatus that has been developed is illustrated in Fig. 1 and shows the adaptability of aluminum to chemical manufacturing.

Nickel and Monel Metal

A Brief Note on the Properties Which Give These Metals a Unique Value in Corrosion-Resisting Work

By R. J. McKay
International Nickel Co.

CERTAIN qualifications are desirable in a metal for corrosion-resisting machinery aside from actual resistance to corrosion. It should possess high strength, particularly in such utility tests as resistance to fatigue and to impact. It should be easy to machine, forge, cast, weld, solder, etc. An alloy should be of such a standard character that the composition does not change and the supply be constant and dependable. Knowledge regarding all its properties should be available and acquaintance with such common characteristics as methods of working, resistance to corrosion, etc., should be widespread.

The increasingly extensive use of pure nickel and Monel metal seems to indicate that they possess a healthy percentage of these properties. For example the tensile strength for hot-rolled Monel metal is 90,000 lb., for nickel 75,000, and the yield points 50,000 and 25,000 respectively. These properties and the hardness and ductility can be controlled within limits by proper working. The metals can be machined, forged hot or cold, cast, cold-drawn, brazed, soldered and welded. Spinning requires considerable power and frequent annealing; high temper cannot be produced.

The Izod impact resistance of Monel metal is 114, as compared with mild steel 77 and forged copper 46. It resists acid corrosion by virtue of

its relatively low position in the electromotive series and oxidation by the pacifying effect of its 67 per cent of nickel. Combinations of as strong oxidizing agent as an acid solution will corrode it. Its corrosion resistance does not depend on protective coatings, and therefore it is relatively resistant to effects of high velocity and abrasion in conjunction with corrosion. Further work is being carried out on these metals in order further to justify the present confidence.

Enamel-Lined Apparatus

Vitreous Enamels Constitute a Type of Surface for Chemical Equipment Which Is Useful With Both Corrosive Materials and Those Which Must Not Be Contaminated

BY EDWARD G. MINER
President and General Manager, The Pfaudler Co., Rochester, N. Y.

AS IS well known, enamel-lined equipment represents a type of construction which is practically indispensable for many processes in the chemical and allied industries, where non-corrosive and acid-resisting properties are essential. For use in these industries the Pfaudler Co. has developed two different kinds of enamel. One, a brown enamel, is highly acid-resistant and is applied wherever concentrated acids or other very corrosive materials are to be handled. The handling of caustics of any nature is not advocated, although this has been done successfully on occasion. The other enamel, blue-black, applied on most equipment designed to handle weak acids, neutral solutions, etc., meets that general requirement which dictates that the container used in the process shall in no way impart any of its surface material to the product handled.

PRESSURE RESISTANCE OF ENAMELED WELDED TANKS

Recent tests have indicated that enameled steel tanks, aside from their non-corrosive and acid-resisting qualities, have the ability to withstand very high pressures. Thus a Pfaudler tank in a recent pressure-resisting test conducted by the Pressure Vessel Committee at Washington withstood the hammer blow on its jacket up to 1,600 lb. This demonstrates the strength of the welded construction used in this equipment. For details of manufacture, the reader is referred to previous articles.[1]

Another advantage offered by this equipment is that processes requiring very high temperatures may be conducted with minimum amount of danger to the equipment itself. By circulating hot oil in the jacket it is possible to maintain temperatures of 400 to 500 deg. F. without even slightly endangering the enamel lining. For the handling of products with a high degree of viscosity, high boiling point, etc., this feature is extremely valuable. It may be noted that the Columbia Graphophone Co. employs this method for melting beeswax in making records.

There are also many products which are practically non-corrosive but which must be carefully protected against the slightest possibility for contamination. Food products, drugs, fine chemicals and other materials of similar nature fall in this class. The problem of finding suitable containers for processing, handling and storing such delicate products is solved in a most satisfactory manner by the use of enameled equipment. As a typical example, the manufacture of cold cream as conducted by the Palmolive Co. may be cited. The various ingredients are agitated in a Pfaudler mixing tank located on the fourth floor of the plant. When the consistency is fairly uniform, the batch is dropped to a conical enamel-lined tank suspended from the ceiling of the third floor directly below the mixing tank. Here the product is agitated again to complete the emulsification and is then drawn off at the bottom into jars for distribution.

CERTAIN UNITS HAVE BEEN STANDARDIZED

Co-ordinated efforts toward standardization have resulted in the development of certain units of general applicability in the chemical industries.[2] These include: A standard jacketed still with reducing ell, which is used for the distillation of essential oils and acids, the reduction of fats, etc.; a standard jacketed closed mixing tank with enameled steel agitator; an open evaporating or crystallizing pan which may be single shell or jacketed as required; a standard utility pot which may be used for a variety of chemical operations. In addition special equipment covering a wide range of designs and applications is manufactured.

[1]See Chester H. Jones, "Enameled Steel Manufacture," *Chem. & Met.*, vol. 25, p. 883, Sept. 9, 1921; Chester H. Jones, "Enamel-Lined Apparatus," *Chem. & Met.*, vol. 25, p. 927, Nov. 16, 1921.

[2]See Emerson P. Poste, "Standardization of Enameled Apparatus for Chemical Purposes," *Chem. & Met.*, vol. 27, p. 1,016, Nov. 22, 1922.

Lead Pigments: Protective Materials for the Chemical Engineering Industries

Chemical Engineers Should Become Better Acquainted With Advantages and Limitations of Paint and Pigments

BY J. H. CALBECK
Director of Research, Eagle-Picher Lead Co., Joplin, Mo.

THE chemical engineer, unless engaged in the actual manufacture of some of the many products in which lead is used, has little to do with lead pigments, except in the case of paints and cements, and it is along these lines that this paper will deal. Included among the lead pigments are the following compounds: basic carbonate white lead or corroded white lead, basic sulphate white lead or sublimed white lead, sublimed blue lead, red lead and litharge. Lead chromate and other colors containing lead will not be discussed.

The painting done around an industrial plant falls into approximately six distinct classes, which will be discussed in turn.

1. *General Exterior Work*—The materials used consist usually of corroded white lead, sublimed white lead and sublimed blue lead purchased either in the paste form or in ready mixed paints. When purchased in the paste form, these pigments need to be mixed with proper amounts of linseed oil, drier and turpentine. When purchased as ready mixed paints they are ready to use. Ready mixed paint contains, in addition to the lead pigments, various percent-

ages of zinc oxide and inerts such as china clay and whiting. The advantages of lead pigments for these purposes are generally known and there are very few instances where they are not entirely satisfactory.

2. *Interior Painting and Decorating*—The necessity of well-painted and well-decorated interior in chemical and other industrial buildings has of late been given much attention both from the standpoint of safety and sanitation and from the standpoint of efficiency and economy. In some instances white lead is employed using special flatting vehicles for thinning instead of linseed oil. Yet the most widely favored pigments for this purpose are lithopone and zinc oxide, which are generally employed in mill whites and other interior paints.

3. *Priming New Work*—Both steel and wooden structures should be primed as quickly as possible and should be primed with lead in oil or a good mixed paint if the subsequent coats are to give satisfaction. There is no economy in cheap primers. Sublimed blue lead is exceptionally good for both wood and steel and may be used for the finishing coat if a dark color is desired. Red lead has been used for years as a primer for iron and steel work and is preferred by many engineers.

4. *Protective Coatings for Iron and Steel*—As mentioned above, sublimed blue lead or red lead should be employed for priming iron and steel work subjected to all except the most extreme conditions. These pigments sometimes fail in the neighborhood of acid plants where very high concentration of corrosive fumes are given off. In such cases the engineer should use bituminous, graphite, cement or other especially prepared paints. If the conditions are especially bad, the finishing coats should be of sublimed blue lead or red lead, but usually the finishing coats are of lighter hues. Contractors find it a good plan to make each coat a slightly different shade, enabling an inspector to distinguish the different coats easily.

5. *Special Purposes*—In addition to this there are certain special purpose paints, a large quantity of which are used around industrial plants for painting smokestacks, vats, tanks, roofs and equipment where acids or chemicals are used. Painting of concrete work such as floors, stacks and tanks call for special paints. The lead pigments are not used extensively in these plants. Bituminous, graphite and cement paints are usually employed.

6. *Special Color Work*—There is in addition to the above a large amount of special color work to be done about a modern industrial establishment. The advantages of painting fire plugs, switch boxes and pipes supplying water, gas or oil, different colors warrants the special attention necessary to give each one a characteristic color. Lead is used here in the red and yellow pigments, but these colors are usually obtained as ready prepared paints and this certainly is the most satisfactory way to obtain them.

There is a tendency among some engineers to make these special-purpose paints all-purpose paints rather than go to the additional trouble and expense of buying a paint best suited for the job at hand. This is often a costly mistake. There is no all-purpose paint. Yet many superintendents insist in using a stack or roof paint for every purpose about the plant, such as priming iron and steel work or repainting it, and then wonder why it is necessary to repaint so frequently.

It appears, therefore, that the chemical engineer should become better acquainted with advantages and limitations of each pigment and should teach his men how to use them properly.

Building Receptacles of Vulcanized Fiber

A Material of Widening Industrial Application Not Only for Containers but for Gears, Washers, and Other Mechanical Shapes

BY C. C. BELL

Vice-President, American Vulcanized Fibre Co., Wilmington, Del.

ALTHOUGH vulcanized fiber is not exactly a new material to the chemical engineer, it may nevertheless be worth while at the beginning to describe briefly what it is and how it is made. It is a cellulose product, manufactured from pure cotton rag paper treated with zinc chloride. Following a washing process the product goes to the dry house. The chemical action is extremely constrictive, causing the sheets to buckle, and considerable pressure is necessary therefore to flatten them for practical use. This is done in power hydraulic presses, which also function to press the material into the shape in which it is finally sold.

At the time the product was first developed, its only apparent market was in the electrical trade, where the principal insulating material used was vulcanized hard rubber. As a competitive material the new cellulose product gradually became known under the trade name of vulcanized hard rubber, although no vulcanizing process enters into its manufacture.

ITS FIELD OF USEFULNESS

The use of vulcanized fiber for electrical insulation was enormously developed. The high tensile strength of the material and its resistance to wear favorably impressed machine builders, boot and shoe manufacturers and many other industries. With the increasing popularity of the automobile, a new market opened which has since been continually expanding.

Except for the use of fiber gears, washers, bushings and other mechanical shapes, the chemical engineer is perhaps most interested in the adaptability of vulcanized fiber for the manufacture of receptacles and containers. In many industries in which chemical technology forms a vital part, fiber cans, boxes and trucks are used successfully in the place of metal or wood, even though the initial cost is materially higher.

The use in the rubber industry is an example of specialized application. Here vulcanized fiber has been introduced in the form of compound pans and barrels, although factory cars are also made of it occasionally. The hard usage to which compound pans are subjected makes imperative the use of a material presenting an enormous resistance to wear. The light weight of vulcanized fiber is in its favor, but one of the most important of its advantages is the fact that vulcanized fiber will not splinter, consequently there can be no chips or small material to fall into the contents of the pan. It is fair to assume that this same property will result in a more general use of these receptacles in other of the chemical and allied industries.

Chemical Stoneware and Its Applications

Being Hand-Molded, Special Shapes Are as Available as Stock Designs for Use Wherever Corrosive Action Is Encountered

BY MAURICE A. KNIGHT
Maurice A. Knight, East Akron, Ohio

WHILE chemical stoneware is a ceramic material made from clay, its composition is very different from that of ordinary stoneware, pottery, tile or brick, since it will withstand the action of acids, alkalis and corrosive chemicals. In addition it must have mechanical and thermal properties that will enable it to withstand considerable shock and reasonable changes in temperature. For the acid-resisting quality the ware as manufactured in the writer's plant does not rely on any glaze, enamel or veneer, but the entire body has this property. A salt glaze is applied for looks and finish, but plays no part in the acid-proof qualities.

When chemical stoneware was first brought on the market the sizes and designs were very limited, but as experience taught the manufacturers more and more about the compounding and nature of the clays used, the drying and firing, more varied and larger sizes and designs were evolved, until today nearly anything mechanically possible can be made in chemical stoneware.

Although the properties involved in the manufacture of chemical stoneware have been covered in detail in a previous article,[1] a brief review may not be out of place here. The raw clays which come from various parts of the United States and from foreign countries are first prepared through the use of special machinery so that they are of the right consistency and fineness for use. They are then washed, screened and filterpressed, after which they go to the blending room, where they are mixed in the proper proportions to form the different bodies. Seven different bodies are used for chemical stoneware, each designed for a particular service with due regard to the type of corrosion which will be encountered by the finished apparatus. After thorough aging, the prepared clay is ready to be molded by hand into the desired shapes. Then the ware must be carefully and evenly dried in a mechanical drier in a hot room or by natural drying in an open room, depending on the size, design and application of the piece. This drying is a very critical operation and one that must be thoroughly understood if the ware is to come through the fire in first-class shape. When thoroughly dry the ware is fired in periodic down-draft kilns, the firing and cooling operation requiring 2 weeks. The apparatus is then drawn from the kiln, inspected, checked for measurements, tested, packed and shipped. On the average, making a piece of chemical stoneware requires from 4 to 8 weeks from the start to the packing room, depending on size, thickness, design, etc., and this time cannot be shortened without danger of losing the piece.

HAND WORK FACILITATES PRODUCTION OF SPECIAL DESIGNS

Experience has shown that the only practical way to make good reliable chemical stoneware involves hand work by skilled workmen, who must be able to read and interpret the most intricate blueprints. This phase of the industry should be of greatest interest to the manufacturer of chemical products, as on this account he is not limited to standard designs for his process, but can have the apparatus made up to suit the requirements of each reaction. Furthermore, making apparatus to the customer's blueprints or designs is not, as many suppose, a costly procedure, but is in fact comparatively no more expensive than were they stock designs, for even stock designs in chemical stoneware are not made by machinery but by hand, as has already been indicated.

As chemical stoneware is made in the form of various designs of pipe and fittings in a wide range of diameters, in kettle designs, tanks, jars, tourills, receivers, storage jars, tower sections, distributors, tower packing, ejectors, blow cases, monkey pumps, faucets, manifolds, carboy stoppers, acid steam jets, brick, tile linings for tanks and towers, perforated filter tile and filters, generators, subliming pans, decanting jars, evaporating dishes, laboratory sinks, coils of many sizes and designs, "S" pipe, return bends, vapor pipe dampers, dipping baskets, pitcher and jugs, funnels, etc., there is hardly an industry that employs acids, alkalis or corrosive chemicals in its processes that has not some use for chemical stoneware, so it can be briefly stated that chemical stoneware is used and can be used in every industry where there is corrosive action of any kind.

[1]Chester H. Jones, "Chemical Stoneware Manufacture," *Chem. & Met.*, vol. 25, p. 289, Aug. 17, 1921.

Glass in Chemical Industry

A Material Which Is Having an Increasingly Wide Use in Chemical Industry—Its Interesting Development

BY J. F. GREENE
The Kimble Glass Co

GLASS as a material for industrial construction has been known and used for some time. Recently, however, it has seen new application in the use of low-expansion glass for the fabrication of pieces much larger and heavier than any previously attempted. The properties of glass which make it a desirable element in industrial chemical engineering practice are: (1) its transparency, (2) its possible perfection of finish, making a "glassy finish" a byword for supreme smoothness, (3) resistance to chemical attack, (4) the facility with which it can be blown, drawn, pressed or cast. All these properties are not inherent to the highest degree in all glasses, and usually a glass which rates high in one desirable quality will be less suitable in another respect.

The disadvantages of glass are likewise more apparent in some types than in others. They are: (1) brittleness and (2) low tensile strength in the piece, due to the enormous influence of scratches and cracks. Two other properties that come in question are resistance to heat shock and ease of annealing. Glasses vary widely in the possession of these qualifications.

Having in mind the necessary properties of the material which is to compose any industrial piece, the chemical engineer will arrive at a reasonable decision by considering how well any commercial glass meets

his specification and how its total cost (first cost and maintenance) will compare with that of any other material from which the piece might be fabricated. It will sometimes be found that a very expensive material will be cheapest in the end, due to low maintenance costs and fewer interruptions to production. In other cases the cheapest possible material will be the only one really economical.

In application where transparency is the determining factor, glass is almost without a rival. Such applications are sight feed glasses, high pressure gage glasses, glass plates for peep holes, etc. Sight feed glasses, gage glasses, etc., are usually connected to a metal fitting. In selecting a glass for this service, accuracy of sizing should be considered, since a good fit is essential. The glass should be selected to meet the temperature, pressure and heat shock requirements of the particular use. The more trying these are the more expensive glass must be used.

For resistance to chemical attack, glass is excelled in some instances by tin and platinum. It is superior to them in its resistance to phosphides, sulphides and the halogens. Earthenware has the disadvantage of porosity, and chemical stoneware improves in resistance as it approaches a glass in composition. No glass offers complete resistance to strong alkalis. However, much glass is used as small parts of electrolytic caustic plant, because the attack that takes place does not harmfully contaminate the caustic and the pieces can easily be replaced. Thus are used brine wells, a molded tube 3x19 in. with a ½-in. hole drilled in the bottom and caustic tubes, eccentrically shaped tubes about 12 mm. in diameter. The manufacture of these small parts in any other material than glass would be more expensive and not so satisfactory in use.

The Newer Uses of Glass

At a recent application of glass as a resistant material was described by F. C. Zeisberg in a late number of *Chem. & Met.* Small glass rings were used as a tower packing. It is possible to make glass rings very much smaller than earthenware or stoneware rings and as a result obtain a packing material with an enormously increased surface in a given volume. The use of glass pipes, known as "powder tubes," for pipe lines in the powder industry is an application of long standing. The well-known Hart condenser, with tubes 3 in. in diameter and 6 ft long, is still another application.

Its ease of fabrication makes glass a desirable material for many applications where transparency and resistance are not especially necessary. Jets and nozzles of various types and sizes are readily made of glass. The fire-polished finish gives a nozzle which offers the minimum resistance to flow, and allows a perfectly untroubled stream to issue. Such jets are usually made from glass tubing by reworking at the lamps, although larger sizes could be blown in a mold.

There are numerous small parts and fittings in use in the chemical industries which could be made of molded or pressed glass, doing away with expensive alloy metals and machine work. The glass piece would besides be of good resistance to chemical attack and could be fabricated from a glass having the necessary strength and resistance to heat shock.

Before settling on the final design of parts which could be made of glass, it is well to inform the manufacturer of the service under which the material is expected to stand up. He may be able to suggest minor changes in design which will greatly increase ease of manufacture. A serious consideration of industrial glass shapes and products will well repay the designing engineer.

Industrial Pyrex

The Material Is Discussed From the Standpoint of Desirable Basic Characteristics and the Methods of Fabrication

By A. E. Marshall
Consulting Engineer, Baltimore, Md

THE interest displayed by chemical engineers and manufacturers in the adaptation of Pyrex glass to plant uses has resulted in a continuous progression of development work and has also provided an indication of the demands of the chemical industry for materials with acid- and heat resisting properties.

In a previous article published in *Chem. & Met.* an outline was given of the initial stages of applying a material, familiar in laboratory shapes and sizes, to actual plant-scale operations. The present article is a summary of more recent developments and the reasons which lend interest to the future possibilities of Pyrex in the industrial field.

A general consideration of the essential requirements for plant construction materials indicates the following as desirable qualities:

Basic Requirements

1. Resistance to chemical corrosion over a wide range of temperatures.
2. Resistance to heat and to changes of temperature.
3. A reasonable degree of mechanical strength.
4. Possibility of production in a variety of shapes.
5. A cost which makes the complete plant unit a commercial possibility.

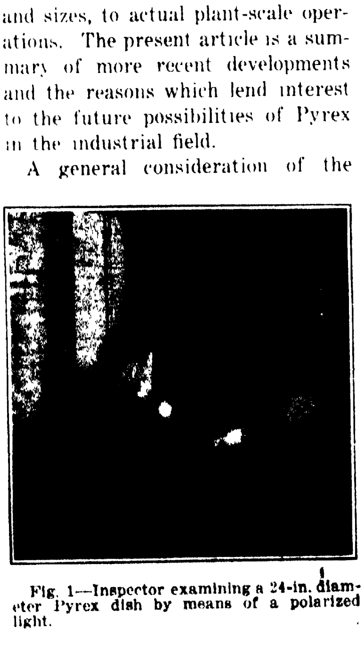


Fig. 1—Inspector examining a 24-in. diameter Pyrex dish by means of a polarized light.

No single manufactured product completely meets all of these requirements, although nature has provided certain precious metals which possess ideal characteristics. In the case of precious metals, however, the quantities available and high cost largely remove them from consideration as industrial possibilities. Plant materials have therefore to be selected with due regard to a balancing of useful properties against known limitations.

A survey of the chemical and physical characteristics of Pyrex indicates many desirable factors coupled with certain present limitations in size which somewhat restrict its field of application or call for the development of new types of construction based on available shapes. Some of

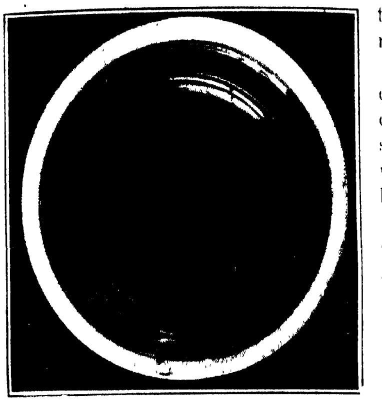


FIG. 2 End view of a 6-in. Pyrex socket pipe showing uniformity of wall of socket portion.

the basic engineering data for Pyrex glassware follow:

Specific gravity	2.25
Specific heat	0.20
Elasticity coefficient	6230 kg. per sq. mm.
Linear expansion coefficient (19°-350° C.)	0.0000032 per deg. C.
Thermal conductivity	0.0027
Electrical resistivity (surface)	10^{14} ohms at 34 per cent humidity

Mineral acids, with the exception of hydrofluoric and phosphoric, have no appreciable action up to their respective boiling points.

LIMITATION ON SIZE VARIES WITH METHOD OF FABRICATION

The limitations of size which have been referred to are of importance to the engineer, as lack of this information may call for substantial changes in design. An appreciation of the present limits can best be secured through a consideration of the various processes employed in fabricating industrial Pyrex. The principal methods of production are: Pressing, blowing and working by lamp.

The maximum size of a pressed article is a factor of weight of glass and nature of shape. Simple shapes such as hemispherical dishes can be made 24 in. in diameter, 30 liters capacity; such a dish shown in Fig. 1. More complex shapes have smaller limits, centrifugal pump liners, for instance, being a possibility up to 15 in. maximum diameter. Pressed shapes are desirable whenever fairly accurate external dimensions are desired, although it should be realized that the precision of a machined metal product cannot be obtained in Pyrex except with an extremely high rejection factor.

The second process, blowing, is restricted, in the case of industrial Pyrex, to blowing into molds. This gives a useful degree of external surface accuracy and also permits manufacture with wall thicknesses adapted to the intended use. Condenser parts made in molds can be held to $\frac{1}{16}$ to $\frac{1}{8}$ in. walls and high cooling efficiencies secured in the complete condensing apparatus. Conversely, socket pipes can be made with heavy walls to withstand the abuse of careless handling and mechanical shocks. Fig. 2 is a photograph of a 6-in. socket pipe viewed from above the socket. It illustrates a desirable thickness for the socket portion and also shows the uniformity of wall. Present sizes of mold-blown ware range from 72 liters capacity for flask or retort shapes to 12-in. diameter for socket pipes and cylinders.

The third process, working in the lamp, is an extension of glass-blowing practice to the manufacture of complex shapes incapable of production by pressing or blowing. T's, L's and other fittings are made by lamp working and have a present limit of 3-in. bore. Lamp work is also resorted to in the attachment of side connection, spigots, etc., to articles produced by the mold-blown process.

All three processes are being gradually developed toward the production of larger sizes, and an evidence of this progress is best supplied by a comparison of material available 6 months ago and at the present time. The final limits of size will of course be set by structural consideration, but these limits are a long way beyond any of the available methods of manufacture.

FIG. 3 TYPICAL PYREX SOCKET PIPE

USES OF INDUSTRIAL PYREX

Industrial uses of Pyrex can be grouped under specific applications of properties, as this method affords a useful guide to the consideration of new apparatus not included in the list. Four classifications have been followed in preparing the summary, although it will be recognized that in some cases several factors are concerned in the one piece of equipment.

1. Uses where acid resistance is important: Acid distillation sets, Hart nitric acid condenser tubes, "S" bend nitric acid condenser, hydrochloric acid coolers, pipe lines for acid gases and liquids, small tanks and pots.

2. Uses where resistance to heat shock is desirable: Condensers for organic liquids, parts for tubular evaporators, receivers for hot condensates, etc., pans and trays for driers.

3. Uses where purity of product is essential: Evaporating and crystallizing dishes, pipe lines for liquid food products, drying trays for biologicals, alkaloids, etc., tanks for precious metals solutions, reels for silk dyeing machines.

4. Uses involving transparency: Sight glasses for stills, etc., gage tubes for boilers, tanks, etc., tail boxes for distilling columns, sight pipe sections for chamber plants, apparatus for photochemical synthesis.

The majority of the applications given above relate to complete pieces of equipment, so in these cases special features of construction are not involved. The user of industrial Pyrex should remember, however, that while the material has a remarkably low coefficient of expansion, it should not be heated by a direct flame. Suitable provision in the design of the heating arrangement to obviate direct flame contact does not imply any appreciable loss in utilization of heat units.

Pyrex pipe lines, whether of the flanged or socket type, call for modification of usual methods of construction. Flanged pipes are not bolted together direct, but use is made of an extra pair of loose flanges (aluminum, cast iron or pressed steel) and external rubber gaskets between the metal flanges and the pipe. The surfaces of the Pyrex pipe flanges are ground true and suitable gaskets inserted.

Socket pipes should not be cemented with hard setting socket fillers, but a cement employed which will give the desired resistance to the acid gas or liquid with retention of plasticity. An asbestos rope ring

forced into the bottom of the socket space has been found often to be a desirable feature of this form of construction.

Development work on a number of new industrial applications of Pyrex is being actively carried on, and it is confidently expected that Pyrex will soon pass from the "new material" stage and become one of the accepted standard materials for chemical plant construction.

Vitreosil in Acid Manufacture

Greater Facility of Manufacture Has Permitted a Wide Extension of the Use of Fused Silica in Industry

BY S. L. TYLER
Thermal Syndicate, Ltd

THE early manufacture of fused quartz was carried on by the blowpipe method, the oxyhydrogen flame used as the source of the heat for fusing rock crystal. Later developments made possible the use of electrical energy as the source of heat and with this the possibility of producing much larger pieces and a greater range of shapes than had even been practical before.

Pure fused silica has a melting point at about 1,750 deg. C. It softens slightly at 1,400 deg. C. but does not reach the truly fluid condition until temperatures well above 2,000 deg. C. are reached and at these temperatures only under increased pressure. At a temperature of about 1,100 deg. C. there is a reversion back from the vitreous state to the crystalline state, but this change is very slow. At higher temperatures the devitrification is more rapid, but at no point does it occur suddenly. The coefficient of expansion of fused quartz is 0.00000054 per deg. C. over the range of 0 to 1,000 deg. C., this being the lowest coefficient of expansion of any material known over a similar range.

HIGH CORROSION RESISTANCE

It is not affected in any way by any of the mineral acids with the exception of hydrofluoric acid and phosphoric acid at high temperatures. It can be used in the handling of solutions or the making of fusions where conditions are acid or neutral. Alkaline solutions or fusions react directly with vitreosil. Ammonia is the exception to the foregoing.

Because of its high acid-resistant nature fused silica has been extensively used in the concentration of sulphuric acid, the cooling and concentration of nitric in the cooling and absorption of hydrochloric and also in the concentration of phosphoric acid and other corrosive liquids such as zinc chloride.

The sulphuric acid concentration units are of the cascade type composed of a number of basins with long spout set in cascade over the fire flue. The weak acid is fed in at the upper end of the cascade and flows by gravity to the lower and hotter portion with a continuous increase in concentration of the acid. In this type of plant the fire gases are kept entirely out of contact with the acid itself and the silica does not introduce any impurities into the acid, so the concentrated acid obtained contains no added impurities. The cascade type of concentrator is generally limited to the production of sulphric acid 66 deg. Bé.

In the cooling and condensation of nitric acid vapors the S bend type of plant is used and from these units an acid of very good quality and strength are obtained. No difficulty whatever is experienced in the packing of the joints, and by operating the condenser on the reflux principle the majority of the acid obtained is water white.

THE SILICA ABSORPTION VESSEL

The cooling of hydrochloric acid gas, whether obtained by the salt sulphuric acid or the combustion method, is carried out in S bends which are thoroughly water cooled and the absorption is carried out in a new absorption unit which has already been described. (*Chem. & Met.*, Aug. 2, 1922, vol. 27, No. 5.)

Fused silica, because of its low coefficient of expansion and good heat transfer, is especially well adapted to the cooling of corrosive gases. It is compact in design and light in weight, which tends toward reducing erection costs considerably. Indications are that the field for this material will be bigger and more extensive in the future because the greater facility in fabrication has permitted the manufacture of numerous shapes.

Fused Silica in Radium Production

Replacing Expensive Porcelain Ware, This Material Has Established Its Industrial Utility—Some Hints About Its Use

BY CHARLES H. VIOL
Director, Vanadium Co. of America

AT the outbreak of the war in 1914, we were using in our refining operations, which involved the fractional crystallization of thousands of pounds of radium barium chloride per year, the best porcelain which the market afforded, this being the Royal Berlin porcelain. The war soon ended our ability to secure these porcelain dishes and we hit upon the use of the larger sized vitreosil fused silica dishes. At that time the dishes were not as large as we would like nor were they provided with an altogether satisfactory lip, but in all other respects they were eminently satisfactory, and in their durability they were superior to porcelain. Later we were able to secure the larger dishes with the good pouring lip as manufactured for the sulphuric acid concentration work, and this form of dish has given us the greatest satisfaction, fulfilling every requirement that could reasonably be asked in ware of this class.

Enameled metal would probably be more durable, but an investigation of this ware convinced us that the cost was prohibitively high for our particular use and while, from the standpoint of mechanical strength, it might be more durable than the silica, it is problematical whether such ware would withstand, as well as does the silica, the fumes and acid liquors which would come in contact with it.

WOODEN STIRRERS DIMINISH BREAKAGE

We have had breakage with this ware from time to time, a large part of which was traceable to the use of heavy glass stirring rods, which have since been replaced by wood. With this change we have been able to heat the dishes directly over a gas flame, supporting the dish by contact with a metal plate provided with a circular opening, and this rather rough treatment of the ware more than anything else goes to show the sturdy quality of the fused silica.

The Week in

Industry and Trade

Current News and Market Developments

News Section

April 16, 1923

CHEMICAL & METALLURGICAL ENGINEERING

Tenth Avenue at 36th Street, New York

H. C. PARMELEE, *Editor*

Market Section

The Summary of the Week

The weighted index of chemical prices showed a moderate reduction for the first time in weeks, reflecting, to a large extent, an easier situation in fertilizer materials.

Phenol on spot, resale parcels, sold at 53@55c. per lb., which compares with 26c. per lb. the contract price at which producers are making deliveries.

Firmer prices were named in some directions for citric acid, spot and shipment.

Cables from Europe reported a higher market for tartaric acid and cream of tartar.

Shipment prices on German chemicals are unsettled, with doubt about deliveries.

Consumers of cresylic acid appoint committee to petition Tariff Commission for reduction in tariff duty on this material.

Trial examiner of Federal Trade Commission recommends dismissal of complaint against the Procter & Gamble Distributing Co., charged with selling its goods with a guarantee against price reduction.

Estimates on supplies of calcium arsenate show increase over earlier figures, but still indicate a shortage.

Caustic potash and potash first sorts sold at higher prices in the spot market.

Consolidations of large manufacturing companies reported, with others in prospect.

Prices for linseed oil were advanced 3c. per gallon on the scarcity of spot stocks.

Federal Trade Commission announces that its investigation into arsenic and calcium arsenate situation fails to disclose any concerted effort of producers to manipulate prices.

Uniform Sales Contract for Heavy Chemicals

AS reported last week in the news columns of *Chem. & Met.*, the Salesmen's Association of the American Chemical Industry has taken up the question of adopting a uniform contract to be used in transactions involving heavy chemicals. Through a committee, consisting of men prominent in the industry, the association already is engaged in the preliminary work of drawing up the provisions of a suitable contract. The committee will welcome suggestions and constructive advice with the sole purpose in view of producing a document that will meet with the approval of the trade and will operate efficiently.

The advantages of such a contract are apparent. To begin with, there is no good reason why a standard contract for heavy chemicals should not be adopted and put into operation. There are many reasons—reasons making for economy, efficiency, simplicity and avoidance of possible misunderstandings—why a uniform contract should supersede the individual and sometimes widely varying contracts now in force.

Trading in imported vegetable oils is regulated by a contract that has been universally adopted by importers and dealers in these oils. There are two features to this contract to which we would direct the attention of the committee now engaged in working out a contract for the heavy chemical trade.

In the first place, it was sponsored by the New York Produce Exchange and functions under the sanction and protection of that institution. Buyers and sellers alike have implicit confidence in a contract wherein terms and conditions have been standardized and where the contract is labeled with the official approval of a recognized organization. The proposed chemical contract will be similar in this respect—that it will be representative of an organization of acknowledged standing in its own field.

This leads up to the second feature to which we have referred, consisting in a clause in the vegetable oil contract wherein it is provided that any disputes arising out of the contract shall be submitted to arbitration in accordance with the rules of the Produce Exchange. These oil contracts can carry an arbitration clause because there is an organization ready and equipped to handle the arbitration. A contract espoused by the Chemical Salesmen's Association likewise can carry an arbitration clause with arbitrations conducted under the auspices of the association.

The advantages of arbitrating commercial disputes may be briefly summed up in the words of the past president of the National Association of Credit Men in session last week:

"Aside from the settlement of disputes in commercial transactions, the arbitration plan could comprehend disputes over contracts in allied fields. Why should the dockets of courts be congested? Why should delays be suffered in the adjudication of contentions when arbitration would insure justice and with very considerable saving in time and cost?"

We respectfully commend the arbitration clause as an integral part of the contract for heavy chemicals.

Technical Societies and Trade Associations

News of the Week

Current Events Legislative Progress

Government Investigations Establish Validity of Calcium Arsenate Prices

Federal Trade Commission Reports Production Inadequate for Demand—Supply Larger Than Had Been Expected

TWO separate investigations by the government have failed to disclose any evidence of concerted action by manufacturers of calcium arsenate to fix prices. One inquiry, by the United States Department of Agriculture and the Geological Survey in response to a Senate resolution, found that uncertainty of the demand was responsible for the present shortage of the insecticide, resulting in price variations that were not brought about by price fixing. In a preliminary report just made public, the Federal Trade Commission, which also investigated the calcium arsenate industry, confirms these findings.

No Unfair Practices

"No widespread or important specific cases of unfair practices in the trade," says the commission in summing up its report, "have been found down to the present stage of the inquiry."

The commission concludes:

"The great increase in the Southern demand for calcium arsenate and the inadequacy of the available supply of white arsenic prevented the insecticide manufacturers from producing sufficient quantities of calcium arsenate to meet this demand, the result being a marked increase in the price of white arsenic and of calcium arsenate during the seasons of 1922 and 1923.

"The low price paid in the State of Georgia during the term of the Sherwin-Williams contract with that state was, in part at least, responsible for the opinion that an injustice was being done by the insecticide manufacturers to those customers outside the state who were paying a price as high in some cases as 100 per cent greater than that named in the above-mentioned contract, an opinion which was shared by the Georgia consumers after the expiration of this contract, when they likewise had to pay similarly high prices for calcium arsenate.

No Evidence of Price Fixing

"While efforts were made by the insecticide manufacturers to establish an association, one of the objects of which seems to have been the adjusting or at least discussion of price discrepancies, it does not appear that these efforts resulted in price-fixing or open-price activities."

The investigation by the commission was made in response to a Senate resolution. Demands for an inquiry were based upon wide variations in the price of calcium arsenate. Prices, which in October, 1922, ranged from 10 to 12 cents a pound, increased rapidly during the next 30 to 60 days, and in February, 1923, had reached a range of 18 to 19 cents.

Increased Supply in Sight

In connection with the supply of calcium arsenate B. R. Coad of the Bureau of Entomology estimates that twenty-five million pounds will have been made available by June. This is practically double the amount of the estimate made last October. "This great increase has not been brought about," says Mr. Coad, "by any sudden discovery of a large quantity of material, but merely by accelerated production throughout the raw arsenic-producing industry, together with readjustments in programs throughout the arsenic-consuming industry, resulting in more arsenic being used for calcium arsenate production than was anticipated at first."

Demand Has Fallen Off

Continuing, Mr. Coad says: "About the first of February a survey of the situation showed that apparently around eighteen or nineteen million pounds had already been contracted for delivery by the manufacturers, and the margin thus left for sale was comparatively small. Since that time, however, there has been a decided lull in buying, and a considerable amount of cancellation of these contracts by jobbers and others, who had bought without any very definite idea of the amount they would be able to distribute. As a consequence, for at least the past few weeks the manufacturers have for the first time been confronted with the possibility of production of material for which there is no immediate demand, and if this situation continues very long, we must expect some curtailment of calcium arsenate production programs.

Shortage Is Predicted

"Every year so far, since calcium arsenate has been used for cotton dusting, we have seen a very heavy last-minute demand during the months of May and June, and particularly during 1922 this demand was so exceedingly heavy that it was impossible to produce material to meet it. As the situation stands today, there are probably several million pounds of material which will be available for this late demand, if present manufacturing programs are carried out, but, as has been pointed out, this production will be reduced somewhat if the demand continues to fall off.

"Furthermore the prices at which the arsenic has been purchased are such that the manufacturers cannot afford to turn it into calcium arsenate to sell at a price very much below the present levels, and thus they will take no chance on overproduction. At the same time, however, if we may judge at all by past experience, the late demand will be far in excess of the margin available for its satisfaction. In other words, as nearly as can be foretold at this time, even with continued maximum production of calcium arsenate and at prices now prevailing, there will be a definite shortage of calcium arsenate by the time dusting becomes active, and probably somewhat earlier, but this shortage will not be nearly as acute as was anticipated in the early fall."

Chemical Salesmen to Meet Wednesday

The April meeting of the Salesmen's Association of the American Chemical Industry will be held Wednesday evening, April 18, at the Chemists' Club, 52 East 41st St., New York City. Dinner will be served at 6.30 p.m. sharp, but members and their friends are urged to be on hand early for the purpose of getting acquainted. H. B. Prior, chairman of the entertainment committee, has arranged an interesting program for the occasion. The principal speaker will be Paul T. Cherington of the J. Walter Thompson Company, one of the leading firms in the advertising field.

Mr. Cherington was formerly professor of marketing in the Graduate School of Business Administration of Harvard University and later was secretary-treasurer of the National Association of Wool Manufacturers. He has had a wide range of experience on the general subject of merchandising and advertising and has earned a reputation as an able writer and a clear speaker. He will speak on the subject: "Problems Experienced in Marketing a Consumer Product." The speaker will be introduced by Charles Wadsworth, 3rd, assistant editor of *Chem. & Met.*, who will also outline a program which has been suggested with the idea of making these meetings more interesting and beneficial.

Washington News

German Chemical Exports Are Restricted

Chance for American Manufacturers to Supply Foreign Markets

The volume in which German chemical exports continue to move is occasioning some surprise, but reports reaching Washington indicate that these exports are confined largely to the United States and to Great Britian, countries in which Germany is particularly anxious to build up credit and to retain markets. Reports from Austria, Germany's next-door neighbor, which has relied on Germany since the war for its entire chemical requirements, indicate that the country is in desperate straits as a result of the practical cessation of chemical supplies from Germany. The situation is one which is expected to force the Austrian chemical plants to reopen. Since the war the financial situation in that country has been such as to discourage any resumption of manufacturing activities.

U. S. and England Favored

The reports from Austria and from other countries indicate that Germany is exporting almost exclusively to the United States and to Great Britain. It is believed, however, that the rate of exportation will diminish sharply from this time forward. An indication of the situation in Germany is had in the fact that inquiries looking to the purchase of chemicals are being received in this country from Germany. Another indication is the increasing shortage of German patented products.

Opportunity for America

Information reaching Washington indicates that chemical manufacturers in this country, engaged as they are in an effort to supply a very active domestic market, are paying very little attention to the opportunities now offered to annex foreign markets. In that connection it is pointed out that such an apportunity rarely knocks twice in a generation. During the war the American chemical industry had an opportunity to annex permanently certain of the foreign markets that had been supplied theretofore by Germany. This opportunity was not improved to any great extent, but at that time the industry had had little experience in foreign merchandising and there were difficulties as to quality and uniformity, which now have been overcome. The opinion is expressed that if the industry does not improve this second opportunity in the scramble to take full advantage of the peak to which the wave of prosperity has pushed domestic demand it would be well now to enter upon manufacturing expansion without losing sight of the volume of domestic business in the off-peak period.

Recommends Dismissal of Price Maintenance Suit

Final arguments were heard on Wednesday before the Federal Trade Commission on its complaint against the Procter & Gamble Distributing Co. of Cincinnati, which was charged with giving rebates to jobbers and with selling its products with a guarantee against price declines. Warren R. Choate of the Federal Trade Commission recommended that the complaint be dismissed.

Although the examiner suggested that an order be issued dismissing the complaint, the commissioners listened to exhaustive arguments by both sides.

In recommending dismissal of the case Mr. Choate stated that the practice of guaranteeing jobbers against price declines and of giving rebates on credit allowances had existed in the soap industry for 30 or 40 years and that the Procter & Gamble Co. had not taken advantage of competitors who did not give price decline guarantees. As used by the respondent, it was declared that the practice did not deter manufacturers from reducing prices, and did not encourage speculation by jobbers.

American Phosphate Rock Shut Out of the Ruhr

Shipments of American phospate rock are not being permitted to enter the occupied portion of Germany, protests to Washington indicate. Representatives of this government in Germany have been asked to ascertain whether this is deliberate action on the part of German authorities or is being occasioned by transportation embargoes incident to the disturbed situation.

Invoices of Coal-Tar Imports Must Show Makers' Name

In compliance with the new tariff act, the Treasury Department has requested the State Department to notify consuls to require additional information with invoices of coal-tar dyes and chemicals.

A proviso of the coal-tar paragraph stipulates that 6 months after passage of the act each invoice and container shall state the name of the manufacturer, the trade name of the article, the chemical formula with the trade name or identification number, if the article is not classified and identified chemically in the Schultz or some other similar publication, the Schultz or other number if any, or if none, the class or color—that is, whether it is an alizarine, azo or sulphur color, etc.; the percentage exclusive of diluents of the pure dye contained in the article, and that these particulars shall also be stated in the case of each dye contained in a mixture of two or more dyes.

Alsatian Output of Potash Increased in 1922

During 1922 the potash mines in Alsace exceeded the production of any previous year. In 1922 the total output was 1,326,727 tons. In 1920 the Alsatian production was 1,222,370 tons. This greatly exceeded, however, the 1919 production, which was 592,365 tons. The 1921 production was 903,134 tons.

Potassium chloride is being produced at the rate of 250,000 tons, which is the maximum which can be produced with the existing plants. In addition to the chloride production, however, there is a very material production of potassium sulphate.

"Turpentine" Is Unfair Name for Turpentine Substitute

Advertising a product so as to give the impression that it is turpentine when such product is a coal-tar distillate and not obtained from the sap of the pine tree is declared by the Federal Trade Commission to be an unfair business practice. The commission in its investigation of the International Paint & Oil Co., of Peoria, Ill., developed the fact that the concern used the name "Tar-Pentine" in marketing a commodity resembling turpentine and made various claims of the superiority of its product over turpentine. The commission's order specifies that respondent must stop using the words "Tar-Pentine," "Tarpentine" or words of similar import, in connection with the sale or offer for sale of a commodity which is not turpentine.

Production of Methanol Declined in February

Acetate of Lime Output for That Month Also Lower

The production of acetate of lime and of methanol declined still further in February from the high mark set in December. Acetate of lime output amounted to 13,894,000 lb., as against 16,544,000 lb. in January, and methanol production was 773,179 gal., as against 933,171 gal. in December. Consumption of wood declined to 85,105 cords and stocks of wood at chemical plants declined to 807,782 cords, the lowest since November, 1921.

The following table shows total comparative figures for the past 5 months, as reported by firms with a daily capacity of 4,500 cords (or prorated to that capacity in months where some reports were lacking), and the comparable monthly figures for 1922, taken from the *Survey of Current Business* published by the Department of Commerce:

	Acetate of Lime Thous. of Lb.	Methanol Gal.
1922		
October	12,217	664,933
November	15,440	835,687
December	16,814	942,008
1923		
January	16,544	933,171
February	13,894	773,179

Mergers of Manufacturing Companies Completed and in Prospect

Certain-Teed Products Corporation Absorbs Linoleum and Cement Companies—Cotton Oil and Linseed Oil Companies Figure in Merger Rumors

GEORGE BROWN, president of the Certain-Teed Products Corporation, which is one of the largest manufacturers of paints and roofing materials in this country, has confirmed earlier announcements to the effect that the company had acquired control of Cooks Linoleum Co., Trenton, N. J., the Acme Cement Co., St. Louis, and Thomas Potter & Sons Co., manufacturer of linoleum at Philadelphia. In confirming the merger of interests Mr. Brown stated:

"These large additions to our present manufacturing facilities and administrative organizations means the completion of our line of products for the construction, protection and equipment of buildings and the distribution of these closely related necessities through the same channels, eliminating all avoidable waste."

The amount involved in completing the merger of these companies was $8 000,000. The consolidation brings under one producing and administrative organization the leading linoleum manufacturers of the United States and also puts the corporation in the fore rank of gypsum producers. The Certain-Teed Products Corporation has shown remarkable growth in the last sixteen years.

Another Merger Rumored

Following the confirmation of this consolidation of interests rumors were heard that a merger of the American Cotton Oil Co., the Portsmouth Cotton Oil Refining Co. and the Gulf & Valley Cotton Oil Co. has progressed to a point where definite terms of consolidation had been agreed on. According to reports the consolidation would require $10,000,000 new capital, which would be used chiefly in retiring outstanding notes of the American Cotton Oil Co. and for working capital. A syndicate was said to have charge of underwriting this stock issue.

The report further stated that no name had yet been selected for the new company and that the stock distribution had not been worked out, but in the case of the American Cotton Oil Co., which has a common stock capital of nearly $21,000,000, it was stated this would be scaled down to about one-third and that holders of this stock would be asked to accept one share of stock in the new company for each three shares of American Cotton Oil stock.

Royal Victor, counsel for the American Cotton Oil Co. and one of its directors, issued a statement denying the accuracy of the reported merger. He stated that: "If any plan of consolidation or merger with other interests is effected, the management will give authentic information concerning it."

The American Linseed Co. and the Midland Linseed Products Co., leading producers of linseed oil, were most prominently connected with still another reported merger. The latter reports apparently originated in financial circles and could not be pinned down to anything definite. The rumor was that the American Linseed Co. would absorb one of its competitors and apparently the Midland Linseed Products Co. entered into the report because of its prominence in the industry.

To Apply for Lower Tariff on Cresylic Acid

More than twenty representatives of consumers, producers and importers of cresylic acid met at the Old Colony Club, New York, on April 9, to discuss the tariff situation, and it was agreed to ask for a lower rate under the flexible rate clause of the tariff. Unless a lower rate is granted, many consumers will be forced to abandon using this important coal-tar product, according to members of the trade. The tariff provides for a rate of 55 per cent ad valorem plus a specific duty of 7c. a pound. Domestic production has been below requirements. Under the tariff cresylic acid cannot be imported under $1.30 per gallon, while producers here are delivering this material against existing contracts at approximately 79c. per gallon. Consumers not protected by contract are at a great disadvantage.

The following were appointed at the meeting to present the matter before the United States Tariff Commission: M. M. Marcus, West Disinfecting Co.; W. E. Jordan, Jordan Coal-Tar Products Co.; W. H. Gesell, Lehn & Fink; P. C. Lemley, William Cooper & Nephews; R. N. Chipman, Chipman Chemical Engineering Co.

Austrian Company to Produce Calcium Nitrate

A message from Munich states that the Stickstoff A. G., which belongs to the Bayerische Stickstoffwerken A. G. of Munich and is an Austrian company working with German capital, is about to construct important works for the production of calcium nitrate at Gollingen. The company will utilize chalk from the neighboring quarries, native peat coke and nitrogen from liquid air, and will obtain electric power from hydraulic forces which can be utilized in the region. The construction at a later period is also contemplated of electric works on the Kapruner-Ache.

Trade Brevities

Ferdinand Kieckheffer has been elected director of the National Enameling & Stamping Co., succeeding W. G. MacQuire, recently made president of the St. Louis Coke & Chemical Co.

Percy J. Flint, for many years connected with the American Agricultural Chemical Co., is now associated with Eugene Suter & Co.

Robert Tomlinson, the 7-year-old son of G. H. Tomlinson, manager of the New York office of the Midland Linseed Products Co., was killed on Sunday while playing at Owen Field, Maplewood, N. J.

E. J. Barber, of the White Tar Co., Inc., returned last week from a business trip to New England.

The export and import business of the Hagemeyer Trading Co., Inc., 17 Battery Place, has been merged into that of William E. Peck & Co., Inc., whose offices are in the Peck Building, 140 Front St.

The offices of Irving R. Boody & Co., vegetable oils and Oriental products, formerly located on the fifth floor of 82 Beaver St., have been moved to Suite 1211, the same building.

The Brooklyn plant of the Kasebier-Chatfield Shellac Co., which was destroyed by fire last fall, has been rebuilt and has resumed operations.

R. E. Dorland, manager of the New York office of the Dow Chemical Co., is on a visit to the main plant of the company at Midland, Mich.

Frank McCartney, general sales manager of the Monsanto Chemical Works, St. Louis, is at the New York office for a stay of a few weeks.

The Republic Trading Co. of New York City has increased its capital stock from $25,000 to $2,000,000.

The Bureau of Foreign and Domestic Commerce announces that C. C. Batchelder has recently returned from Calcutta, India. For the next week or longer he will make his headquarters at the bureau's New York office, room 734, Custom House, where he will be pleased to consult with manufacturers, importers, exporters and others interested in trade with India.

Loss estimated at $50,000 was suffered by the Chemical Utilities Co., Cincinnati, on April 6, when fire destroyed a warehouse stored with large quantities of sulphuric acid along with chemicals of a highly explosive nature. This building had just been acquired by the company and was being remodeled for occupancy. Firemen prevented the blaze from spreading to the adjoining property belonging to Fries & Fries, chemical manufacturers.

William C. Schwarz of New York has joined the Bureau of Foreign and Domestic Commerce at Washington and will have charge of statistical work in connection with imports of dyes.

American Institute of Chemistry Holds First Annual Meeting

The first annual meeting of the American Institute of Chemistry was held at the Hotel Breslin, Monday evening, April 9. The meeting was preceded by a dinner which was very well attended.

The secretary announced a charter membership of 150 and a list of 100 applicants whose credentials had not yet been passed upon by the council. The membership roll reveals the fact that both charter members and applicants represent practically every state in the Union. Even in the short period of preliminary organization the scope of the organization extended from coast to coast. The initial steps for the organization of two chapters of the institute in states where the membership is already more than sufficient were announced at the meeting. These two states are New Jersey and New York. Plans for several other state chapters are under way.

The temporary officers and the council chosen at the organization meeting were confirmed for the ensuing year. The following committees and their personnel were announced:

Professional Education—Dr. Casimir Funk, director H. A. Metz Laboratories; Dr. Arthur E. Hill, head of the department of chemistry, N.Y.U.; Dr. Guy Y. Williams, professor of physical chemistry, University of Oklahoma.

Ethics—Dr. Mathew A. Hunter, professor of electrochemistry, Rensselaer Polytechnic Institute; Dr. Benjamin Harrow, associate in biochemistry, College of Physicians and Surgeons; Dr. H. B. Gordon, chemist, U. S. Testing Co.

Membership — C. L. Bryden, 381 Fourth Ave., New York City; H. L. Lourie, U. S. Tariff Commission, Washington, D. C.; James R. H. Stevens, James H. Wallace Co., Stamford, Conn.; Robert E. Pittman, Sloss-Sheffield Steel & Iron Co., Birmingham, Ala.

Publicity — Dr. Leon W. Parsons, chief chemist, Tidewater Oil Co., Bayonne, N. J.: Prof. Glen V. Brown, professor of chemical engineering, Bucknell University, Lewisburg, Pa.; Dr. Frederick W. Zons, consulting chemist, 239 Center St., New York City; Adriaan Nagelvoort, chemical engineer, 52 East 41st St., New York City.

Legal—Dr. Lloyd Van Doren, patent attorney, 21 West 44th St., New York City; Dr. W. Lee Tanner, research chemist, Grasselli Chemical Co., Cleveland, Ohio; Dr. Carleton Ellis, consulting chemist, Montclair, N. J.

Classification — Dr. Frederick W. Crane, consulting chemist, Montclair, N. J., and professor of chemistry, Newark Technical College; Dr. Stewart J. Lloyd, professor of chemistry, University of Alabama; Dr. Henry G. Knight, director of the Experiment Station, University of West Virginia.

Employment—L. R. Seidell, manager N. Y. Testing Laboratories; Maximilian Toch, Toch Brothers, 110 East 42nd St., New York City; C. V. Bacon, consulting chemist, 3 Park Row, New York City.

Explosion Rends Dye Plant

An explosion which killed two and injured several others occurred at the plant of the National Aniline & Chemical Co. at Buffalo, N. Y., on April 3. The property damage was slight. The explosion occurred in the mixing and grinding department during an operation common to several other plants belonging to the company. The cause of the accident therefore is unknown and consequently is being carefully investigated.

A representative of the National Aniline & Chemical Co. has stated to a member of the *Chem. & Met.* staff that, contrary to early rumors, no picric acid was present or in process at the time of the blow. The possibility of a dust explosion was also doubted.

Calendar

The following important technical meetings are scheduled for the immediate future:

American Assn. of Engineers	Norfolk, May 7-9
American Chemical Society, Regular meeting	New York, May 4
American Electrochemical Society	New York City, May 3-5
Amer Society Mechanical Engrs.	Montreal, May 28-31
American Foundrymen's Association	Cleveland, O., April 30-May 3
American Oil Chemists' Society	Hot Springs, Ark., April 30-May 1
American Welding Society	New York, April 24-27
American Zinc Institute	St. Louis, May 7-8
Canadian Institute of Chemistry	Toronto, May 29-31
Interstate Cotton Seed Crushers Assn.	Hot Springs, Ark., May 2-5
Society of Chemical Industry, Canadian Section	Toronto, May 29-31
Society of Industrial Engineers	Cincinnati, O. April 18-20

New Furnace Tested at M.I.T.

A remarkable series of tests was recently carried out at the Massachusetts Institute of Technology on the Cannon radiating furnace. Essentially this is a combustion chamber in which fuel oil or pulverized coal may be burned at a high rate of speed. This of course implies that the conductivity of the chamber walls is very high, and that is the reason for using carborundum in the walls. As a matter of fact, the Carborundum Co. has purchased the patent rights for this equipment.

The tests at the M.I.T. carried out by Professors Miller and Eames showed a capacity of 320,000 B.t.u. per cubic foot of combustion space for a short time. This is a remarkable figure and gives distinct industrial promise.

Noted Men Receive Medals

The Franklin medal, highest award of the Franklin Institute, was given Sir J. J. Thompson, F.R.S., at a special meeting of the American Philosophical Society in Philadelphia on April 19. He likewise received the John Scott medal and award of $1,000. At the meeting he discussed the possibility of a new form of water molecule.

Other recipients of the Scott medal and the premium were Dr. C. Eijkman of the University of Utrecht, Holland, for his contributions to medical science; Dr. A. L. Day, director of the Geophysical Laboratory of the Carnegie Institute, Washington, for his work in the interpretation of geological phenomena and for producing optical glass, and Dr. F. W. Aston of Trinity College, a leading student of the disintegration products due to radio-activity, who developed a special instrument, known as the mass spectograph, capable of an accuracy of one part in one thousand.

The Scott medals are awarded by the city through the Board of City Trusts. Funds for the purpose were bequeathed to the city in 1816 by John Scott of Edinburgh.

A. De Graeffe, Minister from the Netherlands, received the medal and the premium for Dr. Eijkman, and H. G. Chilton of the British Embassy at Washington accepted them for Dr. Aston.

Fluorspar Situation Alarms Non-Metals Specialists

That the War and Interior Departments in their war minerals activities should include fluorspar is a contention raised by some of the government's non-metals specialists. Some of them go so far as to state that fluorspar is more essential than manganese, since it is possible, in an emergency, to use manganiferous iron ores or to make use of the lower grade manganese deposits. On the other hand, with one exception, no new deposit of fluorspar has been brought in since the beginning of the war.

From this time forward, it is contended, much will be heard of the fluorspar situation. The more readily mined deposits are being exhausted and the apparent lack of domestic resources of this essential flux for the making of basic open-hearth steel is causing apprehension.

A recent questionnaire sent out by the Bureau of Mines to the chief chemists of the principal steel companies brought forth, among other things, the fact that there is no substitute for fluorspar in the making of steel, even at greatly increased prices. In addition, it is the only source of hydrofluoric acid, which also is an essential commodity in carrying on a war.

Cryolite is occasionally used as a substitute for fluorspar. Since the only commercial deposit of cryolite is in Greenland, it would have little bearing on the situation in an emergency.

Phosphate Gains Attention

Extensive Deposits in Idaho Have Been Investigated—Florida's Resources Next to Receive Attention

There are more than 100,000 acres of land in northern and middle Florida believed to contain phosphate rock which have been withdrawn from entry by the Interior Department. Individuals assert patent rights to some of this property and a number of discrepancies in records have developed. Much of the land, however, never has been claimed for patent by private individuals.

Geological work of investigation of these lands is to be conducted by G. R. Mansfield and G. W. Holland of the Geological Survey. The latter already is in Gainesville comparing records and he will be joined by Mr. Mansfield before the end of the month.

The phosphate deposits of Florida are rated as the richest in the United States, particularly the pebble phosphate east of Tampa. In the northern part of the state, the phosphate is hard rock or slate rock. The deposits on private lands have been extensively developed, principally for export demand. Development has slackened recently owing to a decrease in this demand occasioned in part by the development of phosphate in northern Africa, which, although of a lower grade, is closer to the German and French fertilizer markets.

Mr. Mansfield is completing a report on the phosphate deposits of Idaho which will be submitted to Acting Director P. S. Smith of the Survey before he goes to Florida. The Idaho deposits are extensive and of good grade. The greatest development in that state is that of the Anaconda Copper Co. which has built a 7-mile railroad to its phosphate mine and has established a plant to produce superphosphates, using acids from its other plants.

Glass Patent Question Closed

The Supreme Court will not consider the validity of the basic patents involved in the conversion of the glass industry from a hand-blowing to a machine-drawing art. Considerable interest is attached to this decision by the glass industry.

The Window Glass Machine Co. and the American Window Glass Co. sought to bring up for review a case against the Pittsburgh Plate Glass Co. in which the federal District Court for western Pennsylvania held that the patents had not been infringed. It was contended by the companies interested in maintaining control under the patents that in a long list of adjudicated cases presenting similar controversies the federal courts had sustained the validity of the patents. The main patents at issue, it was asserted, had "revolutionized" the industry.

The Third Circuit Court of Appeals affirmed the decision of the District Court, which, it was declared, had reversed a long line of decisions.

Develops Successful Mask

Development of a "universal gas mask" which is considered to have the widest application of any gas mask thus far devised and which fills every demand that may reasonably be made on a gas mask is announced by the Department of the Interior as the result of experimental work performed by the Bureau of Mines at its Pittsburgh, Pa., station. The department also announces the development of a "fireman's canister" which is similar to the "universal canister" but is smaller and lighter, thus making it more convenient for the use of city firemen. By the use of these types of gas masks, workers in many metallurgical and chemical plants may encounter a variety of gases and city firemen may meet almost any type of gas or vapor and do work that they could not do otherwise except at the risk of death or serious disability.

The canister contains granular absorbents, consisting of activated charcoal, for removing organic vapors; a filter of cotton wool for removing smokes, dusts and mists; caustic soda fused on pumice stone for removing acid gases; another cotton-wool filter; fused calcium chloride for extracting water vapor that inhibits action of the next absorbent; "hopcalite," a mixture of oxides of manganese and copper with sometimes silver and cobalt that destroys carbon monoxide; and finally silica gel for absorbing ammonia.

News Notes

French metallurgical production is again gaining slowly. Coke supplies available are gradually growing up. Belgium and Holland are supplying small amounts, while a considerable quantity is beginning to come in from Czechoslovakia.

Technical courses of broad range are to be given at Carnegie Tech. during the coming summer. The school will open June 25 for 8 weeks. The colleges of engineering and industries are to offer an especially good choice in the work which may be taken.

Three airplanes, loaned by the War Department, are now being fitted up for the boll weevil campaign by the Department of Agriculture. If this work is successful, further funds will be used in dusting calcium arsenate by this means.

Five research fellowships, each of value of $810 per year, are open at the College of Mines, Seattle, Wash. The following subjects have been selected for investigation. Coal washing, electrometallurgy, ferrous metallurgy, super-refractories, and white ware bodies. Applications are due not later than May 10 and should be addressed to Dean Milnor Roberts.

Newsprint, woodpulp and lumber are the chief products that contributed to the increase in Canada's exports to the United States for the 11 months of the present fiscal year, as compared with the corresponding period of the last fiscal year, ended March 31. The group of wood, wood products and paper, to which these articles belong, account for more than half of the total increase of $63,000,000 in the total exports to the United States.

Ceramic wares of all kinds are to be produced in growing volume in the United States if the present expansion of the pottery industry is a correct indication of the tendency of the times. Many new additions are in sight in every line from heavy sanitary ware to fine china. The Westinghouse High-Voltage Insulator Co. is to open a new plant in California early in June for the production of electrical insulating porcelains.

Paper men in New York during the week of April 9 staged many affairs of unusual interest. The Technical Association held several sessions, very largely attended, of definite practical value. The exposition at Grand Central Palace lived up to expectations. An account of the week's proceedings and of the exposition will appear in next week's *Chem. & Met.*

Hartford engineers and chemists are considering the formation of an engineers' club. Six technical societies have chapters in or near the city. On April 21 a joint trip, dinner and meeting of all interested is to be held. At this time the new plant of the Hartford Rubber Works is to be open to inspection.

Over 4,000,000 lb. of various metals is to be placed open for bids by the navy on April 19. Brass, copper, aluminum, zinc, bronze and Monel metal are included in the list.

Varied industrial plants, thirty in number, have just been visited by the senior class of the engineering college of the University of Kentucky in a spring tour covering the Buffalo-Pittsburgh centers.

The Ruhr export situation, despite much discussion and many assurances of improvement, remains practically unchanged. German exporters have been instructed by their government not to pay the 10 per cent duty imposed by the French. The blockade remains as effective as ever.

The Gypsum Industries Association of Chicago has been found not guilty of violation of anti-trust laws. The government, through the Federal Trade Commission, has dropped its charge of manipulation to obtain monopoly.

Lignite or brown coal is being used in many German industries, including those producing potash and nitrogenous fertilizer. Power stations, glass and potteries factories are also using lignite for fuel, mainly in form of briquets.

Exceptionally strong fertilizers are obtained by the treatment of Vesuvian lava, according to a dispatch just received from Milan. A phosphoric solution is used in this treatment. If practical results bear out expectations a new fertilizer for Italian agriculture will be available.

Facts and Figures
That Influence Trade
in Chemical Products

Market Conditions

Current Prices
Imports and Exports
The Trend of Business

Active Movement in Heavy Chemicals Absorbs Domestic Output

Trading in German Chemicals for Shipment Restricted—Permanganate of Potash in Strong Position—Arsenic Irregular—Active Call for Tartaric Acid—Higher Prices for Imported Potassium Bromide

CONTINUED call for contract deliveries of heavy chemicals is taking up the bulk of production. New business placed during the week was not large, but this is accounted for by the fact that the large consuming trades are covered ahead. The total movement so far this month has assumed record proportions. The situation surrounding chemicals of German origin is growing more complex. This has resulted in uncertainty regarding shipments and in some cases importers have withdrawn quotations, as no assurance can be given that deliveries will be made within the time limits specified. This condition is true not only of chemicals coming from the Ruhr Valley but also of those from other sections of Germany, as the raw materials in many cases are drawn from the Ruhr. Furthermore the imposition of export taxes on goods shipped from the latter section has a demoralizing effect on business. To add to the confusion the German Government is reported to have advised exporters not to pay the export taxes and if this policy is followed out, no permits for shipment will be issued.

Building Operations Increase

Reports on building operations show that activity in that line is going on unabated. This accounts for the heavy consumption of such chemicals as enter into the dry color trade and other branches of the paint and varnish industries. Substantial decreases in the shortage of freight cars also is reported and fewer complaints are heard about delays in shipping chemicals.

Prices for the majority of chemicals of domestic origin have held a steady position with a firm tone generally noted, due to good consuming demand and strong producing costs. Most imported chemicals have shown a tendency to advance and this is especially true of all potash compounds. Arrivals of foreign made chemicals were of good volume but in most cases they were sold ahead and had little if any influence as price factors. Some speculation has arisen with reference to new contract prices for soda ash and other basic chemicals as it is feared that advances in price are probable, but as these new prices will not be announced for a long time, there may be many changes in fundamental conditions which will nullify present calculations.

Acids

Acetic Acid—Glacial is reported to be easy with some resale lots to be had at price concessions. First hands quote the market unchanged at $12.05@12.85. The lower grades are moving steadily to consumers and prices are well maintained. Quotations are on a basis of $3.17½ for 28 per cent and $6.35 for 56 per cent.

Boric Acid—Producing costs are fairly steady and consuming requirements are up to expectations. The market is reported to be established on a steady basis and no price fluctuations seem in prospect for the near future. Powdered and crystals are quoted at 11c. per lb. in sacks, 12c. per lb. in barrels and 12c. per lb. in kegs.

Citric Acid—Cables indicate a strong market abroad and 52c. per lb. is given as the lowest price for shipments. Consuming interest is good and unless a change takes place in the foreign situation the probability of still higher prices is bright. Domestic goods are firm at 49@50c. per lb.

Hydrofluoric Acid—Buying has been along quiet lines and prices are steadied only by the strong position of raw materials. Export demand is not in evidence. Prices are held at 7@7¾c. for the 30 per cent and 11@11½c. for 48 per cent.

Lactic Acid—Shipment prices for foreign material have been high enough to shut off much business from that direction and that is one reason for the firm condition of the present market. Domestic makes have been finding a ready outlet and prices for all selections are strong. Quotations are 4½@5½c. for 22 per cent dark and 5½@6½c. for 22 per cent light.

Oxalic Acid—Only small lots of imported material were on the market and they were held at 13¼@13¾c. per lb. One lot of 30 bbl. was reported to have been offered at the outside figure. Demand has not been active but restricted imports has a steadying effect on values. Domestic oxalic holds at 12¾c. per lb. at the works with small lots commanding the usual premiums.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	181.48
Last week	181.61
April, 1918 (high)	286.00
April, 1919	231.00
April, 1920	261.00
April, 1921 (low)	140.00
April, 1922	158.00

The weekly index number shows a moderate decline of 0.13 point occasioned by the slightly easier situation in fertilizer materials and a ½c. drop in refined glycerine.

Sulphuric Acid—Contract deliveries are taking up the bulk of production and many producers are unable to accept orders for prompt shipment. This places the market in a strong position. Quotations are $9@$10.50 per ton for 60 degree and $15@16 per ton for 66 per cent. These prices are for tank cars at the works.

Tartaric Acid—Active buying has featured this material. Consumers have covered as far ahead as possible and with prices going up they have taken spot offerings in large volume. Imported could still be procured at 34c. per lb. but 34½c. per lb. was asked in several directions. Domestic grades were steady at 35c. per lb.

Potashes

Bichromate of Potash—Transactions have been confined to small lots and sellers have been eager to book whatever business was in sight. Prices as low as 10½c. per lb. f.o.b. works were heard and ranged upward to 10¾c. per lb. Offerings are not heavy and price fluctuations seem to be influenced more by the volume of trading than by any other factor.

Chlorate of Potash—The shipment situation with reference to most potash compounds has given concern regarding future supplies of foreign goods. This has been noted in the market for chlorate and as spot stocks are pretty well depleted, a firm market has been created. Quotations on spot are given at 7½@7¾c. per lb. but there is not much to be had, especially at the inside figure. Domestic chlorate is offered at 8¼@9c. per lb. f.o.b. works.

Carbonate of Potash—Business has been held down to small proportions by the absence of spot goods. Small lots of hydrated 80-85 per cent have changed hands at 7¾c. per lb. Calcined 80-85 per cent is in a wholly nominal position. Shipment prices are based on so much uncertainty regarding deliv-

eries that they mean hardly anything. Demand has not been active, as most consumers laid in supplies when danger of curtailed shipments first became manifest.

Caustic Soda—Higher prices for shipment have been quoted and this has resulted in a very firm market for spot holdings. Sales of 88-92 per cent have been made at 8¼c. per lb. on spot with some sellers asking 8½c. per lb. Shipment prices are quoted at 8¼c. to 8⅜c. per lb., according to seller. Home producers are firm in their views and maintain carlot quotations for 88-92 per cent at 8¼c. per lb. f.o.b. works.

Permanganate of Potash—Irregularities in price have continued to feature the market for permanganate. This undoubtedly was caused by sales of odd lots at private terms and at prices which did not represent the market, as further lots were not available at those terms. The general asking price at the close was fixed at an inside figure of 25c. per lb. Some goods afloat sold at 25c. per lb. Some importers have withdrawn all quotations for shipments and futures can not be quoted at any level with assurance that deliveries will be made within the contract specifications.

Potash First Sorts—Last trading went through at 8c. per lb., but late in the week leading handlers marked up the quotation to 9c. per lb. nominal. Offerings were scanty, as production has been restricted because of the low selling prices obtaining at the different centers of distribution.

Sodas

Acetate of Soda—Buyers have been showing but little interest and this has given an easy tendency to prices. Leading factors are reluctant to lower quotations and are giving 6c. per lb. as the asking price but on firm bids there is no difficulty in shading that figure materially.

Bichromate of Soda—Although producers are finding a good call from contract holders and a good part of production is being absorbed in this way, there is no scarcity of stocks and selling competition is a factor. The quotation is held at 7½c. per lb., f.o.b. works, but some reports say that equalizing freight rates on delivered prices has practically resulted in price cutting. However, there are different instances where sellers are known to have maintained the quoted price levels, and the business has gone to the maker whose plant was nearest the point of delivery. Fundamentally the market appears to be in a firm position, as producers are operating on a small margin. Chrome ore is quoted at $20.50 per ton, c.i.f. Atlantic ports for Indian, $24@$26 per ton for New Caledonian, and $20@$22 per ton for Rhodesian.

Caustic Soda—There is no abatement to the heavy movement to domestic consumers. Buyers not only hold contracts for amounts considerably above normal, but they also are prompt in asking for deliveries and it is evident that consumption is keeping pace with production. Some producers are unable to accept new business for April delivery, while others quote former prices of 2½c. per lb., works, basis 60 per cent, and are able to make prompt shipments. Dealers are asking 3.50c. to 3.60c. per lb. on spot for 76 per cent solid and small lots sold this week as high as 3.80c. per lb. ex-store. Recent sales for export were made at 3.40c. per lb., f.a.s., and while this price is still heard it is purely nominal for prompt shipment, as the sellers admit they are sold ahead. The best price for export is given at 3.45c. per lb. f.a.s. and up to 3.50c. per lb. has been paid.

Chlorate of Soda—A lot of imported chlorate was scheduled to be sold at auction on Thursday. This lot was held in bonded warehouse in Brooklyn and different members of the trade were on hand at the appointed time to present bids, but the owner paid the charges which had accrued and the auction did not take place. Offerings of imported on spot are limited and values for good quality are steady at 6½@6¾c. per lb. Domestic makers continue to ask 6¾c. per lb. at the works and upwards on a quantity basis.

Fluoride of Soda—Consumers have been taking more interest in this chemical and the volume of business placed shows a material gain. The undertone to prices is strong, and quotations have been marked up to an inside figure of 9½c. per lb.

Hyposulphite of Soda—Recent lowering in prices has failed to stimulate buying to any pronounced degree and another quiet week was reported by sellers. Foreign offerings continue to compete actively with domestic makes and this prevents any real stability to values. Quotations are repeated at $2.50@$2.75 per 100 lb.

Nitrate of Soda—Current business is fairly good for this time of year and while demand in the South has fallen off, there is a steady movement to Northern consumers. Prices are quotably unchanged at $2.65 per 100 lb. ex-vessel, although some sellers have tried to effect sales at higher levels. Business for forward positions is quiet, as domestic buyers feel that new price schedules may work out more in their favor in view of slow call for nitrate from European countries.

Nitrite of Soda—Some improvement in trading was reported in the past few days, but the market is still far from active. Importers are offering freely, but already are quoting close to actual laid down cost and are unwilling to shade prices further. Asking prices for imported are given as 8¾@9c. per lb. depending on quantity and seller. Domestic grades are quiet at 10@10½c. per lb.

Soda Ash—While new contract prices are still several months off, there is considerable speculation on the part of buyers regarding them. In view of the unusually heavy movement so far this year and the increased cost of production it is believed that the new prices will be established on higher price levels than are now quoted. There was no change in the spot on shipment market during the week. Some sellers say if deliveries continue throughout the month on the same scale as during the first half of the month, that April will show a record disappearance. Prompt deliveries of light ash are offered by dealers at $1.75 in bags and $1.95 in barrels. Producers quote contracts at $1.20 in bags and $1.40 in barrels, carlots works, basis 48 per cent. Dense ash holds at $1.25 in bags and $1.45 in barrels.

Miscellaneous

Acetone—Producers reported a steady market, production in several directions being well sold up. The prices were maintained by first-hands at 22@22½c. per lb., the inside figure obtaining on carload lot transactions.

Antimony Oxide—While the undertone of the market reflected the firmer situation in China, prices underwent no further change. White oxide, 99 per cent, held at 9c. per lb. Standard needle antimony, powdered, was available at 8c. per lb. On the lump 7¾c. per lb. represented the market. Several shipments arrived here during the past week.

Acetate of Lime—Demand was moderate, but prices held on the old basis of $3.50 per 100 lb. Production in February was officially placed at 13,894 lb., against 16,544 lb. in January and 7,993 lb. in February a year ago.

Arsenic—Sales of spot goods were reported at 15¼c. per lb. and some material afloat sold at the same figure. The general asking price for spot, however, was 15½c. per lb. Moderate sized arrivals reached the local market from different foreign countries, but most of this went out direct to consumers and there has been no gain in the holdings of local sellers.

Calcium Arsenate — Reports from Washington state that the supply of calcium arsenate will be considerably larger than had been forecast some time ago, but still there will be a scarcity of something like 6,000 tons. Orders for large amounts are reported to be on the market. Prices are firm at 17¾@18c. per lb.

Copper Sulphate—Arrivals of imported sulphate were again noted during the week. Prices for imported grades are rather easy and range from $5.70 to $5.85 per 100 lb. Domestic makes are not moving freely and in general a quiet week was reported. Quotations of domestic sellers are $6.25@$6.50 per 100 lb.

Potassium Bromide—Imported potassium bromide was raised 1c. per lb., closing prices ranging from 16½@17c. per lb., immediate and nearby delivery. Importers refused to name a flat price on forward material because of the shipping situation abroad and the market on futures was entirely nominal.

Coal-Tar Products

Phenol on Spot Higher—Consumers of Cresylic to Ask for Lower Tariff Rate—Naphthalene in Demand and Firm

THE inquiry for phenol was active and the market in "outside" channels developed further strength, resale parcels moving at higher prices. At least three new sources of production will compete for business this fall, but until the output of domestic producers can be increased the trade expects prices to hold relatively firm. The situation in cresylic acid attracted widespread attention. The supply available from domestic sources is inadequate and large consumers have been hard hit by the high tariff on foreign material. At a meeting of importers and consumers held early in the week, a committee was appointed to present the matter before the Tariff Commission in the hope that something might be done to change conditions. The committee will apply for a 50 per cent reduction in the duty. Importers were not disposed to quote on shipment goods except on a flat c.i.f. basis, the buyer to look after all tariff charges, etc. In naphthalene the market presented a rather firm front covering spot and nearby goods, but on futures the outlook appeared to favor buyers. Foreign cables on crude were nominally unchanged. Easier exchange was a factor at different times. Importations of aniline colors from Germany have been larger of late, but apprehension is felt in regard to the supply situation from now on, as the developments in the Ruhr have been decidedly unfavorable. Domestic producers, of course, welcome this opportunity to push their wares in domestic as well as foreign markets. The intermediates reflected the steady situation in the important bases, but prices named covered a wide range, depending upon the make, quantity and delivery.

Coal-Tar Crudes, Etc.

Benzene—Leading factors reported the market unchanged, the demand being sufficient to hold prices on the old basis. Production has been larger and some traders feel that the demand will have to improve considerably in order to bring out any showing of strength in the market. The contract price held at 27c. per gal.

Cresylic Acid—Interest in the tariff situation attracted the attention of producers. Consumers of cresylic acid are dissatisfied with the rate of duty now in force and an attempt will be made to have the rate cut in two. Trading in foreign material was limited in volume because of the "prohibitive" tariff, although it was common gossip that certain consumers were much in need of supplies. English material for shipment held around 85c. per gal., in bond, c.i.f. basis. On spot the market for cresylic ranged from \$1.30@\$1.50 per gal., as to quality, etc. Domestic producers were "sold up" and from all indications will not be in a position to offer supplies in the open market for some time to come.

Naphthalene—Several shipments of crude arrived from abroad last week. The foreign markets for crude ruled firm at the recent advance to 3¼@3½c. per lb., c.i.f. New York basis. Demand for flake and balls was good, the former holding at 9½c. per lb., while the latter was more or less nominal at 10½@11c. per lb.

Phenol—Resale offerings were limited to small lots only and prices developed further strength, actual business passing at 53@55c. per lb., immediate delivery. At the close 55c. apparently was the general asking price. Leading domestic producers were not in a position to quote, the output being sold up around 26@28c. per lb. It was reported in trade circles that three manufacturers were pushing plans to re-enter the field, but new production cannot reach the open market for some months to come. Surplus war material is being consumed at a rapid rate and the supply situation is regarded as a serious one.

Solvent Naphtha—A report to the effect that a large petroleum refiner was in a position to offer solvent naphtha in a liberal way could not be confirmed. Producers regard the situation as firm, having nothing to offer because of the sold-up condition of the market. The nominal quotation on the water-white was unchanged at 37@40c. per gal.

Toluene—Trading was inactive, but with nothing pressing on the market prices were reported at 30@35c. per gal.

Beta-Naphthol—The market was a little irregular in outside channels, scattered lots offering at a shade under 23c. per lb. for the technical variety. Producers, as a rule, hold out for 23½c. per lb. Demand was quiet.

Alpha-Naphthylamine—A firmer undertone featured the market and there was talk of higher prices in some directions. At the close prices ranged from 36@38c. per lb., according to quantity and seller.

Benzoic Acid—There were offerings of the U.S.P. grade for immediate delivery at 72@74c. per lb. Demand was fairly active and prices presented a firm appearance.

Naphthionic Acid—The crude closed at 55@60c. per lb. Prices were unsettled on freer offerings.

Ortho-Toluidine—Closing prices were firmer and the range was revised to 14@15c. per lb. for spot material.

Para-Amidophenol — The base was available at \$1.20@\$1.30 per lb., depending on the brand and quantity. A firmer undertone was apparent in nearly all quarters.

Resorcinal—There were offerings of the technical at \$1.40@\$1.50 per lb., in kegs, with the pure nominal at \$2@\$2.10 per lb. Trading was slow, but prices at the close were steady.

Quiet Week for Alcohol

First hands reported a quiet week, yet prices did not change. Denatured alcohol was a shade easier in some directions because of the seasonable slump in the demand. The No. 1, 188 proof, held at 39c. per gal., with the No. 5 grade at 38c. Ethyl spirits, 190 proof, closed nominally at \$4.75@\$4.85 per gal. Methanol, 95 per cent, settled at \$1.19@\$1.21 per gal. Production of methanol in February was placed at 773,179 gal., against 933,171 gal. in January and 457,656 gal. in February a year ago.

Chemists Investigate Ruling on Glycerine Patent

A committee of the Manufacturing Chemists' Association is investigating the recent action of the Commissioner of Patents in upholding a German allegation of infringement on a patent covering a process for glycerine reduction.

A government employee named Eoff obtained a patent on this process in 1917, which he dedicated to the public. After the enactment of the Nolan act, a German interest filed a contest proceeding, alleging infringement. In that protest it was stated that the reduction process had been perfected in Germany prior to 1917 and had not been patented in the United States solely because of war-time restrictions. The contention of the Germans was upheld by the Commissioner of Patents.

The Manufacturing Chemists fear that were this ruling allowed to stand it would constitute a dangerous precedent in that it would give aliens an opportunity to claim patent rights to which they are not entitled.

Commodity Markets in France

In the naval stores industry the first gathering of the new crop is now taking place under good conditions. Some turpentine from the new crop will be on the market toward the end of April, and the dry products about the middle of May. The French Government denies prohibition of exports.

Stocks of essential oils are too low for the demand.

The production of acids in general is increasing and the market is strong. Of these, sulphuric acid is the most active; the superphosphate and sulphate of ammonia industries, however, are flourishing. Nitric acid is calmer because of difficulties in the metallurgical industry. The secondary chemicals are active largely on account of the Ruhr developments.

The paint and dyestuffs markets are active; buyers, however, are hesitating to cover themselves for long periods because of high prices.

The production of alcohol in France during the period Sept. 1 to March 1 totaled 1,323,000 hl., compared with 1,027,000 for the same period the previous year. The prohibition of the export and import of molasses was re-established by decree on March 14.

Vegetable Oils and Fats

Linseed Oil Again Higher—Crude Cottonseed Steadies—Coconut at 8¾c. Coast—Palm Oils Unsettled

TRADING in vegetable oils and fats was not active, but with stocks available for immediate consumption rather light, the tendency of prices, in the main, favored sellers. Linseed was marked up 3c. per gal. Coconut sold off a little on the Pacific Coast on resale offerings, but this failed to unsettle the market in first-hand quarters. Cottonseed ruled firm despite the talk of a substantial increase in the cotton acreage. Tallow ruled firm on the 9c. basis for the extra.

Linseed Oil—Closing prices were 3c. per gal. higher than a week ago, car lots, April-May shipment, settling at $1.17 per gal. Several crushers refused to quote on full carlot business, nearby delivery, and restricted operations to less than carlots at $1.20 per gal. June oil, carlots, settled at $1.14 per gal., with July forward at $1.10@$1.11 per gal., according to the seller. A parcel of six cars of raw oil sold for July-August-September delivery, two cars each month, at $1.09 per gal., this sale going through just before the advance was announced. Crushers in the East are operating at full capacity, but with the output of the Western mills restricted the supply situation remains tight. A crusher in the West went on record with a statement to the effect that no improvement in the domestic situation could set in before June, at which time the Western plants should have enough seed on hand to resume operations on a normal scale. Foreign oil sold at $1.09 May shipment. April shipment was offered at $1.11½ per gal., duty paid, landed weight, c.i.f. New York. There was a good inquiry for nearby foreign oil.

Cottonseed Oil—Late in the week several cars of crude sold at 10⅝c. per lb., f.o.b. Memphis, indicating that prices stiffened a little. Actual consuming demand for refined oil and compound lard held up well, considering the increased competition with lard, and the trade is speculating on a favorable March report, private estimates on the disappearance ranging from 190,000 to 230,000 bbl. The available supply for the remainder of the season is short of requirements, calculating on a normal volume of business, and most refiners favor the long side of the market. Bleachable oil sold at 11½c., buyers' tanks, f.o.b. Boston. Lard compound held at 13½c. per lb., carlots, f.o.b. New York. Oleo stearine closed steady at 11c. per lb. asked. Hogs in Chicago brought from $7@$8.50 per cwt.

Corn Oil—There were sales of crude in the Middle West at 10⅝c. per lb., tank cars, f.o.b. mills.

Coconut Oil—The sale of two tanks of Ceylon type oil on the Pacific Coast at 8¾c. per lb., a decline of ¼c., failed to shake the confidence of local traders. This sale involved resale material and leading handlers continued to quote the market at 9c., sellers' tanks, coast, and 9½@9¾c., sellers' tanks, New York. A mill on the coast has been forced to shut down temporarily because of the shortage in copra. Copra, sundried, held nominally at 5⅝c. per lb., c.i.f. coast.

China Wood Oil—Meager spot holdings were maintained at 35@37c. per lb. A parcel of May arrival oil was available at 30c., while May-June shipment from the Orient sold at 26½c. per lb. Shorts are being badly squeezed.

Palm Oil—A cargo arrived from Africa, but this oil went directly into consuming channels. Lagos oil for shipment was irregular at 8½@8⅝c. per lb. Niger oil for shipment was available at 8½c., c.i.f. New York, a decline of ⅛c.

Sesame Oil—Prompt shipment from Rotterdam closed at 12½c. on the refined grade, duty paid, New York. On May business the nominal quotation was 12¼c., with intimation that 12c. might go through on May-June.

Peanut Oil—Crude peanut in the South was scarce and 14c. was the general asking price, tank cars, f.o.b. mills.

Soya Bean Oil—Sales of April shipment from the coast went through at 10⅜c., duty paid, sellers' tanks. At the close 10½c. was asked for April and 10⅝c for May, Pacific Coast ports. In New York the market for nearby oil held at 10¾c., duty paid, tank car basis. On bulk oil for shipment from the Orient 8c. was asked, in bond, c.i.f. New York.

Menhaden Oil—The sale of a round lot of crude menhaden oil was reported last week at 55c. per gal., tank car basis, f.o.b. northern plant, an advance of 5c. from the trading level of the week previous. The oil sold on the "if made" basis. It is estimated that more than 22 000 barrels have been disposed of to date.

Tallow and Greases—Bids for city extra tallow at 9c. ex-plant were turned down. The market settled at 9¼c. asked. At the London weekly auction, held on April 11, 1,018 casks of tallow were offered and 721 sold at prices that were 6d. to 1s. higher. Greases in the New York trade were firm on scanty offerings. Good quality yellow settled at 8½@8⅝c. per lb.

Miscellaneous Materials

Glycerine—Chemically pure glycerine was not subjected to any further price changes, leading refiners holding the market on the 18c. per lb. basis, drums included. The demand was inactive, but with no weakness in crude the undertone steadied. Dynamite was quiet, yet producers' ideas held at 16½@17c. per lb., carlots, f.o.b. shipping point. No sales were reported. In crude the feature was the apparent willingness on the part of refiners to consider foreign offerings. Soap-lye, basis 80 per cent, sold in the West at 10¼c., carlots. At the close 10½c. was considered inside. Saponification held around 12c., loose, carlots, f.o.b. point of production.

Casein—Several round lots of casein arrived at New York from foreign ports. The offerings were scanty, as production in this country has not yet assumed normal proportions. Nominal spot prices for the technical grades ranged from 23@26c. per lb. Shipment prices were wholly nominal, as buyers could not be interested at this time.

Lithopone—Producers reported a steady call for lithopone, and with no change in basic products the market ruled firm in all quarters. Domestic held at 7c. per lb. in bags, carlots, nearby positions.

Naval Stores—The new crop season is now at hand and consumers refuse to anticipate in their wants. As a result prices for turpentine softened a little and nominal quotations at the close ranged from $1.58@$1.59 per gal. Export demand, according to advices from Savannah, has suffered by the recent sharp advance in prices. It is yet too early to forecast production. Rosins were nominally unchanged. The "B" grade held on the basis of $6.20 per barrel.

Pyrites—Prices were steady in sympathy with foreign markets. Imported lump and fine held at 12c. per unit, ex-steamer, Atlantic port.

Shellac—With no important change abroad and inquiry here much better, the market for shellac was fairly steady at the close. T. N. sold at 76c. on spot, and 75c. ex-dock. Bleached, bone dry, was offered at 89c. per lb., immediate delivery, while on futures nominal quotations of 85@86c. were named. Superfine orange on spot was traded in at 80c. per lb. T. N. for shipment from Calcutta settled at 70c. c.i.f. New York.

White Lead—The official contract price of the metal did not change, holding at 8.25c. per lb., New York. Corroders report an active market for white lead and with no accumulation in stocks regard the situation as firm. Painting operations are of huge proportions and the output of corroders will be taxed to the limit. Standard dry white lead, basic carbonate, held at 9⅞c. per lb., in casks, carload lots or more. Dry red lead was quotably unchanged at 11.40c. per pound, round-lot basis.

Zinc Oxide—With no important change in the metal prices for oxide were repeated on the old basis. Demand was active and the undertone was steady in all directions. American process, lead free, was offered at 8c. per lb., carload lot basis. The leaded grades held at 7@7½c. per lb. Domestic producers quote 9⅞c. on the French process, red seal.

Imports at the Port of New York

April 6 to April 12

ACIDS—33 dr. cresylic, Glasgow, Order, 147 dem. formic, Hamburg, Innis, Speiden & Co., 40 cs. stearic, Rotterdam, M. W. Parsons; 376 bales stearic, Rotterdam, Smith & Nichols, Inc.; 30 csk oxalic, Rotterdam, Freeff & Co., 5 cs. butyric, Hamburg, Order; 141 pkg. formic, Hamburg, Int'l Accept. Bank.

ALUM, CHROME—20 bbl., Hamburg, Hummel & Robinson.

AMMONIA—14 dr., Callao, Duncan, Fox & Co.

AMMONIUM BIFLORID—14 bbl., Hamburg, Innis, Speiden & Co.

AMMONIUM NITRATE—10 cs., Bremen, Pfaltz & Bauer; 1,157 csk., Hamburg, Kuttroff, Pickhardt & Co.

AMMONIUM PERSULPHATE—20 kegs, London, J. Turner & Co.

ANTIMONY OXIDE—190 bg., London, Wah Chang Trading Corp.

ANTIMONY SULPHIDE—7 csk., London, F. B. Vandegrift & Co.

ARSENIC—188 csk., Hamburg, A. J. Marcus & Co.; 195 cs., Kobe, McKenzie & Foster, 250 cs., Kobe, H. Sundheimer, Inc., 271 cs., Kobe, Takata & Co.; 127 cs., Kobe, S. W. Bridge & Co., 120 cs., Kobe, Busk & Daniels; 600 cs., Yokohama, Chipman Chem Eng. Co.; 46 csk., London, Order; 100 csk., Hamburg, R. W. Greeff & Co.; 200 csk., Hamburg, Order.

BARIUM CARBONATE—252 bg., Hamburg, Hardy & Ruperti, 149 csk., Hamburg, Order.

BARIUM CHLORIDE—56 bbl., Hamburg, Innis, Speiden & Co; 72 csk., Hamburg, Meteor Prod. Co.

BARIUM NITRATE—40 csk., Hamburg, Roessler & Hasslacher Chem. Co.

BARYTES—550 bg., Hamburg, L. A. Salomon & Bros., 135 csk., Hamburg, A. Klipstein & Co.

BORATE LIME—6,744 pkg., Mejillones, Pacific Coast Borax Co.

CASEIN—1,668 bg., Buenos Aires, Bank of America; 1,161 bg., Buenos Aires, Order, 350 bg., London, C. Tennant & Sons.

CALCIUM CHLORIDE—146 dr., Hamburg, Order; 95 dr., Hamburg, Bauer & Co.

CAMPHOR—50 cs., Kobe, Iwai & Co.; 225 cs., Kobe, Mitsui & Co.; 50 cs., Kobe, Vick Chem. Co.; 50 cs., Kobe, E. J. Barry, Inc.; 100 cs., Kobe, Nivoa Nitration Works

CHEMICALS—18 cs., Havre, Order; 47 csk., Hamburg, Chaplain & Bibbo; 30 dr., Hamburg, Order; 17 cs., Bremen, Pfaltz & Bauer; 20 bg., Danzig, Hardy & Ruperti, Inc.; 312 pkg., Hamburg, Roessler & Hasslacher Chem. Co.; 74 dr., London, Mallinkrodt Chem. Wks.; 539 pkg., Hamburg, Order; 114 bbl., Hamburg, Truempy, Faesy & Besthoff, Inc.

CHALK—500 tons, London, Taintor Trading Co.; 1,000 bg., Antwerp, Irving Bank.

COAL-TAR DISTILLATE—30 dr., Glasgow, Order.

COLORS—21 pkg., Havre, Irving Bank, 10 pkg., Marseilles, Order; 90 pkg. earth, Leghorn, H. J. Waddell & Co.; 12 bbl. aniline, Rotterdam, Wetterwald & Pfister; 4 bbl do., Rotterdam, Order; 10 csk dry, Southampton, Order; 10 bbl. dry, Hamburg, Kuttroff, Pickhardt & Co.; 18 pkg. aniline, Hamburg, Kuttroff, Pickhardt & Co.; 32 csk. aniline, Hamburg, H. A. Metz & Co.

COPPER SULPHATE—98 csk., Marseilles, P. H. Brothers; 329 csk., Hamburg, Order; 200 bbl., Hamburg, Order; 102 csk., Hamburg, Order; 200 csk., Liverpool, Nitrate Agencies Co.; 200 csk., Liverpool, Order.

CUTCH—300 cs., Singapore, Order.

DEXTRINE—100 bg., Hamburg, L. A. Salomon & Bros.

DIVI-DIVI—1,685 bg., Maracaibo, Suzarte & Whitney.

DYES—21 cs., Havre, B. Weiner.

EPSOM SALT—5,900 bg., Hamburg, Superfos Co.; 500 bg., Hamburg, Brown Bros. & Co.; 7,000 bg., Hamburg, Irving Bank.

GLAUBERS SALT—200 bg., Hamburg, Order; 253 csk., Hamburg, Globe Shipping Co.; 250 bbl., Hamburg, E. M. Sergeant & Co.; 158 bbl., Hamburg, Order.

GLYCERINE—100 dr. Marseilles, Order; 140 bbl., Marseilles, Order.

GRAPHITE—150 bg., 254 csk., Marseilles, Order.

GAMBIER—150 bg., Singapore, Bank Line Trans. & Trdg. Co.

GUM 20 pkg. tragacanth, Thurston & Braidich, 40 cs. olibanum, Glasgow, Brown Bros. & Co., 32 bg. myrrh., Glasgow, Am. Ex. Nat'l Bank, 210 bg. copal, Singapore, Guaranty Trust Co., 271 bg. copal, Singapore, L. C. Gillespie & Sons, 199 bg copal, Singapore, Brown Bros. & Co.; 100 cs. damar, Singapore, Chase Nat'l Bank; 210 bg. copal, Singapore, Order, 100 bg. arabic, London, Order, 200 bg. copal, Antwerp, A Hurst & Son; 600 bg. copal, Antwerp, Brown Bros.

HEXAMETHYLENE—80 cs., Hamburg Industrial Trust Co.; 10 cs., Hamburg, A. Klipstein & Co.

IRON OXIDE—228 bbl, Malaga, Hummel & Robinson, 76 bbl, Malaga, Reichard, Coulston, Inc, 70 bbl., Malaga, J. L. Smith & Co., 319 bbl., Malaga, C. K. Williams.

MAGNESIUM—1,119 bg., carbonate, Glasgow, Order; 170 bbl., chloride, Hamburg, A. Blanc, 70 csk., chloride, Hamburg, Order; 551 csk, calcined, Rotterdam, H. J. Baker & Bro.; 165 dr., Hamburg, Innis, Speiden & Co.; 502 bbl, Hamburg, Hansa Co., 89 bbl, Hamburg, A. Blank; 151 pkg., Hamburg, Order; e

MYROBALANS—9,600 pkg., Calcutta, Order.

MENTHOL—10 cs., Kobe, Equitable Trust Co., 50 cs., Kobe, Order

NAPHTHALENE—500 bg, Hamburg, W. H. Muller & Co, 495 bg., Hamburg, Irving Nat'l Bank; 750 bg., London, Irving Nat'l Bank, 566 bg., Hamburg, Irving Nat'l Bank.

OILS—Codliver—400 bbl., Bergen, Scott & Bowne, 50 bbl., Bergen, C Hulsking; 50 bbl., Bergen, A. Stallman & Co.; 155 bbl., Bergen, Order; **China wood**—100 bbl., Hankow, Mitsui & Co.; 15,000 piculs, Hankow, L. C. Gillespie & Sons; **Fusel**—30 csk., Marseilles, Order, 70 pkg., Hamburg, Order; 23 dr., Darien, I. Naiditch; 18 csk., Hamburg, Guaranty Trust Co, 10 dr., Malaga, Du Pont de Nemours & Co.; **Linseed**—100 bbl, Rotterdam, Nat'l City Bank; 283 bbl., Rotterdam Order; 88 bbl., London, International Comp. Co.; **Palm**—320 csk., Marseilles, Order, 202 bbl., Hamburg, African & Eastern Trading Corp.; 200 csk., Koke, Niger Co.; 641 csk, Bevinter, Irving Bank; 430 csk., Opobo, Niger Co; 354 csk, Abonema, African & Eastern Trading Corp; 80 csk., Abonema, W. A. Leaman; 800 csk., Abonema, Niger Co.; 570 csk., Port Harcourt, Niger Co.; 72 csk., Lagos, G. B Ollivant & Co., 415 csk, Cotonio, J Holt & Co, 47 csk., Cotonio, Order; 175 csk., Grandpope, Thornett & Fehr; 392 csk., Liverpool, African & Eastern Trading Corp., 155 csk., Liverpool, Order; 380 csk., London, African & Eastern Trading Corp.; **Peanut**—400 csk., Rotterdam, H. S. Head; **Perilla**—250 bbl., Koke, Balfour, Williamson & Co.; 150 bbl., Kobe, Bank of N Y; 325 bbl., Dairen, Cook & Swan Co.; 106 bbl., Dairen, East Asiatic Co., **Sardine**—1,900 cs, Kobe, Cook & Swan Co.

SESAME—279 bbl, Rotterdam, Nat'l City Bank; 292 bbl., Rotterdam, Order.

SULPHUR (olive foots)—500 bbl., Naples, Banca Comm Ital.; 300 bbl., Palermo, Order, 100 bbl., Seville, Chem Nat'l Bank; 600 bbl., Seville, Bank of the Manhattan Co, 100 bbl., Seville, Order; 250 bbl., Malaga, Order; 450 bbl., Naples, Banca Comm. Ital., 300 bbl, Catania, Order.

POTASSIUM SALTS—131 bbl., nitrate, Hamburg, Innis, Speiden & Co.; 10 bbl. prussiate, Hamburg Bank of America; 129 pkg., salts, Hamburg, A. Klipstein & Co.; 227 bbl., nitrate, Hamburg, Order; 10 csk., bisulphite, Hamburg, Order; 70 bbl, carbonate, Hamburg, Order; 596 bbl, chlorate Hamburg, Order, 39 cs., chloride, Bremen, Pfaltz & Bauer; 1,500 csk., chlorate, Hamburg, Mech. & Metals Nat'l Bank; 54 csk., salts, Hamburg, Kuttroff Pickhardt & Co., 55 dr, permanganate, Rotterdam, Order; 644 csk., nitrate, Hamburg, Kuttroff, Pickhardt & Co.; 103 csk., carbonate, Hamburg, Goldschmidt Corp; 30 bbl., carbonate, Hamburg J. Munroe & Co., 702 dr., caustic, Hamburg, A Klipstein & Co; 17 csk., potash salts, Hamburgh, Roessler & Hasslacher Chem. Co; 100 csk., alum, Hamburg, A Klipstein & Co.; 100 dr. permanganate Hamburg, E. M. Sergeant & Co; 22 csk, carbonate Hamburg, Order; 2,000 bbl., chlorate, Hango, Amer Kreuger & Toll Corp.; 33 csk., Hamburg, Am. Ex. Nat'l Bank; 30 dr., permanganate, Antwerp, Ellis Jackson & Co; 140 csk., carbonate Hamburg, Peters, White & Co.; 60 dr., caustic, Hamburg, Peters, White & Co.; 1,200 bbl., chlorate, Hamburg, Mech. & Metals Nat'l Bank, 100 dr, permanganate, Hamburg, Order; 20 kegs prussiate, Liverpool, H. J. Baker & Bro., 22 csk, carbonate, London, Order.

QUEBRACHO—988 bg., Buenos Aires, Columbia Trust Co., 16,740 bg., Buenos Aires, Tannin Corp.; 2002 bg., Buenos Aires, Equitable Trust Co

SEEDS—Linseed—19,316 bg., Buenos Aires, Bank of the Manhattan Co.; 7,450 bg., Buenos Aires, Merchants Nat'l Bank, Boston; 5,940 tons, Rosario, Spencer Kellogg & Sons; 67,806 bg., Santa Fe, Order; 12,255 bg., San Nicolas, Order; 53,595 bg., Santa Fe, L. Dreyfus & Co.; 44,121 bg., Rosario, Order, 48,074 bg., Ibicuy, Order; 5,378 tons, Rosario, Order. **Sesame**—600 bg., Shanghai, Wah Chang Trading Co., 1,200 bg., Shanghai, East Asiatic Co.

SHELLAC 1,800 pkg., Southhampton, Order, 2,291 bg, Southampton, Order, 22 bg garnet, Hamburg, Order; 150 bg., London, Order, 45 cs. garnet, Hamburg, A. Murphy & Co., 45 bg., Hamburg, Order; 200 bg., Calcutta, Chase Nat'l Bank; 47 bg., Calcutta, Nat'l City Bank; 100 chests seed, Calcutta, Bank of America; 100 bg. keerie lac, Calcutta, First Nat'l Bank of Boston, 230 bg., Calcutta, Bank of Br. West Africa, 378 bg., Calcutta, First Federal Foreign Banking Corp., 1,238 pkg., Calcutta, Order.

SAL AMMONIAC—426 bbl., Hamburg, Order; 98 csk., Hamburg, Order; 46 bbl., Hamburg, J Munroe & Co.

SODIUM SALTS 58 cs. cyanide, Marseilles, Nat'l City Bank, 4,105 bg. synthetic nitrate 375 csk. nitrite, Brevik, Order; 400 csk. hyposulphite, Marseilles, Order; 61 csk. sulphide, E. Suter & Co.; 72 bbl. fluoride, Hamburg, Innis Speeden & Co.; 97 cs. bromide, Hamburg, Farmers Loan & Trust Co.; 63 dr. perborate, Hamburg, Chem. Nat'l Bank, 39 csk prussiate, Hamburg, Meteor Products Co.; 291 dr. sulphide, Hamburg, Order; 10,808 bg. nitrate, Iquique, Wessel, Duval & Co., 11,183 bg. nitrate, Iquique, Du Pont de Nemours & Co.; 38,220 bg. nitrate, Antofagasta, Wessel, Duval & Co.; 18,870 bg., Antofagasta, for Norfolk; 30 csk. perborate, Hamburg, Blackburn Trading Co.; 500 sk. nitrate, Hamburg, Kuttroff, Pickhardt & Co.; 150 csk. perborate, Hamburg, Order, 19 cs carbonate, T. Nevin; 53,800 bg nitrate, Tocopilla, W. R. Grace & Co., 49,926 bg., Iquique, W. R. Grace & Co., 17 csk. Rotterdam, A. Klipstein & Co. 9,161 bg. nitrate, Iquique, Baring Bros. & Co.; 26 csk perborate, Hamburg, Globe Shipping Co, 27 csk fluoride, Hamburg, Order; 396 dr sulphide, Hamburg, Order; 54 bbl. acetate, Antwerp, Roessler & Haslacker Chem Co; 94 bbl. phosphate, Antwerp, A Klipstein & Co.; 86 dr. sulphide, E Suter & Co.; 200 bg. sulphide, Hamburg, Equitable Trust Co; 200 bbl. hyposulphide, Hamburg, Order, 10 csk. prussiate, Liverpool H. J. Baker & Bros.

STRONTIUM NITRATE—38 csk., Hamburg, Meteor Products Co.; 100 bbl., Hamburg, Hummel & Robinson.

TANNIN—17 csk., Havre, Geigy Co.

TARTAR, CRUDE—100 sk., Marseilles, 200 sk., Marseilles, C. Pfizer & Co.; 100 pkg., Marseilles, Brown Bros. & Co.; 365 bg., Valencia, C. Pfizer & Co.; 277 bg., Alicante, C. Pfizer & Co.; 484 bg., Alicante, Order; 293 bg., Rotterdam, C. Pfizer & Co; 34 bg., Valparaiso, Order.

TALC—200 bg., Marseilles, Order.

TALLOW—280 csk., Buenos Aires, Bank of the Manhattan Co., 296 csk., Buenos Aires, Armour & Co.

VERDIGRIS—20 cs., Marseilles, C. Hensking; 20 csk., Marseilles, A. Klipstein.

WAXES—100 bg. carnauba, Recife, Elbert & Co.; 121 bg. carnauba, Ceara, Strohmeyer & Arpe Co.; 50 bg., Ceara, Lazard Freres; 2 bg., Ceara, Order; 200 cs. vegetable, Kobe, H. R. Lathrop & Co.; 32 bg. bees, London, Order; 50 bg. bees, Valparaiso, Strohmeyer & Arpe Co.; 40 bg. bees, Valparaiso, Order; 294 bg., Antwerp, Elbert & Co.

WOOL GREASE—90 bbl., Antwerp, Elbert & Co.

ZINC CHLORATE—50 csk., Hamburg, A. Klipstein & Co.

ZINC CHLORIDE—69 csk., Hamburg, Order; 33 csk., Hamburg, Hardy & Ruperti, Inc.

ZINC OXIDE—200 bbl., Marseilles, Bankers Trust Co.; 500 bbl., Marseilles, Nat'l City Bank.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available. In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb	$0 38 -	
Acetone, drums	lb	22	23
Acid, acetic, 28%, bbl	100 lb	3 17½	3 92½
Acetic, 56%, bbl	100 lb	6 35	6 37
Glacial, 99½%, bbl	100 lb	12 05 -	12 80
Boric, bbl	lb	11 -	11½
Citric, kegs	lb	49 -	50
Formic, 85%	lb	.14½ -	17
Gallic, tech	lb	.45 -	50
Hydrofluoric, 52%, carboys	lb	12 -	12
Lactic, 44%, tech, light, bbl	lb	11½ -	12
22% tech, light, bbl	lb	05½	06
Muriatic, 18° tanks	100 lb	90 -	1 00
Muriatic, 20°, tanks	100 lb	1 00	1 10
Nitric, 36°, carboys	lb	04½	05
Nitric, 42°, carboys	lb	06 -	06½
Oleum, 20%, tanks	ton	18 50	19 00
Oxalic, crystals, bbl	lb	13½	13½
Phosphoric, 50%, carboys	lb	07½	08½
Pyrogallic, resublimed	lb	1 50 -	1 60
Sulphuric, 60°, tanks	ton	9 00 -	10 00
Sulphuric, 60°, drums	ton	12 00 -	14 00
Sulphuric, 66°, tanks	ton	15 00	15 50
Sulphuric, 66° drums	ton	19 00	20 00
Tannic, U.S.P., bbl	lb	.65	70
Tannic, tech, bbl	lb	.45	50
Tartaric, imp crys, bbl	lb	.34	
Tartaric, imp, powd, bbl	lb.	.34 -	
Tartaric, domestic, bbl	lb	.35 -	
Tungstic, per lb	lb	1 10 -	1 20
Alcohol, butyl, drums, f.o.b works	lb	.27	.29
Alcohol ethyl (Cologne spirit), bbl	gal.	4 75 -	4 95
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 188 proof No. 1, bbl	gal	39	40
Alum, ammonia, lump, bbl	lb	03½ -	03¾
Potash, lump, bbl	lb	.03 -	03½
Chrome, lump, potash, bbl	lb.	05½ -	05¾
Aluminum sulphate, com., bags	100 lb.	1.50 -	1 65
Iron free bags	lb	.02½ -	02¾
Aqua ammonia, 26°, drums	lb.	.06½ -	07½
Ammonia, anhydrous, cyl	lb.	.30 -	30½
Ammonium carbonate, powd casks, imported	lb.	.09½ -	.10
Ammonium carbonate, powd domestic, bbl	lb.	.13 -	.14
Ammonium nitrate, tech, casks	lb	10 -	11
Amyl acetate tech, drums	gal.	3 50 -	3 75
Arsenic, white, powd, bbl	lb	.15½ -	16
Arsenic, red, powd, kegs	lb	.14½	15
Barium carbonate, bbl	ton	78 00 -	80 00
Barium chloride, bbl	ton	90 00 -	95 00
Barium dioxide, drums	lb	18 -	18½
Barium nitrate, casks		08 -	08½
Barium sulphate, bbl	lb	.04 -	04½
Blanc fixe, dry, bbl	lb	.04½ -	04¾
Blanc fixe, pulp, bbl	ton	45 00 -	55 00
Bleaching powder, f.o.b. wks., drums	100 lb.	2 15 -	
Spot N.Y. drums	100 lb	2 60 -	2 70
Borax, bbl.	lb	.05½ -	05¾
Bromine, cases	lb	.28 -	30
Calcium acetate, bags	100 lb	3 50 -	3 60
Calcium carbide, drums	lb	.04½ -	04¾
Calcium chloride, fused, drums	ton	22 00 -	23 00
Gran. drums	lb	.01½ -	.01¾
Calcium phosphate, mono, bbl.	lb.	.06½ -	.07
Camphor, cases	lb.	.89 -	.91
Carbon bisulphide, drums	lb.	.07 -	07½
Carbon tetrachloride, drums	lb.	10 -	
Chalk, precip—domestic, light, bbl.	lb.	.04½ -	.04¾
Domestic, heavy, bbl.	lb.	.03½ -	.03¾
Imported, light, bbl	lb.	.04½ -	.05
Chlorine, liquid, cylinders	lb.	.06 -	06½
Chloroform, tech., drums	lb	.35 -	.38
Cobalt oxide, bbl	lb.	2.10 -	2.25
Copperas, bulk, f.o.b. wks.	ton	16.50 -	20.00
Copper carbonate, bbl	lb.	.19 -	20
Copper cyanide, drums	lb.	.47 -	.50
Copper sulphate, crys., bbl	100 lb.	6 25 -	6 50
Cream of tartar, bbl	lb.	25½ -	26½
Epsom salt, dom., tech., bbl.	100 lb	2 00 -	2.25
Epsom salt, imp., tech., bags	100 lb.	1 10 -	1.25
Epsom salt, U.S.P., dom., bbl.	100 lb	2 50 -	2.75
Ether, U.S.P., drums	lb.	.13 -	.15
Ethyl acetate, com., 85%, drums	gal.	.80 -	.85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 -	1.00
Formaldehyde, 40%, bbl	lb	.14½ -	.16
Fullers earth, f.o.b. mines	net ton	16 00 -	17.00
Fullers earth—imp., powd.,	net ton	30.00 -	32.00
Fusel oil, ref., drums	gal.	3.55 -	4 05
Fusel oil, crude, drums	gal	2 30 -	2.40
Glaubers salt, wks., bags	100 lb.	1.20 -	1.40
Glaubers salt, imp., bags	100 lb	$1 00 -	$1.25
Glycerine, c.p., drums extra	lb	18 -	.18½
Glycerine, dynamite, drums	lb	16½ -	
Iodine, resublimed	lb.	4 55 -	4 65
Iron oxide, red, casks	lb.	.12 -	.18
Lead:			
White, basic carbonate, dry, casks	lb.	.09¾ -	.10
White, basic sulphate, casks	lb	09¾ -	
White, in oil, kegs	lb.	.12¾ -	.14
Red, dry, casks	lb.	.11¾ -	.12
Red, in oil, kegs	lb.	.13¼ -	.15
Lead acetate, white crys., bbl.	lb.	.13¼ -	.14
Brown, broken, casks	lb.	.12½ -	..
Lead arsenate, powd., bbl.	lb	.23 -	.24
Lime-Hydrated, bbl.	per ton	16 80 -	17 00
Lime, Lump, bbl	280 lb	3.63 -	3.65
Litharge, comm., casks	lb.	.10¾ -	.11
Lithophone, bags	lb.	.07 -	.07¼
in bbl	lb	07¼ -	.07½
Magnesium carb., tech., bags	lb	08 -	.08½
Methanol, 95%, bbl	gal.	1 21 -	1.23
Methanol, 97%, bbl.	gal.	1 23 -	1.25
Nickel salt, double, bbl.	lb.	.10½ -	.
Nickel salts, single, bbl.	lb.	.11½ -	....
Phosgene	..	.60 -	.75
Phosphorus, red, cases	lb.	.35 -	.40
Phosphorus, yellow, cases	lb.	.30 -	.35
Potassium bichromate, casks	lb.	10½ -	.10¾
Potassium bromide, gran., bbl	lb.	.16½ -	.23
Potassium carbonate, 80-85%, calcined, casks	lb.	.06½ -	.07
Potassium chlorate, powd.	lb.	.07½ -	.08
Potassium cyanide, drums	lb.	.45 -	.50
Potassium, first sorts, cask	lb.	09	.09½
Potassium hydroxide (caustic potash) drums	100 lb.	8.25 -	8.50
Potassium iodide, cases	lb	3.65 -	3.75
Potassium nitrate, bbl.	lb.	.06½ -	.07½
Potassium permanganate, drums	lb.	.25 -	.25½
Potassium prussiate, red, casks	lb.	.80 -	.85
Potassium prussiate, yellow, casks	lb.	.37½ -	.38
Salammoniac, white, gran., casks, imported	lb.	.07 -	.07½
Salammoniac, white, gran., bbl, domestic	lb.	.07½ -	.08
Gray, gran., casks	lb.	.08 -	.09
Salsoda, bbl.	100 lb.	1.20 -	1.40
Salt cake (bulk)	ton	26 00 -	28.00
Soda ash, light, 58% flat, bags, contract	100 lb.	1 60 -	1.67
Soda ash, light, basis, 48%, bags, contract, f.o.b. wks.	100 lb.	1.20 -	1.30
Soda ash, light, 58%, flat, bags, resale	100 lb.	1.75 -	1.80
Soda ash, dense, bags, contract, basis 48%	100 lb.	1.17½ -	1.20
Soda ash, dense, in bags, resale	100 lb.	1 85 -	1.90
Soda, caustic, 76%, solid, drums, f.a.s.	100 lb.	3.45 -	3.70
Soda, caustic, 76%, solid, drums, contract	100 lb.	3.35	3.40
Soda, caustic, basis 60%, wks., contract	100 lb.	2.50 -	2.60
Soda, caustic, ground and flake, contracts	100 lb.	3.80 -	3.90
Soda, caustic, ground and flake, resale	100 lb.	4.00 -	4.15
Sodium acetate, works, bags	lb.	06 -	.06½
Sodium bicarbonate, bbl	100 lb	2 00 -	2.50
Sodium bichromate, casks	lb.	.07¾ -	.08
Sodium bisulphate (niter cake)	ton	6.00 -	7.00
Sodium bisulphite, powd., U.S.P., bbl	lb.	.04½ -	.04¾
Sodium chlorate, kegs	lb.	.06½ -	.07
Sodium chloride	long ton	12.00 -	13.00
Sodium cyanide, cases	lb.	.20 -	.23
Sodium fluoride, bbl	lb	$0 09¼ -	$0 10
Sodium hyposulphite, bbl	lb.	.02½ -	.03
Sodium nitrite, casks	lb.	.08½ -	09
Sodium peroxide, powd., cases	lb.	.28 -	.30
Sodium phosphate, dibasic, bbl	lb.	.03¾ -	04
Sodium prussiate, yel drums	lb.	.18 -	.18½
Sodium silicate (40°, drums)	100 lb.	80 -	1 25
Sodium silicate (60°, drums)	100 lb.	2.00 -	2 25
Sodium sulphide, fused, 60-62% drums	lb.	.04½ -	04¾
Sodium sulphite, crys., bbl.	lb.	.03½ -	03¾
Strontium nitrate, powd., bbl.	lb.	.09½ -	10
Sulphur chloride, yel drums.	lb.	.04½ -	.05
Sulphur, crude	ton	18.00 -	20 00
At mine, bulk	ton	16 00 -	18 00
Sulphur, flour, bbl.	100 lb.	2.35 -	3.15
Sulphur, roll, bbl.	100 lb.	2 00 -	2 50
Sulphur dioxide, liquid, cyl.	lb.	.08 -	08½
Talc—imported, bags	ton	30.00 -	40 00
Talc—domestic powd., bags	ton	18.00 -	25 00
Tin bichloride, bbl.	lb.	.13¾ -	.14
Tin oxide, bbl.	lb.	.52 -	.54
Zinc carbonate, bags	lb.	.14 -	.14½
Zinc chloride, gran, bbl.	lb.	.06 -	.07
Zinc cyanide, drums	lb.	.37 -	.38
Zinc oxide, lead free, bbl.	lb.	.08 -	.08½
5% lead sulphate, bags	lb.	.07½ -	..
10 to 35 % lead sulphate, bags	lb	.07 -	..
French, red seal, bags	lb	09¾ -	
French, green seal, bags	lb.	10¾ -	
French, white seal, bbl	lb.	.12 -	.
Zinc sulphate, bbl.	100 lb.	2.75 -	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl	lb.	$0 70 -	$0.80
Alpha-naphthol, ref., bbl	lb.	85 -	.95
Alpha-naphthylamine, bbl.	lb.	36 -	38
Aniline oil, drums	lb.	16 -	.16½
Aniline salts, bbl.	lb.	24 -	.25
Anthracene, 80%, drums	lb.	.75 -	1 00
Anthracene, 80%, imp., drums, duty paid	lb.	70 -	.75
Anthraquinone, 25%, paste, drums	lb.	.70 -	.75
Benzaldehyde U.S.P., carboys	lb.	1.40 -	1.45
Benzene, pure, water-white, tanks and drums	gal.	.32 -	.35
Benzene, 90%, tanks & drums	gal.	.27 -	.30
Benzene, 90%, drums, resale	gal.	.30 -	.33
Benzidine base, bbl.	lb.	.85 -	.90
Benzidine sulphate, bbl.	lb.	.70 -	.75
Benzoic acid, U.S.P., kegs	lb.	.72 -	.75
Benzoate of soda, U.S.P., bbl.	lb.	.57 -	.65
Benzyl chloride, 95-97%, ref., drums	lb.	.25 -	.27
Benzyl chloride, tech., drums	lb.	.20 -	.23
Beta-naphthol, subl., bbl.	lb.	.55 -	.60
Beta-naphthol, tech., bbl	lb.	.23 -	.23½
Beta-naphthylamine, tech.	lb.	.80 -	.90
Carbazol, bbl.	lb.	.75 -	.90
Cresol, U.S.P., drums	lb.	.25 -	.29
Ortho-cresol, drums	lb.	.24 -	.26
Cresylic acid, 97%, resale, drums	gal.	1.40 -	1.50
95-97%, drums, resale	gal.	1.30 -	1.30
Dichlorbenzene, drums	lb.	.07 -	.09
Diethylaniline, drums	lb.	.50 -	.60
Dimethylaniline, drums	lb.	.42 -	.43
Dinitrobenzene, bbl.	lb.	.19 -	.20
Dinitroclorbenzene, bbl.	lb.	.22 -	.23
Dinitronaphthalene, bbl.	lb.	.30 -	.32
Dinitrophenol, bbl.	lb.	.35 -	.40
Dinitrotoluene, bbl.	lb.	.20 -	.22
Dip oil, 25%, drums	gal.	.25 -	.30
Diphenylamine, bbl.	lb.	.50 -	.52
H-acid, bbl.	lb.	.80 -	.85
Meta-phenylenediamine, bbl.	lb.	1.00 -	1.05
Michlers ketone, bbl.	lb.	3.00 -	3.50
Monochlorbenzene, drums	lb.	.08 -	.10
Monoethylaniline, drums	lb.	.95 -	1.10
Naphthalene, crushed, bbl.	lb.	.08 -	.09
Naphthalene, flake, bbl.	lb.	.09½ -	.10
Naphthalene, balls, bbl.	lb.	.10½ -	.11
Naphthionate of soda, bbl.	lb.	.58 -	.65
Naphthionic acid, crude, bbl.	lb.	.55 -	.60
Nitrobenzene, drums	lb.	.10 -	.12
Nitro-naphthalene, bbl.	lb.	.30 -	.35
Nitro-toluene, drums	lb.	.15 -	.17
N-W acid, bbl	lb.	1.25 -	1.30
Ortho-amidophenol, kegs.	lb.	2.30 -	2.35
Ortho-dichlorbenzene, drums	lb.	.17 -	.20
Ortho-nitrophenol, bbl.	lb.	.90 -	.92
Ortho-nitrotoluene, drums	lb.	.10 -	.12
Ortho-toluidine, bbl.	lb.	.14 -	.15
Para-amidophenol, base, kegs	lb.	1.20 -	1.30
Para-amidophenol, HCl, kegs	lb.	1.25 -	1.35
Para-dichlorbenzene, bbl.	lb.	.17 -	.20
Paranitraniline, bbl.	lb.	.74 -	.75
Para-nitrotoluene, bbl.	lb.	.60 -	.65
Para-phenylenediamine, bbl.	lb.	1.45 -	1.50
Para-toluidine, bbl.	lb.	.95 -	.98
Phthalic anhydride, bbl.	lb.	.35 -	.38
Phenol, U.S.P., drums	lb.	.50 -	.55
Picric acid, bbl.	lb.	.20 -	.22
Pyridine, dom., drums	gal.	nominal	
Pyridine, imp., drums	gal.	2.50 -	2.75

Resorcinol, tech., kegs	lb.	$1.40 - $1.50
Resorcinol, pure, kegs	lb.	2.00 - 2.10
R-salt, bbl	lb.	.55 - .60
Salicylic acid, tech., bbl	lb.	.47 - .48
Salicylic acid, U.S.P., bbl	lb.	.50 - .52
Solvent naphtha, water-white, drums	gal.	.37 - .40
Crude, drums	gal.	.22 - .24
Sulphanilic acid, crude, bbl	lb.	.18 - .20
Thiocarbanilide, kegs	lb.	.35 - .38
Toluidine, kegs	lb.	1.20 - 1.30
Toluidine, mixed, kegs	lb.	.30 - .35
Toluene, tank cars	gal.	.30 - .35
Toluene, drums	gal.	.35 - .40
Xylidines drums	lb.	.45 - .47
Xylene, pure, drums	gal.	.45 - .50
Xylene, com., drums	gal.	.35 - .37
Xylene, com., tanks	gal.	.30 - ....

Naval Stores

Rosin B-D, bbl	280 lb.	$6.20 - ..
Rosin E-I, bbl	280 lb.	6 30 - ....
Rosin K-N, bbl	280 lb.	6 35 - 6 75
Rosin W.G.-W W., bbl	280 lb.	7 00 - 8 00
Wood rosin, bbl	280 lb.	6 25 - ..
Turpentine, spirits of, bbl	gal.	1 58 - 1 60
Wood, steam dist., bbl	gal.	1 42 - 1 43
Wood, dest. dist., bbl	gal.	1 15 - 1 17
Pine tar pitch, bbl	200 lb.	.... - 6 00
Tar, kiln burned, bbl	500 lb.	.... - 12 00
Retort tar, bbl	500 lb.	.... - 11 00
Rosin oil, first run, bbl	gal.	.45 - ...
Rosin oil, second run, bbl	gal.	.48 - ...
Rosin oil, third run, bbl	gal.	.52 - ...
Pine oil, steam dist	gal.	.80 - ....
Pine oil, pure, dest dist	gal.	.75 - ....
Pine tar oil, ref.	gal.	.48 - ....
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal.	.31 - .31½
Pine tar oil, double ref., bbl	gal.	.... - .75
Pine tar, ref., thin, bbl	gal.	.... - .25
Pinewood creosote, ref., bbl	gal.	.... - .52

Animal Oils and Fats

Degras, bbl	lb	$0 03¾ - $0 04¼
Grease, yellow, bbl	lb.	.08½ - .08¾
Lard oil, Extra No. 1, bbl	gal.	.92 - .94
Neatsfoot oil, 20 deg. bbl	gal	1 28 - 1 32
No. 1, bbl	gal	.92 - .94
Oleo Stearine		.11 -
Red oil, distilled, d.p. bbl	lb.	.11½ -
Saponified, bbl	lb.	.11½ -
Tallow, extra, loose	lb	.09 -
Tallow oil, acidless, bbl	gal.	.96 - .98

Vegetable Oils

Castor oil, No. 3, bbl	lb	$0.14 - ...
Castor oil, No. 1, bbl	lb.	.14½ - ...
Chinawood oil, bbl	lb.	.35 - .37
Coconut oil, Ceylon, bbl	lb.	.10½ - .10¾
Ceylon, tanks, N.Y.	lb	.09½ - .09¾
Coconut oil, Cochin, bbl	lb.	.10½ - ...
Corn oil, crude, bbl	lb.	.12½ - ...
Crude, tanks, (f.o.b. mill)	lb	.10¼ - .10½
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.10½ - .10¾
Summer yellow, bbl	lb.	.12½ - .13
Winter yellow, bbl	lb.	.13¼ - .13½
Linseed oil, raw, car lots, bbl	gal	1 17 - ..
Raw, tank cars (dom.)	gal	1 12 - ..
Boiled, cars, bbl (dom.)	gal.	1 19 - ..
Olive oil, denatured, bbl	gal.	1 15 - ...
Sulphur, (foots) bbl	lb.	.09½ - .09¾
Palm, Lagos, casks	lb.	.08½ - .08¾
Niger, casks	lb	.08¼ - .08½
Palm kernel, bbl	lb	.09½ - .09¾
Peanut oil, crude, tanks (mill)	lb.	.13½ - .14
Peanut oil, refined, bbl	lb.	.17 - ..
Perilla, bbl	lb	.16½ - .16¾
Rapeseed oil, refined, bbl	gal.	.85 - .86
Rapeseed oil, blown, bbl	gal.	.90 - .91
Sesame, bbl	lb.	.13½ - .13¾
Soya bean (Manchurian), bbl	lb.	.12½ - ...
Tank, f.o.b. Pacific coast	lb.	.10½ - .10¾
Tank, (f.o.b. N.Y.)	lb.	.10½ - .11

Fish Oils

Cod, Newfoundland, bbl	gal.	$0 70 - $0 72
Menhaden, light pressed, bbl	gal.	.76 - ..
White bleached, bbl	gal.	.78 - ..
Blown, bbl	gal.	.82 - ..
Crude, tanks (f.o.b. factory)	gal.	.55 - ......
Whale No. 1 crude, tanks, coast	lb.	.06½ - ...
Winter, natural, bbl	gal.	.76 - .78
Winter, bleached, bbl	gal	.79 - .80

Oil Cake and Meal

Coconut cake, bags	ton	$36 00 - ....
Copra, sun dried, bags, (c.i.f.)	lb.	.06½ - $ .06¾
Sun dried Pacific coast	lb.	.05½ - .05¾
Cottonseed meal, f.o.b. mills	ton	40 00 - 41 00
Linseed cake, bags	ton	36 00 - ...
Linseed meal, bags	ton	38 00 - ...

Dye & Tanning Materials

Albumen, blood, bbl	lb.	$0 45 - $0.50
Albumen, egg, tech, kegs	lb.	.72 - .75
Cochineal, bags	lb.	.35 - .36
Cutch, Borneo, bales	lb.	.04½ - .05
Cutch, Rangoon, bales	lb.	.12 - .12½
Dextrine, corn, bags	100 lb.	3.39 - ......
Dextrine, gum, bags	100 lb.	3.74 - ......
Divi-divi, bags	ton	38.00 - 39.00
Fustic, sticks	ton	30.00 - 35.00
Fustic, chips, bags	lb.	.04 - .05
Logwood, sticks	ton	28.00 - 30.00
Logwood, chips, bags	lb.	.02½ - .03½
Sumac, leaves, Sicily, bags	ton	65.00 - ....
Sumac, ground, bags	ton	$55 00 - $60 00
Sumac, domestic, bags	ton	35 00 - ..
Tapioca flour, bags	lb.	.03½ - .05

Extracts

Archil, conc., bbl	lb.	$0.17 - $0 18
Chestnut, 25% tannin, tanks	lb.	.02 - .03
Divi-divi, 25% tannin, bbl	lb.	.04 - .05
Fustic, crystals, bbl	lb.	.20 - .22
Fustic, liquid, 42°, bbl	lb.	.08 - .09
Gambier, liq., 25% tannin, bbl	lb.	.08 - .09
Hematine crys., bbl	lb.	.14 - .18
Hemlock, 25% tannin, bbl	lb.	.04 - .05
Hypernic, solid, drums	lb.	.24 - .26
Hypernic, liquid, 51°, bbl	lb.	.14 - .17
Logwood, crys., bbl	lb.	.19 - .20
Logwood, liq., 51°, bbl	lb.	.09 - .10
Quebracho, solid, 65% tannin, bbl	lb.	.04½ - .05
Sumac, dom., 51°, bbl	lb.	.06½ - .07

Dry Colors

Blacks-Carbongas, bags, f.o.b. works	lb	$0.16 - $0.18
Lampblack, bbl	lb	.12 - .40
Mineral, bulk	ton	35.00 - 45 00
Blues-Bronze, bbl	lb.	.55 - .60
Prussian, bbl	lb.	.55 - .60
Ultramarine, bbl	lb.	.08 - .35
Browns, Sienna, Ital., bbl	lb.	.06 - .14
Sienna, Domestic, bbl	lb.	.03½ - .04
Umber, Turkey, bbl	lb.	.04 - .04½
Greens-Chrome, C.P. Light, bbl	lb.	.32 - .34
Chrome, commercial, bbl	lb.	.12 - .12½
Paris, bulk	lb.	.30 - .35
Reds, Carmine No. 40, tins	lb.	4.50 - 4 70
Oxide red, casks	lb.	.10 - .14
Para toner, kegs	lb.	1 00 - 1.10
Vermilion, English, bbl	lb.	1 30 - 1.32
Yellow, Chrome, C.P. bbls	lb.	.20 - .21
Ocher, French, casks	lb.	.02½ - .03

Waxes

Bayberry, bbl	lb.	$0.28 - $0.30
Beeswax, crude, bags	lb	.21 - .25
Beeswax, refined, light, bags	lb.	.32 - .34
Beeswax, pure white, cases	lb.	.40 - .41
Candellila, bags	lb.	.24 - .25
Carnauba, No. 1, bags	lb.	.39 - .40
No. 2, North Country, bags	lb.	.23 - .23½
No. 3, North Country, bags	lb.	.19½ - .....
Japan, cases	lb.	.14½ - .15
Montan, crude, bags	lb.	.04½ - .04¾
Paraffine, crude, match, 105-110 m.p.	lb.	.04½ - .04¾
Crude, scale 124-126 m.p., bags	lb.	.03 - .03½
Ref., 118-120 m.p., bags	lb.	.03½ - ..
Ref., 125 m.p., bags	lb.	.03¾ - ..
Ref., 128-130 m.p., bags	lb.	.04 - .04¼
Ref., 133-135 m.p., bags	lb.	.04½ - .04¾
Ref., 135-137 m.p., bags	lb.	.05 - .05½
Stearic acid, sgle pressed, bags	lb.	.14 - ......
Double pressed, bags	lb.	.14½ - ...
Triple pressed, bags	lb.	.16 - ......

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb.	$3.25 - $3 30
F.a.s. double bags	100 lb.	4 00 - ..
Blood, dried, bulk	unit	4 50 - .
Bone, raw, 3 and 50, ground	ton	27 00 - 30.00
Fish scrap, dom., dried, wks.	unit	3 75 - 10.00
Nitrate of soda, bags	100 lb.	2.65 - 2.67½
Tankage, high grade, f.o.b. Chicago	unit	4.25 - 4 50
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$4.00 - $4.50
Tennessee, 78-80%	ton	8.00 - 8.25
Potassium muriate, 80%, bags	ton	35.00 - 36.00
Potassium sulphate, bags basis 90%	ton	45.67 - ....

Crude Rubber

Para—Upriver fine	lb.	$0.30 - ......
Upriver coarse	lb.	.27 - ....
Upriver caucho ball	lb.	.29 - ....
Plantation—First latex crepe	lb.	.33½ - ....
Ribbed smoked sheets	lb.	.33½ - ....
Brown crepe, thin, clean	lb.	.31½ - .32..
Amber crepe No. 1	lb.	.32½ - .....

Gums

Copal, Congo, amber, bags	lb	$0.18½ - $0.19
East Indian, bold, bags	lb	.22 - .23
Manila, pale, bags	lb.	.21 - .22
Pontinak, No. 1 bags	lb.	.21 - .22
Damar, Batavia, cases	lb.	.30½ - .31
Singapore, No. 1, cases	lb.	.34 - .35
Kauri, No. 1, cases	lb.	.62 - .66
Ordinary chips, cases	lb.	.18 - .20
Manjak, Barbados, bags	lb.	.09 - .09½

Shellac

Shellac, orange fine, bags	lb.	$0.78 - ....
Orange superfine, bags	lb.	.80 - ....
A. C. garnet, bags	lb.	.77 - ......
Bleached, bonedry	lb.	.89 - ......
Bleached, fresh	lb.	.77 - ......
T. N., bags	lb.	.76 - .77

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh. ton	$450.00 - $550.00
Asbestos, shingle, f.o.b., Quebec	sh. ton	$60.00 - $80.00
Asbestos, cement, f.o.b., Quebec	sh. ton	15.00 - 17.00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	16.00 - 20.00
Barytes, grd., off-color, f.o.b. mills bulk	net ton	13.00 - 15.00
Barytes, floated, f.o.b. St. Louis, bbl	net ton	28.00 - ....
Barytes, crude f.o.b. mines, bulk	net ton	10.00 - 11.00
Casein, bbl., tech	lb.	.23 - .25
China clay (kaolin) crude, f.o.b. Ga.	net ton	7.00 - 9.00
Washed, f.o.b. Ga.	net ton	8 00 - 9.00
Powd., f.o.b. Ga	net ton	13.00 - 20.00
Crude f.o.b. Va.	net ton	8 00 - 12.00
Ground, f.o.b. Va.	net ton	13 00 - 20.00
Imp., lump, bulk	net ton	15 00 - 20.00
Imp., powd.	net ton	45 00 - 50.00
Feldspar, No. 1 pottery	long ton	6 00 - 7.00
No. 2 pottery	long ton	5 00 - 5.50
No. 1 soap	long ton	7.00 - 7.50
No. 1 Canadian, f.o.b. mill	long ton	25.00 - 27.00
Graphite, Ceylon, lump, first quality, bbl	lb	.06 - .06½
Ceylon, chip, bbl.	lb.	.05 - .05½
High grade amorphous crude	ton	35.00 - 50.00
Gum arabic, amber, sorts, bags	lb.	.15 - .16
Gum tragacanth, sorts, bags	lb.	.50 - .60
No. 1, bags	lb.	1.75 - 1.80
Kieselguhr, f.o.b. Cal.	ton	40 00 - 42.00
F.o.b. N.Y.	ton	50 00 - 55.00
Magnesite, crude, f.o.b. Cal.	ton	14 00 - 15.00
Pumice stone, imp., casks	lb	.03 - .05½
Dom., lump, bbl	lb.	.05 - .05½
Dom., ground, bbl	lb.	.06 - .07
Silica, glass sand, f.o.b. Ind.	ton	2 00 - 2.50
Silica, sand blast, f.o.b. Ind	ton	2.50 5.00
Silica, amorphous, 250-mesh, f.o.b. Ill	ton	17 00 - 17.50
Silica, bldg. sand, f.o.b. Pa	ton	2 00 - 2.75
Soapstone, coarse, f.o.b. Vt., bags	ton	7 00 - 8.00
Talc, 200 mesh, f.o.b., Vt., bags	ton	6 50 - 9.00
Talc, 200 mesh, f.o.b. Ga., bags	ton	7.00 - 9 00
Talc, 200 mesh, f.o.b. Los Angeles, bags.	ton	16 00 - 20.00

Mineral Oils

Crude, at Wells

Pennsylvania	bbl	$3 75 - ......
Corning	bbl	2 15 - ......
Cabell	bbl	2 41 - ......
Somerset	bbl	2 20 - ......
Illinois	bbl	2 37 - ......
Indiana	bbl	2 38 - ......
Kansas and Oklahoma, 28 deg	bbl.	1 50 - $1.60
California, 35 deg. and up	bbl.	1.04 - ......

Gasoline, Etc.

Motor gasoline, steel bbls	gal.	$0.24½ - ......
Naphtha, V. M. & P. devd, steel bbls	gal	.23½ - ......
Kerosene, ref. tank wagon	gal.	.15 - ......
Bulk, W. W. export	gal.	.08 - ......
Lubricating oils		
Cylinder, Penn., dark	gal	.27 - .30
Bloomless, 30@31 grav.	gal.	.20 - .22
Paraffin, pale	gal.	.24 - .25
Spindle, 200, pale	gal.	.25 - .26
Petrolatum, amber, bbls.	lb	.05 - .05½
Paraffine wax (see waxes)		

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	ton	$45-50
Chrome brick, f.o.b. Eastern shipping points	ton	50-52
Chrome cement, 40-50% Cr_2O_3	ton	23-27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	40-46
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	36-41
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65-68
9-in. arches, wedges and keys	ton	80-85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48-50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	48-50
F.o.b. Mt. Union, Pa.	1,000	42-44
Silicon carbide refract. brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N.Y.	ton	$200.00 - $225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11½ .11¾
4-6% C	lb.	.12 - .13
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	115.00 - 120.00
Spiegeleisen, 19-21% Mn.	gr. ton	35.00 - 37.00
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb.	1.90 - 2.15
Ferrosilicon, 10-15%	gr. ton	38.00 - 40.00
50%	gr. ton	86.00 - 89.00
75%	gr. ton	150.00 - 160.00

Ferrotungsten, 70-80%, per lb. of W	lb.	$0.85 –	$0 90
Ferro-uranium, 35-50% of U per lb. of U	lb.	6 00 –	
Ferrovanadium, 30-40%, per lb. of V	lb	3 75 –	4 00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f o b shipping points	ton	$6 50 –	$8 75
Chrome ore, Cuban concentrates, 50% min. Cr_2O_3	ton	22 00	23 00
C.i f Atlantic seaboard.	ton	20 50	26 00
Coke, fdry, f o b ovens	ton	8 25 –	8 50
Coke, furnace, f o b ovens...	ton	7 00	7 25
Fluorspar, gravel, f.o b. mines' Illinois	ton	21 50	
Ilmenite, 52%, TiO_2	lb.	01¼	01½
Manganese ore, 50% Mn, c i f Atlantic seaport	unit	33 –	
Manganese ore, chemical (MnO_2)	ton	75 00	80 00
Molybdenite, 85% MoS_2, per lb MoS_2, N Y.	lb	65 –	70
Monazite, per unit of ThO_2, c i f, Atl seaport .	lb	06	08
Pyrites, Span, fines, c i.f Atl seaport	unit	11½–	12
Pyrites, Span, furnace size, c i.f. Atl seaport	unit	11½–	12
Pyrites, dom fines, f.o.b mines, Ga	unit	.12	
Rutile, 95%, TiO_2	lb	12 –	
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8 50	8 75
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	8 00	8 25
Uranium ore (carnotite) per lb of U_3O_8	lb	3 50	3 75
Uranium oxide, 96% per lb. U_3O_8	lb	2 25	2 50
Vanadium pentoxide, 99%	lb	12 00	14 00
Vanadium ore, per lb V_2O_5	lb	1 00	
Zircon, washed, iron free, f.o.b. Pablo, Fla	lb	04½–	13

Non-Ferrous Materials

	Cents per Lb
Copper, electrolytic	16½ 16¾
Aluminum, 98 to 99%	23 24
Antimony, wholesale, Chinese and Japanese	9– 9¼
Nickel, virgin metal	25 27
Nickel, ingot and shot	29 00
Monel metal, shot and blocks	32 00
Monel metal, ingots	38 00
Monel metal, sheet bars	45 00
Tin, 5-ton lots, Straits	47 625
Lead, New York, spot	8 25
Lead, E St Louis, spot	8 20
Zinc, spot, New York	7 85
Zinc, spot, E St Louis	7 50

Other Metals

Silver (commercial)	oz	$0.65¼
Cadmium	lb	1.10
Bismuth (500 lb lots)	lb	2.55
Cobalt	lb	2 65@2 85
Magnesium, ingots, 99%	lb	1 25–
Platinum	oz	115.00
Iridium	oz	260 00@275 00
Palladium	oz	79 00
Mercury	75 lb.	70 00–

Finished Metal Products

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20 75
Copper bottoms	30 75
Copper rods	20 50
High brass wire	19 50
High brass rods	17 00
Low brass wire	21 10
Low brass rods	22 00
Brazed brass tubing	24 25
Brazed bronze tubing	29 00
Seamless copper tubing	25 25
Seamless high brass tubing	23 50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11 30@11.50
Copper, heavy and wire	11 25@11.50
Copper, light and bottoms	9 25@ 9.50
Lead, heavy	5 75@ 6.00
Lead, tea	3 50@ 3 75
Brass, heavy	6.25@ 6 40
Brass, light	5 35@ 5.75
No. 1 yellow brass turnings	6.30@ 6.50
Zinc	3.50@ 4 00

Structural Material

The following base prices per 100 lb are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3 27	$3.14
Soft steel bars	3.19	3 04
Soft steel bar shapes	3 19	3 04
Soft steel bands	3 29	3 19
Plates, ¼ to 1 in. thick	*3.29*	*3.14*

Industrial

Financial, Construction and Manufacturing News

Construction and Operation

Arizona

MESA The Attaway-Phelps Cotton Co. has perfected plans for the erection of a new cottonseed oil mill on local site, estimated to cost about $50,000. Four primary presses and auxiliary machinery will be installed E G Attaway is president

California

SAN MATEO -The McClenahan Products Co 601 Howard St., San Francisco, manufacturer of brick, sewer pipe and other burned clay products, has plans under consideration for the erection of a new plant on site selected at East San Mateo It is estimated to cost close to $40,000, with machinery

VINDALE STATION—The Rio Grande Oil Co, operating in the Montebello field, near Santa Fe Springs, has acquired a local site, comprising about 100 acres, for the construction of a new oil refining plant, estimated to cost in excess of $100,000, with machinery The company is operating other refineries in this district L E Lockhart is president

LOS ANGELES The Pacific Coast Borax Co, Kohl Bldg, San Francisco, will commence the immediate erection of the first unit of its proposed new plant in the harbor district to be equipped for general reduction and refining service It will be 3-story, with foundations to provide for two additional floors at a later date, estimated to cost approximately $500,000, with machinery Albert C Martin, Higgins Bldg., Los Angeles is architect

OAKLAND The California Salt Co, Mills Bldg San Francisco, will enlarge its plant at Alvarado, near Oakland, in connection with the rebuilding of the portion of the works destroyed by fire in January Plans are being completed and operations will soon be commenced. The cost is estimated at $300 000, with machinery

Connecticut

SOUTH COVENTRY— The Willimantic River Paper Co will soon commence the erection of an addition to its plant, comprising the former mill of the South Coventry Paper Co and has work in progress on alterations and improvements for considerable increase in capacity. New paper-making machinery and power equipment will be installed. Charles E Clute is president

THAMESVILLE—The Uncas Paperboard Co. has completed plans for enlargements in its local mill to increase the capacity from 100 to 200 tons a day Considerable new machinery will be installed James E Smith is president

Delaware

NEW CASTLE -The Wilmington Fibre Specialty Co has commenced preliminary work for the erection of 3 new additions to its plant, consisting of a 1-story structure, 86x170 ft., for enlargements in the sheet-making department, 3-story, 64x108 ft, for general manufacture; and 1-story, 30x100 ft New machinery will be installed, including fiber-making equipment, rolls, hydraulic presses and power apparatus. The expansion is estimated to cost in excess of $250,000. The Austin Co., Bulletin Bldg., Philadelphia, Pa, is the general contractor.

Georgia

SUMMERVILLE—The plant of the Standard Chemical Co., devoted to the manufacture of fertilizers, has been acquired by C. F. Hoffman. Gadsden, Ala., and associates. The new owners plan for extensions and improvements, and will place the works in service at an early date.

ATLANTA—The Atlanta Glass Mfg. Co. is taking bids for the erection of two new plant units on site recently acquired, and purposes to commence work at an early date The structures will be equipped for the production of glass bottles and containers.

Illinois

URBANA—The Clifford Jacobs Forging Co. has tentative plans under consideration for the rebuilding of the portion of its foundry, destroyed by fire, March 27, with loss estimated at $75,000, including equipment.

Indiana

NEW PALESTINE—The Indianapolis Steel Products Co has work under way on a new 1-story plant, 100x200 ft, on local 14-acre site, lately acquired, to be equipped for the manufacture of small steel specialties. Initial employment will be given to about 100 men, and this number considerably increased in the near future W M Lewis and Walter Bledsoe head the company

INDIANAPOLIS—The Jones X-Plo Mfg Co has arranged for the operation of a plant at 341 West 26th St, for the manufacture of chemicals and chemical byproducts.

UPLAND—Fire, April 2, destroyed a portion of the plant of the Upland Flint Bottle Co., including blowing department, with loss estimated at $100,000, including equipment. It is planned to rebuild

Kansas

WICHITA -The Derby Oil & Refining Corp has commenced enlargements in its local oil refinery to increase the capacity from 1 000 to 5 000 bbl per day. Other extensions and improvements will be made in the plants in this section A preferred stock issue of $2,325,000 is being sold, to be used, in part, for the expansion. A. L. Derby heads the company.

ANTHONY—Fire, March 29, destroyed a large section of the local plant of the Anthony Salt Works, Inc, with loss approximating $250,000, with buildings, machinery and stock.

Louisiana

MONROE- The Zeigin-Clarke Oil & Gas Co., recently organized with a capital of $150,000, has plans in progress for the erection of a new gasoline-refining plant, estimated to cost approximately $75,000, with machinery G. W Zeigin and W B Clarke head the company. Henry Walton is engineer in charge.

MERREAUX The Sinclair Refining Co. has tentative plans under consideration for the rebuilding of the portion of its oil-refining plant at Merreaux, near New Orleans, destroyed by fire March 28, with loss reported in excess of $750,000, including equipment Headquarters of the company are at 45 Nassau St, New York.

Maine

LINCOLN—The Lincoln Eastern Pulp Mill is planning for the rebuilding of the portion of its plant destroyed by fire March 22, with loss reported at $23,000.

Maryland

CRISFIELD—The Crisfield Light & Power Co., recently acquired by new interests headed by Isaac H. Tawes and associates, has plans under consideration for extensions and improvements in the local artificial gas plant, including the installation of additional equipment.

Massachusetts

EAST WALPOLE—Bird & Son, Inc., manufacturer of paper and composition roofing, has commenced excavations for a 1- and 2-story plant addition, 90x540 ft., to cost close to $300,000, with equipment. The general contract was awarded recently to *the Central Engineering & Construction Co.*, Pawtucket, R. I. Monks & Johnson, 99 Chauncey St., Boston, are architects and engineers.

NATICK—The Griess-Pfleger Tanning Co.

Sycamore St., Cincinnati, O., has acquired the tannery of C. W. Dean & Co., and will occupy the structure at an early date. Improvements and alterations will be made; a large portion of the works will be given over to leather-cutting and similar operations.

Michigan

LUDINGTON—The Morton Salt Co. is planning for the erection of a 1-story addition at its local plant, 120x139 ft., for considerable increase in capacity. New grainer pans and other equipment will be installed.

JACKSON—Plans are being completed for the construction of a new 1-story heat-treating plant, 75x125 ft., at the works of the American Gear & Mfg. Co., a subsidiary of the Hupp Motor Car Corp., Detroit.

GRAND RAPIDS—The National Brass Co. will commence immediately the erection of a new 1-story addition, 45x230 ft., at Evergreen and Madison Aves., estimated to cost $25,000, exclusive of equipment.

Missouri

JOPLIN—The Mogul Mining Co., Miami, Mo., has plans in progress for the erection of a new concentrating plant, with capacity of about 200 tons per day. A. E. Dunlap is general manager.

MOUND CITY—The Mound City Roofing Tile Co. is planning for the rebuilding of the portion of its plant on Morganford Ave., recently destroyed by fire with loss of about $25,000.

New Jersey

TRENTON—The New Jersey Porcelain Co. has filed plans for the erection of a new plant on the block bounded by Plum and Strawberry Sts., and Pennsylvania and New York Aves., estimated to cost $60,000. A list of equipment to be installed will be prepared at an early date. Fowler, Seaman & Co., Broad St. Bank Bldg., are architects.

PAULSBORO—The Vacuum Oil Co., 61 Broadway, New York, will commence the erection of a new oil storage and distributing plant here, consisting of a 3-story structure, 100x120 ft., and 2-story building, 60x60 ft. A general contract for the work has been let to the Turner Construction Co., 242 Madison Ave., New York.

MILFORD—The Warren Mfg. Co., specializing in the production of glassine papers, will install additional machinery at its local mill for considerable increase in capacity.

BOUND BROOK—Fire, March 26, destroyed a portion of the foundry of the Bolte Piano Plate Co., Middlesex Borough, near Bound Brook. An official estimate of loss has not been made. It is planned to rebuild. Harry Bolte heads the company.

New York

ROME—The Rome Brass & Copper Co., Bouck St., has plans in progress for the construction of a 1-story and basement addition at its local mill, 50x175 ft., estimated to cost $180,000, including machinery. The company specializes in the manufacture of brass and copper tubing, sheets, etc. Alfred F. Pashley, 431 South Dearborn St., Chicago, Ill., is architect.

BUFFALO—The General Castings Corp., 577-89 Tonawanda St., has tentative plans under consideration for the rebuilding of the portion of its foundry, destroyed by fire March 27, with loss estimated at about $50,000, including equipment.

LITTLE FALLS—The Little Falls Chemical Co., is planning for the erection of a 1-story addition to its plant, 50x100 ft., estimated to cost about $35,000. Louis Vandermeer is treasurer.

ALBANY—Construction will soon be commenced on a new 1-story foundry at the local plant of the Federal Signal Co., to be equipped primarily for the production of steel castings.

TONAWANDA—Officials of the American Radiator Co., Buffalo, have organized the Tonawanda Iron Co., with capital of $1,500,000, to take over the local blast furnaces of the Tonawanda Iron & Steel Co., controlled by the Donner Steel Co., Buffalo. Immediate possession will be taken, and the two stacks remodeled and improved. The plant has a rated capacity of 180,000 tons of pig iron per annum, and will be run on this basis by the new owner, the material to be used at the different radiator works. B. M. Wooley is president, and Wetmore Hodges, secretary and treasurer.

BUFFALO—The Kelly Island Lime & Transport Co., Cleveland, O., will build an addition to its local limekiln plant on the Buffalo River, to cost about $30,000.

North Carolina

RALEIGH—The State Highway Commission has tentative plans for the construction and operation of a cement manufacturing plant, to be used as a source of supply for state road work. Frank Page is chairman.

Ohio

AKRON—The Miller Rubber Co. will commence the immediate erection of a 4-story addition to its tire manufacturing plant, 98x285 ft., estimated to cost about $325,000, with machinery. It will be located in the South Akron section.

HUBBARD—The American Sintering Co., Youngstown, O., has commenced the construction of a new local plant, to be equipped to handle about 1,000 tons of sinter per day.

AKRON—The Anaconda Copper Co. is planning for the immediate construction of a new building at its recently established zinc oxide plant in the North Akron section. The works is giving employment to about 150 men and this force will be increased in the near future.

TOLEDO—The United States Malleable Castings Co. has preliminary plans under consideration for the rebuilding of the portion of its plant, destroyed by fire March 29, with loss estimated at about $500,000, with equipment.

Oklahoma

TULSA—The proposed new local plant of the Union Carbide Co., 30 East 42nd St., New York, on property recently acquired, will be used by its subsidiary organizations, the Prest-O-Lite Co. and the Linde Air Products Co., manufacturers of acetylene products and industrial oxygen specialties, respectively. The works for the last-noted organization will consist of a main 1-story building, 150x200 ft., with smaller structures adjoining.

OKMULGEE—The Waite-Phillips Refining Co. will make enlargements in its local oil refinery, to increase the output from 3,000 to 5,000 bbl. per day. New pressure stills and other equipment will be installed.

HASKELL—The Coleman-Nelson Corp., Tulsa, has acquired the refinery of the Southern Oil Refining Co., at Haskell, with rated capacity of 1,000 bbl. daily. The new owner will take possession immediately and plans for extensions and improvements, including the installation of additional equipment.

Oregon

PORTLAND—The Portland Gas & Coke Co., Gasco Bldg., will commence immediately erection of a new 2-story oil purification plant on St. Helens Rd.

Pennsylvania

LANCASTER—Bids are being taken for the erection of a new 1-story foundry at the plant of the E. T. Fraim Lock Co., Park Ave., 43x170 ft., estimated to cost about $17,000, exclusive of equipment. J. Wilmer Hershey, 1012 East Orange St., Lancaster, is architect.

PITTSBURGH—Fire, March 31, destroyed a portion of the plant of the American Window Glass Co., in the vicinity of New Kensington, near Pittsburgh, with loss estimated at about $200,000, including equipment. It is planned to rebuild. Headquarters of the company are in the Farmers Bank Bldg.

LANCASTER—The city council has tentative plans under consideration for the construction of a filtration plant at the municipal waterworks.

EDGELY—The Margaree Paper Co., Modena, Pa., will break ground at once for the construction of its proposed new local plant on site recently acquired, comprising two main mills, each 180x200 ft., estimated to cost about $550,000, including machinery. The works will include a power house.

Tennessee

CHATTANOOGA—The Crane Enamelware Co. has tentative plans for the erection of an addition to its local plant, estimated to cost in excess of $150,000, with machinery. It is purposed to develop a large increase in capacity.

Texas

BRECKENRIDGE—The Columbian Carbon Black Products Co. has been granted permission to construct and operate a local plant, on site recently acquired about 5 miles from the city. It will consist of a number of buildings and is estimated to cost approximately $350,000, with machinery. J. W. Hassell heads the company.

MIRANDO—The Tex-Pata Pipe Line Co. has plans under way for the construction of a new oil refinery on local site, with initial capacity of about 2,000 bbl. per day. Oliver W. Killam is president.

DALLAS—The Centrifugal Concrete Products Co. of America has leased a portion of the factory site of the Liberty Yeast Co. for the establishment of a new plant for the manufacture of special concrete pipe products, made under a centrifugal process.

Washington

CAMAS—The Crown Willamette Paper Co. is arranging for the immediate erection of an addition to its plant, 57x60 ft., to be used as a digester building. R. O. Young is manager at the mill.

Wisconsin

WHITEWATER—Fire, March 30, destroyed a portion of the plant of the Kinzie Rubber Co., occupying a portion of the Kiser Bldg., with loss reported at about $30,000. It is planned to rebuild.

TOMAHAWK—The Tomahawk Kraft Paper Co., recently organized, has taken over the local plant of the Pride Pulp & Paper Co., including mill, water power sites and other property. Plans are under consideration for the construction of a new pulp mill in the vicinity of Grandmother Falls. The Tomahawk plant will be improved and remodeled, and used for the production of kraft papers. Henry M. Thompson and D. C. Everest, the latter of Wausau, Wis., head the company.

Industrial Developments

GLASS—The Inland Glass Co., Chicago, Ill., has increased operations at its new local plant, recently completed, representing an investment of about $500,000, and purposes to develop maximum production at an early date. The mill will be devoted to the manufacture of illuminating glassware. The company was incorporated recently with a capital of $750,000. J. B. Weaver is president.

Decorated glassware plants in all parts of the country are running at maximum capacity and are from 30 to 90 days behind on orders. It is said that the present basis of operations will be maintained throughout the year.

The Ball Brothers Glass Mfg. Co., Muncie, Ind., manufacturer of glass jars, is operating full at its local plant, giving employment to about 1,500 persons. It is expected to run on this schedule for an indefinite period.

Window glass mills in West Virginia are advancing production and additions are being made to the working forces. A number of plants have orders on hand insuring maximum output for a number of months to come.

CERAMIC—The Edwards Brick Co., Columbia, Mo., is arranging for increased production at its plant, and will install considerable new equipment for this purpose. It is planned to develop the 6-kiln plant to maximum, with an output of about 55,000 bricks per kiln, including paving, face and common brick.

The La Junta Clay Products Co., La Junta, Colo., has resumed production at its plant, following the installation of additional equipment, and plans for full operations for an indefinite period. The company specializes in the manufacture of face brick, blocks, drain tile and other burned clay products.

Sanitary ware plants in the Raritan River section of New Jersey are running at full capacity, with full working forces. Orders on hand insure this basis for some months to come.

Brick-manufacturing plants in the Hudson River district, New York, are making ready for early resumption of production following a shut-down through the winter. It is expected to develop maximum output at the majority of the plants at the earliest possible date.

The Marshfield Brick & Tile Co., Marshfield, Wis., is advancing production at its plant, and plans for improvements to provide for greater capacity. Considerable additional equipment will be installed, both for brick and drain tile manufacture.

PAPER—The Scott Paper Co., Chester, Pa., has completed the installation of additional equipment at its local plant and will main

tain capacity operations for some time to come. A full working force is employed Heavy incoming orders are reported

The Backus-Brooks Co., Kenora, Ont., has commenced operations at its new pulp mill and will place other departments of the plant in service as soon as completed The plant is expected to develop a total capacity of 80 tons of pulp daily.

The Lincoln Paper Co., Elkhart, Ind., is maintaining capacity production at its local plant, giving employment to a full working force. The mill will be continued on this basis for an indefinite period.

The Spruce Falls Co., Ltd., Kapuskasing, Ont., is running at close to normal at its local sulphite plant, averaging about 90 tons per day The company has plans under consideration for the establishment of a paper mill in the near future

MISCELLANEOUS - E I du Pont de Nemours & Co Wilmington, Del, have advanced the wages of employees at their explosive and dye works at Carneys Point, Gibbstown and Deepwater, N J, 10 per cent, or an hourly wage increase of about 6 cents per hour Approximately 2,000 persons are affected

The Oklahoma Production & Refining Corp., Muskogee, Okla., has closed its local refining plant as a result of the scarcity of crude oil It is expected to resume at an early date

The Vacuum Oil Co., New York, has increased the wages of employees at its Paulsboro, N J, works 5 cents an hour, effective April 4

The Carnegie Steel Co., has resumed operations at the first unit of its coke plant at Farrell, Pa, giving work to about 500 men The plant has been inactive for 24 months past Other units will be started up until the entire 182 ovens are charged The benzol plant has also been placed on the active list.

The American Vulcanized Fibre Co Wilmington, Del, is running at full capacity at its mill at Newark, Del, giving employment to an increased working force

New Companies

THE ROLLSTONE PAPER CO, Fitchburg Mass, has been incorporated with a capital of $300,000, to manufacture paper products Louis T Stevenson is president, and Henry M. Wheelwright, Newton, Mass, treasurer The last noted represents the company

THE BARON PRODUCTS CORP, New York care of S T Stern, 11 Park Row, representative, has been incorporated with a capital of $100,000 to manufacture chemicals and affiliated products. The incorporators are H Meier, L Javitz and L Baker

CHARLES E SALMON, INC, Detroit, Mich, has been incorporated with a capital of $25,000, to manufacture inks and kindred products. The incorporators are William H Wendell, G. W and Charles E. Salmon, 2501 Gladstone Ave, Detroit The last noted represents the company

THE FLORIDA CHINA CLAY CO, Leesburg, Fla., has been incorporated with a capital of $100,000, to operate clay properties and clay refining plants R L Fox is president, and R B Bourlay secretary treasurer, both of Leesburg

THE NEW PRESSMAN TIRE & RUBBER CO, Newark, N J, has been incorporated with a capital of $2,000,000, to manufacture tires and other rubber products The incorporators are Herman Pressman, Herbert G Tully and Joseph E. Monteith, 776 Broad St, Newark. The last noted represents the company

THE RADEX LABORATORIES, INC, care of the Corporation Service Co, Equitable Bldg., Wilmington, Del, representative, has been incorporated under Delaware laws with capital of $100,000, to manufacture chemical products.

THE GILMOUR CHEMICAL CO, Waterbury, Conn, has been incorporated with a capital of $50,000, to manufacture chemical compounds, paint and varnish removers and kindred specialties The incorporators are A L and John Gilmour, 21 Newell Place, Waterbury

THE NEW JERSEY WAXED PAPER CO Passaic, N J, has been incorporated with a capital of $50 000, to manufacture paper products The incorporators are Walter M and E M Crowell, and Benjamin H Ballard, 36 Vineyard Place, Passaic The last noted represents the company

THE MARKER CHEMICAL CO, Fairmont, W. Va, has been incorporated with a capital of $1,000,000, to manufacture chemicals, fertilizers, etc The incorporators are R. L Long and S. S. Burke, Fairmont; and Earl Van Horr, Clarksburg, W. Va.

THE AMALGAMATED LEAD-ZINC SMELTERS CORP, care of the Corporation Trust Co. of America du Pont Bldg, Wilmington, Del., representative, has been incorporated with a capital of $1,250,000, under Delaware laws, to operate metal smelting and refining plants

THE CONROE BRICK CO, Conroe, Tex, has been incorporated with a capital of $15,000, to manufacture brick, tile and other burned clay products. The incorporators are B. E. Hinchcliffe, B. J. Lacka and W M Merriss, all of Conroe

THE HOLLAND FOUNDRY CO, Holland, Mich has been incorporated with a capital of $35,000, to manufacture iron and other metal castings The incorporators are Theodore Fisher, Chicago, Ill, Robert H Carnahan, Jr, and Frank P Parish, both of Holland The last noted represents the company

THE HERMAN CHEMICAL CO OF MASSACHUSETTS, INC, Boston, has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. John N. Penick is president, and Walter T. Hannigan, Newton, Mass, treasurer The last noted represents the company

THE MARSHALL REFINING CO, Kansas City, Mo, has been incorporated with a capital of $49,000, to manufacture refined petroleum products. The incorporators are W S Primley and D. B Sevastian, both of Kansas City

THE VAN PELT CONCRETE CO, Milltown, N J has been incorporated with a capital of $50,000, to manufacture cement and concrete products. The incorporators are Archie Van Pelt, Conrad W Kuhlthau and Howard J Booream all of Milltown

THE AGRILIN CHEMICAL CO, New York, care of the Delaware Registration Trust Co, 900 Market St, Wilmington, Del, representative, has been incorporated under Delaware laws with a capital of $550,000, to manufacture chemicals and chemical byproducts The incorporators are Horace N. Taylor and Louis Pavelek, New York; and William I Brophy, Rockaway Beach, L. I

THE W. P. COLLINS OIL CO, 2619 Mary St, Chicago, Ill, has been incorporated with a capital of 900 shares of stock, no par value, to manufacture oils, greases, lubricants, etc The incorporators are John J, Thomas J, and William J Collins

THE BRILLIANT PRINTING INK CO, Philadelphia, Pa, has been incorporated with a capital of $5 000, to manufacture printing and other inks Ernest Osborne, 5636 Belmont Terrace, Philadelphia, is treasurer

Industrial Notes

C W HUNT CO, INC., West New Brighton N Y, designer and manufacturer of material-handling equipment, announces that the exclusive license to manufacture and sell the Mitchell electric vibrating screen has been acquired by it More than 300 of these screens are in operation throughout the world.

THE GIFFORD-WOOD CO, Hudson, N Y., announces that A. W. Berghoefer has again become associated with it.

THE PURE CARBON CO, Wellsville, N. Y., announces the recent establishment of a northern West Virginia representative in the person of Norman Strugnell of Clarksburg, W Va

F J RYAN & CO, Philadelphia, announce that J. L. Edwards, for the past 4 years district engineer for the Mahr Mfg. Co., with headquarters at Pittsburgh, Pa., has resigned to take the position of district manager of the Pittsburgh territory of the Ryan Company. Mr. Edwards has been actively participating in the design, installation and sale of steel plant equipment in the Pittsburgh district for nearly 10 years, having been associated with the Westinghouse Electric & Mfg Co. and the Fairbanks company previous to becoming connected with the Mahr company. The Ryan company's offices will be located in the Oliver Bldg, Pittsburgh, and this office will have supervision over the entire territory of eastern Pennsylvania, certain sections of eastern Ohio and the northern section of West Virginia. Mr. Edwards will be assisted by a corps of trained men.

THE UEHLING INSTRUMENT CO., manufacturer of CO_2 recorders and other power plant gages, has placed Charles J. Schmid in charge of sales in Greater New York and Long Island. Mr. Schmid is well qualified for his duties in this important territory due to his close contact with power plant operators in the interest of fuel economy when formerly in charge of the Boston office. Temporarily Mr. Schmid will make the home office in Paterson, N. J., his headquarters.

Coming Meetings and Events

AMERICAN ASSOCIATION OF CEREAL CHEMISTS will hold its ninth annual convention at Hotel Sherman, Chicago, June 4 to 9.

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual convention in Norfolk, Va., May 7 to 9.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York.

AMERICAN FOUNDRYMEN'S ASSOCIATION will hold a meeting in Cleveland, O., April 30 to May 3.

AMERICAN GAS ASSOCIATION will hold its annual convention the week of Oct. 15 at Atlantic City An elaborate exhibition of gas-making and gas-utilization equipment is planned.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its summer meeting June 20-23 at Wilmington, Del.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W Va., June 7, 8 and 9.

AMERICAN OIL CHEMISTS' SOCIETY will hold its annual meeting at the Eastman Hotel, Hot Springs, Ark., April 30 and May 1

AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold its spring meeting May 28 to 31 in Montreal, Canada

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week

AMERICAN WELDING SOCIETY will hold its annual meeting April 25 to 27 at the Engineering Societies Building, New York.

AMERICAN ZINC INSTITUTE, INC., will hold its fifth annual meeting at the Hotel Chase, St. Louis May 7 and 8.

CANADIAN INSTITUTE OF CHEMISTRY will hold its annual meeting in Toronto, May 29 to 31.

ENGINEERING SECTION of the National Safety Council will hold a mid-year safety conference April 17 in the auditorium of the Western Society of Engineers

INTERSTATE COTTON SEED CRUSHERS ASSOCIATION will hold its annual convention at Hot Springs, Ark., May 2 to 4

IRON AND STEEL INSTITUTE (London) will hold its annual meeting May 10 and 11 at the House of the Institution of Civil Engineers, London, S W. 1.

NATIONAL ASSOCIATION OF MANUFACTURERS OF THE UNITED STATES OF AMERICA will meet in annual conference May 14 to 16, inclusive, at the Waldorf-Astoria, New York City

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (NINTH) will be held in New York Sept. 17-22

NATIONAL FOREIGN TRADE COUNCIL has postponed its annual conference from April 25, 26 and 27, to May 2, 3 and 4. It will be held in New Orleans, La.

NATIONAL LIME ASSOCIATION will hold its fifth annual convention at the Hotel Commodore, New York City, June 13 to 15

NATIONAL SYMPOSIUM ON COLLOID CHEMISTRY will be held at the University of Wisconsin, June 12 to 15.

SOCIETY OF CHEMICAL INDUSTRY Canadian Section, will meet in Toronto, May 29 to 31

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY FOR STEEL TREATING — Eastern sectional meeting will be held June 14 and 15, in Bethlehem, Pa.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: May 4—American Chemical Society, regular meeting May 11—Société de Chimie Industrielle (in charge) American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8 — American Chemical Society, regular meeting.

// CHEMICAL
& METALLURGICAL
ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

Volume 28 New York, April 23, 1923 *Number 16*

Intelligent Caution Or Careless Ignorance

NEWSPAPERS recently featured a tragedy in Chicago in which six persons died in a flat in consequence of the seepage of fumes of hydrocyanic acid gas from a restaurant on another floor, which was being fumigated. The reporter described the insecticide thus: "It is made of cyanide of sodium, sulphuric acid and water. The combination forms a substance that eats up the oxygen and hydrogen in air, leaving only a poisonous gas." Blatant ignorance of the characteristics of the poison, however, was not confined to the narrator of the event; the account showed that the fumigation was being directed by an individual who styled himself the manager of the National Hygienic Corporation of Buffalo! The history of the disaster was traced back to the dissemination of pamphlets throughout the city. When apprehended, the director of the enterprise is reported to have affirmed that the gas used was non-poisonous. He was held by the police on a charge of criminal negligence; to us it would seem to have been a case of criminal ignorance.

The inculcation of fear in the public mind as to the effects of the so-called deadly poisons is detrimental to the progress of civilization. Cowardice is the father of superstition, and superstition is the antithesis of science. Knowledge and familiarity in the handling of the products of science are all that are needed to insure their full utilization for the benefit of humanity. Popular prejudices must be overcome by education. The drawback to hydrocyanic acid as an insecticide has been due almost entirely to the slipshod methods of preparation by those who are inexperienced in the handling of chemicals and ignorant of their effects. The combination of sodium cyanide and sulphuric acid leaves a residuum that invites accident. The use of liquid hydrocyanic acid leaves no residuum; in experienced hands, it is a safe and efficient insecticide. Its extended use in the near future for the extermination of pests from fruit trees will mark a new phase in the science of horticulture.

The fact that familiarity with poisons is the best insurance against accident is exemplified in the history of the cyanide process for the recovery of gold and silver from ores. When JOHN STEWART MACARTHUR developed a practicable scheme of operations for the use of potassium cyanide as the solvent, many were the apprehensions that its use in large plants would lead to frequent accident and heavy loss of life. As a matter of fact, the opposite was the result. The number of poisonings that have occurred in cyanide plants, despite the world-wide application of this method of hydrometallurgical extraction, has been negligible. The death rate is as low as or lower than in any other industry that is considered to be free of appreciable hazard. This result has come about because of a wide education in the properties and effects of cyanide.

The so-called accidents that happen from time to time are often the effects of ignorance or carelessness, sometimes both. Intelligent technicians are conquering the inanimate world; and those bolder spirits are deserving of credit who can make fire and flood and poison the servants, rather than the masters, of humanity. But until that happy day arrives we shall persist in demanding that those who offer to serve the public with chemical products shall not only use them intelligently but also safeguard the people against the results of carelessness or ignorance.

A Week of Paper and Pulp

APRIL 9 to 14 was a history-making week for the pulp and paper industry. Many healthy signs of the times were in evidence at the meetings of the American Paper and Pulp Association and its affiliated societies which were held in New York coincident with the Paper Industries Exposition. Perhaps the most encouraging development to the technologist was the changing attitude toward industrial research, which is paralleling the paper industry's trend away from rule-of-thumb operation and unscientific methods. Other signs of progress are to be seen in the increasing interest in process efficiency and in the war on waste both in production and distribution.

The Technical Association of the Pulp and Paper Industry—known more familiarly as TAPPI—has had a large part in co-ordinating and directing the research activities of the industry. By standardizing processes and materials, defining units of measurement and establishing fixed objectives in its experimental work, the association is putting paper research on a comparative basis and making its results intelligible and of value to investigators in other plants and other fields.

The Paper Industries Exposition, the first of the kind ever held, proved its worth quite convincingly. By bringing together under one roof all the interests of the industry—from standing tree to a highly fabricated paper product—the exposition acted as an effective means of demonstrating the intrarelations of the industry and the dependence of the different branches upon one another. Production men carried away many practical ideas from the equipment exhibits. The purchasing and marketing men exchanged views and learned of latest developments in their respective fields. And not the least important was the educational value to the public, for all who came in contact with the exposition went away with a keener appreciation of the importance of America's seventh industry and its essential rôle in modern life and progress.

Pekinese Or Pekiner?

OUR late editorial comment on an excellent method of teaching chemistry in China has called forth a protest from an esteemed Chinese reader. The offence consisted in the quotation from BRET HARTE'S poem to the effect that "the heathen Chinee is peculiar." We hasten to assure all readers from the Orient that no offence was intended. The adjective heathen has lost its sting to many of us, and we believe the subject debatable whether it is not better to be a heathen than a member of the Ku Klux Klan, which boasts of something like 120 per cent Americanism. To be peculiar is really a virtue, and we cherish the hope that we are a bit peculiar ourselves—at least enough so to be individual.

About the expressions Chinee and Chinaman, to which our correspondent objects, we are a little bewildered, because Chinese, which is the term he approves, properly speaking is an adjective, and we are at a loss for a good noun to indicate a native of China. True, American is both an adjective and a noun, because custom makes it so, and in time it may be the same for Chinese. If a better contemporary substantive than Chinaman is suggested we promise to be good and to use it, so long as it accords with our literary conscience. We have immense admiration for people and things Chinese, and we want to be set right in this matter. We want to make friends among them, not enemies. We acknowledge frankly our lack of the Oriental slant in expression. For instance, we should hesitate to refer to a gentleman from Pekin as Pekinese, on account of the infernal little dogs that women carry about and which are called Pekinese. What should we call him? Would Pekinian do? We call a man from New York a New Yorker, but if we call one from Pekin a Pekiner that would be German, not English. We're in a quandary. We're doing our best, and we seek enlightenment.

Researching the Staff of Life

ON ANOTHER page there is indicated, in an article on baking, the practical, dollar value of engaging in research, even as pioneers. Here was a household art, developed into a major industry which was supposed to have its beginning and its end in kitchen culture. Twenty years ago there was no one less welcome in a bakery than the chemist. So long as ignorance reigns we think we know it all, but as soon as we begin to prosecute research intelligently the problems spring up as did the fabled warriors when dragons' teeth were sown. Now, in this baking industry, research has only begun. The baker with scientific curiosity has questions enough to baffle the wisest of us. Here are a few of his inquiries:

He would like to ferment his dough in the pan—that is, to ferment each loaf separately. The yeast plant converts into alcohol and CO_2 about 4 per cent of the dry material used, and any reduction of this waste of flour and sugar would be worth while. By fermenting in the pan it might be accomplished.

The problem of the flavor of bread needs better control. Knowing how to make it good and agreeable to the taste is far from a complete solution. If he only knew why it has the desired flavor he would be in a position to make all kinds of bread taste better. This would be an important contribution to economics. A bushel of wheat is converted into food and fuel to the extent of 90 per cent of its weight. A cow will convert 18 per cent of wheat or grain into milk, the pig 15½ per cent into pork, hens 5 per cent into eggs, and fowls a little over 4 per cent into dressed poultry. The amount of bread eaten is determined even more by its tastiness than by its nutritive value.

The baker needs to know more than he does of the effect of moisture on the baking and keeping qualities of flour. And what is the physical effect of mixing dough? Different types of flour require different degrees and periods of mixing. This fact is determined by tests, but what's the chemistry of it? There is a relationship between the hydrogen-ion concentration of dough and its requirements as to mixing, but what is that relationship?

What is the actual function of shortening—i.e., of the fats used in baking? What is the proper protein content of bread, and which proteins are most wholesome and most desirable? What are the changes that take place in canned eggs, more especially in reference to their food value? Why does bread deteriorate so rapidly, and how may deterioration be delayed? How may mold be controlled and avoided?

Indian corn or maize lacks gluten, and therefore it does not leaven properly; it cannot be made into a loaf with holes in it. To make a light, tasty cornmeal bread such as that made of wheat or rye would be another real contribution to economics.

And how much heat can cornmeal stand in milling? It is almost always much better if ground between slow-moving burr stones than in a Hungarian roller mill. It appears that the greater velocity and consequent heat of the roller mill injures the flour.

These are merely a few of the many problems that present themselves, but they are far and away from being the complete substance of things hoped for. They are, indeed, merely a few trivial wishes about the portals of research. If bread should ever be made into a ration at once complete, varied and desired by all, as well as healthful for all, we might have a different organization of society as its sequel.

The Portland Cement Industry And Its Association

AN editorial bearing this title appeared in *Chemical & Metallurgical Engineering* on July 26, 1922. It was written after an extended trip during which many executives and engineers connected with the manufacture and use of portland cement were interviewed and was designed to represent a chemical engineer's estimate of the industry and the association.

We believe that recent developments in the industry deserve such comment that a revision of the former editorial is in order. Before discussing this, however, two mistakes have come to our attention in the former editorial. The first was the crediting of the Portland Cement Association with the good work of developing standards for portland cement. As a matter of fact this work was actually done by the American Society for Testing Materials, the confusion arising because many of the committee were prominent in the Portland Cement Association. The second mistake was more serious in its implication than in its statement. "Invariably every improvement in concrete making which

is announced [by the association] indicates the desirability of using more cement [in the mix]. After a certain time this becomes monotonous and then suspicious." Since then recommendations have come to our attention in which the association has advised a smaller quantity of cement than that recommended for the same purpose by the Department of Agriculture and other bodies. Our statement was published with complete confidence in a hitherto reliable source of information. We accept complete responsibility for the error and believe that, while the opinion has following, it is decidedly unfair, being based partly on prejudice and partly upon an unfortunate interpretation of the policy of the Portland Cement Association of giving minimum requirements for cement in concrete specifications, leaving the upper limit open.

There were two main criticisms advanced in the former editorial—criticisms of the cement industry as a whole and of the association as its representative. The first had to do with the grading of cement and the second with the absence of fundamental research in the industry. We believe that the present standard specifications of portland cement are inadequate in that a wide variation in quality can be labeled "standard." These variations are known to many large consumers who purchase on their own specification and to experienced concrete foremen throughout the country, who will frequently designate a brand of cement which will be more desirable for a given type of work. We have therefore in part at least a grading of cement which we believe must become universal and which so far as our acquaintance goes would be unwelcome to the industry, since it would vastly complicate both sales and manufacturing.

With regard to fundamental research we are delighted to be able to withdraw our criticism. In our former editorial we had deplored the absence of fundamental research in the cement industry. "No work was being done to improve the product." We did not mean the more obvious improvements such as uniformity or fineness, but the study of fundamentals such as is carried out in Schenectady in the electrical industry or at Whiting and many other places in petroleum refining. There seemed to be an absence of research vision which would make it comparable to progressive industries. What constituted good cement? What factors improve the quality? What are the limiting percentages of the various constituents? Is it conceivable that other ingredients would be better? There was no interest in such questions.

Now, however, the research laboratory of the association has been instructed to undertake a comprehensive inquiry into the many fundamental questions. Most happily the association has enlisted the co-operation of the Bureau of Standards in this work so that both the producer and the consumer interest will be represented. It means further that the outstanding figures in cement and concrete work will be pulling together for the best interests of all.

Our enthusiasm is kindled and we wish to extend our congratulations upon the splendidly constructive program. It complements the work which the Portland Cement Association has already done toward educating the consumer in the use of concrete. This work has been well conceived and splendidly carried out for a long time.

Henry Ford Works Miracles

THE Associated Press has announced, and the newspapers have been giving the widest publicity to the statement, that HENRY FORD has purchased undeveloped coal lands in Kentucky and that he intends not only to provide for his own fuel requirements by this means but to induce others to join him in his "coal conservation scheme." The scareheads declare that "he has a plan "to burn the coal twice" and that "he will ask all industrial users of his coal to install furnaces that will remove only the gas, leaving a fuel unimpaired for domestic purposes. The coal, after the process, would be sold to heat the homes of hundreds of thousands of workers throughout the country. According to a technical explanation of the gas-removing process, the fuel would then be more valuable than ordinary coal for heating." This reminds us of the "Dere Mable" letters. "That's teckenickle, Mable," said the swain, "you wouldn't understand."

It probably takes a publicity bureau to put over a statement like the despatch quoted. Editors do their best to avoid this kind of free advertising, but now and then a blurb of this sort gets through. In this instance the Associated Press and all its subscribers, followed by those who copied the news, have effectively joined to present Mr. FORD as a miracle man who will keep poor folks warm in winter. Many papers which printed this as an item of news would refuse to accept it as an advertisement if their business managers knew how misleading it was. The reason is, of course, that the man of science has no place in a newspaper organization. Without saying so, it appears from the statement that the great HENRY FORD can induce manufacturers generally to equip their plants not only with a gas system but a briquetting outfit as well, or else that he can persuade the "hundreds of thousands of workers throughout the country" to burn coke. Thus far they haven't taken to it any too well. How does he propose to transport his domestic coke? And what argument has he for gas making that the manufacturers of gas equipment have not urged for years? Has he anything new? Not a word is said of his method. All we have is the misleading intimation that he plans to persuade manufacturers to "extract the gas" and that then they will have more heat units left over in the coke than they had in the coal. While not saying so in measured words, it gives the impression that HENRY can do what others cannot do. He may aspire toward conservation, but a more effective and immediate step in this direction would be to redesign the Ford automobile engine so that it consumes less gasoline. Mr. FORD is a genius at making cheap cars and selling them, and at getting rich, but thus far we have not heard of his successful efforts at conservation.

The article goes on to say that he will "devote his energies" to reforestation of the timber lands where he has half a billion feet standing, *without cutting down a single tree*. How can he reforest if he doesn't deforest? Without definitely announcing it, the impression is given that the hills are covered with virgin timber. And it is indicated that half a billion feet are ready for harvesting. If that is true the mature trees should be cut. The only value in letting the timber stand would be to teach know already.

Readers' Views and Comments

An Open Forum for Subscribers

The editors invite discussion of articles and editorials in *Chem. & Met.* or on other topics of pertinent interest

Dirt In Steel

To the Editor of Chemical & Metallurgical Engineering

SIR:—I should like to second most heartily Mr. Epstein's plea, in your issue of March 14, for better preparation of specimens before taking micrographs for publication. Almost any sample of steel, no matter how clean, can be made to look dirty like his Fig. 1 by careless work, and the ease with which erroneous conclusions are arrived at in this way cannot be emphasized too strongly. I congratulate Mr. Epstein on his clear exposition of this point and of the importance of stating the magnification, and it is to be hoped that this article will be brought to the attention of every metallographist in the country.

There is just one criticism which I would make of this excellent contribution, and that is that the statement that a pit invariably forms around each inclusion during polishing is exaggerated. Alumina is the only inclusion which has invariably given this effect in my experience. Sulphides, iron oxide and silicates can be polished without the slightest pitting of the steel around them, and in soft, unhardened steel too. The way to accomplish this is to do as much of the abrasive work as possible with dry emery papers, and to reduce all wet abrasion to the absolute minimum, on a cloth like "duck" without too much "nap." The final polishing with rouge is of course a wet process, but need not cause any pitting.

Two photomicrographs are offered herewith as illustrations of inclusions in unhardened steel which show a few pits within the area of the inclusion (this is indeed often unavoidable unless the inclusions are small), but absolutely no pitting of the steel around the inclusion. The boundary between inclusion and steel is sharp and flat, even in the soft steel. In the writer's opinion there is no excuse for any other result where silicates or sulphides are photographed.

It seems rather unfortunate therefore that the Bureau of Standards should have to admit that it is necessary for it to harden its steel samples to reduce the "invariable" pitting around inclusions. Nevertheless it is to be hoped that the main point of Mr. Epstein's article will not lose anything in force on account of this minor detail in which his methods may seem somewhat open to criticism.

GEORGE F. COMSTOCK.

Metallurgical Engineer,
Titanium Alloy Manufacturing Co.
Buffalo, N. Y.

The "Modification" of Aluminum-Silicon Alloys

To the Editor of Chemical & Metallurgical Engineering

SIR:—G. W. Walker's comments in the April 9, 1923, issue of *Chem. & Met.* on a particular case of the modification of aluminum-silicon alloys are concerned with an alloy sufficiently different in composition from that described by the writer in *Chem. & Met.*, Aug. 23, 1922, to account for the difference in structure observed.

Mr. Walker's specimen contained iron 1.75 per cent and manganese 0.26 per cent, against iron 0.70 per cent and manganese 0.01 per cent in the material used by the writer.

It seems quite probable that the structure in Mr. Walker's sample is thoroughly modified and that the needles remaining consist of an iron silicide with possibly some similar manganese compound.

These needles are similar to those shown in Figs. 4 and 6 of the article by Jeffries, *Chem. & Met.*, April 19, 1922, representing an alloy of "approximately the same chemical composition—namely, Si 10 per cent, Fe

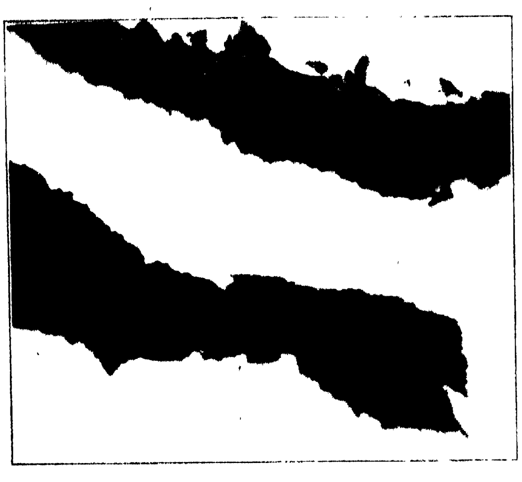


FIG. 1—SLAG IN CENTER OF WEB OF OPEN-HEARTH STEEL RAIL. × 200

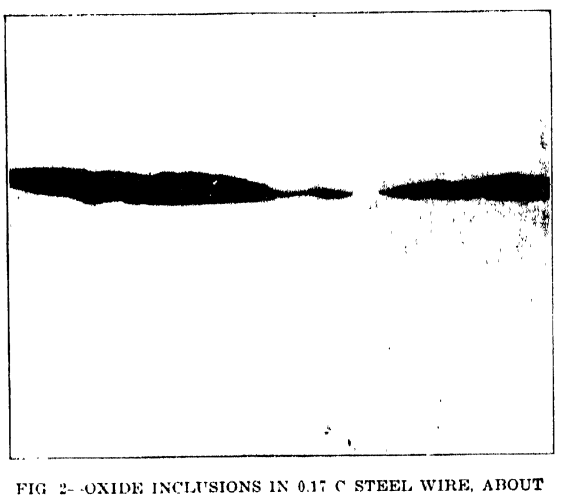


FIG. 2—OXIDE INCLUSIONS IN 0.17 C STEEL WIRE, ABOUT 0.2 IN. DIAMETER. × 200

about 1 per cent." If we choose to consider the "about 1 per cent" as a low estimate, the similarity in both structure and composition becomes more pronounced.

In this connection it is of interest to note in the summary of Jeffries' article: "Iron makes the aluminum-silicon alloys more corrodible and in general weakens and embrittles them." "The greater the amount of silicon used the less is the permissible iron." Also, in a publication of the Aluminum Co. of America, "Silicon-Aluminum Alloys," the following statements and recommendations are made: "The proportion of iron in the alloy should be strictly limited for the best result. Iron forms with silicon an iron silicide, which appears as needles in the microstructure. The modifying treatment has little refining effect on the particle size of this constituent, and its presence tends to reduce the ductility. The alloy as cast should preferably contain not over 0.5 to 0.6 per cent iron." . . . "High-grade ingot should be used in diluting the rich alloy to the required composition, so as to keep the iron content to a minimum. This point is mentioned again, for the highest strength and ductility are developed only when the iron is 0.6 per cent or under, and the rich silicon alloy, although made from a specially pure grade of silicon, may unavoidably contain more iron than 99/100 per cent ingot."

THE HENRY SOUTHER ENGINEERING CO.,
Hartford, Conn JAMES J. CURRAN

The Purpose Of a Standard

To the Editor of Chemical & Metallurgical Engineering

SIR:—Dr. Skinner's article on "Food Standards" is an excellent and forceful presentation of the subject. The fundamental functions of a standard, as applied to chemical products, are also clearly expressed in your editorial. I believe, however, it is worth while to call you attention to the fact that somewhat the same ideas are expressed in the annual report of the director of the Bureau of Standards for the fiscal year ended June 30, 1922. The following paragraphs are pertinent in this connection:

Standards of Quality:

Specifications for material (by description, sample, or both), known as *standards of quality*, fixing in measurable terms a property or group of properties which determine the quality.

The numerical magnitude of each constituent property pertinent to the quality involved, and specific magnitude in units of measure of such significant factors as uniformity, composition, form, structure and others.

Purpose:

To secure ***high utility*** in the *products* of industry by setting an attainable standard of quality.

To furnish a *scientific basis* for *fair dealing* to avoid disputes or settle differences.

To *promote truthful branding* and *advertising* by suitable standards and methods of test.

To *promote precision* and *avoid waste* in science and industry by affording quality standards by which materials may be made, sold and tested.

A standard of quality for a given material necessarily takes into account the purpose for which the material is to be used. To set the standard too low results in losses, poor efficiency and even loss of life; to make it too high may result precisely in the same thing—that is to say, the material must be suitable for the purpose intended, and the bureau's investigations in connection with the properties of materials are to enable the user of these materials, first, to select intelligently the material best suited for the purpose; second, to specify it in terms which the producer cannot mistake; and third, to make the necessary tests to ascertain whether or not the material supplied is in accordance with the specifications.

As you doubtless know, the Bureau of Standards is also authorized to deal with standards of measurement, standard values of constants, standards of mechanical performance, and standards of practice. These subjects are discussed in the annual report cited.

As an outstanding result of the government's work on standardization, it should be noted that the Federal Specifications Board is bringing about the use of standard specifications by all departments and independent establishments of the government for use in connection with the purchase of the more important materials.

The fundamental functions of a standard will depend on the type of standard in question. The annual report of the director of the Bureau of Standards sets forth the fundamental functions of each type of standard listed above. F. W. SMITHER.

Bureau of Standards,
Washington, D. C.

Gas in Monel Metal

The Bureau of Standards has just completed determinations of oxygen and hydrogen in samples representing three stages of the deoxidation of Monel metal. The samples were all from 50-lb. blocks cast during the progress of a regular heat: (1) The metal at the time of tapping the furnace before the addition of any deoxidizers; (2) the above metal after the addition of ferromanganese in the ladle, and (3) the above metal after the further addition of magnesium in the ladle—that is, after all additions have been made. Both oxygen and hydrogen in the metal decreased rapidly with the progress of the deoxidation. The finished metal, as represented by the last sample of this heat and by samples of completely deoxidized metal from two other heats, contains from 0.002 to 0.005 per cent oxygen. All samples appear rather porous under a magnification of 100.

A sample of Monel metal prepared as above, except that a portion of the deoxidation was carried out in the furnace, showed no porosity, and no oxygen could be detected. A sample of Monel metal from a Heroult furnace heat which had been completely deoxidized in the furnace likewise was entirely sound and contained no oxygen. Thus of the five samples of finished Monel metal examined, the three which were deoxidized by addition of ferromanganese and magnesium in the ladle were porous and contained from 0.002 to 0.005 per cent oxygen, while the two which were deoxidized entirely or in part in the furnace were sound and contained no oxygen.

Huge New Government Camera

The largest metal camera in the world is located in the Department of the Interior. It weighs 7,000 lb., occupies two complete rooms, takes a picture 1 yd. square and is operated either by electricity or by hand as easily as a tiny kodak in the hands of a tourist. Reorganization of the Interior Department's photographic activities, now in progress, is centered around this mastodon.

The lens, bellows and copy holder are in one room and the plate holder and dark room in the other. Focusing is done by an electrical contrivance which flashes a signal when the proper focus is reached. The 3½-ton giant was designed by A. H. Linsenmeyer, leading photographer of the Geological Survey of the Department of the Interior.

Technical Developments in the British Chemical Industries

Report of Progress in Radiant Heat Utilization, Use of Refractories, and Industrial Applications of Rubber Latex and Colloid Mill

FROM OUR LONDON CORRESPONDENT

RESEARCHES carried out in Great Britain before the war by Prof. W. A. Bone and the late C. D. McCourt on the flameless combustion of combustible gases when mixed with practically the theoretical quantity of air and in contact with special refractory surfaces culminated in the development of a type of boiler which under suitable conditions showed a thermal efficiency of 93 per cent or more. The boiler has been commercially developed both here and in America and successive modifications have brought it to a form quite different from the original form, in which 3-in. tubes were filled with granular refractory material. At present very large units can be supplied with tubes 12 in. in diameter and 20 ft. long and filled with special iron or brick spirals or other packing taking up very little room but sufficient to produce the radiant heat which gives the tube such a high efficiency and an evaporation of up to 20 lb. per sq.ft.

USE OF RADIANT HEAT

Bone and McCourt also developed a refractory diaphragm, the surface of which becomes red hot owing to the flameless combustion of the explosive mixture of gas and air on its surface. These are likely to have application in the chemical industry and for industrial heating operations generally. Thus the evaporation of liquids by radiant heat thrown down on their surfaces and the heat-treatment of any articles passed through a tunnel kiln or kindred heating or drying appliances should be facilitated and rendered more efficient, particularly as the products of combustion consist almost entirely of inert gases, and if necessary a reducing atmosphere can be used. The more general applications that have been developed so far comprise machinery for the baking of biscuit and the making of confectionery, and grillers and toasters for hotels. Other domestic heating operations and more particularly the introduction of highly efficient domestic gas fires and hot plates are foreshadowed and a modification consisting of a granular bed surrounding the furnace or apparatus to be heated enables metallurgical operations and the melting and heat-treatment of metals to be carried out in a convenient and efficient manner. Almost any industrial gases can be used as well as oil or gasoline, and the convenience of such local applications of radiant heat should be useful in many chemical manufacturing operations. It is understood that Professor Bone is preparing one or two scientific papers for the Royal Society of Arts in connection with the development of these methods.

SPALLING OF REFRACTORY BRICKS

Recent investigations have thrown some light on the considerable variation in the life of high-temperature furnace linings. Failures and short life do not necessarily prove that the bricks used were not up to specification and the spalling or progressive splitting away of the brick surfaces have in some cases been traced to small variations in the sodium chloride and sulphate content of the fuel used. With refractory brick a kind of hard porcelain glaze appears to be formed, which on cooling is liable to lateral cracking or spalling, and the formation of the glaze has been traced to volatilized chlorides and sulphates. The use of a coal the inorganic residue of which contains, say, 18 per cent of sodium sulphate and 2 per cent of sodium chloride may add 10 or 15 per cent to the life of the brick lining as compared with a content of 36 per cent of sulphate and 4 per cent of chloride. The method of firing, quantity of excess air and fire mouth design are not without importance. The best results have been obtained by careful limitation of the salt content of the fuel and by using furnace linings lower in silica and higher in alumina.

PROGRESS IN OTHER TECHNICAL PROCESSES

An interesting possible development in connection with the use of dehydrated liquid rubber latex in accordance with the process mentioned in these notes of February is the possibility of mixing this special product with viscose solution, by which it is hoped to render artificial silk less hygroscopic and more resistant. The idea is similar to the use of liquid latex in paper manufacture, and kindred applications in connection with casein and like products are foreshadowed.

The concerns exploiting the colloid mill appear to be developing a more rational selling policy and progress is reported in certain directions such as the intimate mixing of water with tar or bitumen, partly for spreading on roads and also for watering them in dry and dusty weather. It is claimed that with a very small proportion of tar suspended in the water, evaporation is so slow that watering is not again required for several days, and the method employed is to take a relatively concentrated suspension and mix this with a large bulk of water before spraying.

A firm in Manchester is now carrying out extensive experiments on rubber roadways using slabs of rubber 2 in. thick and weighing about 600 lb. The slabs are reinforced with steel bars and their surface is corrugated. The slabs are set on a concrete foundation with tar joints.

GENERAL NEWS AND NOTES

The organization of the chemical exhibits at the British Empire Exhibition, Wembley Park, near London, to be held next summer, has already begun and it is understood that Mr. Woolcock, general manager of the Association of British Chemical Manufacturers, is likely to be one of the principal organizers. In spite of the heavy cost involved, this exhibition is expected to be an important factor in the industry and the most elaborate preparations are to be made for the accommodation and convenience of overseas visitors.

Chemical engineering education seems to be the latest vogue and the Ramsay Chair of Chemical Engineering at London University is now open. Liverpool is likely to follow and the newly formed Institution of Chemical Engineers, which has just held its first corporate meeting, is likely to play an important part in promoting and advising upon recognized courses in chemical engineering.

Among recent nominations to the Royal Society may be mentioned Prof. J. W. MacBain, professor of physical chemistry at Bristol, who was among those visiting the United States last year.

What Chemical Technology Has Done in the Shoe-Manufacturing Industry

Comparatively Recent Invasion Has Resulted in the Development of Many New Raw Materials of High Quality as Well as Profitable Byproducts—Improvements in Standard Processes Making for More Efficient Production

BY STANLEY P. LOVELL
Chief Chemist, George E Keith Co., Brockton, Mass.

ABOUT a decade ago chemistry invaded the shoe-manufacturing industry. The assault was of such meager proportions that it provoked only general mirth in the strongly intrenched shoe world. The making of footwear centers in and about Brockton, Mass., and although many other focal points of the trade exist, nowhere is the technique nor the high art of the Brockton district maintained. When the cult of scientific management swept American industries, it made no impress on the shoe business. That was already organized and specialized to an extent not found in any other fabricating art. Two hundred and thirty-six separate operations converge to make the finished shoe. Thirty-two separate crafts supply the shoe artisan with his materials. The method of shoemaking is furthermore so tangible, so apparent to eye and hand, so obvious in its gradations, that the mere thought of chemistry having a place in its craft or contributing anything of value to its product was somehow a capital joke.

If you will consider the primitive sandal or slipper, you will recognize it as an assemblage of three elements—the sole, the cap extending over the toes and receiving the forward impetus (now called the "box toe") and the support around the side wall of the heel receiving the backward impetus (now called the "counter").

THE FIRST CHEMICAL SUBSTITUTE

It was with the last two articles—the box toe and the counter—that the original chemical approach to the shoe industry concerned itself. Both were made from sole leather by separate companies that specialized in these parts and had brought them to a high degree of fabrication. Although sole leather had been the material used for these stiffening parts of footwear, it was apparent that it possessed inherent defects. When exported it would not stand the heat and humidity of the hold of a ship; it was easily attacked by the ordinary mold and maggot growths; and it was softened by but not soluble in water, thus losing when wet the delicate lines of the shoe last.

The method used to demonstrate these weaknesses of sole leather to shoemakers has possibly more so-called "human interest" than chemical interest, but it is nevertheless presented for what it is worth. A negro coal-heaver in the yard was asked to wear a pair of white socks for a week. These socks had been boiled in castile soap, rinsed repeatedly in distilled water, then extracted in alcohol and ether. After a week's wear, the socks were finely comminuted and extracted in a Soxhlet apparatus for water solubles, which were found to be as follows: Urea, sodium chloride, formic and butyric acids (trace).

Then into a concentrated solution of these substances was immersed a No. 1 grade sole-leather box toe, every substitute material on the market and a new product which proved to be the initial answer of chemistry to this problem. In 60 hours the materials were all destroyed except the chemical product, which was a mixture of cotton-wool fiber and nitrocellulose of the following composition by weight: Pyroxylin (nitrogen content 11.1 per cent), 81 per cent, and cotton-wool fiber, 19 per cent. From this indication of adaptability the use of nitrocellulose in one form or another has grown to the sizable amount of 2 tons a week.

A UNIQUE SOLUTION OF A CHEMICAL PROBLEM

It was soon found that the product must conform itself to the established time of shoe operations. In order to change the pyroxylin to a plastic condition it had to be treated with a solvent and the time required to soften the box toe or counter blank when made with any of the familiar solvents was found to be too great. How to make a nitrocellulose blank relatively instantly soluble throughout was a desperately serious problem and promised to bring to ruin all our fine hopes of success. This problem we met by a unique treatment. Always previously it has been the endeavor of persons skilled in the use of pyroxylin to condition their product so that precipitation of the film (so-called "blushing") did not occur. To this end the name of John H. Stevens will always be famous. For this purpose some makers have even frozen out the entire moisture content of the air in their factories in order to insure against precipitation from atmospheric moisture.

Reversing this line of thought, we first impregnated

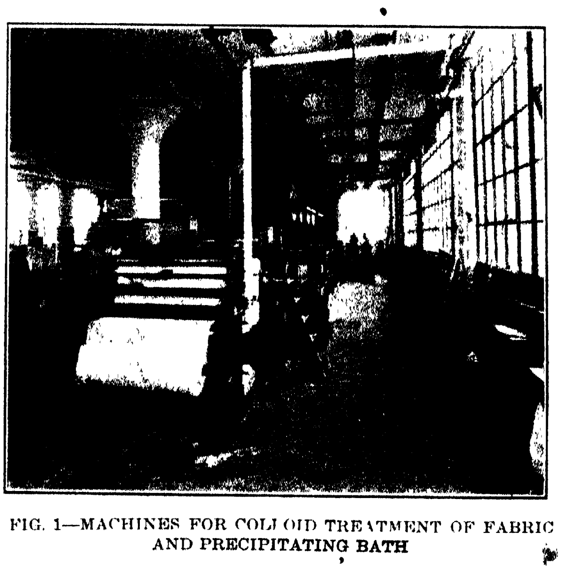


FIG. 1—MACHINES FOR COLLOID TREATMENT OF FABRIC AND PRECIPITATING BATH

our fabric skeleton or vehicle with pyroxylin in a water-miscible solvent, then immediately passed it into a precipitating bath. The precipitation, which at first is a mere surface condition, gradually penetrates throughout the sheeted material. Under a magnification of 300 diameters it shows itself to be composed of precipitated colloidal aggregates of the average diameter of 7μ. This gives a material of very high capillarity, there being countless ducts or capillary avenues opened from the former film surface to the center of the goods. This allows an immediate entry and instantaneous dispersion of the solvent into which the blank is dipped. In turn a flaccid, limp condition is produced, which with no appreciable loss of time allows the piece to be lasted and will faithfully reproduce every contour of the wooden last.

Thus we met our first obstacle of instant solubility by simply precipitating our nitrocellulose so finely that it was open to solvent action from every side of its vastly increased surface.

FIG. 2 ONE CORNER OF A BATTERY OF DIGESTORS

A web treated with precipitated colloid is to be seen winding up in the background.

Lowering Production Costs

The chemist and chemical engineer has at his elbow daily, hourly, the problem of putting production costs on an economical, competitive basis. Viewed with an unprejudiced eye, all leather is a byproduct of the production of foodstuff. It is for the meat, not the skin, that a Calabrian goat, an Indian cow, an American or pampas steer is grown. Therefore the skin, which must be removed to make the meat marketable, will either be allowed to decompose or will be preserved by such chemical agents as tannic acid, chromic acid, formaldehyde or alum and salt. Thus it follows that the skin or hide in the form of leather can be sold and would be sold at only a nominal profit over the cost of preserving or tanning should a synthetic chemical product be developed that would threaten to replace leather in industry.

Costs must be reduced to a wide margin under the production of leather. Seen from this angle, it early became important that the solvents used in the production of our precipitated sheet for box toes and counters should be recovered for re-use. Recovery was made relatively easy by the fact that these solvents, passing directly to a miscible precipitant, were never allowed to leave the vapor phase. By keeping them always as liquids even at extreme dilutions of 5 per cent, two ends were met:

(1) Their economical and continuous distillation was made possible without scrubbing towers, refrigeration or all the paraphernalia of the gas-to-liquid change.

(2) The fire and explosion hazard was reduced to a point where factory-scale production was practicable.

This twofold recovery advantage was not achieved without bitter experience with alcohol vapor—an experience which ended in an explosion of almost fatal proportions.

Camphor a Byproduct

It developed that pyroxylin plastics (such as celluloid, etc.) of good quality were preferable to straight nitrocellulose. The problem of a uniform raw material was solved by the easy scheme of "averaging out"—that is, the plastics were used in such large amounts that the variation in nitrogen content or in camphor content were averaged to a constant factor.

If you will retrace the steps taken to that stage where the colloid is precipitated in and on its fibrous base, you will see that if the solvent used is, for example, acetone and the precipitant is water, a relatively high acetone layer will surround the sheet as it passes through the bath. Into this stratum the camphor diffuses with a constantly increasing tendency to precipitate as it reaches greater dilutions of acetone. Eventually it becomes suspended like the casein suspension in milk, although scarcely colloidal. As the total volume of weak liquor passes into the base section of our continuous still the camphor passes up through the column to a point of maximum concentration. Fortunately this does not occur at the higher acetone or alcohol concentrations where the column might become obstructed and serious consequences result, but at the narrow range of 65 to 69 per cent acetone or alcohol. From these decks it is extruded at high velocity into a water jet of equal force, the impact throwing out the camphor as flowers of camphor. For ordinary use it is a commercial product at this stage, but for pharmaceutical uses it must be sublimed. Many tons of this grade of camphor have been absorbed by the American market. It is a highly important byproduct of our business.

One phase of this work has baffled the writer for many years. In the precipitating bath the urea or other antacid stabilizer must of necessity be completely removed by washing. Samples of the colloid-treated fabric show no trace of urea and the theoretical urea content is nicely balanced by the ammonia-carbon dioxide gases produced under the conditions of distillation. Nevertheless, samples of the product manufactured in 1915 and subsequently show no signs of decomposition, nor has the development of free acid in the nitrocellulose so precipitated ever been observed. Perhaps it is possible that the fact that urea has been there is sufficient to maintain stability almost indefinitely.

All of the camphor is not removed, between 5.1 and 9.3 per cent remaining in the sheet material entrained in the colloid. This has a most unexpected and desirable result. Being a remarkable insecticide, it prevents bacterial growth with mold and maggot formations not only in the box toe and counter but in the whole shoe as well. This is of first moment in the export of American shoes to sub-tropical countries and to the Orient.

The solvents used to colloidallize the finely precipitated celluloid just before its incorporation by the assembler in the shoe were various ethyl esters. These

solvents developed a most serious fault. The footwear would leave the factory in excellent condition, but upon being worn would develop a very disagreeable odor—not the pleasant fruity smell of the ester, but an offensive odor highly discreditable to the wearer. We found that when warmed repeatedly to 30 or 35 deg. C. the residual deposit of the solvent gave off the same odor. Nothing will more quickly stop the sale of footwear than this trouble. Furthermore, the factory operatives were finding the solvent unpleasant to work with and in the confined, close application which shoemaking compels, it would soon have proved a serious health hazard. Worden truly observes that the pyroxylin arts expand only as solvent knowledge grows.

It was imperative, then, to find a solvent of nitrocellulose that would have no appreciable odor under working conditions nor a residual odor in the shoe. After a prolonged research we found our answer in diacetone alcohol. This chemical, with a boiling point of 163 deg. C. and a specific gravity of 0.924, is miscible in all proportions with ethyl and methyl alcohol, acetone, benzol, water or any of the common esters. It is expressed chemically as 4 hydroxy-2 keto-4 methyl pentan. It leaves no residual odor and its rate of evaporization is so slow that it cannot be detected by smell in the workrooms. By diluting it, a degree of softening or solution may be maintained in the box toe for any desired length of time, thus allowing the product to conform to any established usage or schedule in shoemaking.

FIG. 3—CONTROL AND RESEARCH LABORATORY IN A SHOE FACTORY

No investigator seems to have observed that it is the only solvent of cellulose esters that has at once a high boiling point, is miscible in all proportions with water and leaves no residual odor. Most books of reference on applied chemistry such as Watts, Thorpe, Olsen and the Condensed Chemical Dictionary do not cite it. To those industries where the odors invariably associated with cellulose esters have been handicapping factors diacetone alcohol should prove of great value.

We erected and operate a large plant for the production of diacetone alcohol. Its manufacture by the polymerization of c.p. acetone is expressed by the following equation:

$$2CH_3{\cdot}CO{\cdot}CH_3(+\text{ Catalyst}) \rightarrow CH_3CO{\cdot}CH_2{\cdot}C(CH_3)_2OH$$

Since the balance between the c.p. acetone and diacetone alcohol produced in the presence of the catalyst is in direct proportion to the temperature and greater at lower temperatures, the utilization of sulphur dioxide or ammonia refrigeration is strongly indicated.

The catalysis building shown in Fig. 4 has a daily capacity of 600 gal. of diacetone alcohol of specific gravity 0.910. Sufficient water is used for condensing to warrant two artesian wells which deliver an unlimited supply of water at 10 deg. C.

The box toe and counter produced are waterproof, sweatproof and safe against the ordinary forces of destruction. They have the peculiar property of resisting distortion. This true elasticity retains the lines of footwear in a way never before possible.

Chemical technology having met with tolerable success in the make-up of a shoe, the same approach was tried on the innumerable items applied to the outside of a shoe. These comprised dressings, polishes, waxes, inks, washes, etc., to a degree of complexity fairly confusing. We now manufacture over one hundred and thirty separate materials of this sort. All were subjected to analysis, made interesting because the method of analysis had first to be worked out. Many weird combinations were unmasked, but on the other hand many combinations were shown to possess a high degree of observation and skill.

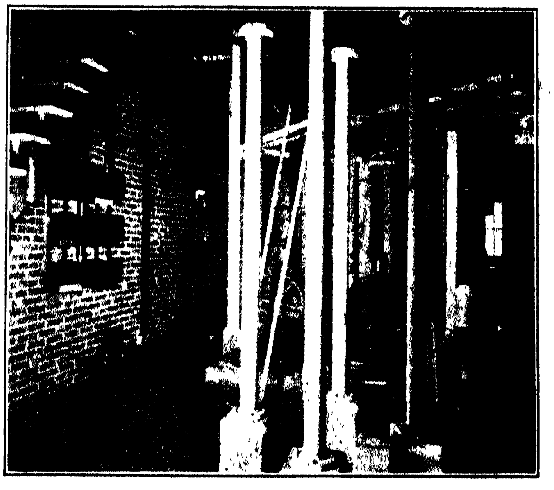


FIG. 4—CATALYSIS BUILDING WHERE 600 GAL. OF DIACETONE ALCOHOL IS PRODUCED DAILY

I strongly advise any industrial chemist who scoffs at rule-of-thumb products (and I am one) to make a water paste for shoe use. I have a record of over three hundred experiments before satisfactory results were obtained on this product. That with so little understanding of the nature of their materials the non-technical men can accomplish so much will always be a source of wonderment to me.

I think it is conservative to say that chemical engineering has a place even in such an apparently barren field as shoemaking. It has led to one of the large uses for pyroxylin, it has produced diacetone alcohol on a basis never before attempted and it has made camphor a small byproduct of shoes. But more than that, it has allowed the production of a better shoe than before chemical technology entered shoemaking, and that is the test of its worth.

The Incidence of Research On the Baking Industry

Pioneering Work in the Application of Science to a Successful Commercial Enterprise

By Ellwood Hendrick
Consulting Editor, Chem. & Met.

THE penetration of the industries by science is sometimes along curious roads, and it is well to bear in mind that these are often in their beginnings far from academic. The active research that has developed within the baking industry during the past few years induced us to visit the Ward Baking Co.'s establishment in New York, to note the incidence of research upon this ancient domestic art, to inquire into the way in which it was begun, what problems are pressing and what fields are tempting them toward further study. We selected the Ward company because we knew them to be progressive and also that the president of the corporation had been an active supporter of research for a number of years. It was done with no unfavorable reflection on competitive baking establishments.

We found a large bakery operated under laboratory cleanliness, with standard machinery which we shall not attempt to describe, because such details are available elsewhere. Two laboratories are maintained, one for control that is predominantly chemical, and a separate research laboratory in which biochemistry leads. About twenty-five chemists and biologists are employed constantly.

The central control laboratory functions for the company's various bread and cake bakeries, of which there are seventeen of the former and nine of the latter in different localities throughout the country. This calls for over 20,000 analyses or tests per year. The capacity of the bread bakery attached to the main office in the Bronx in New York City is over a quarter of a million loaves a day.

Beginning of Baking Research

The beginning of research, which has continued to be coincident with the progress of the company, is an instructive tale. The president of the concern was a hard-working neighborhood baker in Allegheny, Pa., and he was so diligent in extending his trade that he became pressed for funds. His bank of deposit would not increase his credit, and a second bank visited felt in the same way. Then, unknown, he called at the Mellon bank in the hope of securing an accommodation of $10,000. He saw the present Secretary of the Treasury, Andrew W. Mellon, and told him his story. Mr. Mellon surprised him with a more complete report of his standing and business than he expected him to have, and said he didn't see how $10,000 would solve his problem. The banker figured the situation over, and it did not look promising. What the baker really needed was about $25,000. So Mr. Mellon declared that he couldn't see his way clear to lending him $10,000 although if he wanted $25,000 he could have it. That was a jolt up rather than a shake down, and it will be easily understood that from that time forth George S. Ward was a frequent visitor at the Mellon bank.

Then came the organization of the Mellon Institute of Industrial Research at Pittsburgh, and by this time Mr. Ward had prospered. He had bakeries in various cities—in Pittsburgh, Chicago, New York, Cambridge, Mass., and elsewhere. Mr. Mellon was full of enthusiasm for the Research Institute, and the prosperous baker had enthusiasm for Mr. Mellon's opinions as well as a sound belief that whatever happened must be due to a cause and if the cause lay hidden it was his business to look for it. He started with an open mind toward and a prepossession in favor of scientific research. He already had laboratory control of his various bakeries. This fact is the text for a longer sermon than we have the space to preach. Without at least one successful man in an industry who has an abiding faith in the value of scientific research there can be no real beginning. The baking industry was one of the last of the major industries to come under scientific control, and yet its present rate of progress is remarkable.

The First Problem

In later years laboratory control has developed important refinements, but even then the flours were tested for gluten, moisture, ash, etc., and several bakings were made to obtain uniform results. Flours differ according to their origins and according to the year in which the wheat is grown. Some require long mixing, others short, some long and others short fermenting, and some long and others quick baking and the like. Yeast also requires constant testing. But with the same flour, the same yeast and the same apparatus and methods, the bread from one city differed from that baked in another, and the reason for this was a problem in research.

There had been a research fellowship in bread baking established at the University of Kansas by the National Bakers Association before Dr. Duncan left there for Pittsburgh, but this had been allowed to lapse. The problem before the baker as patron of research was the contumaceousness of that bread which should have been the same, whether made in Cambridge, Mass., or Pittsburgh, Pa.—but wasn't. He applied for one of the early fellowships of the then new Mellon Institute and Dr. Duncan was ready for it with Drs. Kohman and Hoffman, who have not quit the study of baking from that day to this. Investigation began with comparison of waters used, and their differences showed their effects mainly on the yeast, which responded quickly to differences of salts in solution.

For maximum health and growth yeast needed more nitrogen in simple fixation, more calcium and other mineral salts than are available for it in ordinary dough. It was also discovered that when these usually delinquent salts are added to the dough, the yeast grows so lustily and acts so vigorously that only one-half the amount of it is needed to produce the same or even better bread. Experience shows that by using the mineral salts in the dough a saving is made of one-half the amount of yeast, one-sixth the amount of sugar and about 2 per cent of the flour. The yeast food mixture was patented and named "Arkady" after the initials of Dr. Robert K. Duncan, the director of the Mellon Institute, and it has now come into general use in the baking industry. The owners of the patent make it in carload lots in their New York bakery, and they have additional factories in England and Canada.

The Fight Over Yeast Food

But improvements have hard sledding when they are introduced. Trouble arose in one commonwealth where the gifted statesmen of the Legislature took a hand and assumed a firm stand against any effort to "cheapen"

the staff of life. They knew from their blessed mothers and the faithful wives of their manly bosoms that only certain ingredients should be used in making bread, and they passed a law that said so. Otherwise each loaf was to be labeled as containing in the original mix whatever was not indicated in the statute as proper. Calcium sulphate, for instance, was an important factor in this yeast food, but inasmuch as it was not recorded in the law, it had to be mentioned in the label, along with potassium bromate, ammonium chloride, etc. Despite the fact that calcium salts are sorely needed in human nutrition and that human diet of today is often inadequate in this respect, it shocked the lawmakers to think that there should be such a thing as lime in bread. Soon the fight was on, although bread so baked and labeled continued to sell. The legislative plan was to educate the public down to its own level —rather than to educate it up; but this time it did not work. Then a law was proposed forbidding altogether the use of yeast food in baking, but this was defeated, and finally the fight was won. It took time and vigorous effort and money for lawyers. Today yeast food is in general use, and even manufacturers of yeast whose sales are decreased by it recommend it because it reduces complaints about this product to a minimum.

An old and serious trouble in baking is the occasional presence of "rope," or stringiness, in bread. It is due to an organism present in all flours, but more abundant—and therefore worse—in some than in others. We understand that the defect has been practically overcome by the proper control of the p_H values in the dough.

In the course of time the more progressive bakers recognized the value of research, organized the American Institute of Baking, first at Minneapolis and now located at Chicago, under the competent supervision of Dr. H. E. Barnard. But private research for the Ward company continues also at the Mellon Institute in Pittsburgh, under Dr. Kohman, and in the laboratory of the New York bakery under Dr. Hoffman.

Food Value and the Vitamines

Bread making has only so lately entered into the domain of science from rule-of-thumb control that it fairly bristles with questions. For instance, bread is a food, but how much of a food is it? This was the beginning of a long work at research by the Ward company, from which, in the end, positive results of an interesting character were achieved. It was found that a good bread is adequate in carbohydrates, but deficient in protein, mineral salts, especially lime, and in all three vitamines. Quantitative determinations were made. Whole wheat bread, it was observed, adds vitamine B from the bran and wheat germ contained in it, and it is adequate in carbohydrates, but research proved it to be lacking in other respects. Experiment demonstrates it to be an incomplete food, although better than an ordinary white bread.

Now the major purpose of this research was to make a bread at once good, and at the same time having a maximum nutritive value. It is easy enough to throw a number of nutritive ingredients into a dough that will serve as a "complete food," but when it is baked it will be more of a dog biscuit than a bread.

The problem was to provide, as carrier of these exceptional nutritive values, a fine, tasty and attractive loaf of white bread. This involved thousands of feeding tests as part of the work. Another step was the extraction of the germ of the wheat, which is ordinarily discarded in white flour, and this involved a new process and finally a separate plant equipped at large cost at Warren, Ohio. The final loaf is made far richer in milk than ordinary bread; it contains the germ extract that is as rich in vitamine B as the best brewer's yeast, and it contains abundant mineral salts, which are greatly needed for the maintenance of health and for healthy growths, even to the extent of the slight but requisite amount of manganese.

Feeding Experiments

The final loaf is white, looks and tastes rather like home-made bread, and it is already in active demand. It is not only rich in vitamine B but carries enough of the A type to support life, growth and reproduction. Ordinarily the vitamine A is provided by spreading bread with butter, but this bread also contains a supply from the extra whole milk. Tests made with white rats and white mice show remarkable results with no other food than this new, enriched bread and water. With any other type, including the best whole wheat bread, as the sole diet with water, they fail to grow, fail to reproduce and in time starve for lack of one or another kind of nutrition. With this new bread as sole diet, growth is vigorous and healthy, and already a fifth generation of white mice that, beginning with the first, have never had any other food, is thriving and growing normally.

Observations are now being made and recorded of children from pre-school age up to adolescence who include this bread in their diet, compared with those who do not. While results are not ready for publication, they appear to confirm the animal feeding experiments already made, and promise to add materially to our knowledge of nutrition. One point we are allowed to mention is that less meat seems to be desired along with this special bread than if ordinary bread is eaten.

Large Quantities of Copper Imported

In *Commerce Monthly* it is reported that large amounts of copper have been imported into the United States in the form of ore, matte or blister copper, the smelting and refining of which are done in this country. Imports from Chile have shown a remarkable gain from pre-war years, when they were very much less than those from Mexico, Canada, Peru or Spain. During the past few years they have constituted more than one-third of the total imports.

Shipments from Peru and Cuba have also increased. Peru sends chiefly blister copper, while most of the Cuban shipments are in the form of ore and concentrates. From Japan and Australia, however, a very much smaller quantity has been imported recently because of the decline in production in those countries. Mexican and Spanish imports have also declined. From the average rate for the first part of the year it appears that Canadian shipments in 1922 were as large as before the war. Most of the copper was in the blister form.

Of the total imports in the first part of 1922, 53 per cent was blister, 21 per cent refined, 14 per cent ore, 6 per cent old copper and clippings and 4 per cent concentrates. Imports of matte constituted the remaining 2 per cent. Composition metal in which copper forms the chief value amounted to only 0.2 of 1 per cent of the total.

A Modern Tar Distillation Plant

A Description of the Plant of the American Tar Products Co., in Chicago, Illinois, an Example of Permanent and Conservative Design Which Warrants Study

BY WILBERT J. HUFF
Chemical Engineer, The Koppers Co.

THE Chicago plant of the American Tar Products Co., which commenced operation for the first time only a few months ago, undoubtedly ranks as one of the leading, if not the very first, merchant tar plants in the United States. A brief description of its salient features will be of interest to those who are engaged in this and related industries.

The plant was built by the Koppers Co., which has installed several other tar distillation plants for the American Tar Products Co. It is situated on a 35-acre tract at South 52nd Ave. and West 39th St., directly south of the once famous Hawthorne Race Course, and immediately north of the Chicago & Illinois Western R.R. and the Chicago Drainage Canal. The plant of the Chicago By-Product Coke Co., at present the chief source of the tar distilled, is east about one mile, in plain view across the prairie. Switching facilities are provided both to the C. & I. W. (a belt line) at the south and to the Illinois Central (a trunk line) about 1½ miles to the north. Should the proposed development of the drainage canal occur, service to any plant on the Chicago waterfront will be available by barge.

Only about 20 of the 35 acres are at present occupied; and the arrangement of the equipment upon these 20 acres is such that the inevitable expansion of the plant may proceed along orderly lines until the entire 35 acres can be occupied, without necessitating the misplacement of any part.

The general plan of the present plant is shown in the accompanying diagram (Fig. 1). The observer, upon first entering the plant, will be impressed not only with the systematic plan and convenient arrangement, but especially with the quality and permanency of the equipment. The construction throughout, save of the barrel shed, is of brick and steel, with concrete foundations and cement floors and platforms; and all shipping and receiving wharves and platforms are elevated to car level. The exposed brick surfaces are buff and yellow. All elevated platforms, walkways, ladders and stairs have been designed and erected in accordance with the best practice as regards safety.

Before considering in detail the component parts of the plant it may be well to recall the general technology of tar distillation. This was discussed by the writer in this journal recently,[1] accordingly only a brief mention is warranted here. Coal tar, the primary condensation product from the carbonization of coal, is a complex mixture chiefly of aromatic hydrocarbons and tar acids, with small amounts of tar bases, organic sulphur compounds, variable amounts of so-called "free carbon" and other materials. Some water is also present.

As produced these are so thoroughly incorporated that it is necessary to resort to a process of fractional distillation in order to effect separation. This process the writer has shown diagrammatically in the accom-

[1]*Chem. & Met.*, vol. 26, No. 3, Jan. 18, 1922

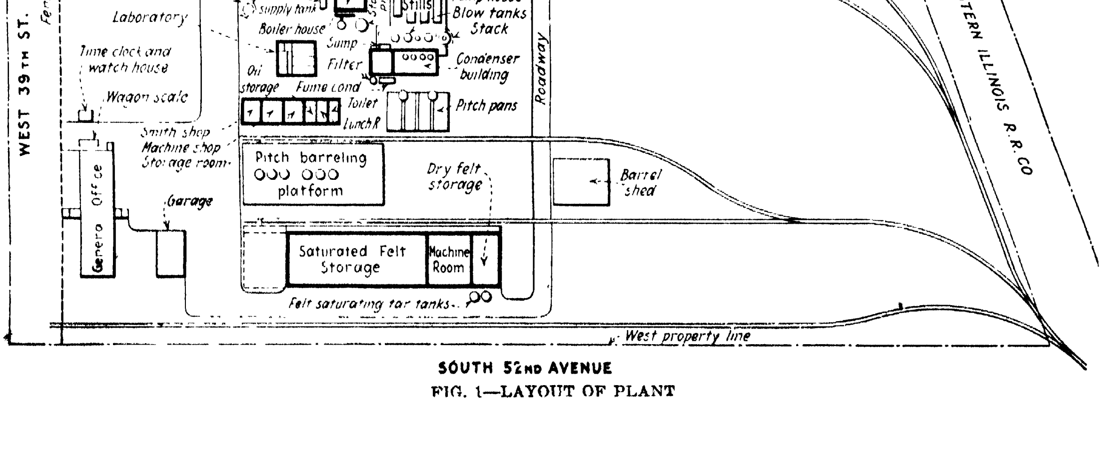


FIG. 1—LAYOUT OF PLANT

panying sketch (Fig. 2). The residue remaining in the still, generally amounting to over 50 per cent of the raw tar and sometimes as much as 70 per cent, is the familiar bituminous aggregate known as pitch. Depending upon the amount of oil removed, it may be soft or hard; and if only a little oil is removed, it may be called merely a refined tar.

Handling of Tar

Procedures are, of course, modified to meet varying local conditions. Thus, if the water content of the coal tar available is low, it is not always necessary to subject it to a preliminary dehydrating process. Instead the raw tar is often charged directly into the still and the water removed by cautious firing. Not all of the fractions need necessarily be taken. The number is determined by the kind of residue which must be produced, and as the character of this is varied to meet the wishes of the purchaser, so too the character of the distillation must be varied. Nor are all the products shown necessarily manufactured. Thus, while at this

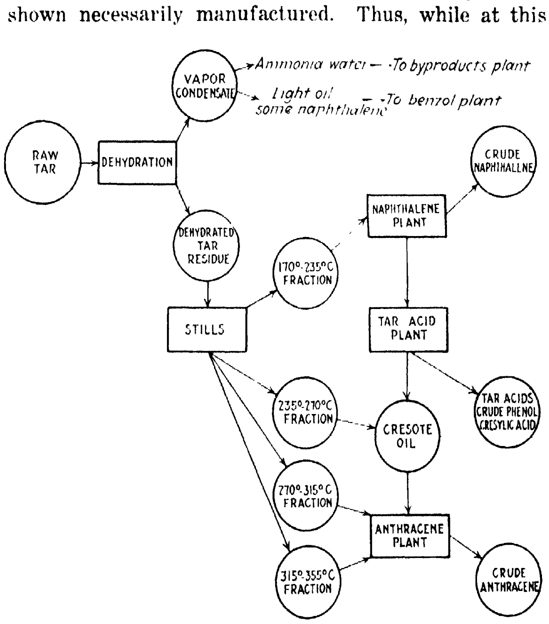
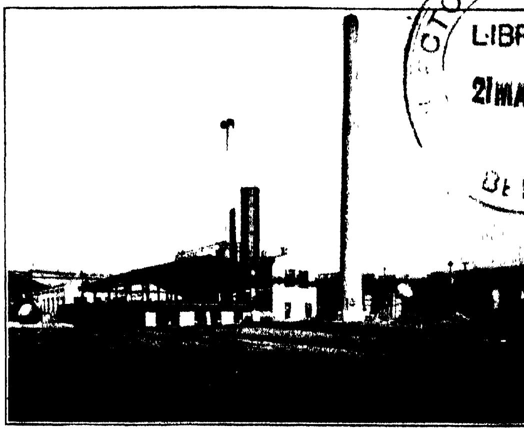


FIG. 2—FLOWSHEET FOR TAR REFINING

plant provision has been made for the future recovery of anthracene, naphthalene, tar acids and other materials from the distillate oils, and detailed drawings and specifications for the buildings and equipment have been prepared, construction has not yet begun, and the distillate oils are not treated further here.

The tar is brought to the plant in a tank car. Here it is placed over one of three concrete sections of the unloading pit, where it is emptied by gravity through the bottom cock. Each section holds 10,000 gal., so three cars can be unloaded simultaneously without calling upon the tar pumps. These are two in number, steam driven, all iron-fitted duplex pumps, having a capacity of 20,000 gal. per hour. They are situated in a pump house adjacent to the tar unloading pits and are mounted on a floor depressed about 6 ft. below the yard level. Connections are provided so that the pumps may be applied as needed in the transportation of tar from the unloading pit to the tar receiving tanks or to the tar storage tanks; and for pumping tar to the stills, to mixing tanks and to cars. A large amount of water-gas tar is produced at the plant of the Chicago By-Product



GENERAL VIEW OF PLANT—PITCH PANS IN FOREGROUND

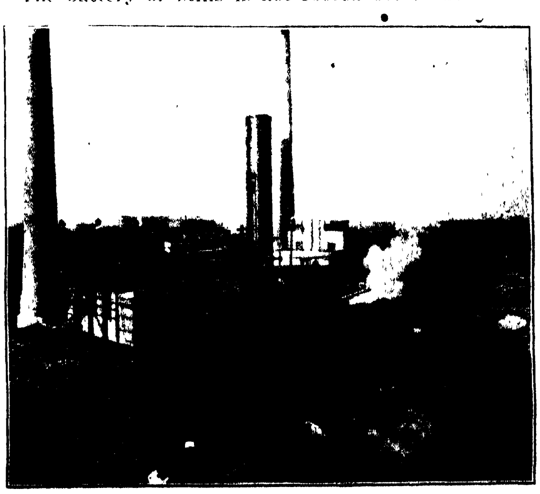
Coke Co. and much of this is re-handled here. The car-loading appliances (swing pipes with swivel joints), three in number, are located just east of the unloading pit and so placed that three cars can be loaded without shifting.

Distilling Tar

Tar for distilling is pumped from the appropriate tar tank to any one of the stills which are grouped in battery. They are mounted in brick settings with underground concrete and brick breeching leading to a 130-ft. brick stack and are equipped with grates of the rocking type for coal firing by hand and burners for firing with liquid fuel when such firing is economical. Coal is brought up to the stills in the railway cars and is discharged from an elevated track, parallel to and in front of the firing doors. This same track also serves the boiler house, adjacent to and north of the stills. The concrete floor from the stills and boiler house extends under this track. A concrete wall parallel and east of the track retains the discharged coal upon this floor.

From the stills may be seen two other details which further illustrate the attention and care expended in the construction and management of the plant—a concrete subway affording convenient passage under the fuel track, and the practice of painting different pipe lines in distinctive colors.

The battery of stills is not roofed over. This dim-



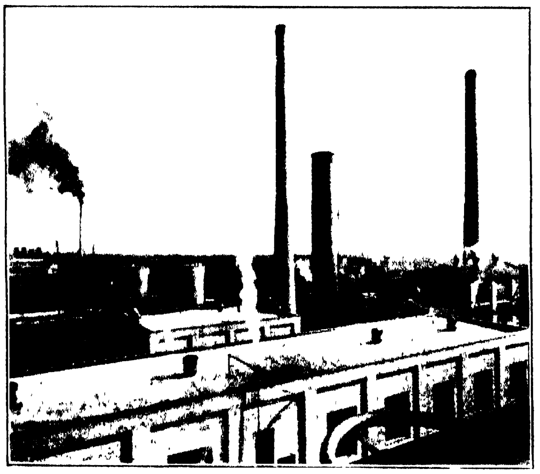
TANK CAR LOADING AND UNLOADING
Stills, pumphouse and standpipe in background.

inishes the fire hazard, for experience has shown that fires are much less serious when no overhead roof deflects the flames from one still to another. The firemen, however, are well protected by a corrugated steel roof extending over the firing floor, and access to manholes and connections on the top of the stills is rendered convenient by railed steel walkways and two steel stairways, one on each side of the battery. Provision is made to facilitate cleaning of the stills. The tar used, however, has so far shown little tendency to deposit objectionable material, and this cleaning consequently has been very simple. A special sampling winch is mounted above each still, for the stills are designed and calked to withstand a vacuum of 26 in. of mercury, and special provision must be made to permit sampling without breaking this vacuum. Each still is equipped with safety valves so piped that such of the still contents as may blow over is discharged into a sump about 60 ft. distant from the nearest fire door. Provision is also made that the contents of any still may be diverted from the usual receiving tank to this sump.

Condenser House

Between the battery of stills and the condenser house are pitch blow-tanks, measuring and mixing tanks. All blow, storage and receiving tanks, wherever situated, are equipped to permit easy access. Every large tank is provided with hand rails and is accessible by wide, easily scaled stairs and walkways. Above the pitch blow-tanks extend four insulated condenser lines from the still domes to the condenser house. Here they enter four elevated coil condensers of equal size. At the discharge of every condenser is a receiving tank, divided into two compartments, each of which may be completely cut off from the other. The condensate may be directed into either of the two receiving compartments at will. This permits easy fractionation under vacuum, as one compartment may be cut out and drained under atmospheric pressure while the vacuum is carried on the other.

Each compartment is equipped with an indicating device to mark the oil level and a manhole to permit easy cleaning, and is piped so that it may drain by gravity into any one of the run-down tanks, which are of various capacities to suit the size of fractions being made. Provision is made for easy access to all parts. Two independent sets of pyrometers, operating and master, are mounted so that their dials may be read from the platform that commands the four receiving tanks. This permits the operator to follow simultaneously the pitch and vapor temperatures, and the volume of oils condensed.



SHOPS. TANK FIELD IN BACKGROUND

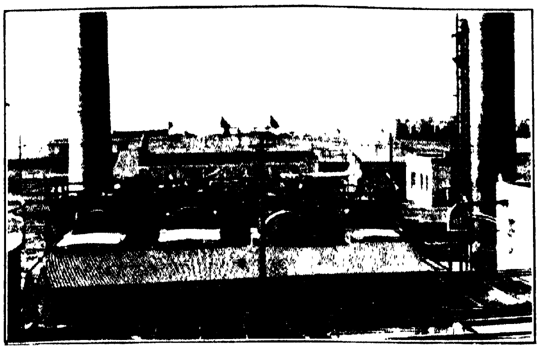
TAR AND CREOSOTE STORAGE TANKS

The condenser house also provides protection for two steam-driven air compressors; two steam-turbine exhausters, so piped that any uncondensed vapors from the receivers carried by these exhausters are expelled into a secondary condenser; two steam-driven, all iron-fitted, duplex oil transfer pumps, and one steam-driven duplex emergency pump. Provision is made so that the final stages of the distillation may be completed under vacuum, or by the aid of steam or air agitation, if desired.

The Power Equipment

North of, and adjacent to, the battery of stills is located the boiler house, containing two 250-hp. Stirling boilers, of which one is in daily use, while the other is held in reserve. These are both arranged in one setting, and are supported on a structural steel frame independent of the setting. At present they are equipped with non-dumping rocking grates for hand firing, but are set at such height and arranged so that chain grate stokers may be installed at some future time. The foundations are also arranged with ashpit and tunnel to facilitate such installation. In times of coal shortage, these boilers may be fired by liquid fuel pumped from a tank north of the boiler house through an overhead return system running parallel to the fuel track and extending to the southern end of the battery of stills. Provision for steam heating the liquid fuel to diminish its viscosity is made. The liquid fuel consumed is metered. Draft is provided by means of a 150-ft. stack. The boilers are fed by two steam-driven duplex feed pumps and are provided with an open type feed water heater.

An extensive equipment for protection against fire is provided. Capacity and auxiliary water pressure is obtained by means of a standpipe about 90 ft. high and 15 ft. in diameter located just south of the boiler house stack. This is divided into two compartments by means of a partition 60 ft. above the ground, and the top compartment is held full in reserve for fire, while the lower compartment serves as a general service water supply. In the boiler house is located the fire pump—a standard



STILLS AND CONDENSER HOUSE

duplex fire pump having a capacity of four standard fire streams. Six twin fire hydrants are located at advantageous points about the plant, and five 250-ft. lengths of hose are distributed in convenient boxes. In addition, hand foamite and carbon tetrachloride extinguishers are located in the buildings.

Oil and Pitch Handling

From the oil run-down tanks, the distillate oil may be pumped to one of three oil barreling tanks above the pitch barreling platform, or to any one of the creosote storage tanks situated between the boiler house and tar storage tanks, or to either of two mixing tanks on line with and just south of the creosote storage tanks, or to the pitch blow and mixing tanks or the mixing storage tank.

Hot liquid pitch is transferred by compressed air from the pitch blow tanks to the barreling tanks or chilling tanks. Proper piping and other equipment have been installed to condense all vapors or fumes incident to handling hot pitch, thus recovering some oil otherwise lost and also avoiding trouble caused by the nuisance of tar, oil and pitch fumes.

When a hard pitch is produced, it may be blown to one of two tanks located above the pitch pans, west of the condenser house. These pans are of steel, four in number, supported on steel beams about 6 ft. above the yard level. Each pan is about 50 ft. long and about 20 ft. wide, and not quite 2 ft. deep. The hard pitch, when sufficiently cool, is discharged from the tank by means of a trough into either of the two pans immediately below it, where it is allowed to solidify. Pitch of this quality is sufficiently hard and brittle to permit it to be broken up and loaded in bulk. The pans are covered by a galvanized steel roofing, supported on steel beams; but the sides are not inclosed.

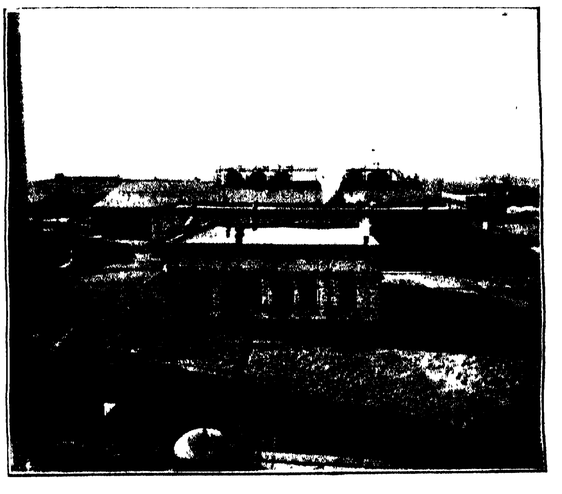
The soft grades of pitch may be blown to one of the pitch barreling tanks supported on steel framework above the pitch barreling platform. This platform is approximately 200 ft. long and 80 ft. wide, and consists of concrete walls a little over 4 ft. high, between which is filled well-tamped earth to within a foot of the platform level. Cinders and concrete are placed above the earth and the whole is topped with a smooth coat of cement and sand cut off into squares. In addition to the pitch barreling tanks, there are oil tanks for the drumming of distillate oils. All tanks are of the same size and are located above the north and central portion of the platform.

About the tanks and over the entire platform extends a galvanized steel roof supported on steel framework. The sides are, of course, not inclosed. Access to the tanks is provided by means of a ladder and a walkway placed above the roof. The southern portion of the platform serves as storage for steel drums, and it is to this portion of the platform that the empty barrels are delivered from the barrel storage shed. This is isolated well to the south of the present equipment, thereby minimizing its fire hazard. The floor consists of well-packed cinders and the roof and sides are of galvanized sheet steel, supported upon a wooden framework. The sides are inclosed from the roof to a height 12 ft. above the ground. The barrels are rolled to the platform by placing them upon the inclined elevated barrelway which extends from a point a few feet north of the barrel shed to the southern end of the barreling platform.

Felt Saturating

West of the barreling platform is located the felt-saturating building. This is of light structural steel construction with walls of Chicago yellow building brick and a roof of gypsum covered with pitch and gravel. The interior is well lighted by numerous windows along both sides. It is divided into a warehouse which occupies the northern and central two-thirds of the building, a machine room, and a dry felt storage room which divide the remaining space equally between them. The floor is of concrete. Roof and floor are extended to form a covered wharf the height of a car floor along the entire eastern side of the building. Dry felt is continuously saturated with especially prepared tar in such a manner that evenness of saturation is obtained and sticking of felt in the small tarred felt rolls as delivered to the roofer is eliminated. The hot saturator baths give off tar vapors which are somewhat objectionable, so the necessary ventilation is secured by means of two steel stacks about 2½ ft. in diameter extending about 25 ft. above the roof. Storage for the saturating tar is provided by two tanks just outside the west wall of the machinery room and the drip tanks from the saturators drain into an underground tank. This drain tank is emptied by air pressure into drums located on the machinery room floor.

East of the pitch barreling platform is located the shops and service building, containing machine and blacksmith shop, storeroom, oil room, service room and lunch room. The machine shop contains the necessary pipe-fitting machines, drill press, lathe, grinding ma-



LABORATORY, SERVICE BUILDING, PITCH-BARRELING SHED

chine, forge and anvil for local repair and equipment purposes. Power is supplied by a steam engine. The service room is provided with lockers and the usual complement of showers, wash stands, toilets, etc. Three solid brick walls within the building separate the lunch room, the service room, the oil room and store room, so that the first three are accessible only from the outside and are protected from each other in case of fire. In harmony with the others, this building is of Chicago yellow building brick.

LABORATORY AND OFFICE

East of the shops, in the north central portion of the plant, is the laboratory—a one-story building containing not only the regular plant laboratory but also a large research laboratory devoted to chemical problems common to the numerous plants of the company, together with an office for the chemical director of the company and his stenographer, a library, a locker and toilet room and store rooms. A sketch of the floor plan is shown (Fig. 3). The building is approximately

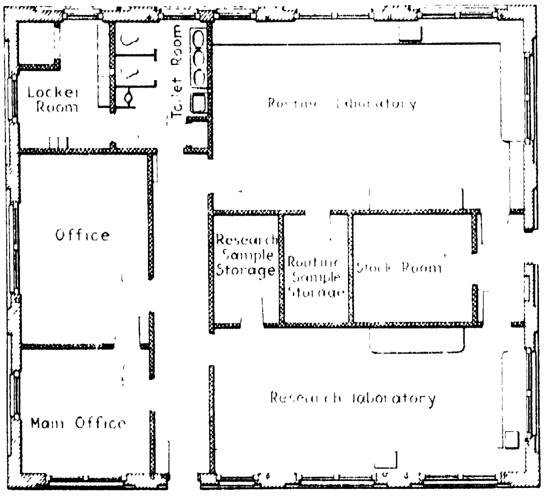


FIG. 3—LABORATORY

43x54 ft. with 10-ft. ceiling, and with a concrete floor at yard level. There is no basement. An emergency shower for extinguishing blazing clothing is provided in each laboratory.

In addition to the foregoing, there is a garage north of the felt saturating building. This serves the usual trucks and cars and the motor-driven distributors employed by the company for the hot application of road tar. An office building will be located at the northwest corner near the gate and wagon scales, but the erection of this has not yet been begun.

A plant such as that described above can supply a large number of tar, oil and pitch products—such as creosote oils, wood-preserving oils, high-tar acid oils, tar felt, dehydrated tar, refined tar, tar and oil mixtures such as the rather well-known 20 tar 80 oil mixture used in wood preserving, and such pitch products as pitch paints for the protection of iron and steel, for acid-proofing and alkali-proofing and waterproofing, roofing pitches and patching compounds, waterproofing pitches, paving pitches for hot or cold application, for concrete and for tar macadam, and as a filler for block and for brick pavements, core pitch, briquet pitch, and pitch for the preparation of pitch coke.

The Koppers Co. Laboratories,
Mellon Institute of Industrial Research,
Pittsburgh, Pa.

Action of Water on Zinc Chloride in Wood

Although zinc chloride is one of the most effective of wood preservatives, it will not give permanent protection. Under the action of water this preservative loses its strength in two ways. In time a considerable amount of the solution is leached out of the wood, and that remaining is not of sufficient strength to be effective. It has also been brought out in a study of preservatives at the Forest Products Laboratory at Madison, Wis., that water eventually causes a chemical decomposition of zinc chloride by the removal of excess amounts of chlorine.

Samples of ties analyzed after service had a zinc content equivalent to 0.4 lb. of zinc chloride, with scarcely enough chlorine present for 0.08 lb. of zinc chloride per cu.ft. Treated blocks leached for a month at the laboratory lost about 90 per cent of their chlorine content and only 70 per cent of their zinc.

The disappearance of the chlorine from zinc chloride explains decay which has been found in treated ties and timbers which still have high zinc content. Although the zinc is the toxic or poisonous part of zinc chloride, it is not effective against the fungi which cause decay unless it is combined with some acid radical which makes it soluble. In analyzing zinc-chloride-treated wood after service, it is necessary to determine both the chlorine and zinc content in order to calculate the amount of preservative solution present in the wood. Even then only a rough estimate can be formed, for some of the chlorine which would be obtained in the analysis is in the wood in the form of an insoluble basic chloride of unknown composition.

Paint and Varnish Production

During 1922 the production of white lead in oil amounted to 292,588,900 lb., as compared with 274,226,900 in 1921, an increase of 6.7 per cent. Zinc oxide in oil produced during the past year amounted to 9,944,400 lb., representing an increase of 62.1 per cent from the previous year. Figures reported for the production of paste paint show an increase of 29.4 per cent. The paste paints as a group increased considerably during 1922. The large increase is found, however, in ready mixed and semi-paste paints, varnishes, japans and lacquers—44.4 per cent in the case of the former and 54.5 per cent for the latter group.

Distillation of Hardwood in Canada

The majority of the destructive distillation plants in Canada have been absorbed by the Standard Chemical Iron & Lumber Co. of Canada, Ltd., now reorganized as the Standard Chemical Co., Ltd., Montreal. Central alcohol refineries have been established at Longford Ont., and Montreal, Que., acetone plants at Longford and Sault Ste. Marie, Ont., acetic acid and formaldehyde plants in Montreal. Considerable quantities of charcoal are used by a subsidiary, the Standard Iron Co., Ltd. in making charcoal iron. Distributing companies have been formed to market charcoal in the principal cities as household fuel.

During the war the demand for acetone, methyl hydrate, formalin and other hardwood distillation products was very great and it is a significant fact that a single well-organized company handles practically all operations from the cutting of the wood to the manufacture and sale of the finished chemicals.

Eighth Annual Convention of T.A.P.P.I.

Many Paper Technologists Take Part in Program Covering the Most Vital Problems of the Industry—First Paper Industries Exposition a Success

THE Technical Association of the Pulp and Paper Industry held its annual spring meeting at New York during the week of April 9. The American Paper and Pulp Association and other affiliated organizations also held meetings at the same time in order that as many paper men as possible might attend the first Paper Industries Exposition, which was likewise held during the week.

At its annual election of officers the Technical Association made H. S. Taylor of Dayton, Ohio, president, with G. N. Collins of Philadelphia vice-president. These men succeed G. F. Williamson and F. C. Clark respectively. The only vacancy on the executive committee was filled by the election of B. T. McBain to this body. W. G. MacNaughton continues as secretary-treasurer of the association.

At the first session of T.A.P.P.I. reports of officers and of standing committees were read showing what progress had been made along the various lines of association activity during the war. The bibliography committee has begun the work of indexing all the literature available on paper and pulp. The executive committee has obtained the co-operation of several other societies, including the American Society of Mechanical Engineers, the Cost Association of the A.P.P.A., the National Lime Association, the National Safety Council and the Wire Manufacturers' Association.

Vocational Work Centers Much Interest

The vocational work of the association is being more actively supported in every way in Canada than in the United States. Greater contributions to the fund for preparation and publication and greater use of the texts are reported in that country than in this. The fourth volume on the preparation of stock for paper manufacture is nearly ready for the press. The final volume will probably be published about January, 1924.

Feel Decided Need of Standardization

Nearly every committee reporting on research emphasized the increasing demand for standardized specifications and methods throughout the industry. Investigational and operative data require adoption of standard units for measurement and test. Apparatus used for test purposes is especially in need of this standardization. Uniform tests are in demand more and more for unusual products.

Increase Production Efficiency by Cutting Waste

G. E. Williamson, chairman of the waste committee, presented three main subjects for discussion, white water losses, bark utilization, and broke loss prevention. Fiber loss in mill effluent prevents maintenance of maximum efficiency in use of materials. This can be cut by use of save-alls—simple inclined screens over which white water (fiber-bearing water) flows, rotary screens such as ordinary continuous rotary filters, or more complex arrangements of tanks and screens. Large sedimentation tanks give very good recovery of pulp. In discussing this subject W. E. Baker, of the York Haven Paper Co., reported a fiber use efficiency of 98 per cent through the entire plant. Slime, which gives trouble in save-alls, can be reduced by frequent washings of the apparatus.

Bark and wood room scrap can be burned and one pound of steam can be made from a pound of bark 65 per cent dry by the use of a specially designed furnace. J. D. Rue, of the Forest Products Laboratory, showed that to be useful total moisture of material burned must not exceed 50 per cent. During the year a specially designed bark press for compressing and extracting moisture has been tested, with results showing that such a piece of apparatus is practical.

Broke or waste paper losses can be reduced by careful regulation of the consistency of the stock, by the analysis of records made regularly in each department, and most especially by maintenance of proper mechanical condition of machine.

Drying Losses Require Analysis for Prevention

To know what is happening to paper and to the bill for heat costs in drying, samples of paper should be taken at frequent intervals along the driers and tested for moisture. This work was carried out by Chairman S. B. Jones of the committee on drying, who plotted the results and presented them at the meeting. To reduce waste of heat, temperature must be regulated carefully in successive cylinders. Predetermined wet end moisture should be maintained and air circulation held within limits depending on control tests.

Norman Clark, having studied carefully the use of coloring matters for coated paper, finds that basic dyes usually fade due to the presence of alkali. Casein, which is usually used, also tends to precipitate the basic dye. Acid dyes are better as far as permanence is concerned but are less brilliant in color. Flat tones may well be obtained by use of insoluble pigments. Accurate control of pulp moisture in application is highly desirable. In discussing the desirable characteristics of a paper to be coated, Mr. Clark showed that the paper must be well formed, dirt free, of uniform color and thickness, free of slack edges, and of surface fuzz, that it should have the least possible finish required for uniform surfacing and that it should be leathery in "feel."

The relative merits of festoon and flat driers used in finishing of special coated papers were discussed by J. O. Ross. Festoon drying should be employed wherever space permits. Speed and width and the exact nature of the process determine the best system to employ. Throughout such processes accurate control of conditions is especially necessary to obtain economical production.

Newsprint Production Involves Grinder Development

The Groundwood Section Meeting under Chairman W. A. Munro held a symposium on Grinders. Magazine grinders must be employed and power input per unit increased if the man-per-hour production in the groundwood mill is to be efficient. The new chain-feed magazine grinder gives a more uniform grade of pulp and surpasses the pocket type of grinder in that it maintains constant pressure on the stone and constant load on the motor.

Screen rejections can be made into shipping wrappers. Two new refiners are being tested to turn these

screenings into No. 1 pulp. Success will make possible a closed system in the groundwood mill.

Use and standardization of the freeness-slowness tester now coming into use will make possible uniform grading of groundwood pulp and more accurate control of the product. White water can be re-used in groundwood manufacture.

Evaporation Problems Emphasized

Soda and sulphate men, meeting with G. K. Spence in the chair, agreed that no hard drawn lines can be drawn in solving evaporation difficulties. Boiling out at least once a week is necessary unless the liquor going to the evaporator is screened effectively. H. K. Moore advocates counter-current flow in multiple-effect systems, but many mill men find efficiency lowered by this procedure. Common practice in several mills is to introduce liquor into the second or third unit, thence to the first and finally to the fourth. Capacity required must be balanced against cost of steam and necessary exit temperature in deciding what type of evaporator best suits a given operation. Multiple-effect evaporators should operate at high vacuum and if proper conditions are obtained a double will evaporate 1.8 lb., a triple 2.7 lb. and a quadruple 3.6 lb. of water per lb. of steam consumed.

Excess use of bleach in bringing pulp to color can be avoided by knowing the history of the pulp. It must be cooked under exact conditions determined by test as best suited to wood in process. Thorough washing after blowing is the next essential. The bleach requirement, determined by test before the pulp reaches bleach system, should be largely added with the pulp at the start of the bleaching period. Under these conditions time and bleach required will be a minimum, according to G. M. Trostel.

The cause of color change in soda pulp on aging is shown by analysis to be the result of the building up of alkalis at surface by process of drying, etc. These alkalis, even in small quantities, will cause the change.

Light, Heat and Power Problems Most Essential

Freight rates will largely determine the possibility of substituting oil for coal as fuel. Oil is cheaper to handle and burn but more expensive to store.

H. S. Taylor, chairman of this section, led the discussion following J. O. Ross' thoughtful presentation of the problems of heat transfer in the machine room. Inside gutters on skylights and roof are essential. Skylights are a cause of inefficiency due to added amount of heat required to prevent condensation. Amount of air circulated, contrary to usual practice, should be balanced against amount of water being evaporated. Exit air should be held as close to dew point as possible. In general good operation should require a total about 4 lb. of steam per lb. of paper made. Hoods over machines will usually increase efficiency due to possible cutting down of live steam consumption.

In order to use steam and electricity to maximum advantage, according to recommendations of E. P. Gleason, these commodities should be measured in terms of units of output. Daily graphic records, weeding out of duplicate, wrong size or uncovered steam pipes, planning of load to keep it as constant as possible, avoidance of leaky traps and valves will reduce losses to a minimum.

Frictionless bearings are being used to an increasing extent because of the smaller amount of attention required and the increased speed obtainable by their use. Felt life may be increased by doing away with gear drive of rolls, since such arrangement sets up undue strains in the felt. Power consumption and lubrication difficulties are likewise lessened by use of ball bearings.

Froth troubles in the mill can be decreased by the use of a moving spray on the head box of the machine, by the moderate use of an oily medium in the washing of the pulp, by careful preliminary cooking and by careful avoidance of carbonates in presence of alum.

Paper Industries Exposition

The first Paper Industries Exposition, held at Grand Central Palace, New York, during the week of April 9 to 14, demonstrates another step of progress in the history of the paper industry. First conceived as a means of bringing the various branches of the industry closer together, this first Paper Exposition succeeded in a larger measure by showing the public a cross-section of the complex workings of the mills in the fabrication of this commonest of commodities. Larger in size than the first Chemical Industries show, according to the management, the first Paper Industries Exposition has shown what a single industry can do in this regard.

Despite the fact that there were empty booths, neither the layman nor the paper man could well be disappointed in the exposition. The story of paper was very well told. Nor did the exhibits end by showing paper and paper materials in their many ordinary forms. Tapestry, furniture, twine, fiber commodities, curiously shaped dishes, containers of broad utility, bags, boxes and bottles of all forms were on display as well. One exhibit showed those products which come largely from wood pulp or ground wood such as artificial silk, celluloid, and products having a wood flour base such as talking-machine records. Another showed what byproducts may be obtained from Southern pine wood when used for pulp, including rosin, pine oil, turpentine, tar oils, pitch and acetic acid.

Among the many exhibits, a few stood out especially. The Hammermill Co. demonstrated the fabrication of paper by a complete series of samples and illuminated panels at various stages of the process. The Nash Engineering Co. and the Sandusky Foundry & Machine Co. had bronze models of pumps and of couch rolls respectively, which because of size and remarkable workmanship were conspicuous. Bearings were well displayed by the S.K.F. Co. and by the Gurney Co., each using unusual mechanical ingenuity to demonstrate its products. The Mathieson Alkali Co. showed a small model of a modern bleach plant, and the Bird Machine Co. demonstrated its save-all in action.

In discussing the exposition with various exhibitors, it was the general feeling that considerable machinery had been sold, enough to cancel the expense of exhibiting; but, as expected, the chemical firms would have to call it advertising.

Correction

Through an error Dr. C. N. Vrol was referred to as "Director, the Vanadium Company," in our issue of April 16. He is Director of Radium Research Laboratories of the Standard Chemical Co.

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Pummerer and Burkhard was done justified our accepting their conclusions that the formula for rubber was not $C_{10}H_{17}$, as has recently been claimed, but that the rubber nucleus is really C_8H_8.

In addition to a review of his recent work on vulcanization accelerators, Prof. Giuseppe Bruni talked at some length on the various problems being studied at his laboratory in Milan. One of these was on the subject of tearability, having reference to the work of Zimmerman, Tuttle and others in this field. It may be noted that this field is one which only in the past few months has been considered by the rubber chemists, and results of considerable interest and value have been brought out. Other work deals with the effect of temperature upon the determination of the tensile properties of vulcanized rubber, the purpose of the investigation being centered about the determination of a constant that will permit of correction being made for the temperature at which the tests are made. If such a constant can be worked out, tensile tests would then be referred to a constant temperature and thus make such tests easier of comparison Professor Bruni has also been working upon the subject of the dispersion of crude rubber, with special reference to the work on this subject which has been published by J. B. Tuttle. Touching upon the subject of organic accelerators, Dr. Bruni brought out the point that the matter of most interest to them was the temperature at which the accelerators became active. He described briefly a method which he had employed for the determination of this effect.

Action of Litharge and Organic Acids

In previous work L. E. Weber had shown that when the resins of rubber are removed by solution in acetone, such extracted rubber shows a very poor cure when vulcanized with inorganic accelerators such as litharge. C. W. Bedford and H. A. Winkelmann gave the reason for this behavior. They showed that such extracted rubber will attain the normal vulcanization when there is added 1.5 to 2 per cent of such organic materials as oleic acid, stearic acid, pine tars, etc. This is particularly noticeable in the lower grades of rubber, in which there is a comparative deficiency of normal organic acids. The addition of a small amount of oleic acid to such rubbers materially increases the tensile properties when litharge is used as the vulcanization accelerator. They conclude from this that such a reaction is the true explanation for the improved results obtained when low-grade rubbers are vulcanized with the aid of lead oleate, but they point out that in such cases only a small amount of oleate is necessary for the purpose. They conclude that a material will not accelerate as an inorganic accelerator unless it is able to form a definite compound with the acetone soluble constituents of the rubber, and further that the resultant compound must be soluble in the rubber.

E. Hopkinson described L-S rubber, a new crude rubber obtained by spraying rubber latex on a rapidly revolving disk, the rubber spray being dried by a current of warm air. The resultant rubber sponge is compressed for purposes of shipment. This rubber contains all the solid substances of the latex, being high in water-soluble constituents (around 6 per cent). When vulcanized with the formula 90 per cent rubber, 10 per cent sulphur, this L-S rubber shows a much more rapid cure than is obtained under similar conditions with the ordinary smoked sheets or pale crepe.

Manufacture of Sulphuric Acid and Acid Phosphates During 1922

That a large increase in the production of sulphuric acid and acid phosphates occurred in the last half of 1922 over the first half of 1922 is apparent from the report of the Department of Commerce that has just been issued. From July 1 to Dec. 31, 932,747 net tons of sulphuric acid was used in the manufacture of fertilizer, while in the first 6 months of 1922 only 657,062 tons was used. The stocks of sulphuric acid on hand at the end of the year and at the beginning were substantially the same.

The concerns producing acid phosphates report the manufacture of 1,589,483 tons, containing 26,507,858 units (a unit is equal to 20 lb.) available sulphuric acid, during the second half of 1922, as compared with 1,198,724 tons, containing 20,104,992 units, during the first half, which makes a total production of the year of 2,788,207 tons containing 46,612,850 units. The stock of acid phosphate on hand at the end of the year amounted to 1,689,562 net tons, as compared with 2,129,339 tons at the beginning of the year.

FERTILIZER INDUSTRY SULPHURIC ACID STATISTICS, 1922
(Ton, 2,000 lb.)

United States	Full Year	First Half Jan.-June	Second Half July-Dec
On hand at beginning of period	131,516	131,516	
Manufactured (made in plant reporting)	1,423,917	574,013	849,904
Purchases*	544,277	249,345	294,932
Sales			
To fertilizer manufacturers*	246,544	99,719	146,825
Other than to fertilizer manufacturers	125,493	85,134	40,359
Used in making fertilizers	1,589,809	657,062	932,747
On hand at end of period	137,864		137,864
Southern District			
On hand at beginning of period	66,774	66,774	
Manufactured (made in plant reporting)	581,327	199,471	381,856
Purchases*	280,891	113,869	167,022
Sales			
To fertilizer manufacturers*	72,143	24,023	48,120
Other than to fertilizer manufacturers	31,393	24,444	6,949
Used in making fertilizers	747,014	273,739	473,275
Per cent of U. S. total	47.0	41.7	50.7
On hand at end of period	78,442		78,442
Northern and Western Districts			
On hand at beginning of period	64,742	64,742	
Manufactured (made in plant reporting)	842,590	374,542	468,048
Purchases*	263,386	135,476	127,910
Sales:			
To fertilizer manufacturers*	174,401	75,696	98,705
Other than to fertilizer manufacturers	94,100	60,690	33,410
Used in making fertilizers	842,795	383,323	459,472
Per cent of U. S. total	53.0	58.3	49.3
On hand at end of period.	59,422	..	59,422

*Transfers from or to other plants of the same company are reported as purchases or sales, as the case may be

In order to get an idea of the geographical distribution of the business done, the states were divided into two districts "Southern" and "Northern and Western," the Southern comprising all those states south of the Virginia-North Carolina line—namely, North and South Carolina, Georgia, Florida, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma and Texas. The remainder of the country designated is "Northern and Western" district. The Southern district reports 50.7 per cent sulphuric acid used in making fertilizer during the last half of the year, compared with 41.7 per cent for the first half; for the year the amount used was 47 per cent. With respect to acid phosphates the Southern district reports 30.1 per cent of the sales for the second half of the year, as compared to 56.9 per cent for the first half and 48.3 per cent for the year.

The data are compiled and made up from the reports of 198 fertilizer establishments, of which 127 are in the Southern district and 71 in the Northern and Western district. Of these various establishments sulphuric acid is manufactured in 71: 39 in the Southern district and 32 in the Northern and Western district.

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Machinery and Appliances for Production and Control

Equipment News

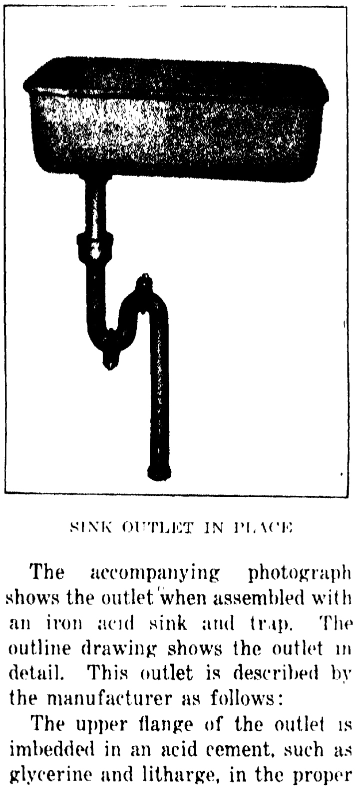
From Maker and User

Materials and Accessories for Chemical Industries

Sink Outlet

The Duriron Co., of Dayton, Ohio has had on the market for a short time an acid-proof sink outlet which has not previously been called to the attention of chemical engineers.

This outlet is for use with acid sinks and can be used with wood, Alberene stone, stoneware, or Duriron. It is all Duriron except the locknut, which does not come into contact with the acid.



SINK OUTLET IN PLACE

The accompanying photograph shows the outlet when assembled with an iron acid sink and trap. The outline drawing shows the outlet in detail. This outlet is described by the manufacturer as follows:

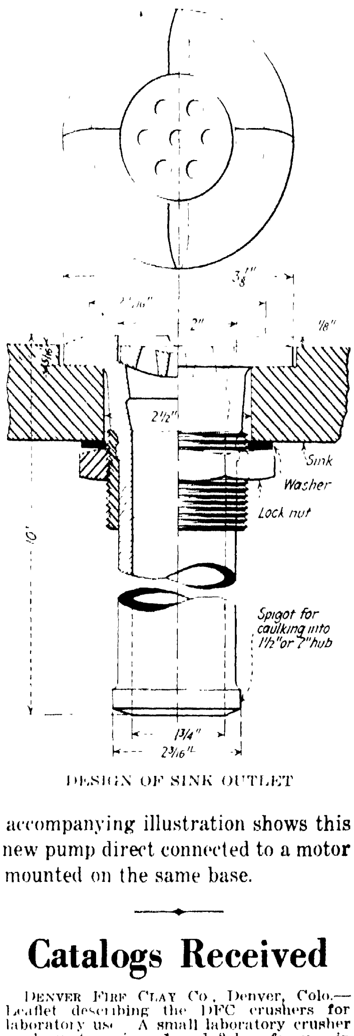
The upper flange of the outlet is imbedded in an acid cement, such as glycerine and litharge, in the proper recess in the bottom of the sink. Note this recess should be $\frac{3}{16}$ in. The washer and locknut are then applied, drawn up tight, and a permanent connection is made.

The wrought-iron nipple cast on the outside of the Duriron does not come in contact with any acid. The strainer is a loose piece, and can be removed readily for cleaning purposes.

The top of the flange is beveled upward from the edge; four grooves providing for complete drainage of the sink. This design adds strength to the connection at the proper point, and keeps filter papers from floating over the outlet and stopping it up.

The spigot end is calked in the hub of trap in the usual manner, using asbestos rope and lead.

The cost of this connection is low, considering the saving in time in making a permanent acid-proof joint; and expensive lead work and wiped joints are eliminated. This sink outlet will connect either to 1½- or 2-in. trap. It is carried in stock for immediate shipment.



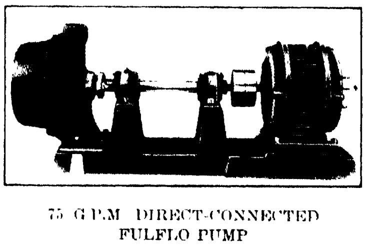
DESIGN OF SINK OUTLET

Ball-Bearing Self-Priming Pump

A new ball-bearing, self-priming, centrifugal pump has recently been placed on the market by the Fulflo Specialty Co., of Blanchester, Ohio. This pump has a capacity of 75 gal. per minute. Its makers recommend it for use with oils, brines, enamels, cooling liquids, compounds and other similar materials.

The features of this pump are those already embodied in the smaller pumps marketed by this company. Self-priming is attained by having the outlet and the inlet above the level of the pump so that the liquid being pumped remains in the pump when it is stopped. This makes it necessary to prime the pump only when starting for the first time.

Clogging of the pump is prevented by having the openings in the impeller as large as the inlet, so that anything entering is free to flow through. Clearances are ample so as to reduce wear to a minimum. The accompanying illustration shows this new pump direct connected to a motor mounted on the same base.



75 G.P.M. DIRECT-CONNECTED FULFLO PUMP

Catalogs Received

DENVER FIRE CLAY CO., Denver, Colo.—Leaflet describing the DFC crushers for laboratory use. A small laboratory crusher made in two sizes, 1 and 2 hp., for use in crushing various materials for laboratory experiments.

J. H. DAY CO., Cincinnati, Ohio. Catalog 100. This catalog, entitled "Paint Machinery," is a new issue descriptive of the complete line of paint machinery, including various types of mills, mixers, cutters, kettles, chasers, fillers and other equipment used in the paint mill.

FRANKLIN FILING SUPPLY CO., 70 Duane St., New York City. Leaflet, "The Oxford Flexindex," descriptive of this company's method of indexing correspondence and data.

BAUSCH & LOMB OPTICAL CO., Rochester, N. Y.—Catalog describing the Bausch & Lomb contour-measuring projector, a device used for measuring contours of mechanical parts by optical projection of the magnified image.

COMBUSTION ENGINEERING CORPORATION, New York, N. Y.—Catalog on the Combusco Ash Conveyor, descriptive of new type of water-sealed drag chain ash conveyor, which has been introduced in this country recently by the Combustion Engineering Co. for the purpose of handling ashes from boilers in power houses.

Book Reviews

ELECTRIC BRASS FURNACE PRACTICE. By *H. W. Gillett* and *E. L. Mack*. 334 pp., 70 illustrations. Government Printing Office, Washington, D. C.

This publication (Bulletin 202 of the Bureau of Mines) records the progress so far made in melting brass in electric furnaces. It is designed to aid plants that have not installed such melting practice by pointing out the types of furnaces available, describing their performance and indicating their possibilities and limitations.

Messrs. Gillett and Mack have been in a unique association with the development of electric brass melting since the first commercial experiments in the United States. They are enabled to draw upon a wide experience and extensive notes of actual experiments in a way that brings out very clearly indeed the troubles encountered in developing the art. They describe the failures and the first halting steps. It is very seldom that an unsuccessful experiment is adequately described, although full information about such is nearly always far more instructive than an account of a successful operation. A perusal of these pages, therefore, will be of the greatest benefit to anyone who is attempting to design an electric furnace for a new alloy or an untried service.

Crucible furnaces heated by electric resistors were first tried, probably because the designers attempted to approximate the conditions existing in an ordinary melting hole. One attempt after another led to failure, and finally the designers turned to a hearth furnace, where the molten metal is contained in a basin rather than in crucibles, the laboratory being heated by various kinds of electrical resistors. This type of furnace quickly demonstrated that it had all the advantages of the crucible type—namely, production of high-quality metal with a low loss—with none of its disadvantages.

Fundamentals of successful commercial operation are discussed carefully: namely, the metallurgical fitness of a furnace, its reliability, a high rate of production, a good thermal efficiency, electrical characteristics that will not derange the entire supplying system, and finally a reasonable operating cost. Following some sound ideas to their correct conclusion, the authors were enabled to design a rocking furnace which was patented, and has, during the last 5 years, been manufactured and marketed by the Detroit Electric Furnace Co. This furnace, together with a very similar design made by E. H. Booth, has supplied to the large majority of users now making electric brass in the United States, and melt perhaps one-half the total tonnage. This furnace, however, is by no means given the lion's share of attention, and all of the present commercial furnaces are described in as much detail as necessary, giving figures for the operating characteristics, capacities, metal losses, and cost. A final chapter covers the electric melting of aluminum, copper and rarer alloys.

Altogether, this is a book that will not only prove most valuable to a prospective user of electric furnaces but will be eagerly read by all students of electric furnace design.

E. E. THUM.

THE PRINCIPLES OF RADIOGRAPHY. By *J. A. Crowther*. vi + 138 pp., illustrated. D. Van Nostrand Co., New York. Price, $2.

When the reviewer picked up this volume he hoped it would be the book to fill the need which he experienced when in 1907 he taught Radiology in the Medical Department of the American University at Beirut. This hope was encouraged by the standing of the author as a physicist and his position as University Lecturer in Physics applied to Medical Radiology at Cambridge, England.

In some respects the book meets expectations. The material is set forth briefly in a manner readily grasped by the intelligent but non-technical reader. But it is to be wished that, instead of confining attention to Radiography, it had covered the entire field of Radiology and so included the important region Radio-Therapy. Had this been done, we feel certain that more consideration would have been given to the so-called "interrupterless" equipments and their very decided advantages, and to the important properties of the Coolidge tube. As it is, the reader is led to believe that the alternating current transformer is an unsatisfactory source of power and that the Coolidge tube, in spite of its many advantages, is not convenient nor comparable with the gas-filled tube. For instance, on page 81 he says of the Coolidge tube: "Its main disadvantage, besides cost (which is very high), is the necessity for the auxiliary battery and apparatus. The accumulator cells need careful attention and frequent charging, and of course must be carefully insulated." There is no mention of the use of a transformer to supply the filament current, although this is now the common practice. If this omission is due to ignorance it is amazing, considering the author's position; if intentional, it is unpardonable.

There are other sins of omission, such as the failure to mention the use of films, double intensifying screens and cellular diaphragms between the patient and the film. The importance of protecting patient and operator is not stressed sufficiently and according to the reviewer's experience the protection mentioned is scarcely adequate. In comparing the X-rays generated by different sources of power the results published by Dr. A. W. Hull showing that with the same maximum voltage the energy distribution is practically the same have been overlooked or ignored.

These defects are so glaring that the book picked up with hope was laid down with disappointment.

ANCEL ST. JOHN.

AMERICAN FUELS. By *R. F. Bacon* and *W. A. Hamor*. 1245 pp., 382 illustrations. Two volumes. New York City: McGraw-Hill Book Company, Inc. Price $12.

This two-volume work brings together important material from a number of well-known authors whose opinions are always highly regarded. It is particularly valuable to the man who wishes to study the processing of fuels, for the chapters on technology of coke, briquetting of fuel, distillation of coal at low temperature, producer-gas technology, water gas, the Dayton process and others are of very great value. In fact, if these were the only chapters of the book, the contribution could not help finding most cordial welcome among fuel engineers.

Since the work is the composite of contributions from about twenty authors, it is not strange that there is considerable diversity in treatment and some variation in the value of the different chapters. However, any work including contributions by men like Sperr, Coffin, Blake and the other prominent authors is certainly as a whole worth while. Some of those chapters which in the present first edition do not come wholly up to the standard set by these more experienced writers will doubtless be strengthened in later editions so that in every respect the book can be of maximum usefulness.

The object of the volume as stated by the authors in their preface is to assist in "deciding upon the most suitable fuel to use or the changes to make in the utilization of fuel or of heat in order to get the highest efficiency in plant operation." In some respects, however, the reader must bear responsibility for decision on his own shoulders, as most of the authors are enthusiastic supporters of the form of fuel or method of processing about which they write. This is but a natural result of the fact that each is an expert in his particular line and therefore naturally enthusiastic about those materials or processes with which he has had the maximum experience. As a consequence of this practical experience on the part of the authors, the reader can be sure that he is getting reliable and usable information, not at all of an academic or theoretical sort. This advantage largely outweighs any overenthusiasm on the part of the several writers.

The authors have been most successful in eliminating from the work the impression that it is simply a composite "catalog," a failing all too common in works on mechanical engineering and fuels. The illustrations are well chosen and well presented, having in almost every case a significance as to types of equipment rather than any specialized significance with reference to particular makes of machinery or varieties of process. As a consequence not only the experienced but also the inexperienced engineer will find profitable and safe guidance in the work. The volumes should certainly be available in any library that makes a pretence of covering the subjects of fuels or technology.

R. S. MCBRIDE.

Synopsis of Recent Literature

Ammonia Losses in Carbonization

H. D. Greenwood in *Gas Journal* of March 21 (page 750) discusses this subject in some detail. He summarizes his conclusions as follows:

"It is evident that the most important factor is the rapid removal of the ammonia from the hot retort. The temperature of maximum ammonia evolution (about 800 deg. C.) corresponds with the temperature at which the evolution of hydrogen is also at a maximum, hence the ammonia is formed under the most favorable conditions as regards its gaseous atmosphere. The introduction of air and flue gases into the retort will increase the percentage of nitrogen in the gases, and may tend to increase the loss of ammonia by dissociation. An ideal condition for the preservation of the newly formed ammonia would be to maintain a certain percentage of moisture in the gases throughout the distillation, which condition is to some extent attained in steaming vertical retorts, where the steam may play a double rôle in increasing the initial formation of ammonia and in maintaining an atmosphere rich in moisture and hydrogen. From the results of recent research it appears probable that the ammonia yields in practice may be considerably influenced by the character of the coal ash, and to a lesser degree by the type of refractory material used; and the former factor may conceivably bear some relation to the widely different yields which are obtained from coals containing the same percentage of nitrogen and which are generally similar in character."

Buildings From the Manager's Viewpoint

The location, size and design of entrances, stairways and windows in factories are of paramount importance to efficient production and industrial safety. To obtain the most satisfactory service from these very necessary parts of the building, a manager in planning a new structure should keep in mind the factors pointed out by G. L. H. Arnold in his paper on this topic in *Management Engineering* for April, 1923. This is the second paper of the series, the first of which appeared in March.

Entrances. These should be located to avoid all conceivable hazards, as those caused by tracks and roadways. Care should be taken that entrances be not blocked in case of fire. The nature and extent of traffic through the entrance must be considered and the entrances located to avoid cross-currents and complicated routing.

There should be at least one entrance for each stairway. At least one entrance should be large enough to admit the largest piece of apparatus whose use can be foreseen. Doors should open outward for safety, and space allowed outside to permit full and safe opening. Entrance ramps should not exceed 7½ deg. slope and should be provided with anti-slip treads.

Stairways. The principal considerations in specifying stairs for an industrial building are: (1) Safety of employees in daily use. (2) Safety of employees in emergency use; (3) Safety of building in case of fire. (4) Convenience for daily use. (5) Effect on heating and ventilation. (6) Space occupied. (7) Cost.

Building codes usually govern the number of stairways. In the absence of a code, one stairway should be provided for each 5,000 to 6,000 sq.ft. of space except in special cases. In any case there should be at least two stairways. In considering stairways with relation to number of employees, there should be one 4-ft. stairway for each 250 persons using it.

Every stairway should communicate directly with an exit. The floor at the head and foot should always be level. Landings should be rectangular and as deep as the stairs are wide. A 7½-in. rise and 9-in. run is best practice in most cases. The general rule is length of run plus twice the rise equals 24 to 24½ in. The tread should be 1¼ to 1½ in. wider than the run. The best width is 44 to 48 in. between hand rails. A headroom of 7 ft. is a minimum. Safety treads 4½ to 5 in. wide are good practice. Open stairways should be avoided.

Windows. In placing windows the chief considerations are illumination, ventilation, spread of fires and appearance of buildings. It is well to have the window as near flush with the outside of the wall as possible.

The type of windows used largely depends on the extent to which they are depended on for ventilation. The double sliding sash and the double balanced pivot types are good where windows furnish most of the ventilation. Where the windows are not called on to supply much ventilation, the fenestral type with pivoted ventilating sash are cheaper and give better lighting. Casement windows are not recommended for industrial buildings.

Tests for High-Temperature Refractories

In changing from coal to oil firing for warships, the Navy Department encountered such difficulties from the failure of refractories used in boiler linings under the high furnace temperatures that it became necessary to establish new testing methods in order to obtain satisfactory brick. G. M. Galvin, of the Navy Department Fuel Oil Testing Plant, describes these tests under the title "Solving the Refractories Problem of the Navy" in the

Important Articles in Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem & Met*. The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. Those that are of unusual interest will be published later in abstract in this department, but since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage. The magazines reviewed have all been received within a fortnight of our publication date.

REPORT II OF THE COMMISSION ON RESUSCITATION FROM POISONING BY MANUFACTURED GAS. Cecil K. Drinker, M.D., and Walter B. Cannon, M.D. *American Gas Association Monthly*, p 195, April, 1923.

CAPACITIES OF CONSUMERS' METERS. Walton Forstall. *American Gas Association Monthly*, p. 255, April, 1923.

SULPHUR COMPOUNDS OTHER THAN HYDROGEN SULPHIDE IN GAS AS A FACTOR GOVERNING THE SELECTION OF GAS COALS. J. B. Craven and W. A. Dunkley. *American Gas Association Monthly*, p 251, April, 1923.

ACTION OF SLAG UPON SILICA, MAGNESITE, CHROME, DIASPORE AND FIRECLAY REFRACTORIES. R M Howe, S M. Phelps and R. F. Ferguson. *Journal American Ceramic Society*, April, 1923, pp 589-595.

METALLURGICAL REQUIREMENTS OF REFRACTORIES FOR FURNACES MELTING COPPER ALLOYS. H W. Gillett. *Journal American Ceramic Society*, April, 1923, pp 596-609.

PROBLEMS OF CONTINUOUS KILN BURNING. Mark A. Taylor. *Brick and Clay Record*, April 3, 1923, pp. 597-598.

BUILDING FROM THE MANAGER'S VIEWPOINT, Part II. G L. H. Arnold. *Management Engineering*, April, 1923, pp 229-234.

QUALITY CONTROL IN THE MANUFACTURE OF CEMENT. G. E. Warren. *Management Engineering*, April, 1923, pp. 265-266.

SOLVING COST AND ECONOMY PROBLEMS BY GRAPHS. J. A Brown. *Management Engineering*, April, 1923, pp 251-254.

THE THERMAL EFFICIENCIES OF PRODUCTION OF DIFFERENT GRADES OF GAS. A Parker. *J Soc. Chem Ind.*, pp. 111-117T., March 23, 1923.

STUDY OF THE SOLVENTS OF SOME CELLULOSE ESTERS. E W J Mardles. *J Soc Chem. Ind.*, pp 127-36T, March 29, 1923.

THE MANUFACTURE OF SULPHURIC ACID BY THE CONTACT PROCESS III. Processes for Purification of Sulphurous Gases. H. Braidy. *L'Ind Chim.*, pp. 103-5 March, 1923.

COLORING OF PAPER. André Beltzer. *L'Ind. Chim.*, pp. 106-9, March, 1923.

SOME ASPECTS OF GASEOUS FUEL UTILIZATION. J. G. Clarke. *Gas Journal*, pp. 690 and 754, March 14 and 21, 1923.

THE VENTURI GAS METER. John L Hodgson. *Gas Journal*, p 752, March 21, 1923. Includes a history of its development.

A BRIEF REVIEW OF THE CRUDE DRUGS ENTERED AT THE PORT OF NEW YORK DURING THE PAST YEAR. L. J Schwartz. *J. Am Pharm. Assoc.*, vol 12, No. 3, March, 1923.

PREMIER MILL IN CHEMICAL INDUSTRY. F. J. E. China. *Chemical Age* (London), March 31, 1923, pp 329-330.

THE INFLUENCE OF COPPER SPRAYS ON THE YIELD AND COMPOSITION OF THE IRISH POTATO TUBER. F. C. Cook. Published as Department of Agriculture Bull. 1146, April 5, 1923.

Journal of the American Society of Naval Engineers for February, 1923.

The test described in Bureau of Standards Paper 10, somewhat modified, was adopted by the navy for determining fusion point. This modified test is conducted in a Hoskins type electric furnace, capacity to 3,000 deg. F., and Seger cones are used for pyrometric agents. The test consists of comparing Seger cones under heat with similar cones made of the material under consideration.

Refractory Specifications

As a result of examining some hundreds of brands of refractories purchased on the open market, the navy established its standard specification 50B6, covering workmanship and physical and chemical properties. The workmanship clause is general. The physical requirements set 3,100 deg. F. as the minimum acceptable fusion point for firebrick and 3,000 deg. F. for fire cement. A composition of approximately 54 per cent SiO_2, 41 per cent Al_2O_3, and not over 5 per cent total basic fluxes (Fe, Ca, Mg, K, Na), determined as oxides, constitute the chemical requirements.

The procedure in using these standard specifications is to examine a refractory for general characteristics and workmanship, to subject it to chemical analysis and to determine the softening temperature. This last is considered of major importance and final acceptance is based upon it.

The Simulative Test

After a refractory has passed the acceptance test described above, it is subjected to a simulative test, which duplicates, in so far as is possible, the conditions encountered in service. This test is conducted in a small oil-fired furnace. One side wall of the combustion chamber is constructed of brick and cement of the kind on which a test is desired, the opposite side wall of brick and cement already proved satisfactory. A compressed-air-atomizing fuel oil burner is used. The flame sweeps the length of the furnace, returns and escapes to the stack. The test comprises three runs at temperatures of 2,800, 2,900 and 3,000 deg. F. respectively, each of 24 hours duration.

During the test temperatures are ascertained at 15-minute intervals with a Morse optical pyrometer, sighting into the furnace above the burner. To compare the heat-insulating properties of the walls, temperatures of the outer faces are read each half-hour with the pyrometer sighting on the brickwork through sillimanite tubes, the ends of which are placed flush with the walls.

Immediately after each run a spalling test is conducted by injecting cold air at high velocity into the furnace until the walls are cool. Results are obtained by comparison; the comparative heat-insulating properties, together with the relative conditions of the competing sidewalls at the conclusion of the test, determining whether or not the material under test is acceptable.

On Beilby's Amorphous Theory

Sir George Beilby's views on the flow of solids and on the amorphous phase in metals, and more particularly his beautiful volume on "Aggregation and Flow of Solids," having attracted considerable attention and facilitated the generalization of these views, C. Benedicks, (*Revue de Métallurgie, Memoires*, 1922, vol. 19, pp. 505-513), took occasion to draw attention to some important points, and, at the request of the *Revue de Métallurgie*, undertook to review critically the facts on which Beilby's theory is based.

In the author's opinion, some of the results obtained by Beilby may be explained without assuming the formation of a thin mobile amorphous skin or film in metals.

According to Beilby, the essential feature of polishing as distinguished from grinding is that the polished sur-

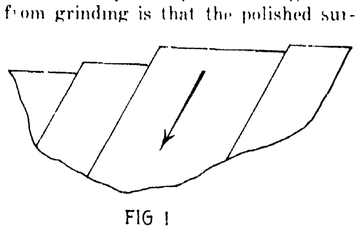


FIG 1

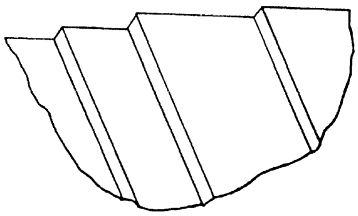


FIG. 2

FIGS 1 AND 2—MOVEMENT BY TRANSLATION AND TWINNING, RESPECTIVELY

face is formed by a kind of skin of vitreous material caused by *flow* of the superficial layers. Benedicks believes that it would follow from such theory that hard and fragile substances are more difficult to polish than the plastic ones. The experience, however shows the reverse. So, for instance, quartz is much easier to polish than the relatively plastic fluorite.

In the case of speculum metal, Benedicks observes that if the amorphous layer had really been the cause of the disappearance of scratches "partly filling them up and partly bridging them over" then a fortiori the network of the eutectic would have also been eliminated; however, Fig. 43 of Beilby's book shows that the structure remains perfectly visible.

Beilby finds in polished surfaces of pure metals, like antimony and copper, small rounded areas which he thinks are cavities roofed over with a thin film of a viscous layer. Benedicks rather ascribes these appearances to the presence of slag inclusions, Sb_2O_3 in antimony, or Cu_2O in copper. Since Cu_2O appears red in transmitted light but the complementary color blue in reflected light, microscopic inclusions of that oxide observed in an opaque ground like metallic copper will appear distinctly blue.

The most important application of Beilby's theory concerns the increase of hardness after cold work. In Benedicks' opinion, it is perfectly fair to assume that if the amorphous phase exists on the surface of a polished metal, it would also appear in the interior of a deformed metal. However, to consider the amorphous phase as being possessed of a great hardness is a quite new and distinct hypothesis and seems hardly to agree with facts. For instance, a bismuth filament drawn at ordinary temperature must become as amorphous as possible; that filament, however, is not hard at all. It seems, therefore, to the author, that the hypothesis of amorphous state does not appear to bring much light to the study of the nature of cold work.

In order to exonerate himself of a purely negative attitude, Benedicks advances the following theory not as yet published:

An originally plain surface after deformation may exhibit a "parallel translation" (Fig. 1) as shown by Ewing and Rosenhain, in which every particle slides over the next in the direction of the arrow, just as a pile of books or flat plates would. The same external shape "in steps" would, however, result from another regular deformation also known by crystallographers, the so-called "proportional translation" (Fig. 2). In this latter case there is no actual sliding, but rotation ("twinning") of the crystalline elements. The difference between these two kinds of movement is fundamental. In the former the space lattice remains identical, the optical properties remain the same and the amount of possible deformation is practically unlimited. In the latter, on the contrary, the space lattice is subjected to profound modification by the formation of twined lamellæ. This change is made apparent in polarized light; the amount of possible deformation is strictly limited by the angle of twinning. Thus, a metal, as for instance pure zinc, which deforms by "parallel translation," may be subjected to very great change of volume without any appreciable increase in hardness. On the other hand, the same zinc, containing some impurity as cadmium, twins, and thereupon deformation increases the hardness of the metal.

"Therm" Charges for Gas

The English authorities have been making a very extended investigation of the system of charging for gas on the basis of the "therm," 100,000 B.t.u. This committee has reported to the British Board of Trade recommending continuance of this system of charging, but providing for circulating additional information so that gas users will better understand it. The full text of the committee report is in *Gas Journal* (London), March 14, page 676.

Review of Recent Patents

Manufacture of Organic Oxides—In preparing organic oxides, such as propylene oxide and the oxide derived from trimethyl ethylene, by treating a chlorhydrin with an alkali, the yields may be increased by carrying out the reaction under as nearly anhydrous conditions as possible. Thus, the yield of ethylene oxide is only about 12 per cent theoretical when a 20 per cent solution of chlorhydrin is treated with 20 per cent caustic soda solution, while with 80 per cent chlorhydrin and solid caustic soda the yield is 83 per cent.

The process is carried out substantially as follows: A quantity of solid caustic alkali or calcium oxide is placed in an apparatus provided with means for stirring the contents, with an inlet for adding the chlorhydrin and an outlet through which the more volatile oxides may be distilled. The quantity of caustic alkali or lime taken should be in excess, preferably one and one-half to two times the amount theoretically required by the chlorhydrin. The chlorhydrin substantially free from water is then permitted to flow slowly in on the alkali, which is continually stirred to prevent caking and to effect good contact of the chlorhydrin with the alkali. In the case of ethylene, propylene and butylene oxides the heat of the reaction is sufficient to distill

American Patents Issued April 3 and 10, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.*'s staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,450,174—Nickeliferous Catalyzers and Process of Manufacturing Same. Albert Granichstadten and Emil Sittig, Vienna, Austria.

1,450,289—Apparatus for Entraining and Removing Fines From Conical Mills. Harry W. Hardinge, New York, N. Y.

1,450,290—Oversize Return for Mills. Harry W. Hardinge, New York, N. Y.

1,450,338—Apparatus for Producing Gaseous Fuel. Max Sklovsky, Moline, Ill., assignor to Deere & Co., Moline, Ill.

1,450,377—Method of Drying Colloids. George Perkins Lunt, New York, N. Y.

1,450,462—Method of Acidizing Rubber Waste. Richard A. Terhune, Fairhaven, Mass., assignor, by mesne assignments, to Conrad Gaschott, Caroma, N. Y.

1,450,463—Sulphurized Compound of Phenols. Alfred Thauss, Deutz, near Cologne, and Alfred Gunther, Cologne, Germany, assignors to Farbenfabriken vorm. Friedr. Bayer & Co.

1,450,464—Crystal Formation. Elihu Thomson, Swampscott, Mass., assignor to General Electric Co.

1,450,467—Silicate Cement. Hermann Weyland, Elberfeld, Germany, assignor to Farbenfabriken vorm. Friedr. Bayer & Co.

1,450,493—Ketone Body and Process of Making Same. Carleton Ellis and Alfred A. Wells, Montclair, N. J., assignors, by mesne assignments, to Seth B. Hunt, trustee, Mount Kisco, N. Y.

1,450,507—Method of Recovering Vanadium From Its Ores. Philip Alexander Mackay, London, England.

1,450,545—Apparatus for Separating Liquids of Different Densities. Oscar E. Hans, Bartlesville, Okla.

1,450,562—Process for the Treatment of Gases From Gas Producers. Olivier Piette, Brussels, Belgium.

1,450,569—Apparatus for Producing Ketones. Robert R. Williams, Chicago, Ill., and Herbert L. J. Haller, Cincinnati, Ohio, assignors, by mesne assignments, to Seth B. Hunt, trustee, Mount Kisco, N. Y.

1,450,617—Process of Purifying Mineral Oils. James Smith, Glasgow, Scotland.

1,450,661—Apparatus for the Manufacture of Sulphuric Anhydride. Paul Audianne, Paris, France, assignor to Etablissement Kuhlmann, Paris.

1,450,675—Process of Separating Isomeric Trinitrotoluenes. Charles M. Stine, Wilmington, Del., assignor to E. I. du Pont de Nemours & Co., Wilmington, Del.

1,450,677—Sulphur Burner. Horace G. Chickering, Wilmington, Del., assignor to E. I. du Pont de Nemours & Co., Wilmington, Del.

1,450,678—Process of Producing Phthalimids. Harry D. Gibbs, Penns Grove, N. J., assignor to E. I. du Pont de Nemours & Co.

1,450,685—Bituminous Emulsion and Process of Making Same. Lester Kirschbraun, Chicago, Ill.

1,450,688—Paint. John T. Lawrence, Newark, N. J.

1,450,692—Printing Ink. William J. McElroy, New York, and John Clarke, Manhasset, North Hempstead, N. Y., assignors, by mesne assignments, to Alchemic Gold Co., Inc.

1,450,704—Production of Zinc Oxide. James A. Singmaster and Frank G. Breyer, Palmerton, Pa., assignors to New Jersey Zinc Co., New York.

1,450,712—Process of Making Prepared Roofing. Walter H. Cady, Boston, Mass.

1,450,714-15-16—Cellulose-Ether Solvent and Composition. Stewart J. Carroll, Rochester, N. Y., assignor to Eastman Kodak Co.

1,450,856—Non-Conducting Material. Robert Illemann, Glasgow, Scotland.

1,450,865—Water-Soluble Product and Process of Making the Same. Joseph Pele, Cicero, Ill.

1,450,888—Coking of Coal. Stewart Roy Illingworth, Radyr, Glamorgan, Wales, assignor to Illingworth Carbonization Co., Ltd., Manchester, England.

1,450,912—Method of Making Anhydrous Magnesium Chloride. Paul Cathringer and William R. Collings, Midland, Mich., assignors to the Dow Chemical Co., Midland, Mich.

1,450,926—Composition of Matter for Silverplating Metals. Landolph Minar Sherow, Ossining, N. Y.

1,450,951—Wet-Filter Screen. Lucien Charles Cruyt, London, England, assignor to Heenan & Froude, Ltd., Worcester, England.

1,450,975—Process for the Manufacture of Borax and Boric Acid. Andrew Kelly, London, England, assignor to Borax Consolidated, Ltd., London, England.

1,450,982—Process for Removing Destructive Substances From Non-Aqueous Media. Melville J. Marshall and George S. Shaw, Shawinigan Falls, Canada, assignors to Shawinigan Laboratories, Ltd., Montreal, Que., Canada.

1,450,983—Manufacture of Aldehyde-Ammonia. Howard W. Matheson, Montreal, Canada, assignor to Shawinigan Laboratories, Ltd., Montreal.

1,450,984—Process of Making Condensation Products of Aliphatic Aldehydes. Howard W. Matheson, Montreal, Canada, assignor to Canadian Electro Products Co., Ltd., Montreal.

1,450,985—Process of Regenerating Beds of Exchange Silicates. Joseph M. Maxwell, Wichita, Kan.

1,450,990—Process of Making 2-Naphthol-3-Carboxylic Acid. Edmund C. Shorey, Washington, D. C.

1,450,992—Crystallizer. Truman E. Stevens, Omaha, Neb., assignor to Potash Reduction Co., Hoffland, Neb.

1,451,004—Method of Separating Zircon From Undesired Substances. Louis E. Barton and Charles J. Kinzie, Niagara Falls, N. Y., assignors to the Titanium Alloy Manufacturing Co., Inc., Niagara Falls, N. Y.

1,451,052—Treatment of Hydrocarbons. Heliodor Rostin, Vallo, Norway.

1,451,092—Cumaron Paint. Carleton Ellis, Montclair, N. J., assignor to Ellis-Foster Co.

1,451,113—Process of Producing Catalytic Material. George A. Richter, Berlin, N. H., assignor to Brown Co., Berlin, N. H.

1,451,125—Process for the Production of Paper Pulp and the Like. Bertrand S. Summers, Port Huron, Mich.

1,451,129—Method of and Apparatus for Oil Distillation. John W. Van Dyke, Philadelphia, Pa., assignor to the Atlantic Refining Co., Philadelphia, Pa.

1,451,135—Food Product and Process of Production. Albert W. Wright and Elisabeth H. Wright, San Francisco, Calif.

1,451,190—Gas Condenser. Frederick E. Voorhies, Tulsa, Okla.

1,451,313—Art of Reducing Inflammability of Materials. Arthur Arent, Des Moines, Iowa, assignor to Arthur Arent Laboratories, Inc., Des Moines, Iowa.

1,451,330-31—Manufacture of Cellulose Derivatives. Henry Dreyfus, London, England.

1,451,367—Process of Treating Shale. Stephan Marko, Chicago, Ill.

1,451,399—Process of Producing Halogen Acids. Frank S. Low, Niagara Falls, N. Y., assignor to Weaver Co., Madison, Wis.

1,451,472—Pulverizing Mill. Ralph E. H. Pomeroy, Canton, Ohio.

1,451,485—Composition for Fireproofing and Other Purposes and Process of Preparing Same. William Levis Wootton, Brooklyn, N. Y.

1,451,489—Process for the Manufacture of Azoxy, Azo, Hydrazo and Amino Compounds. Oliver W. Brown and Clyde O. Henke, Bloomington, Ind.

1,451,522—Mechanism for the Recovery of Paper Stock. Burke M. Baxter, Cleveland, Ohio, assignor to American Reduction Co., Pittsburgh, Pa.

1,451,540—Manufacture of Self-Hardening Refractory Articles. William A. France, Philadelphia, Pa.

1,451,543—Electroplating With Zinc. Joseph Haas, Jr., Muncie, Ind., assignor to the Roessler & Hasslacher Chemical Co., New York, N. Y.

1,451,574—Oil-Refining Device. Charles Fred Hillman, Wichita Falls, Tex.

1,451,575—Oil Shale Retort. George Edward Holmes, Salt Lake City, Utah.

1,451,589—Drier. Walter M. Schwartz and Elwood B. Ayres, Philadelphia, Pa., assignors to Proctor & Schwartz, Inc., Philadelphia, Pa.

1,451,603—Still. Henry C. P. Weber, Edgewood Park, Pa., assignor to Westinghouse Electric & Manufacturing Co.

1,451,666—Production of Alpha-Naphthylamine. Stuart P. Miller, Philadelphia, Pa., assignor to The Barrett Co.

1,451,670—Antiseptic and Insecticidal Soap or Composition. Robert MacPherson, Worthing, and William E. Heys, Bushel, England.

For complete specifications of any U. S. patent remit 10c to the Commissioner of Patents, Washington, D. C.

the oxides almost as fast as they are formed. For the higher alkylene oxides means for heating should be provided such as a jacket for steam or hot oil. It is important, in order to get the best yields, to remove the oxides as fast as formed, since other products are formed by the action of caustic alkali or lime on the oxides in the presence of water or glycol.

Oxides prepared in this manner may be used in various ways in the arts, as for example as blending or mixing solvents to cause liquids normally immiscible to mix. For example, gasoline or kerosene does not mix well with ethyl alcohol, but addition of oxides prepared from olefines of cracked petroleum brings about the desired miscibility. (1,446,872. Benjamin T. Brooks, of Bayside, N. Y., assignor to Chadeloid Chemical Co. Feb. 27, 1923.)

Manufacture of Potassium Sulphate—Camille Horst, of Wittelsheim, France, has obtained a patent for a process of treating gypsum with carbon dioxide suspended in an aqueous solution of caustic potash to obtain a saturated solution of potassium sulphate. The reaction is as follows:

$$CaSO_4 + 2KOH + CO_2 = CaCO_3 + K_2SO_4 + H_2O$$

This reaction is thought to take place in two steps; first forming a carbonate of potash, as follows:

$$2KOH + CO_2 = K_2CO_3 + H_2O$$

and the second reaction:

$$CaSO_4 + K_2CO_3 = CaCO_3 + K_2SO_4$$

This process is based upon the difference of solubility between the carbonate and the sulphate of calcium, the carbonate being practically insoluble and the sulphate very little. The reaction is said to be quantitative and the byproduct—namely, calcium carbonate—is a product capable of industrial application. (1,446,185. Feb. 20, 1923.)

Treatment of Raw Rubber and Like Plastic Substances—A patent has been issued to the estate of S. C. Davidson, of Belfast, Ireland, for an improved method in treating raw rubber and similar substances. Raw rubber freshly coagulated from the latex is placed in a machine consisting of three rolls, which act in the same manner as the usual massaging or kneading machines used for this purpose. The final traces of water may be removed in this process by rolling and elongating under pressure the mass to be treated. While still under full pressure the rolled mass is enveloped. The material used is substantially inextensible under any ordinary tensile stress and is at the same time readily suitable for the absorption of the moisture exuding from the mass. The wrapped material is then hung in an airy room, well ventilated, where after a few days its tendency to contract is entirely overcome. At this stage the final traces of moisture ooze out and evaporate from the wrapping. For the wrapping material a heavy strongly woven cotton tape or similar webbing is employed. An automatically attached string buckle is used in fastening the webbing to the roll. (1,446,737. Feb. 27, 1923.)

Acetyl Cellulose From Bleached Sulphite Paper Pulp—W. J. Stevenson of Charing Cross, England, has obtained a patent for improvement in methods of manufacturing acetyl cellulose. Instead of employing bleached cotton wool, as has been the case in the past, he makes use of bleached sulphite paper pulp, which he claims gives greater stability, better control, longer life and easier impregnation with dyes and colors. Glacial acetic acid and acetic anhydride are used in carrying out the reaction. As catalyzers zinc chloride, nitric acid or dimethyl sulphate are employed. These materials, thoroughly mixed, are allowed to stand for 7 to 8 hours at a temperature of 60 to 70 deg. C., submerged in an excess of water. The precipitate is washed and dried at a temperature of 100 to 120 deg. C. (1,441,541. Jan. 9, 1923.)

Oxy-derivatives of Anthraquinone—Oxy-derivatives of anthraquinone, especially alizarin, may be manufactured by the following method, patented by A. H. Davies of Carlisle, England. He has assigned the patent to Scottish Dyes, Ltd., of same address. If mono- or 2-chlor anthraquinone is autoclaved for 24 hours at 170 deg. C. in a caustic alkali solution in the presence of such an oxidizing agent as a chlorate or nitrate, the chlorine atoms are replaced by hydroxyl groups. Moreover, a further hydroxyl group is introduced into the molecule.

From 2-chlor anthraquinone, by using caustic soda as the alkali and sodium chlorate as oxidizing agent, alizarin is obtained. The dye is extracted by diluting and acidifying the filtered solution. (1,446,163. Feb. 20, 1923.)

Recovery of Products From Tinned-Iron Waste—A patent has been granted H. V. Welch and W. A. Sheek of Los Angeles and Long Beach, Calif., for the recovery of tin, lead and iron from scrap. The scrap is sheared or divided into fragments of suitable size and fed into a cupola furnace of special construction which allows more time than does the usual type of furnace for melting down. Carbonaceous material, also lime, may be fed into the furnace along with the material to be melted down. Air is supplied through tuyeres at the bottom of the furnace, as in usual practice. Gas may also be forced in at this point and burned with the carbonaceous material in order to obtain the reducing atmosphere desired in the furnace. To aid in the volatilization of the tin and lead which may be present, halogen gases or halide in solid form may be utilized. If in gaseous form, they are fed in at the tuyeres; if in solid form, they are fed in with the charge. The amount of gas required is at least 5 lb. for every 2 lb. of tin known to be present in the charge. Tin or lead which are volatilized in the process are recovered by a Cottrell or similar fume separator. The temperature employed for volatilization is as near the melting point of iron as is possible. (1,446,953. Feb. 27, 1923.)

Method of Treating Fibrous Material—A patent has been granted to Eduard Dyckerhoff of Hanover, Germany, for waterproofing material to make it useful for building or insulating purposes. The treatment consists in heating the material on trays or in drying drums to a temperature of approximately 120 deg. C. This process renders the material water-resisting and non-hygroscopic. Subdivided wood thus treated is suitable for filler material in the manufacture of cements, mortars, etc. (1,446,888. Feb. 27, 1923.)

Treatment of Products Made With Cellulose Derivatives—L. G. Richardson of Nottingham, England, has assigned to the American Cellulose & Chemical Manufacturing Co., Ltd., of New York, the following patent for treating of cellulose products. The saponification of cellulose acetate products (lower than tri-acetate) is carried out in a bath to which sodium acetate has been added in addition to the straight caustic solution usually employed. This addition intensifies and controls the partial saponification and enables level dyeing to be more easily obtained. A small amount of caustic soda is maintained in the bath at all times. As fast as this NaOH is exhausted the supply is replenished and in this way the bath may be maintained in active condition over an indefinite period. It is essential that the amount of free caustic in the bath at any time be maintained as low as possible and that the temperature at which the operation is carried out be held between 50 and 75 deg. C. (1,442,631. Jan. 16, 1923.)

Lubricants From Tar—This patent covers a process of obtaining lubricants from a low-temperature tar. The process starts with a low-temperature tar, rich in non-saturated compounds, whose constituent parts distill between 260 to 320 deg. C., and preferably between 275 and 300 deg. C., at atmospheric pressure, after being first freed of paraffin and phenols.

Polymerization is then effected together with some such means as blowing air through it while holding at some predetermined temperature or subjecting it to high tension electrical oscillations, while in an atmosphere of hydrogen and at a proper temperature. The lower the temperature during polymerization the better the properties of the final product. The viscosity can be increased at will according to the degree to which the polymerization medium is allowed to act. Viscosities up to 30 deg. Engler at 50 deg. C. are obtained. The final product is light colored. (1,450,026. Egen Eichwald and Hans E. R. Vogel, Hamburg, Germany. March 27, 1923.)

Men in the Profession

CARL L. ALSBERG, director, Food Research Institute, Stanford University, spoke before the Washington Chemical Society, April 12, on "Agriculture and Fuel Supply as the Limiting Factors in the Food Supply of the World."

C. L. BACHELDER has left the employ of the Consolidated Water Power & Paper Co. and is now with the Interlake Pulp & Paper Co., Appleton, Wis.

Dr. ARTHUR W. BROWNE, of the chemistry department of Cornell University, recently addressed the Syracuse Section of the American Chemical Society on "An Organic Compound of Sulphur."

C. B. CARPENTER, ARTHUR W. THOMAS and J. ENRIQUE ZANETTI have been raised from the rank of assistant professors to that of associate professors of chemistry at Columbia University.

Dr. ARTHUR B. CLARK, of the National Aniline & Chemical Co., of Buffalo, N. Y., read an interesting paper on Photomicrographic Records at a recent meeting of the Miscroscopical Section of the Buffalo Society of Natural Sciences.

C. R. DELONG, chief of the chemical section of the Tariff Commission, spoke before the American Drug Manufacturers Association, New York, April 17 on "The Tariff of 1922, and the Chemical Industry." Mr. DeLong made a comparison of some of the rates of duty on medicinal chemicals and drugs in the new tariff and previous tariffs, and explained the operations of the flexible tariff section of the act.

Dr. F. G. DONNAN, professor of chemistry, University College, London, and Dr. JAMES C. IRVINE, principal and vice-chancellor, University of St. Andrews, talked of their recent researches in chemistry, April 17, 1923, at a joint meeting of the Philosophical Society of Washington, the Chemical Society of Washington and the Washington Academy of Sciences. These gentlemen, accompanied by Prof. A. F. Holleman of Amsterdam and Prof. Giuseppe Bruni of Milan, Italy, spent practically the entire week of April 16 in Washington, visiting chemical laboratories of the government and attending special luncheons, dinners and other forms of social activities.

L. H. DUSCHAK, secretary of the California Section of the American Chemical Society, presented a paper on the chemical engineer's part in the fighting of mine fires, at the Mine Safety Conference recently held at Globe, Ariz.

Dr. E. C. FRANKLIN, president of the American Chemical Society, spoke before the New Jersey Chemical Society on April 13 and the Syracuse Section of the A.C.S. on April 17. His subject at both meetings was "Ammonia System of Compounds."

R. C. HARTONG, formerly chief chemist at the plant of the Goodyear Tire & Rubber Co., Akron, Ohio, has been elected president and treasurer of the Chemitex Products Co., recently organized by local interests to establish a plant at Mogadore, near Akron.

Dr. ELLWOOD HENDRICK, consulting editor of *Chem. & Met.*, spoke before the following local sections of the American Chemical Society: Lansing, Mich., April 18; Chicago, Ill., April 20; Purdue, Lafayette, Ind., April 21, and at Cincinnati, April 23. His subject at Chicago was: "Obligations of Physical Science."

RAYMOND HERTWIG, assistant chemist, San Francisco station, Bureau of Chemistry, has been assigned to the food-control laboratory of the bureau in Washington for 2 months

ARTHUR J. HOSKINS, research assistant professor of mining, has been appointed the acting head of the department of mining, University of Illinois, to fill the vacancy caused by the sudden death of Dr. H. H. Stoek, the founder of the department of mining at Illinois. Professor Hoskins has had 33 years experience in mining and metallurgy.

J. M. MALLORY, general industrial agent of the Central of Georgia R.R., and R. T. STULL, formerly the ceramic engineer in charge of the Columbus Experiment Station of the Bureau of Mines and who is now doing special work on Georgia clays, conferred recently with chemists in Washington on the general progress of the work.

Dr. ROYAL A. MEEKER, state commissioner of labor and industry, Pennsylvania, has resigned as chief of the scientific division, international labor organization of the League of Nations secretariat, Geneva, effective March 31.

Dr. E. S. MERRIAM has resigned as chief chemist of the Safe Cabinet Co. in order to resume his consulting work in connection with natural gas, casinghead gasoline and carbon black, at Marietta, Ohio.

Dr. R. B. MOORE, chief chemist of the Bureau of Mines, will discuss hafnium and other rare and suspected elements when he addresses the New York Section of the American Chemical Society on June 8.

EDMUND O'NEILL, for 45 years a member of the faculty of the University of California, recently announced his resignation as professor of inorganic chemistry to take effect after this semester. Professor O'Neill's personality has endeared him to all with whom he has come in contact, and he relinquishes active work to the regret of his colleagues and associates. He has been granted sabbatical leave by the university authorities and will travel in the Orient during the summer.

GEORGE H. RASCH, general manage byproducts department, Morris & C has resigned to become president a general director of the United Seru Co., with plants at Kansas City, Ka Wichita, Kan., and East St. Louis, I

P. O. ROSEWARN, of the Canadi Department of Mines, inspected t Bureau of Mines Cryogenic Laborato in Washington recently.

Dr. E. W. SCHWARTZE, pharmacol gist in charge of the pharmacologic laboratory, Bureau of Chemistry, r cently lectured before a class of grad ate physicians from the Veteran Bureau

Dr. WALTER O. SNELLING, director research for the Trojan Powder C gave an address on the subject of sy thetic chemicals, particularly relatir to new developments, before the men bers of the Allentown Radio Clu Allentown, Pa., March 26.

Prof. JULIUS STIEGLITZ, of the Un versity of Chicago, is to be the recipie of the J. Willard Gibbs medal, award annually by the Chicago Section of t American Chemical Society, for his r searches in organic chemistry. T medal will be presented in May.

Dr. ALBERT P. SY, of the departme of chemistry of the University of Bu falo, spoke before the alumni club the university April 7, on "Food an Food Values."

Obituary

ELMER A. COTTEN, refinery superi tendent of the Atlas plant of the Stan ard Oil Co., at Buffalo, N. Y., di April 11. Mr. Cotten had been 4 years with the Standard Oil Co. an had been refinery superintendent mo than a score of years.

J. EMIL FRANK, owner and publish of the *Textile Colorist*, died March 1 o pneumonia at his home in New Yor The journal was founded by his fathe Dr. Morris Frank, in 1879 and M Frank had been connected with throughout his life.

WILHELM KONRAD RONTGEN, who wa born in 1845, died recently in Munic Germany, at the age of 78. A Germa physicist, born at Lennep, in Rhenis Prussia, he received his doctor's degre in 1869 at the University of Zuric where he studied under Kundt. H was afterward professor at Hohenhei Strassburg, and Giessen, and in 1885 h became professor at the University o Würzberg. In 1899 he was appointe professor of experimental physics a the University of Munich. In Novem ber, 1895, before the Physico-Medica Society of Würzberg he read a paper o his discovery of the rays which bear hi name. For this discovery he receive many honors, including the Rumfor medal of the Royal Society of Londo and the Barnard medal of Columbi University, awarded in 1900 for th greatest discovery in science during th preceding 5 years. In 1901 he wa awarded the Nobel prize for physics.

The Week in

Industry and Trade

Current News and Market Developments

News Section

April 23, 1923

CHEMICAL & METALLURGICAL ENGINEERING

Tenth Avenue at 36th Street, New York

H. C. PARMELEE, *Editor*

Market Section

The Summary of the Week

Census reports show that domestic production of organic chemicals increased 177 per cent in the seven-year period from 1914 to 1921.

Local importers' protest against levying duty on arrivals of cresol from foreign markets overruled by Treasury decision.

Active trading in salicylic acid cleans up surplus holdings and causes the market to close in a strong position.

Copper sulphate sold down in price with supplies of imported grades pressed for sale. Domestic makes are not following the lead of the imported.

Tartaric acid was advanced one cent per pound due to continued good demand and lessened foreign competition.

March cottonseed products report indicates small supply of cottonseed oil for remainder of crop year.

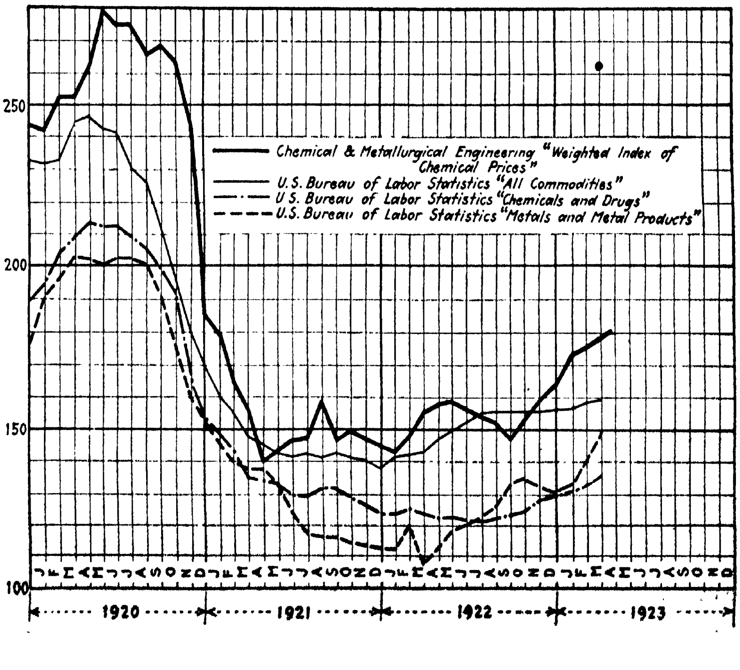
The Upward Trend of Chemical Prices

PROBABLY there is no more convincing evidence of the return of business confidence than is to be seen in the upward surge of commodity prices. Since the first of the year the general level of wholesale prices has shown a consistent advance, but this movement has been most marked in the case of chemicals and a few related materials.

Measuring this trend of prices in terms of the index numbers of the Bureau of Labor Statistics, it will be observed that the "all commodities" index has risen from 142 in March, 1922, to 159 in March, 1923—a gain of 12 per cent. The chemical group stood at 131 in January, 1923, and increased to 132 in February and to 135 in March. Metal prices, in terms of the same index numbers, rose from 109 in March, 1922, to 149 in March, 1923. This is an increase of 36.4 per cent and the largest gain for any group.

Chem. & Met.'s weighted index of chemical prices, based on a somewhat different series of commodities, shows an even more striking improvement. Emerging from the slump of October, 1922, when this stood at 147, it has since climbed steadily until at the present time it is at a level of about 180—i.e., 80 per cent above the pre-war prices of 1913-14.

For the benefit of new readers it might be explained that *Chem. & Met.'s* index is a weekly compilation based on the average wholesale prices in New York for twenty-five representative chemicals. In order that these commodities might be considered according to their relative importance, a "weighting" factor was obtained by multiplying the production plus imports of each chemical during the last census year by its average price for the fiscal year 1913-14. After these factors had been reduced to a percentage basis the procedure is repeated using the weekly quotations for each commodity. The index number thus obtained gives a clear and accurate idea of the average fluctuations in the chemical industry and makes it possible to compare these fluctuations with those taking place in other industries.



Technical Societies and Trade Associations

News of the Week

Current Events Legislative Progress

Methods for Operating Flexible Provisions of Tariff Law

How Tariff Commission Will Obtain Production Costs—Individual Manufacturers' Costs Not to Be Made Public—Applications for Tariff Changes Held Confidential Until Investigations Are Justified

IN AN address before a meeting of the American Drug Manufacturers' Association at New York, last Wednesday night, C. R. DeLong, chief of the Chemical Division, United States Tariff Commission, discussed the tariff of 1922 with especial reference to its bearing on the chemical industry.

Mr. DeLong gave a very instructive exposition of the flexible features of the tariff, in which he said:

Flexible Tariff Provisions

"The flexible provisions of the present tariff act are an innovation in tariff law, and therefore I assume that you are more or less interested in the plans of the commission for investigations under these sections. They are found in sections 315, 316 and 317 of Title III of the law. It is apparent from the applications which the commission has received that there is considerable misapprehension as to what can be accomplished under these provisions. Many of the requests deal with questions of classification, which are clearly a function of the Treasury Department; others ask that commodities be changed from the dutiable list to the free list or *vice versa*, which is specifically prohibited by law. The maximum modification possible under the law is either an increase or a decrease of 50 per cent of the existing rates, or in the case of ad valorem duties a change in the basis of valuation from foreign value to American selling price of the domestic product. It is, however, impossible to increase the duty and at the same time change the basis of valuation. In the case of coal-tar products under paragraphs 27 and 28 no increase in duty can be made by the President under section 315; the only possible change in the duty on these products is a decrease, not to exceed 50 per cent.

Changes in Classification

"The law also states that changes in classification may be made. Many people have taken this to mean that changes in classification which would increase or decrease a duty could be made without consideration of the cost of production. This, however, is not the case, as any change in classification which would involve a change in the rate of duty must be warranted by the facts relative to costs of production, as set forth in the law.

"An important question, and one on which the workability of section 315 may depend, is whether or not actual and complete costs of production must be obtained both here and in the principal competing countries before changes may be made in rates of duty in pursuance of the flexible provisions of the tariff act. In other words, is the term 'cost of production' as used in the act limited to the ordinary understanding of what constitutes costs? It is readily conceivable that in certain cases considerable difficulty may be encountered in ascertaining foreign costs of production, and the question naturally arises as to whether or not section 315 can be effective in such cases.

Basis for Changes in Duty

"Wherever changes in rates of duty are referred to, it is stated that these changes shall be such that they will equalize the differences in costs of production. Subdivision (*c*), however, enumerates certain elements which may be taken into consideration, as far as practicable, in ascertaining differences in production costs, a qualification which may prove to be serviceable and important.

"If it should be held that actual costs of production must be obtained both here and abroad, it is evident that the usefulness of the flexible tariff provisions will be greatly impaired. On the other hand, it is conceivable that, if the commission makes an earnest effort to obtain costs of production from firms in foreign countries and meets with a refusal to divulge this information, other methods of arriving at costs may be employed. Accurate information can be obtained in this country as to prices of imported merchandise c.i.f. New York, ocean charges, packing charges, and the price f.o.b. foreign ports. With these facts and other information that may be obtained in foreign countries, such as costs of materials, power and fuel and wage rates, in many cases a close approximation can be made of the actual cost of production in foreign countries. It is not unreasonable to expect that such information would satisfy the law so far as costs of production are concerned.

Method of Obtaining Costs

"You may be interested to know the methods of procedure of the commission in obtaining costs of production here and abroad. At the present time all domestic firms engaged in the manufacture of the chemicals for which the commission has ordered investigations have been requested to submit their costs to the commission in accordance with a definite cost form. The commission is not requesting these firms to fill in cost schedules, but is using cost forms as an indication of the detail in which it is desired that costs be submitted. The costs may be submitted on the individual company's forms.

"A question that is naturally foremost in each manufacturer's mind is whether or not the costs of production of individual manufacturers are to be made public or held confidential. The commission has decided that costs of individual manufacturers will be held strictly confidential and for the exclusive use of the commission. Costs will be published or revealed only in the form of averages or so as not to reveal the operations of individual firms. The commission has also taken the same attitude in regard to costs that may be obtained from foreign manufacturers.

Publicity as to Applications

"The commission has adopted the policy of not making public information as to whether or not applications have

Calendar

The following important technical meetings are scheduled for the immediate future:

AMERICAN WELDING SOCIETY New York, April 24-27

AMERICAN OIL CHEMISTS' SOCIETY Hot Springs, Ark., April 30-May 1

AMERICAN FOUNDRYMEN'S ASSOCIATION Cleveland, O., April 30-May 3

INTERSTATE COTTON SEED CRUSHERS ASSN. Hot Springs, Ark., May 2-5

AMERICAN ELECTROCHEMICAL SOCIETY New York City, May 3-5

AMERICAN CHEMICAL SOCIETY Regular meeting, New York, May 4

AMERICAN ZINC INSTITUTE St. Louis, May 7-8

AMERICAN ASSN. OF ENGINEERS Norfolk, May 7-9

AMER SOCIETY MECHANICAL ENGRS. Montreal, May 28-31

CANADIAN INSTITUTE OF CHEMISTRY Toronto, May 29-31

SOCIETY OF CHEMICAL INDUSTRY Canadian Section Toronto, May 29-31

been filed on various commodities until it has been decided whether investigations are justified. It is, of course, impossible to prevent applicants from giving such information to the public, and the information which has appeared prior to the announcement of an investigation by the commission has come from this source. The commission is of the opinion that publicity in connection with each complaint as filed would tend to keep domestic manufacturers and other interested parties in an unsettled condition. Since all complaints may not warrant an investigation or may not for various reasons be investigated, it seems that it would be an unwise policy to keep business in a constant state of turmoil by giving publicity to each application as filed. The commission, however, assures you that following the announcement of an investigation, ample opportunity will be given to all parties to submit evidence and testimony, and to be heard at a public hearing.

"It is apparent that considerable stress has been placed by interested parties on the nature of applications—that is, whether they are for an increase or a decrease in duty, and also as to the names of the applicants. Although the commission has decided to make such information public, when an investigation is ordered, undue weight should not be given to these facts. The law clearly states that any changes resulting from investigations shall equalize the difference in cost of production in this country and in the principal competing foreign country. It is, therefore, clear that if an application is for an increase of duty and the facts show that a decrease in the rate is the only change that will equalize this difference in costs, such a decrease can be made. The same holds true for converse conditions. The facts should appear to warrant the desired change before an application for an investigation is filed. Otherwise, a change may result which would be adverse to the applicant's interest.

"That this situation is not fully understood is shown by the fact that since the commission has ordered an investigation of certain chemicals, requests have been made for a change contrary to that of the application which resulted in an investigation being ordered by the commission. It should be clearly understood that a finding by the commission may be made either way, depending upon facts in the case, regardless of the nature of the application."

Washington News

Investigate Production Costs of Casein

F. W. McSparren, a chemist of the Chemical Section of the Tariff Commission, and Edwin Schoenrich, an accountant and linguist, sailed from New York April 14 for the Argentine, where they will conduct an investigation into costs of production of casein, regarding which American manufacturers of coated paper have applied for a reduction in duty under the flexible tariff law. Their schedule calls for a month in the South American republic.

Hankow Cables Show Advance in Wood Oil Prices

Prices of china wood oil have advanced materially in China. A cable quotation indicates that $316 U. S. gold per ton was being paid on April 16 at Hankow. This is an increase from $260 the latest preceding quotation. Even with the very high prices being offered, spot oil is very scarce. The difficulty of getting stocks to Hankow from the interior is given as the cause of the shortage.

Japan Hoarding Dyestuffs

The dullness which has characterized the dyestuff market in Japan recently was transformed into a period of speculative activity in which prices throughout the list rose sharply. The situation was precipitated, it is believed, by the realization that supplies were being quietly hoarded and the realization that the situation in the Ruhr would not be a temporary one.

Good Car Service for Movement of Fertilizers

Fertilizer manufacturers are particularly pleased with the car service which is being afforded them for the movement of this season's fertilizers. The railroads have made a special effort to co-operate with the manufacturers, and general satisfaction is expressed at the result. The performance of the railroads during this period in which fertilizers must be moved is the first general recognition which has been given of the necessity of handling fertilizers with an understanding of their seasonal application.

Higher Prices for German Potash in May

A material increase in the export price of German potash is expected May 1. The present prices applying to potash exports for the United States are: Chloride, $32; sulphate, $41.10; manure salt, $9.50; kainit, $6.50.

The total German export of potash in 1922 was approximately one million long tons. Of that amount, 25 per cent came to the United States. The pre-war movement to the United States alone was about one million tons annually.

February Chemical Exports Show Gain in Value

Substantial Increases as Compared With Figures for January and for February, 1922

A material increase in the value of chemicals and allied products exported in February is shown in comparison with the value of exports in January and in February of 1922. In February of this year the value of all chemicals and allied products exported, according to the returns to the Department of Commerce, was $9,321,365. The exports in January were $8,638,779. The value of exports in February, 1922, aggregated $7,665,272.

The value of coal-tar products exported in February was $986,545. This is an increase of more than $300,000 over the volume of exports in January and is more than $600,000 greater than those of February, 1922.

Sodas and sodium compounds were exported in February to the extent of $760,859. This is a slight decrease when compared with the value of exports in January and with those of February of 1922.

Pigments, paints and varnishes valued at $1,020,989 were exported in February of 1923, which represents an increase of more than $250,000 over February of 1922 and shows a continuance of the large volume of these exports maintained during January.

Exports of fertilizer and fertilizer materials augmented appreciably. The movement in February of 1923 was valued at $1,448,804. This is nearly half a million dollars greater than the value of exports in January. The movement of sulphate of ammonia increased from $549,108 in January to $797,041 in February.

The shipment of explosives abroad continues to pick up. The February total was $1,485,011 lb., which is more than half a million pounds greater than the January export movement of these commodities.

Exports of soaps contributed to the February increase, with the exports of laundry soap reaching the high total of 5,739,720 lb., and those of toilet soap attaining an aggregate of 842,971 lb. Other soaps to the extent of 2,017,531 lb. were exported.

Other chemical products exported during February which show an increase over the January movement, with February totals, are as follows: Benzol, 5,637,621 lb; crude tar, 14,097 bbl.; other crude distillates, 36,934,756 lb.; coal tar, colors, dyes and stains, 1,338,395 lb.; acetic acid, 102,670 lb.; wood and denatured alcohol, 190,289 gal.; other alcohol, 33,699 gal.; ammonia and ammonium compounds, 1,511,518 lb.; copper sulphate, 636,448 lb.; glycerin, 87,760 lb.; cyanide of soda, 210,780 lb.; borax, 5,081,352 lb.; silicate of soda, 1,770,500 lb.; sal soda, 878,670 lb.; red lead, 576,062 lb.; white and sublimed lead, 614,884 lb.; prepared fertilizer mixture, 4,682 tons.

Organic Chemical Production Increases 177 Per Cent in 7-Year Period

Domestic Output Lower Than Abnormal Production of 1919, but Shows Healthy Expansion Over 1914 Totals

REPORTS made to the Bureau of the Census by establishments manufacturing organic chemicals that are not included in special chemical groups (listed below) show a production aggregating in value \$45,476,600 in 1921, as compared with \$72,141,542 in 1919 and \$16,377,955 in 1914—a decrease of 37 per cent as compared with 1919, but an increase of 177 per cent for the 7-year period 1921-1914.

	1921	1919	1914
Alcohols:			
Amyl alcohol, gal	107,200	241,254	(2)
Glycerin (glycerol).			
Crude, lb.	21,856,000	21,402,735	16,568,920
Refined, lb.	68,843,700	69,464,298	60,944,799
Alcohols other than amyl and ethyl, but including absolute ethyl alcohol produced in chemical establishments	\$804,800	\$553,234	(2)
Aldehydes			
Formaldehyde, lb	9,682,700	25,006,815	
Vanillin, lb.	191,700	134,687	120,619
Other aldehydes	\$484,000	\$1,794,268	(2)
Amines and amids, lb.	1,374,200	(2)	(2)
Carbon bisulphide, lb.	22,741,000	15,469,567	(2)
Hydrocarbons, including acetylene	\$8,289,800	\$8,060,541	(2)
Other carbon compounds, calcium carbide, decolorizing carbon, carbon electrodes, etc.	\$13,851,000	\$20,301,657	(2)
Esters:			
Amyl acetate, gal	56,300	125,692	
Ethyl acetate, gal	906,600	770,739	(2)
Ethyl nitrite, lb	59,400	43,153	(2)
Other esters	\$106,900	\$1,007,794	
Halogen compounds			
Chloroform, lb	944,300	1,677,641	1,333,954
Ethyl chloride, lb	208,300	248,103	(2)
Other halogen compounds and carbon tetrachloride, chloral hydrate, ethyl bromide, iodoform, etc	\$599,300	\$1,057,896	(2)
Ethers Ethyl (sulphuric) and other, lb	3,763,300	4,898,033	
Ketones			
Acetone, lb	4,380,100	6,045,914	10,425,817
Other ketones, lb	1,218,600	1,531,808	(2)
Other organic chemicals	\$2,135,300	\$1,409,158	(2)
Unclassified organic chemicals	\$1,245,700	\$4,138,359	(2)

(1) Not including (except as noted) ethyl or grain alcohol, the products of distilleries, or methanol (wood alcohol), for which see "Wood Distillation."

(2) Figures not available.

The special chemical groups for which separate reports are being issued are as follows: (1) Acids; (2) nitrogen compounds; (3) sodium compounds; (4) potash and potassium compounds; (5) alums, aluminum, and compounds; (6) bleaching compounds; (7) coal-tar chemicals; (2) plastics; and (9) compressed and liquefied gases.

The principal organic chemicals here included are the following:

Refined glycerin, with a production for sale in 1921 of 59,861,400 lb., valued at \$9,514,300, a decrease on a quantity basis of 11 per cent as compared with 1919, but a slight increase (less than 1 per cent) as compared with 1914.

Vanillin, with a production in 1921 of 191,700 lb., valued at \$1,496,900, an increase on a quantity basis of 42 per cent over 1919, and of 59 per cent over 1914.

Ethyl ether, with a production for sale in 1921 of 3,416,100 lb., valued at \$920,700, a decrease of 17 per cent in quantity compared with 1919, but an increase of 61 per cent over 1914.

Carbon bisulphide, with a production for sale of 14,942,000 lb., valued at \$795,900, an increase in quantity of 29 per cent compared with 1919.

Formaldehyde, with a production for sale of 6,088,700 lb., valued at \$649,000, a decrease in quantity of 69 per cent as compared with 1919, and of 28 per cent as compared with 1914.

Acetone, with a production of 4,380,100 lb., valued at \$441,700, a decrease of 27 per cent in quantity as compared with 1919, and of 58 per cent compared with 1914.

Chloroform, with a production of 944,300 lb., valued at \$289,300; a decrease of 44 per cent in quantity as compared with 1919, and 29 per cent as compared with 1914.

Ethyl acetate, with a production of 410,800 gal., valued at \$241,200, an increase in quantity of 16 per cent as compared with 1919.

The figures for 1921 are preliminary, and subject to such change and correction as may be found necessary from a further examination of the original reports.

The detailed statistics of production for 1921, 1919 and 1914, are given in the accompanying table.

Refractories Merger Looms

Negotiations for the purchase of American Refractories Co. by the General Refractories Co. have been concluded and it is said that the merging of the two companies now awaits only the formal approval of the stockholders of the two organizations.

By this purchase the General Refractories Co. increases its annual capacity to about 300,000,000 bricks, making it the second largest producer in the country. It has plants at Baltimore and at Danville and Joliet, Ill. The recent purchase will add particularly to the company's silica and magnesite brick capacity.

Chemical Salesmen Dine and Hold Business Meeting

A well-attended meeting of the *Salesmen's Association of the American Chemical Industry was held last Wednesday evening at the Chemists' Club, New York City. Dinner was served at 7 o'clock. While the dinner was in progress songs were sung under the* able leadership of F. E. Signer, D. F. Stewart and G. A. Bode. R. E. Dorland presided at the business meeting. Reports of progress were given by the committees on uniform sales contracts and return packages, as submitted by Messrs. Haynes and Tunison respectively. R. C. Anthony was appointed chairman of the entertainment committee for the next meeting, which will be held late in May or early in June and will be in the nature of an "outing." The following eight new members were admitted to the association: B. K. Hotchkiss, representing Hooker Electrochemical Co.; P. M. Dinkins, of the Kalbfleisch Corporation; H. G. Stephenson, of E. I. du Pont de Nemours & Co., Inc.; E. V. Finch, of the United States Alkali Export Association; John F. Martini, of Monsanto Chemical Works; Milton Louria of Maple Chemical Co.; Arthur J. Binder, of the Sherwin-Williams Co., and B. M. Van Clive, also from the Sherwin-Williams Co.

H. Seydel, of the Seydel Chemical Co., spoke briefly on the interdependence of the executive and sales branches of the industry. He was followed by Charles Wadsworth 3d, assistant editor of *Chem. & Met.*, who discussed problems of distribution. Mr. Wadsworth then introduced the principal speaker of the evening, Paul T. Cherington, of the J. Walter Thompson Co. Mr. Cherington delivered a very interesting and instructive address on the subject, "Problems Experienced in Marketing a Consumer Product."

Acid Accidents Must Stop

Tank cars carrying acids, more especially sulphuric, should not be subjected to pressures of over 30 lb. per sq.in. The tank car pressure committee of the Manufacturing Chemists' Association reported to the executive committee of that association at its New York meeting on April 18 that in many cases pressures as high as 80 lb. per sq.in. are being used. Serious damage to apparatus as well as personal injury has resulted due to accidents caused by neglect of heeding the 30 lb. per sq.in. pressure recommendation. A campaign of education to correct this malpractice among producers and consumers is to be carried on by the association.

The executive committee at the same time appointed two members to establish standard specifications for earthenware apparatus.

The annual meeting of the association is to be held at the Whitehall Club, New York, on June 6.

Foreign Chemists Amazed at Development Here

Such an ambitious program of meetings, visits and social affairs was arranged by the chemists of Washington and other scientists in the capital for the recent visit of foreign chemists that the visitors all but lacked the necessary physical strength to keep all of the appointments which had been made for them. The visiting chemists were: Dr. F. G. Donnan, professor of chemistry at University College, London; Dr. James C. Irvine, principal and vice-chancellor, University of St. Andrews, St. Andrews, Scotland; Prof. Giuseppe Bruni, of the Polytechnical School at Milan, Italy, and Prof. A. F. Holleman, of the University of Amsterdam.

The visitors were the guests of honor at a dinner on April 17 tendered jointly by the Washington Academy of Sciences, the Philosophical Society of Washington and the Chemical Society of Washington. After the dinner Dr. Donnan and Dr. Irvine delivered addresses in the auditorium of the Interior Department.

Dr. Charles L. Parsons, secretary of the American Chemical Society, on April 16 arranged a dinner for the visiting chemists and twenty other guests, including the Italian Ambassador, at the Cosmos Club. During the course of that dinner Ambassador Caetani announced that he had suggested to Italy's Premier that arrangements be made for the sending to America, at public expense, a number of graduate engineers each year, with the idea of giving them the advantage of a certain amount of American experience and contact with American ideas of engineering efficiency. On the same occasion Dr. Irvine stated that he is advising British students to do post-graduate work in the United States.

Each of the visitors expressed astonishment at the rapid growth of scientific development in the United States. Fifteen years ago, it was pointed out by one of the visitors, America was known as the source of certain scientific work of a very high character, but the amount of work being done was not great. The visitors also were much impressed by the facilities which we possess in the way of laboratories, books of reference and current technical publications.

Australia Has Surplus Arsenic

An increasing volume of white arsenic imported from Australia is expected as a result of reports reaching Washington from that country. Australia makes its own sheep dips and other arsenicals, but its production of white arsenic is in excess of those requirements. The present level of prices is sufficient to make it profitable to send this surplus to the United States.

Sir J. J. Thomson Visits G. E.

Sir Joseph J. Thomson, Master of Trinity College, Cambridge, England, spent 2 days of his stay in this country at the research laboratories of the General Electric Co., Schenectady, on April 6 and 7, previous to his series of lectures before the Franklin Institute on "The Electron in Chemistry."

He gave an informal talk to the laboratory staff and engineers, inspected the works, and evinced much interest in the latest developments as demonstrated during his visit. He inspected the various types of radio vacuum tubes employing thoriated filaments to obtain greater electron emission, examined the 1,000-kw. tube set and other features.

Sir Joseph was accompanied by Dr. R. B. Owens, secretary of the Franklin Institute, and W. C. L. Eglin, vice-president. In the accompanying photograph he is shown with them and with Dr. Irving Langmuir and Dr. Coolidge.

BEST MINDS IN SCIENCE MEET

Sir Joseph J. Thomson, Master of Trinity College, Cambridge, England, is here shown with Dr. Irving Langmuir, assistant director, G-E Laboratory; Dr. R. B. Owens, secretary of the Franklin Institute; W. C. L. Eglin, vice-president, the Franklin Institute; and Dr. W. D. Coolidge, inventor of the Coolidge X-ray tube. When this photograph was taken Sir Joseph was examining a 20-kw. radio tube.

A.E.S. Meets May 3-5

Two Symposiums, an Inspection of Dorr Plant and Social Events on Program

With headquarters at the Commodore Hotel, New York, the American Electrochemical Society is to hold its annual meeting May 3 to 5. Technical sessions are to be held on Thursday, Friday and Saturday.

Members of several New York sections of scientific organizations have been invited to attend these meetings. The list includes: American Chemical Society, Society of Chemical Industry, American Institute of Chemical Engineers, Société de Chimie Industrielle, New Jersey Chemical Society, American Institute of Mining and Metallurgical Engineers, Metallurgical Society of America, American Institute of Electrical Engineers, American Electroplaters' Society, National Electric Light Association and New York Electrical Society.

On Thursday, May 3, the program of the day includes a symposium on "Electrode Potentials." With W. G. Horsch as chairman the following men are to present papers in this connection: H. S. Taylor, H. C. Howard, M. Knobel, P. Caplan, M. Eiseman, N. H. Furman, A. H. Aten, A. Lowy, H. S. Frank, W. Blum, C. G. Schluederberg, F. A. J. FitzGerald, H. S. Rawdon, H. E. Haring, A. K. Graham, M. R. Thompson, H. D. Heneline, W. Baughman.

The program of the day includes an inspection of the McGraw-Hill plant at noon and an informal luncheon following. In the evening the Electrothermic Division Council is to hold a dinner.

The Friday morning session includes the following papers:

J. C. Woodson: Heat Insulating Material for Electrically Heated Apparatus.

F. W. Brooke: Methods of Handling Materials in the Electric Furnace and the Best Type of Furnace to Use.

M. deKay Thompson and P. K. Frölich: The Conversion of Diamonds to Graphite at High Temperatures.

A. E. R. Westman: The Relation Between Current, Voltage and the Length of the Carbon Arcs.

C. E. Williams, C. E. Sims and C. A. Newhall: Electric Furnace Detinning and Production of Synthetic Gray Iron From Tin Plate Scrap.

C. W. Drury: Cobalt—Its Production and Uses.

F. C. Kelley: Chromizing.

Following the technical meeting members will journey to Westport, Conn., where the plant of the Dorr Co. is to be visited. Following the plant inspection there is to be a dinner and dance at the Westport Country Club.

The final meeting on Saturday morning, includes a symposium on "Production and Application of Rarer Metals." Speakers include: C. James, H. S. Cooper, H. W. Gillett, E. L. Mack, B. D. Saklatwalla, R. W. Moore, J. A. Holladay, T. R. Cunningham, R. P. Neville, E. Wichers, L. Jordan and F. E. Carter.

Moroccan Phosphate May Rival Florida Deposits

Huge Amounts of Rich Rock Are Becoming Available Through Intensive Development

ADDITIONAL information as to the phosphate situation in Morocco has become available. The 1922 production was 80,583 tons. It is estimated that 300,000 tons will be exported in 1923 and that by 1927 a production of 1,100,000 tons will have been attained.

The increase in production is being made possible by the installation of mechanical handling at Casablanca, the port. The narrow-gage railway connecting Casablanca and the mines is being changed to a broad-gage line. The influence the broad-gage railroad will have on the movement of these phosphates is indicated by the fact that the freight rate will be reduced from 52 francs to 16 francs per ton.

The phosphate beds are situated 160 kilometers south of Casablanca. The beds themselves occur in an area 75 kilometers in length which varies from 5 to 35 kilometers in breadth. The beds are in horizontal layers several meters in thickness. The percentage of phosphate is said to average from 73 to 78 per cent. Reports from disinterested sources agree that there are very extensive deposits of very high-grade phosphate of lime.

For the past 2 years the deposits have been under the direct control of a state monopoly. It is conducted under a board of management with wide powers vested in a head manager, which gives it the flexibility of administration enjoyed by a private industry. At the same time the enterprise has been benefited greatly by its governmental character, as it has made easy the construction of railways and the providing of port facilities which would have taken a much longer time to arrange had private interests only been concerned.

While the Moroccan authorities claim that a small profit now is being realized from these operations, there is reason to believe that all phosphate exported is being sold at a loss. The development of the deposits, however, and the facilities connected with the whole enterprise are being conducted with assurance because Europe's annual requirements of phosphate exceed four million tons. When provisions are complete to handle production and shipments in quantity, there seems little doubt of the ability to compete successfully with the Florida product.

Gives Fund for Soap Study

The Palmolive Co., of Milwaukee, announces the establishment of a Fellowship for the study of the fundamental principles connected with the detergent action of soap. The Fellowship carries an annual stipend of $2,000. The Fellow will have the privilege of pursuing his studies at any institution in the country which is properly equipped for this purpose. The candidate must possess the equivalent of a Master's degree.

The Fellowship will be awarded by a committee consisting of the following: W. D. Bancroft, professor of chemistry, Cornell University; E. C. Franklin, American Chemical Society; H. N. Holmes, chairman colloid division, National Research Council; Victor Lenher, professor of chemistry, University of Wisconsin; J. C. Sellmer, representing Palmolive Co.

General Motors to Produce Anti-Knock Gasoline

A subsidiary of the General Motors Corporation, to be known as the General Motors Chemical Co., is about to use gasoline filling stations as a medium for placing a modified type of gasoline on the market. This new type of gasoline, it is announced, contains an anti-knock compound which has been developed after many years of experiment by the General Motors Research Corporation.

News Notes

The oldest powder yard in the country went out of existence recently when E. E. du Pont de Nemours & Co. closed their plant on the Brandywine. This yard was founded in 1802.

Cement manufacturers are reported to be considering a change from cloth to paper bags for handling their product. Decreased cost without increased loss of product through breakage or dampening is expected if the change is made.

Changes in tariff rates have been requested by no less than 159 applicants. It is understood that in addition to the list of seventeen commodities already being investigated another group of eight is now being prepared for investigation. The list will of course be acted on only with the President's approval.

Czecho-Slovakian industry is staging a "comeback" according to reports received here by the consul general of that country. The greatest improvements noted are in iron, coal and engineering industries. Machinery for sugar works, breweries and alcohol distilleries is being shipped in increasing amounts to France, Belgium and Italy.

Paper and ink as related in the printing industry were discussed before the Society of Chemical Industry at its New York meeting on April 13. The nature and composition of inks, the causes of fading of lithographs and the inter-relationship of paper and ink colors in printing were the topics of the evening.

The Electric Steel Founders' Research Group held a convention at East Aurora, N. Y., April 13 and 14. The gathering was one of the most successful in the history of the group, which has been in existence since 1920. Representatives and executives from the five electric steel casting plants forming the Research Group joined in a discussion of important steel foundry problems covering both technical and commercial phases. W. H. Worrilow, president of Lebanon Steel Foundry, Lebanon, Pa., presided over the sessions.

The principal effort of the Division of Research Extension of the National Research Council during the coming year will be to raise funds in sufficient amount to permit intensive work on the tables of physical and chemical constants, being edited by the Council.

Eighteen American students have been awarded scholarships by the American-Scandinavian foundation. Of this number several are to study chemistry, engineering and metallurgy in Denmark and Sweden.

French naval stores are now practically exhausted. Commercial Attaché C. L. Jones reports that there is probably not more than 100 tons in warehouses in the Bordeaux district. It is yet too early to estimate the size of the crop, but it is evident that it will exceed 1922 crop, which was about 32,000 metric tons of turpentine and 118,000 tons of rosin.

Spraying potatoes with copper salts such as Bordeaux, Pickering mixtures and likewise barium water not only has the effect of controlling the diseases for which they are applied but, according to the United States Department of Agriculture, thorough and timely spraying usually greatly increases the yield, influences the composition of the tubers and increases their keeping qualities in storage.

A course in illuminating gas manufacture and distribution is to be given at Columbia University this summer by Prof. J. J. Morgan. This course will include plant inspection, laboratory work and a thorough lecture treatment of the entire subject. To furnish a motive for the work the class is to be given the problem of laying out a gas plant for a small city.

To determine how long it takes to "tire" a metal to the point where it gives way under repeated strains or shocks the Engineering Foundation, in collaboration with the National Research Council, the Copper and Brass Research Association, the University of Illinois, the General Electric Co., Western Electric Co. and other corporations has undertaken a comprehensive program of research to establish the endurance limits or so-called "fatigue" of copper, brass, bronze and other metals.

Facts and Figures That Influence Trade in Chemical Products

Market Conditions

Current Prices Imports and Exports The Trend of Business

Speculative Trading in Chemicals No Longer A Market Factor

Consuming Buying Moderate Owing to Heavy Contract Holdings—Tartaric Acid Advances in Price—Fluoride of Soda Strong—Metal Salts Unchanged But Easy in Tone—Less Interest in Arsenic

CENSUS reports, just issued, covering production of chemicals for 1921, in general reveal a healthy growth as compared with 1914. However, material increases over the 1921 figures may be expected in the current year if present rate of output is maintained or even approximated for the balance of the year.

With different consuming trades covered by contracts, new business placed in the past week was not heavy. As prices for the speculative commodities are high enough to be considered dangerous, there is a decided falling off in activity on the part of speculators, and this gives the market a quieter appearance than actually is the case when measured by normal standards, as different sellers report a fair average volume of business. Prices for the most part are fluctuating within narrow limits. Seasonable demand and limited stocks have a strengthening effect on some chemicals and the position of foreign markets also has an influence on many commodities. The easy tone to basic metals has caused buyers of metal salts to regard present prices as safe from advances and they are buying in a hand to mouth way with the hope that values will work more in their favor. Permanganate of potash is holding attention, but prices are irregular and demand is in evidence only on dips in the market. There are well defined rumors of short interests in arsenic, but if correct, attempts to cover are well concealed; however, spasmodic buying on weak spots is regarded as significant. Copper sulphate, which was selling freely for export a year ago, is now depressed by the weight of foreign offerings in our markets, and prices went to still lower levels during the week as the result of selling pressure. Demand for fertilizer chemicals is not expected to show any immediate improvement, and interest is mainly confined to prices for deferred shipments. Sulphuric acid is in a very strong position, with producers sold ahead, and it is difficult to negotiate business for prompt deliveries. Tartaric acid moved into higher prices during the week and with German grades out of the question, the prospect for low priced imported material is not bright.

Acetic Acid—Demand has not picked up enough to bring about any material change and raw materials likewise offer nothing new, so the price schedule of makers is on an unchanged basis. Business during the week was described as routine. Asking prices are $3.17½ for 28 per cent and $6.35 for 56 per cent, with glacial at $12.05@$12.85.

Citric Acid—Firmness is the keynote in this market. Domestic offerings continue to be quoted at 49c. per lb., but the bulk of home production is sold ahead and this places considerable dependence on imported. Foreign markets are strong and 52c. per lb. is asked for shipments. Some spot offerings are held here which were imported at more favorable prices and holders are not eager to sell below replacement costs, so the latter also is quoted at 52c. per lb.

Formic Acid—Prices have not been disturbed by trading, in fact the call for fresh supplies is described as very moderate. For domestic acid the asking price is maintained at 16c. to 17c. per lb. for 85 per cent. Imported acid was not pressing for sale but was easy in tone because of the lack of buying interest. Prices for the latter were 14½@14¾c. per lb. Shipments were practically on the same level as spot.

Hydrofluoric Acid — Consumers are not active at present and seasonable dullness is found in most quarters. Considerable interest in future prices, however, has arisen because of reports that raw materials, especially fluorspar, are becoming scarcer and this is taken as an indication that values later in the year will be higher. Acid grades of fluorspar, 98½ per cent or better, crushed, are offered at $27.50 per ton delivered. No change in acid prices has taken place, and for the time slow consuming demand is the governing factor. Quotations are 7@7¾c. for the 30 per cent and 11@11½c. for 48 per cent.

Oxalic Acid—There has been less disposition on the part of sellers to shade prices and difficulties surrounding shipments have given a firmer feeling to prices, which is reflected in the market for domestic offerings as well as imported. Prices for domestic are reported as strong at 12¾@13c. per lb., f.o.b.

"Chem. & Met." Weighted Index of Chemical Prices

Base — 100 for 1913-14

This week	178.31
Last week	181.48
April, 1918 (high)	286.00
April, 1919	231.00
April, 1920	261.00
April, 1921 (low)	140.00
April, 1922	158.00

Another slight recession in the index number occurred last week. The decline was brought about by the ½c. reduction in crude cottonseed oil and the easier position of formaldehyde

works. Imported is held at 13½@14c. per lb., according to quantity and seller.

Tartaric Acid—Predictions of higher prices have been verified, as early last week there was a general rise of one cent per lb. for both domestic and imported. Demand is holding up well and recent advances have failed to check the buying movement. Current prices are 36c. per lb. for domestic and 35½c. per lb. for imported. Reports from the Italian market indicate firm conditions there.

Potashes

Bichromate of Potash—An easy tone continued throughout the week and while 10¾c. per lb. is given as the open quotation for round lots at the works, this price is not firm and 10½c. per lb. is said to be possible on firm bids. Despite the apparent easy tone to prices it is believed that there are no heavy stocks to work off and increased buying would be immediately felt.

Caustic Potash — Sales of two cars afloat were put through at 8c. per lb. Spot goods sold at 8½c. per lb. and despite reports of limited stocks the undercurrent seemed less strong than a week ago. Many consumers are interested only at price concessions and lack of actual buying interest prevents any real strength to prices.

Chlorate of Potash—This chemical has been marked by the steady position of values. Imported offerings are held at an inside figure of 7¼c. per lb. and shipments also are steady at that figure. Domestic is moving normally at unchanged price levels of 8½c. per lb. and upwards, according to quantity. These prices being f.o.b. works. Large consumers are covered by contracts.

Permanganate of Potash — Developments in permanganate are being followed more closely than most of the other items in the chemical list. Demand is fair, but buyers have their own views about values and place orders only when they think prices are

right. The general asking price on spot is 24c. per lb., but this has not been entirely adhered to and sales were reported fractionally under that level. *Goods afloat were available at 23c. per lb. On shipments 22½c. per lb. was asked for April and 21½c. per lb. for May.*

Potash First Sorts—*Leading sellers have turned down business under their asking levels and a very firm market continues. Buyers are not active, but this is offset by reduced production and limited stocks in sellers' hands. Prices are on a basis of 9c. per lb. for moderate sized lots.*

Sodas

Acetate of Soda—It is a buyers' market and values are easy under selling pressure. As low as 5½c. per lb. was heard during the week and even at the reduced prices, buying has not been stimulated to any extent.

Bichromate of Soda—Raw materials used in the manufacture of bichromate are holding a steady position and this is reflected in the market for the finished product. Producers are maintaining prices at 7½c. per lb., works, for round lots. Most of the present movement from the plants is against old orders with new business quiet. In the spot market 7⅞@8c. per lb. is the ruling quotation.

Caustic Soda—Independent interests which a short time ago were reported to be finding difficulty in placing goods for export are now said to be getting a good share of that business. The so-called outside brands have sold at 3.35c. per lb., f.a.s., while standard brands are held at 3.45c. per lb., although the latter do not seem to be as strong as previously. Domestic buyers were not much in evidence last week and small lot business predominated. The contract price is held at 2½c. per lb., works, basis 60 per cent. Spot material is offered at 3⅞c. per lb. for less carlots, 76 per cent solid.

Chlorate of Soda—Off-grade material of foreign make is still on the market with holders willing to do business on private terms. On prime goods the price is well maintained at 6½c. per lb. No change has taken place in domestic makes and sellers hold out for an inside price of 6½c. per lb., works.

Cyanide of Soda—Reports are now current that two new producing companies are preparing to enter the field in the West. Of course it will be some time before they will be able to influence values. Imported cyanide is offered rather freely in the local market but is not meeting with a ready sale and prices are easy at 20@21c. per lb. Domestic cyanide is steady at 22½@23c. per lb.

Fluoride of Soda—Producing costs are on the upward trend and indications point to further price advances. During the week business at 9½c. per lb. was said to have been turned down and 9½c. per lb. is held as the lowest figure at which sellers will accept orders.

Nitrate of Soda—With the heavy buying season over, prices for nitrate are a little weaker and selling pressure has become more of a factor. Importers as a rule are not disposed to shade asking *prices of $2.65 per 100 lb., but in the open market it was possible to do $2.60 per 100 lb. and possibly a little lower. Considerable interest is taken in future prices but offerings under $2.50 per 100 lb. have failed to bring buyers into the market. On the one hand is the attempt in primary points to curtail production and stabilize prices and on the other the uncertainty about the extent to which European markets may be expected to buy. If the latter purchase sparingly it is held that prices will be made attractive to stimulate American buying.*

Prussiate of Soda—Competing materials have been offered at more attractive relative prices and this has had the effect of cutting down the demand for prussiate. This may be illustrated in the case of dry colors where the chemical colors are not finding the outlet which is noted for the earth colors. Prices for yellow prussiate were decidedly easier last week. Offerings were available at 17¾c. per lb. and even this price was said to be none too strong.

Soda Ash—Scattered buying on new account is noted but contract withdrawals continue heavy and this is the feature of the market. Prices are steady, with hardly any chance for a lowering of values. In fact some well posted traders say indications favor rises in quotations. Production is still at close to capacity of plants but is equalled by consuming requirements. Quotations are holding at $1.75 in bags and $1.95 in barrels.

Miscellaneous

Arsenic—In spite of reports that prominent interests are said to need arsenic in order to take care of sales of calcium arsenate, the market last week showed a falling off in interest. Some sellers hold that buyers are holding out in order to let values ease off through lack of support. The undertone was a shade easier. Spot goods were quoted at 15½@15½c. per lb. Mexican arsenic for shipment was offered at 15c. per lb. and Japanese was reported to have sold at 14½c. per lb. Cables to Washington state that Australia has surplus stocks of arsenic which can compete in price in our markets.

Calcium Arsenate—Fundamental conditions have undergone no change and as demand is expected to continue for three months and no way is in sight to make up the prospective shortage, the outlook can hardly be interpreted as favoring price declines. Sellers appear to be willing to hold prices from advancing and during the week it was possible to do 17⅞c. per lb.

Copper Sulphate—Inquiry was more active and sales of round lots were reported in both imported and domestic grades. Yet many sellers say business is still below expectations. There is no definite quotation on imported and buyers are taking advantage of the situation to depress values by making low bids. Sales were made at 5½c. per lb. Domestic grades are more steadily held *than imported but there are differences according to brand and seller with 6½c. to 6½c. per lb. asked.*

Tin Oxide—*In common with the other metals tin has worked into an easier position, but, while this was reflected in a slightly easier feeling for tin oxide, the leading factors maintained prices on the basis of 52c. per lb. Trading was slow, buyers holding off for further developments because of the unsettled state of the metal.*

Formaldehyde—It was reported that the cheap lots have all been cleaned up, some business passing early in the week as low as 13¾c. per lb. Most of the sales went through around 14c. At the close the situation firmed up somewhat and "outside" lots were held at 14½c. per lb. First hands maintained prices on the 16c. basis. The market was irregular all through the early part of the week.

Sulphate of Ammonia—Local sellers report export inquiry of fair volume and sales are said to have been made to Japan in the past few days. The quotation, f.a.s. New York, is generally given at 3.90c. per lb., but with firm business in hand it is stated that 3.85c. can be done.

Alcohol Trade Slow

Some traders reported fair business in alcohol, but in the majority of instances business was described as quiet. Prices did not change, but the undertone was barely steady, especially on denatured spirits. The No. 1 denatured was offered freely at 39c. per gal., 188 proof. Ethyl spirits, 190 proof, was unchanged at $4.75@$4.85 per gal. Methanol, 95 per cent, was available at $1.19@$1.21 per gal.

Trade Notes

Export duty on copra from Fiji has been fixed at 10 shillings per ton, which is a reduction of 5 shillings per ton from the rate effective last year.

The Tannin Corporation will move on May 1 from 80 Maiden Lane to larger quarters in the new building at 11 Pershing Square.

J. M. Lowe, manager and chief chemist of the Edgewater, N. J., plant of the Midland Linseed Products Co., returned last week from Toledo.

Herbert J. Cantrell, identified with the cottonseed oil business since 1907 and a member of the New York Produce Exchange, has retired from business.

H. D. Ruhm of 136 Liberty St., New York, is now in the South in connection with his interests in phosphate rock and calcium arsenate interests.

Coal-Tar Products

Active Trading in Salicylic Acid—Phenol Higher in Second Hands—Steady Call for Naphthalene—Benzene Quiet

An active demand for salicylic acid set in toward the close and the market strengthened in all directions. While no actual advance in prices was announced by leading producers, the continued buying made operators more cautious and offerings late in the week were very much smaller. The buying came from a good source and it looked as if an upward movement in prices for the salicylates was in order. The phenol situation did not change for the better. The offerings were scanty and it was doubtful whether resale parcels could have been picked up for less than 56c. per lb., immediate delivery. Producers have not changed their views, being well sold up on nearby material. In naphthalene the demand continues active, with distributors anxious for goods purchased some time ago. It is reported that several domestic producers have not yet delivered March commitments. There was no buying interest in forward material; traders see no reason for a material reduction in prices, pointing to the strong market for crude.

The tariff situation in connection with cresol attracted attention. The Treasury Department, in a ruling handed down recently, held that the duty of 7c. per lb. and 55 per cent was the proper rate on cresol containing less than 5 per cent of tar acid distilling below 190 deg. C. Importers had little faith in the claim for free entry under paragraph 1549. However, it is felt that the application for a 50 per cent reduction in the rate of duty will be more successful, as domestic producers appear satisfied that the existing rate is too high. The market for cresylic acid at the close was firm. Benzene demand continues quiet, but prices were nominally unchanged. Solvent naphtha was in scanty supply and firm. Pure xylene was strong on spot around the 75c. basis. Second hands were asking around $1 per lb.

Coal-Tar Crudes, Etc.

Benzene—Offerings were plentiful, but prices underwent no change, as traders take the stand that new business will soon come forward in volume and surplus stocks are really not burdensome. Benzene, 90 per cent, in tanks. held at 27c. per gal., contract basis, the customary premium obtaining on small quantities. On the pure, water-white, the market held at 30@32c. per gal., immediate delivery.

Cresylic Acid—With no prospects for a change in the interpretation of the tariff law, traders have abandoned all hope for free entry of the lower grades of this acid. Attention will now be directed to the application for a 50 per cent reduction in the rate of duty on cresylic acid, which has been agreed upon by both importers and domestic producers, the prevailing rate being prohibitive and working many hardships on the consuming industry. The foreign markets were firm, holding on the basis of 85c. per gal., in bond, prompt shipment from the other side, New York, for the 97 per cent material. Spot 97 per cent acid closed nominally at $1.40 per gal., with the lower grades at $1.30.

Naphthalene—Demand for naphthalene was active and with producers behind in making deliveries, the market for spot goods presented a firm appearance. With the weather unseasonable, actual consuming demand for ball naphthalene has not been so urgent, but distributors, nevertheless, are anxious about their supplies. The market settled at 9¼@9¾c. per lb., carlot basis. Traders held out little hope for a material reduction in new contract prices, owing to the strong position of crude. Crude naphthalene of good color for shipment from abroad settled around 3c. per lb.

Phenol—The offerings of resale material were scanty and prices at the close were strong and more or less nominal. Early in the week several parcels brought 55c. per lb., but later it was said that nothing could have been picked up in outside channels at less than 56c. per lb., immediate delivery. Leading domestic producers have not changed their selling views, delivering all they can make on the old basis of 26c. per lb. New production can hardly come on the market for some time to come, with the result that the market prospects covering nearby material are in an exceedingly strong position. The extraordinary demand for phenol is attributed to the absorbtion of this material by manufacturers of phenol resins.

Aniline Oil—Producers report a moderate amount of business, but with stocks not pressing on the market, quotations were maintained on the basis of 16c. per lb., round lots. Scattered business was put through at this figure.

Beta-Naphthol—No further changes were reported in the market for beta-naphthol, leading handlers asking 23½c. per lb., while in outside quarters there were offerings at 23c. per lb.

Dimethylaniline—The demand for dimethylaniline was fair and producers reported a steady market, maintaining prices on the former basis of 42c. per lb., in drums, immediate delivery.

Paranitraniline—There was more buying interest and prices steadied in some directions. Quotations varied, depending upon the make, etc. Most traders were asking around 75c. per lb.

Toluene—The market was a featureless affair, production being restricted because of the limited outlet for this material. Nominal quotations were repeated at 30@32c. per gal.

Xylene—Because of higher manufacturing costs leading interests have raised their views on the pure to 75c. per gal., carlot basis, forward delivery, to consumers only.

Cottonseed Oil Visible Down to 846,000 Barrels

The Bureau of Census report on cottonseed products, issued on Tuesday, April 17, indicated that 167,000 barrels of cottonseed oil was consumed during the month of March. This compares with 194,000 barrels in February and 204,000 barrels in March a year ago. The showing was not so good as trade leaders expected, but, considering the small visible supply, the situation is regarded as firm and no real downward movement in prices of old crop oil is looked for at just this time. The visible supply of oil on March 31 is estimated at 846,000 barrels, which compares with 963,000 barrels on the corresponding date a year ago.

Receipts of cottonseed at the mills from Aug. 1 to March 31 amounted to 3,167,750 tons, against 2,857,824 tons for the corresponding period a year ago. The amount of seed actually crushed for the eight months ending with March 31 amounted to 3,016,865 tons, against 2,853,762 tons for the same time a year ago. Production of crude oil for the eight months ending with the last day in March amounted to 922,224,522 pounds, contrasted with 878,821,894 pounds for the corresponding period a year ago. The production of refined oil for the eight months covered by the report reached the total of 779,015,120 pounds, which compares with 744,804,378 pounds for the same period last year.

Stocks of cottonseed on March 31 were placed at 159,922 tons, against 101,193 tons on the same day a year ago. The stocks of crude oil on hand March 31 amounted to 60,137,116 pounds, which compares with 54,907,155 pounds a year ago. The stocks of refined cottonseed oil on the last day of March amounted to 239,925,412 pounds, contrasted with 299,860,679 pounds on the corresponding date a year ago.

Treasury Decision Upholds Duty on Cresol

The Collector of Customs at New York last week received a decision from the Treasury Department at Washington, upholding an appraiser's report on an importation of cresol, where the entry was classified as dutiable under paragraph 27 of the tariff act at the rate of 7c. per pound and 55 per cent ad valorem. Attorneys for the importers had contended that free entry should be given under paragraph 1549 of the tariff act, which provides for free entry of all distillates of any of the tars mentioned in the paragraph which, on being subject to distillation, yield in the portion distilling below 190 deg. C. a quantity of tar acids less than 5 per cent of the original distillate.

Vegetable Oils and Fats

Crude Cottonseed Lower—Coconut Sales at 9¼c. New York—Linseed Holds Firm—Tallow Steady

THE cottonseed oil market developed weakness on the showing made in March, which took the trade by surprise. The Bureau of Census report indicated consumption of 167,000 barrels, a good volume, but not quite up to expectations. Another feature was the activity in coconut oil. The New York market was unsettled early in the week but steadied later on buying for export, evidently to satisfy a short account in London. Linseed was nominally unchanged, with sentiment on futures somewhat easier because of the freer movement of Indian seed and the tendency to increase the Argentine estimates on the exportable surplus. Soya was higher in the forward positions. Trading, taken as a whole, was good on nearby material, but inactive on futures.

Linseed Oil—At the close crushers offered April-May oil at $1.17 per gallon, carload lots, cooperage included Several operators also named this figure on June business, but appeared willing to do $1.14 on July and $1.10 on August forward. New business was inactive and large consumers showed no anxiety for summer oil, many of them entertaining bearish views because of the more favorable seed situation. The Argentine Ministry of Agriculture revised the final estimate on the crop, bringing the figures up to 52,960,000 bushels. The previous "final" estimate put the crop at 47,023,000 bushels, while early in the season a production of 61,240,000 bushels was the forecast India shipped 528,000 bushels of new crop seed last week, indicating that the movement was on. An exportable surplus of 12,000,000 bushels may be expected from India. A full cargo of Argentine seed now afloat sold late in the week at $2.39½ per bushel, c.i.f. New York. Linseed cake was steady at $36 per ton, f.a.s. New York.

Cottonseed Oil—Prices eased off in all directions on the drop in lard and the less favorable showing on March consumption as revealed in the Census figures. The visible supply of oil on the last day of March was placed at 846,000 barrels, which compares with 963,000 barrels on the corresponding date a year ago, a bullish statistical situation according to trade authorities. At the close it was felt that prices will advance on the first showing of strength in lard. Lard stocks in Chicago on April 15 amounted to 29,327,935 pounds, against 13,495,496 pounds on April 1. Hogs were easy all week on heavy receipts. Exports of cottonseed oil for the eight months ending with March 31 amounted to 48,984,982 pounds, against 75,195,473 pounds for the corresponding period a year ago. Crude oil sold in the Southeast at 10c., f.o.b. mills. Bleachable oil sold at 11½c. per lb., buyers' tanks, f.o.b. New York. There were rumors of new crop (Oct.-Nov.-Dec.) crude selling at 7½c., f.o.b. Texas mills.

Coconut Oil—The sale of 35 tank cars of Ceylon type oil was reported at 9¼c. per lb., f.o.b. New York. One lot sold down to 9⅛c. during the past week. This naturally steadied prices a little and at the close 9⅜c. was the market. Europe bought here and, according to traders, this represented covering by shorts. The sale of 100 tons of Central American copra was reported at 5½c., c.i.f. New York. On Manila sun-dried, there were offerings at 5.75c., c.i.f. New York. Coconut cake was dull and the price was lowered to $33 per ton.

Corn Oil—Crude closed at 10¼@10⅜c. per lb sellers' tanks, Middle Western points. Refined in barrels, New York, held at 13½@13⅝c. per lb.

China Wood—A small lot brought 37c. per lb. on spot. May arrival was available at 30c. with June-July shipment at 25½@26c. per lb. On the Pacific coast 25c. was asked on May-June sellers' tanks.

Palm Oil—Trading was slow and prices on futures irregular. Niger oil for shipment closed at 8⅞c. asked. Lagos held at 8½c. With the movement of oil in Africa about to set in operators were disposed to hold off.

Soya Bean Oil—April shipments from the coast held steady at 10¼c., sellers' tanks, duty paid. On futures the asking price was raised to 10⅜c., coast basis. In New York City one car of prompt oil was held at 10⅞c., duty paid.

Fish Oils—The sale of several tank cars of crude menhaden oil was reported at 50c. per gal., which compares with 55c., the ruling price a week ago. The transactions, of course, cover futures "if made" as the season is fully two months away. Newfoundland cod oil was offered at 68c. per gal. A shipment of sardine oil arrived here from the Orient. There were no changes in the crude whale oil situation.

Tallow and Greases—The sale of 10 cars of extra special tallow was reported at 9c. per lb., f.o.b. plant, the prices showing no change for the entire week. Several shipments of South American tallow arrived here last week. At the weekly London auction, held on April 17, 1,442 csk. of tallow were offered and 720 csk. were disposed of. Prices were unchanged to 6d. higher. Oleo stearine sold at 10⅜c. and later at 10⅞c., f.o.b. New York. Choice yellow grease was scarce at 8½c. New York.

Miscellaneaus Materials

Glycerine—The market was a dull affair, but prices did not ease off. Refiners take the stand that contract business will come along in volume in a short time and, with a firm situation in crude, they refuse to force the market. C. P. held at 18c. per lb., in drums, carload lots, and 20c. in tins. Dynamite sold at 16½c. in this territory. The leading "buyers" have been reselling scattered lots without depressing the views of actual holders in producing circles. Crude soap lye, basis 80 per cent, held at 10¼c. loose in the West, and 10½@10¾c. in the East. Saponification was wholly nominal at 12¼@12¾c. per lb. loose, carload lots.

Casein—The past week witnessed the arrival of 7,450 pkg. of casein from various foreign sources of supply, but principally New Zealand and the Argentine. The market was unsettled on "nearby" material. On spot most traders held out for 25c. on the technical grade.

Naval Stores—The market was easy early in the week, the price for turpentine declining steadily until it reached $1.48 per gal. in New York and $1.40 per gal. in Savannah. Late in the week business showed moderate improvement. The arrival of new season's production is increasing and stocks are gradually accumulating. Export business was inactive. Steam distilled turpentine settled at $1.43 per gal. Rosins went off 5c. per barrel, the "B" grade settling at $6.15. Trading was slow, even after the decline. The market for tar and rosin oils was quotably unchanged.

Shellac—Lower cables from Calcutta and London unsettled the market and prices at the close were weak. T. N. was offered down to 71c. per lb., spot New York, round-lot basis. Superfine orange closed nominally at 76c., with the ordinary at 74c. per lb. Bleached, bonedry, closed at 84@86c. per lb., immediate and nearby delivery. Demand was moderate, the decline naturally frightening prospective buyers.

White Lead—The easier market for the metal failed to change the attitude of producers of lead pigments. Trading in the pigments since the first of the year has been active, notwithstanding the numerous upward revisions in prices. Standard dry white lead (basic carbonate) held at 9⅝c. per lb. in casks, carload lots. The sulphate was unchanged at 9¼c.

Zinc Oxide—There was an easier market for spelter as well as ore, yet this failed to weaken the ideas of producers of zinc oxide. First-hands reported a good volume of orders on their books and production appears to be sold up over the next two months in more than one direction. American process lead free was available at 8c. per lb., carload lots. French process, red seal, was offered at 9⅝c., carload lots.

Imports at the Port of New York

April 13 to April 19

ACIDS—2 bbl. coal tar, Hull, Merck & Co.; 10 csk. cresylic, London, T. G Cooper; 76 dr. cresylic, Liverpool, W. E. Jordan; 135 dr. cresylic, Liverpool, Order; 100 csk. citric, Palermo, R. F. Downing & Co; 150 csk. citric, Palermo, Order; 6 dr. cresylic, Liverpool, Monsanto Chem Wks.; 100 dr. cresylic, Liverpool, Order; 23 dr. cresylic, Hull, Order; 50 dr. cresylic, Glasgow, Irving Bank-Col. Trust Co.; 24 dr cresylic, Rotterdam, Bregent Corp of America.

ALUM—29 csk., Rotterdam, A. Klipstein & Co., 154 csk. sulphate, Rotterdam, Meteor Products Co.; 66 csk dr., 500 bg. hydrate, Rotterdam, Greeff & Co.

AMMONIUM—50 cs. chloride, Liverpool, Wing & Evans; 10 csk. carbonate, Liverpool, Brown Bros & Co.; 10 csk. carbonate, Liverpool, Order.

ANTIMONY SALT—10 bbl, Hamburg, Am. Exchange Nat'l. Bank.

ARSENIC—117 csk., Antwerp, Order, 8 cs, Liverpool, F B. Vandegrift & Co., 240 cs., Kobe, Mitsui & Co., 104 cs. Kobe, J. D. Lewis, 348 cs, Kobe, G. F. Taylor, 220 cs, Kobe, Takata & Co; 100 cs., Kobe, S L. John & Co.; 120 cs., Kobe, Order

ARGOLS- 140 bg., Lisbon, Royal Baking Powder Co.

BARIUM — 15 csk hydrate, Hamburg, Order; 52 csk. chloride, Antwerp, Order, 54 csk. chloride, Hamburg, United Hardware Mfg Co of Am.

BARYTES—134 bg., Bremen, Equitable Trust Co.; 100 csk, Bremen, Order.

BORATE LIME—6,467 bg., Mejillones, Pacific Coast Borax Co

CASEIN—165 bg, Hamburg, Manhattan Co; 120 bg., Melbourne, Order; 80 sk, London, Order, 1,502 bg., Buenos Aires, Brown Bros & Co.; 1,667 bg., Buenos Aires, Kalbfleisch Corp, 2,523 sk., Auckland, Asia Banking Corp.; 232 sk., Auckland, Bank of America; 383 sk, Auckland, Order, 175 bg, Bombay, Order.

CHALK — 1,100 bg., Antwerp, Irving Bank; 500 tons, London, Baring Bros & Co., 400 bg., London, W E Miller Co., 1,397,000 kilos in bulk, Dunkirk, Taintor Trading Co., 500,000 kilos in bulk, Dunkirk, J. Higman Co.; 1,000 bg., Antwerp, Bankers Trust Co; 200 bg powdered, Antwerp, Cooper & Cooper; 500 tons, London, Taintor Trading Co., 650 pkg. precipitated, Bristol, H. J. Baker & Bros

CHEMICALS—68 pg., Hamburg, Order; 3 cs Hamburg, Merck & Co.; 40 csk., Bremen, Roessler & Hasslacher Chem. Co., 117 pkg, Bremen, Pfaltz & Bauer, 26 pkg., Bremen, Order; 1,000 bg., Antwerp, Order; 430 bg., Hamburg, J. Munroe Co.; 573 bbl., Hamburg, Roessler & Hasslacher Chem. Co; 298 pkg., Hamburg, Jungmann & Co., 20 bbl., Hamburg, Pfaltz & Bauer, 20 bbl., Hamburg, Hummel & Robinson; 10 cs., Hamburg, H. Lieber & Co.; 54 csk., Hamburg, Order; 112 pkg, Rotterdam, Order.

COPPER SULPHATE—500 bg., Antwerp, Order; 330 csk., Antwerp, Am. Exchange Nat'l Bank.

COAL-TAR DISTILLATE—16 dr., Glasgow, Guaranty Trust Co.

COLORS—33 csk. earth, Bremen, L. H. Butcher & Co.; 27 pkg., Havre, Irving Bank-Col. Trust Co.; 18 csk. umber, Hull, L. H Butcher Co.; 20 csk umber, Hull, Tidewater Chemical Co; 5 pkg. aniline, Liverpool, Order; 17 pkg aniline, Genoa, Am. Ex. Nat'l Bank; 27 pkg., Genoa, Nat'l. Aniline & Chem. Co; 22 pkg., Genoa, Order, 18 bbl. ultramarine blue, Antwerp, Order; 37 csk. earth, Hamburg, Reichard, Coulston, Inc.; 10 csk., Hamburg, J. M Huber; 359 pkg. red earth, Bristol, Order; 10 csk aniline, Rotterdam, Kuttroff, Pickardt & Co.

COPRA—51 bg, Montego Bay, Franklin Baker Co.,

CHINA CLAY—200 bg., Bristol, Order; 103 csk., Bristol, C. F. Wilson Co.

CREOSOTE — 6 bbl. distillate, Hull, Merck & Co.

CUTCH—3,500 bg., Singapore, Order.

DIVI-DIVI—500 bg., Pampatar, Goldsmith & Co.; 40 bg, Curacao, R. Desvernine.

FULLERS EARTH—1,700 bg., Bristol, L. A. Salomon & Bro.

FERTILIZER—4,000 bg., Hull, Order.

GUMS—2,422 bg. copal, Antwerp, Order; 950 bsk. copal, Antwerp, Order; 60 pkg. copal, London, Chemical Nat'l Bank; 50 pkg. arabic, Hamburg, Order, 98 pg. kauri, Auckland, Brown Bros. & Co; 108 cs kauri, Auckland, Guaranty Trust Co.; 100 cs kauri, Auckland Coal & Iron Nat'l Bank; 706 sk kauri, Auckland, Nairn Linoleum Co.; 204 cs. kauri, Auckland, Order; 972 bg copal, Antwerp, W. Schall & Co.; 2,355 pkg. copal, Antwerp, Order; 256 bg. copal, Singapore, Guaranty Trust Co.; 280 bg. copal, Singapore, Order; 100 cs. damar, Batavia, Balfour, Williamson & Co; 700 cs. damar, Padang, Order; 886 bg. damar, 140 bg copal, Singapore, Kidder, Peabody & Co., 740 pkg. damar, 70 bg. copal, Singapore, Baring Bros & Co.; 489 pkg. copal, Singapore, Irving Bank; 120 pkg. copal, Singapore, Order; 100 cs. damar, Batavia, L. C Gillespie & Son; 400 cs. do., Batavia, Kidder, Peabody & Co.; 200 cs. do., Batavia, Bank of Manhattan Co.; 300 cs. do., Batavia, Order, 4,974 pkg. kauri, Auckland, various, 575 pkg. karaya, Auckland, Order.

GAMBIER — 261 cs, Singapore, East Asiatic Corp.; 635 pkg, Singapore, E. Baustead & Co.

GLAUBERS SALT—500 bg., Hamburg, A J. Marcus; 281 csk., Hamburg, Globe Shipping Co

GLYCERINE—40 dr., Antwerp, N. Y Trust Co., 10 dr., Hull, Marx & Rawolle.

HYDROGEN-PEROXIDE — 64 cs, Antwerp, Order

IRON OXIDE—22 csk., Liverpool, L. H. Butcher & Co.

IRON SULPHATE—92 csk., Antwerp, E M. Sergeant & Co.

LITHOPONE—180 csk., Bremen, Pfaltz & Bauer; 1,000 csk., Antwerp, Benj. Moore & Co; 600 csk, Rotterdam, Order

LOGWOOD EXTRACT—220 bbl., Cape Haitien, Logwood Mfg. Corp.

MAGNESIUM—282 dr. chloride, Innis, Speiden & Co.; 506 dr chloride, Hamburg, Brown Bros & Co.; 1,278 bg. carbonate, Glasgow, Bankers Trust Co.

MINERAL WHITE — 1,200 bg., Hull, Hammill & Gillespie; 300 bg., Hull, C. B. Crystal Co.

MYROBALANS — 8,000 pkt., Calcutta, Order; 16,687 pkt, Calcutta, Nat'l City Bank; 2,116 pkt, Calcutta, Standard Bank of South Africa; 7,000 pkt., Bombay, Order.

NICKEL SULPHATE — 25 csk., Hamburg, Blackburn Trading Corp.; 277 csk., Bristol, Perry, Ryer & Co.; 297 csk., Swansea, Order

NAPHTHALENE—695 pkg., London, Order; 500 bg., London, Irving Bank; 113 bg, Bristol, Order.

NUX VOMICA — 431 bg., Coronada, Order; 200 bg., Bombay, Order.

OILS—**Castor**, 56 bbl., Hull, Brown Bros. & Co., 200 bbl., Hull, Order. **Cod** — 100 bbl., Hull, Order; 305 csk., St. Johns, R. Badcock & Co; 300 csk, St Johns, National Oil Products Co. **Sardine**—2,000 cs., Kobe, C. A. Reddin; 1,700 cs., Kobe, Cook & Swan Co.; 4,400 cs, Kobe, Balfour, Williamson & Co. **Fusel**—9 dr., Antwerp, Guaranty Trust Co, 12 csk., Dunkirk, Guaranty Trust Co; 35 dr., Dunkirk, Order. **Soya Bean**—1,201 tons, Canton, Mitsubishi Shoji Kaisha. **Olive foots** (sulphur oil)—220 bbl, 60 csk Leghorn, Am. Co. for Int'l Commerce; 150 bbl., Leghorn, Order; 700 bbl., Bari, Nat'l City Bank; 500 bbl., Bari, Leghorn Trading Co, 400 bbl., Bari, Irving Nat'l Bank; 800 bbl., Bari, Fourth Street Nat'l Bank, Philadelphia; 200 bbl., Bari, Banca Comm. Ital.; 200 bbl., Bari, Bank of Manhattan Co.; 100 bbl., Messina, Leghorn Trading Co.; 100 bbl., Palermo, Order. **Peanut**—240 cs., Hongkong, Man Hing; 500 bbl, Bristol, Balfour, Williamson & Co; 160 bbl., Bombay, Order. **Linseed**—478 bbl., Hull, I. R Boody & Co.; 300 bbl., Hull, Balfour, Williamson & Co.; 750 tons (bulk), Hull, Midland Linseed Products Co.; 128 bbl., Bombay, Order. **Perilla**—500 bbl., Canton, Cook & Swan Co.; 100 bbl., Kobe, Balfour, Williamson & Co.; 2,000 cs., Kobe, Mitsui & Co.; 1,280 bbl., Kobe, Cook & Swan Co. **Palm**—87 csk., Liverpool, D. Bacon; 15 csk., Liverpool, African & Eastern Trading Co.; 156 csk., Liverpool, Order, 173 bbl., Belawan, Nat'l City Bank; 85 csk., Liverpool, D. Bacon, 81 csk., Liverpool, W. Leaman; 29 csk., Liverpool, Order; 534 csk., Rotterdam, Order. **Rapeseed**—200 bbl., Hull, Hudson Oil Co., 500 bbl, Hull Vacuum Oil Co.; 300 bbl, Hull, Nat'l City Bank; 385 bbl., Hull, Order, 154 bbl., Hull, Order. **China Wood**—100 csk, Shanghai, F. A. Cundill & Co.; 292 csk., Hankow, L. C. Gillespie & Sons, 299 csk., Hankow, Cook & Swan Co.; 237 csk., Hankow, Nat'l City Bank, 50 dr, Hong Kong, Order.

POTASSIUM SALTS—4,000 bg. muriate, Bremen, A. Vogel, 3,916 bg. and quantity in bulk, Antwerp, Société Commerciale des Potasses d'Alsace; 1,000 bg. kainit, Antwerp, Société Commerciale des Potasses d'Alsace; 106 csk perchlorate, Antwerp, Order, 3,000 bg. sulphate, Bremerhaven, A. Vogel; 9 bbl. prussiate, Hamburg, Broedermann & Litzrodt; 166 dr. caustic, Hamburg, Innis, Speiden & Co., 20 csk. perchlorate, Swansea, Order, 68 csk. alum, Rotterdam, Meteor Products Co.; 125 bbl. chlorate, Marseilles, Nat'l City Bank.

PITCH—259 bbl., Hull, Order.

QUEBRACHO—1,969 bg., Buenos Aires, Guaranty Trust Co; 1,836 bg., Buenos Aires, Order, 10,700 bg., Buenos Aires, Tannin Corp.

SOAP STOCK — 300 bbl., Liverpool, Order.

SODIUM SALTS—18 csk. bisulphite, Hamburg, Order, 168 cs cyanide, Havre, Asia Banking Corp.; 111 cs. cyanide, Havre, H W. Peabody & Co.; 134 dr. salts, Hamburg, C. S Grant & Co.; 5,627 bg. nitrate, Antofagasta, Wessel, Duval & Co.; 5,512 bg. nitrate, Mejillones, Anthony, Gibbs & Co; 5,572 bg. nitrate, Iquique, Wessel, Duval & Co; 96 cs. chlorate, Genoa, A. R. Pickering & Co.; 578 bbl. hyposulphite, Marseilles, E M. Sergeant & Co.

SEEDS—**Castor** 9,522 bg., Coconada, Order; 12,646 bg, Bombay, Order. **Linseed**—95,245 bg, Buenos Aires, American Linseed Co.; 8,887 bg, Buenos Aires, Order; 8,820 bg., Buenos Aires, L Dreyfus & Co

SHELLAC — 10 cs., Hamburg, Irving Nat'l Bank; 200 bg., Calcutta, Lee, Higginson & Co.; 100 bg, Calcutta, Iwai & Co.; 175 bg, Calcutta, Cont. Comm. Nat'l Bank, 500 bg., Calcutta, Chase Nat'l Bank; 100 bg., Calcutta, Bank of Br. West Africa; 100 bg., Calcutta, London & Liverpool Bank of Comm; 481 bg., Calcutta, Anglo South Am. Bank; 1,841 pkg., Calcutta, Order; 150 pkg, London, Order; 38 bg., garnet, Kasebier-Chatfield Shellac Co.; 200 bg., Calcutta, Am. Exchange Nat'l Bank; 100 pkg., Calcutta, London & Liverpool Bank of Comm; 425 pkg., Calcutta, Order; 314 pkg., Marseilles, Order.

STARCH—1,250 bg. potato, Rotterdam, Stein, Hall & Co; 500 bg. do., Rotterdam, Spier, Simmons & Co.

SUMAC—590 bg., Palermo, Order; 700 bg, Palermo, Equitable Trust Co.; 1,400 bg., Palermo, Am. Express Co.; 1,400 bg., Palermo, Bank of N. Y.; 550 pkg., Palermo, Order; 350 bg., Palermo, Order.

TALLOW—728 tc., Buenos Aires, Bank of New York & Trust Co.; 778 tc., Buenos Aires, Swift & Co.; 673 tc., Buenos Aires, Order; 452 csk., Montevideo, Bank of New York & Trust Co.; 78 csk., Buenos Aires, Swift & Co.; 279 csk., Buenos Aires, Order; 127 pipes, Melbourne, Nat'l City Bank; 111 pipes, Melbourne, Nat'l City Bank; 98 pipes, Sydney, Order.

TANNIN—24 csk., Antwerp, Geigy Co.

TALC—1,800 bg, Genoa, Italian Discount & Trust Co.; 900 bg., Genoa, Order.

WAX—2,400 bg. paraffin, London, Order; 72 bg. bees, London, Order; 26 bg. bees, Leghorn, Order; 5 bg. bees, Rio de Janeiro, D Steengrafe; 75 bg bees, Rio de Janeiro, London & Braz. Bank; 90 bg. carnauba, Pernambuca, Irving Nat'l Bank.

WHITING—2,000 bg., Antwerp, Brooklyn Trust Co.

WOOL GREASE — 50 bbl., Bremen, A. Klipstein & Co.

ZINC OXIDE — 250 bbl., Marseilles, Nat'l City Bank.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

General Chemicals

Acetic anhydride, 85%, drums	lb.	$0 38 –
Acetone, drums	lb.	.22 – .23
Acid, acetic, 28%, bbl	100 lb.	3 17½ – 3 92½
Acetic, 56%, bbl	100 lb.	6 35 – 6 37
Glacial, 99½%, bbl.	100 lb.	12 05 – 12 85
Boric, bbl	lb.	.11 – .11½
Citric, kegs	lb.	.49 – .50
Formic, 85%	lb.	.14½ – .17
Gallic, tech	lb.	.45 – .50
Hydrofluoric, 52%, carboys	lb.	.12 – .12½
Lactic, 44%, tech., light, bbl.	lb.	.11½ – .12
22% tech, light, bbl.	lb.	.05½ – .06
Muriatic, 18° tanks	100 lb.	.90 – 1.00
Muriatic, 20°, tanks	100 lb.	1.00 – 1.10
Nitric, 36°, carboys	lb.	.04½ – .05
Nitric, 42°, carboys	lb.	.06 – .06½
Oleum, 20%, tanks	ton	18.50 – 19 00
Oxalic, crystals, bbl.	lb.	.13½ – .13¾
Phosphoric, 50% carboys	lb.	.07½ – .08½
Pyrogallic, resublimed	lb.	1 50 – 1 60
Sulphuric, 60°, tanks	ton	9 00 – 10 00
Sulphuric, 60°, drums	ton	12 00 – 14 00
Sulphuric, 66°, tanks	ton	15 00 – 15 50
Sulphuric, 66° drums	ton	19 00 – 20 00
Tannic, U S P, bbl.	lb.	.65 – .70
Tannic, tech, bbl.	lb.	.45 – .50
Tartaric, imp. crys., bbl.	lb.	.35½ –
Tartaric, imp, powd, bbl.	lb.	.35½ –
Tartaric, domestic, bbl.	lb.	.36 –
Tungstic, per lb.	lb.	1.10 – 1.20
Alcohol, butyl, drums, f.o.b. works	lb.	.27 – .29
Alcohol ethyl (Cologne spirit), bbl.	gal.	4.75 – 4.95
Alcohol, methyl (see Methanol)		
Alcohol, denatured, 188 proof No. 1, bbl	gal.	.39 – .40
Alum, ammonia, lump, bbl.	lb.	.03½ – .03¾
Potash, lump, bbl	lb.	.03 – .03½
Chrome, lump, potash, bbl.	lb.	.05½ – .05¾
Aluminum sulphate, com., bags	100 lb.	1.50 – 1 65
Iron free bags	lb.	.02½ – .02¾
Aqua ammonia, 26°, drums	lb.	.06½ – .07½
Ammonia, anhydrous, cyl.	lb.	.30 – .30½
Ammonium carbonate, powd casks, imported	lb.	.09½ – .10
Ammonium carbonate, powd domestic, bbl	lb.	.13 – .14
Ammonium nitrate, tech., casks	lb.	.10 – .11
Amyl acetate tech., drums	gal.	3 50 – 3 75
Arsenic, white, powd, bbl	lb.	.15½ – .16
Arsenic, red, powd, kegs	lb.	.14½ – .15
Barium carbonate, bbl	ton	78 00 – 80 00
Barium chloride, bbl	ton	90 00 – 95 00
Barium dioxide, drums	lb.	.18 – .18½
Barium nitrate, casks	lb.	.08 – .08½
Barium sulphate, bbl	lb.	.04 – .04½
Blanc fixe, dry, bbl.	lb.	.04½ – .04¾
Blanc fixe, pulp, bbl	ton	45 00 – 55 00
Bleaching powder, f.o.b. wks., drums	100 lb.	2 15 –
Spot N. Y. drums	100 lb.	2 60 – 2 70
Borax, bbl.	lb.	.05½ – .05¾
Bromine, cases	lb.	.28 – .30
Calcium acetate, bags	100 lb.	3 50 – 3 60
Calcium carbide, drums	lb.	.04½ – .04¾
Calcium chloride, fused, drums	ton	22 00 – 23.00
Gran. drums	lb.	.01½ – .01¾
Calcium phosphate, mono, bbl	lb.	.06½ – .07
Camphor, cases	lb.	.88 – .90
Carbon bisulphide, drums.	lb.	.07 – .07½
Carbon tetrachloride, drums	lb.	.10 –
Chalk, precip —domestic, light, bbl	lb.	.04½ – .04¾
Domestic, heavy, bbl.	lb.	.03½ – .03¾
Imported, light, bbl	lb.	.04½ – .05
Chlorine, liquid, cylinders.	lb.	.06 – .06½
Chloroform, tech, drums	lb.	.35 – .38
Cobalt oxide, bbl	lb.	2 10 – 2 25
Copperas, bulk, f.o.b. wks.	ton	16 50 – 20.00
Copper carbonate, bbl.	lb.	.19 – .20
Copper cyanide, drums	lb.	.47 – .50
Coppersulphate, crys., bbl.	100 lb.	6.25 – 6 50
Cream of tartar, bbl.	lb.	.25½ – .26½
Epsom salt, dom., tech., bbl.	100 lb.	1.90 – 2.15
Epsom salt, imp., tech., bags	100 lb.	1.10 – 1.25
Epsom salt, U.S.P., dom., bbl.	100 lb.	2.50 – 2.60
Ether, U.S.P., drums	lb.	.13 – .15
Ethyl acetate, com., 85%, drums	gal	.80 – .85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 – 1.00
Formaldehyde, 40%, bbl.	lb.	.14½ – .16
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00
Fullers earth—imp., powd.	net ton	30.00 – 32.90
Fusel oil, ref., drums	gal.	3.55 – 4.05
Fusel oil, crude, drums	gal.	2.30 – 2.40
Glaubers salt, wks., bags	100 lb.	1.20 – 1.40

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available. In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

Glaubers salt, imp., bags	100 lb.	$1 00 – $1.25
Glycerine, c.p., drums extra	lb.	.18 – .18½
Glycerine, dynamite, drums	lb.	.16½ –
Iodine, resublimed	lb.	4.55 – 4 65
Iron oxide, red, casks	lb.	.12 – .18
Lead.		
White, basic carbonate, dry, casks	lb.	.09½ – .10
White, basic sulphate, casks	lb.	.09½ –
White, in oil, kegs	lb.	.12½ – .14
Red, dry, casks	lb.	.11½ – .12
Red, in oil, kegs	lb.	.13½ – .15
Lead acetate, white crys., bbl	lb.	.13½ – .14
Brown, broken, casks	lb.	.12½
Lead arsenate, powd., bbl.	lb.	.23 – .24
Lime-Hydrated, bbl	per ton	16 80 – 17 00
Lime, Lump, bbl	280 lb.	3 63 – 3 65
Litharge, comm., casks.	lb.	.10½ – .11
Lithophone, bags	lb.	.07 – .07½
in bbl	lb.	.07½ – .07¾
Magnesium carb., tech., bags	lb.	.08 – .08½
Methanol, 95%, bbl	gal.	1 21 – 1 23
Methanol, 97%, bbl.	gal.	1 23 – 1 25
Nickel salt, double, bbl.	lb.	.10½ –
Nickel salts, single, bbl	lb.	.11½ –
Phosgene		.60 – .75
Phosphorus, red, cases	lb.	.35 – .40
Phosphorus, yellow, cases	lb.	.30 – .35
Potassium bichromate, casks	lb.	.10½ – .10¾
Potassium bromide, gran., bbl	lb.	.16½ – .23
Potassium carbonate, 80-85%, calcined, casks	lb.	.06½ – .07
Potassium chlorate, powd	lb.	.07½ – .08
Potassium cyanide, drums	lb.	.45 – .50
Potassium, first sorts, cask	lb.	.09 – .09½
Potassium hydroxide (caustic potash) drums	100 lb.	8 25 – 8 50
Potassium iodide, cases	lb.	3 65 – 3 75
Potassium nitrate, bbl	lb.	.06½ – .07½
Potassium permanganate, drums	lb.	.24 – .24½
Potassium prussiate, red, casks	lb.	.80 – .82
Potassium prussiate, yellow, casks	lb.	.37 – .37½
Salammoniac, white, gran., casks, imported	lb.	.07 – .07½
Salammoniac, white, gran., bbl, domestic	lb.	.07½ – .08
Gray, gran, casks	lb.	.08 – .09
Salsoda, bbl.	100 lb.	1.20 – 1 40
Salt cake (bulk)	ton	26.00 – 28.00
Soda ash, light, 58% flat, bags, contract	100 lb.	1.60 – 1.67
Soda ash, light, basis, 48%, bags, contract, f.o.b. wks.	100 lb.	1.20 – 1.30
Soda ash, light, 58%, flat, bags, resale	100 lb.	1.75 – 1.80
Soda ash, dense, bags, contract, basis 48%	100 lb.	1.17½ – 1.20
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90
Soda, caustic, 76%, solid, drums, f.a.s.	100 lb.	3.45 – 3.50
Soda, caustic, basis 60%, wks., contract	100 lb.	2.50 – 2.60
Soda, caustic, ground and flake, contracts	100 lb.	3.80 – 3.90
Soda, caustic, ground and flake, resale	100 lb.	3.72½ – ...
Sodium acetate, works, bags	lb.	.05½ – .06¼
Sodium bicarbonate, bbl	100 lb.	2.00 – 2.50
Sodium bichromate, casks	lb.	.07½ – .08
Sodium bisulphate (niter cake)	ton	6.00 – 7.00
Sodium bisulphite, powd., U.S.P., bbl.	lb.	.04½ – .04¾
Sodium chlorate, kegs	lb.	.06½ – .07
Sodium chloride	long ton	12.00 – 13.00
Sodium cyanide, cases	lb.	.20 – .23
Sodium fluoride, bbl.	lb.	$0.09½ – $0.10
Sodium hyposulphite, bbl.	lb.	.02½ – .03
Sodium nitrite, casks	lb.	.08½ – .09
Sodium peroxide, powd., cases	lb.	.28 – .30
Sodium phosphate, dibasic, bbl	lb.	.03½ – .04
Sodium prussiate, yel. drums	lb.	.17½ – .18
Sodium silicate (40°, drums)	100 lb.	.80 – 1.25
Sodium silicate (60°, drums)	100 lb.	2.00 – 2.25
Sodium sulphide, fused, 60-62% drums	lb.	.04½ – .04¾
Sodium sulphite, crys., bbl.	lb.	.03½ – .03¾
Strontium nitrate, powd., bbl.	lb.	.09½ – .10
Sulphur chloride, yel drums.	lb.	.04½ – .05
Sulphur, crude	ton	18.00 – 20.00
At mine, bulk	ton	16.00 – 18 00
Sulphur, flour, bbl.	100 lb.	2.35 – 3.15
Sulphur, roll, bbl	100 lb.	2.00 – 2.50
Sulphur dioxide, liquid, cyl.	lb.	.08 – .08½
Talc—imported, bags	ton	30.00 – 40.00
Talc—domestic powd., bags.	ton	18.00 – 25.00
Tin bichloride, bbl.	lb.	.13½ – .14
Tin oxide, bbl	lb.	.52 – .54
Zinc carbonate, bags	lb.	.14 – .14½
Zinc chloride, gran, bbl.	lb.	.06 – .07
Zinc cyanide, drums	lb.	.37 – .38
Zinc oxide, lead free, bbl.	lb.	.08 – .08½
5% lead sulphate, bags	lb.	.07½ – ..
10 to 35% lead sulphate, bags	lb.	.07 – ..
French, red seal, bags.	lb.	.09½ –
French, green seal, bags	lb.	.10½ –
French, white seal, bbl	lb.	.12 –
Zinc sulphate, bbl.	100 lb.	2.50 – 3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb.	$0 70 – $0.80
Alpha-naphthol, ref., bbl	lb.	.85 – .95
Alpha-naphthylamine, bbl.	lb.	.36 – .38
Aniline oil, drums	lb.	.16 – .16½
Aniline salts, bbl	lb.	.24 – .25
Anthracene, 80%, drums	lb.	.75 – 1.00
Anthracene, 80%, imp., drums, duty paid	lb.	.70 – .75
Anthraquinone, 25%, paste, drums	lb.	.70 – .75
Benzaldehyde U S P, carboys	lb.	1.40 – 1.45
Benzene, pure, water-white, tanks and drums	gal.	.32 – .35
Benzene, 90%, tanks & drums	gal.	.27 – .30
Benzene, 90%, drums, resale	gal.	.30 – .33
Benzidine base, bbl	lb.	.85 – .90
Benzidine sulphate, bbl	lb.	.70 – .75
Benzoic acid, U.S.P., kegs	lb.	.72 – .75
Benzoate of soda, U S P., bbl.	lb.	.57 – .65
Benzyl chloride, 95-97%, ref., drums	lb.	.25 – .27
Benzyl chloride, tech., drums	lb.	.20 – .23
Beta-naphthol, subl., bbl	lb.	.55 – .60
Beta-naphthol, tech., bbl	lb.	.23 – .23½
Beta-naphthylamine, tech.	lb.	.80 – .90
Carbazol, bbl.	lb.	.75 – .90
Cresol, U S P, drums	lb.	.25 – .29
Ortho-cresol, drums	lb.	.24 – .26
Cresylic acid, 97%, resale, drums	gal.	1.40 – 1.50
95-97%, drums, resale	gal.	1.30 – 1.30
Dichlorbenzene, drums	lb.	.07 – .09
Diethylaniline, drums	lb.	.50 – .60
Dimethylaniline, drums	lb.	.42 – .43
Dinitrobenzene bbl.	lb.	.19 – .20
Dinitroclorbenzene, bbl.	lb.	.22 – .23
Dinitronaphthalene, bbl.	lb.	.30 – .32
Dinitrophenol, bbl	lb.	.35 – .40
Dinitrotoluene, bbl.	lb.	.20 – .22
Dip oil, 25%, drums	gal.	.25 – .30
Diphenylamine, bbl.	lb.	.50 – .52
H-acid, bbl.	lb.	.85 –
Meta-phenylenediamine, bbl.	lb.	1.00 – 1 05
Michlers ketone, bbl	lb.	3.00 – 3 50
Monochlorbenzene, drums	lb.	.08 – .10
Monoethylaniline, drums	lb.	.95 – 1.10
Naphthalene, crushed, bbl.	lb.	.08 – .09
Naphthalene, flake, bbl.	lb.	.09½ – .10
Naphthalene, balls, bbl.	lb.	.10½ – .11
Naphthionate of soda, bbl.	lb.	.58 – .65
Naphthionic acid, crude, bbl.	lb.	.55 – .60
Nitrobenzene, drums	lb.	.10 – .12
Nitro-naphthalene, bbl.	lb.	.30 – .35
Nitro-toluene, drums	lb.	.15 – .17
N-W acid, bbl.	lb.	1.25 – 1.30
Ortho-amidophenol, kegs.	lb.	2.30 – 2.35
Ortho-dichlorbenzene, drums	lb.	.17 – .20
Ortho-nitrophenol, bbl	lb.	.90 – .92
Ortho-nitrotoluene, drums	lb.	.10 – .12
Ortho-toluidine, bbl.	lb.	.14 – .15
Para-amidophenol, base, kegs	lb.	1.20 – 1.30
Para-amidophenol, HCl, kegs	lb.	1.25 – 1.35
Para-dichlorbenzene, bbl.	lb.	.17 – .20
Paranitraniline, bbl.	lb.	.74 – .75
Para-nitrotoluene, bbl.	lb.	.60 – .65
Para-phenylenediamine, bbl.	lb.	1.45 – 1.50
Para-toluidine, bbl.	lb.	.95 – .98
Phthalic anhydride, bbl.	lb.	.35 – .38
Phenol, U.S.P., drums	lb.	.55 – .57
Picric acid, bbl.	lb.	.20 – .22
Pyridine, dom., drums	gal.	nominal
Pyridine, imp., drums	gal.	2.50 – 2.75

Resorcinol, tech., kegs	lb.	$1.40 –	$1 50
Resorcinol, pure, kegs	lb.	2.00 –	2.10
R-salt, bbl.	lb.	.55 –	.60
Salicylic acid, tech., bbl.	lb.	.47 –	.48
Salicylic acid, U.S.P., bbl.	lb.	.50 –	.52
Solvent naphtha, water-white, drums	gal.	.37 –	.40
Crude, drums	gal.	.22 –	.24
Sulphanilic acid, crude, bbl.	lb.	.18 –	.20
Thiocarbanilide, kegs	lb.	.35 –	.38
Toluidine, kegs	lb.	1.20 –	1.30
Toluidine, mixed, kegs	lb.	.30 –	.35
Toluene, tank cars	gal.	.30 –	.35
Toluene, drums	gal.	.35 –	.40
Xylidines drums	lb.	.45 –	.47
Xylene, pure, drums	gal.	.75 –	.85
Xylene, com., drums	gal.	.37 –	...
Xylene, com., tanks	gal.	.32 –	...

Naval Stores

Rosin B-D, bbl.	280 lb.	$6.15 –	...
Rosin E-I, bbl.	280 lb.	6.25 –	...
Rosin K-N, bbl.	280 lb.	6.30 –	6.60
Rosin W.G.-W.W., bbl.	280 lb.	6 80 –	7 80
Wood rosin, bbl.	280 lb.	6.20 –	...
Turpentine, spirits of, bbl.	gal	1.47 –	1 48
Wood, steam dist., bbl.	gal.	1.41 –	1 42
Wood, dest. dist., bbl.	gal.	1.10 –	1 15
Pine tar pitch, bbl.	200 lb.	... –	6 00
Tar, kiln burned, bbl.	500 lb.	... –	12 00
Retort tar, bbl.	500 lb.	... –	11 00
Rosin oil, first run, bbl.	gal.	.45 –	...
Rosin oil, second run, bbl.	gal	.48 –	...
Rosin oil, third run, bbl.	gal.	.52 –	...
Pine oil, steam dist.	gal.	.80 –	...
Pine oil, pure, dest. dist.	gal.	.75 –	...
Pine tar oil, ref.	gal.	.48 –	...
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal.	.31 –	.31½
Pine tar oil, double ref., bbl.	gal.	... –	.75
Pine tar, ref., thin, bbl.	gal.	... –	.25
Pinewood creosote, ref., bbl.	gal.	... –	.52

Animal Oils and Fats

Degras, bbl.	lb	$0 03¾ –	$0 04¼
Grease, yellow, bbl.	lb	08½ –	08¾
Lard oil, Extra No. 1, bbl.	gal	92 –	94
Neatsfoot oil, 20 deg. bbl.	gal	1 28 –	1 32
No. 1, bbl.	gal	.92 –	94
Oleo Stearine	..	.10¾ –	.10¾
Red oil, distilled, d.p. bbl	lb.	.11½ –	
Saponified, bbl	lb	11½ –	..
Tallow, extra, loose	lb	09 –	
Tallow oil, acidless, bbl.	gal.	96 –	.98

Vegetable Oils

Castor oil, No. 3, bbl.	lb.	$0 14 –	.
Castor oil, No. 1, bbl.	lb	.14½ –	...
Chinawood oil, bbl.	lb.	.36 –	.38
Coconut oil, Ceylon, bbl.	lb	.10¾ –	.10½
Ceylon, tanks, N.Y.	lb	.09½ –	.09¾
Coconut oil, Cochin, bbl.	lb.	.10¾ –	...
Corn oil, crude, bbl.	lb.	.12½ –	...
Crude, tanks, (f.o.b. mill)	lb.	10¾ –	10½
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.10 –	10½
Summer yellow, bbl.	lb.	.12½ –	.12½
Winter yellow, bbl.	lb.	.13½ –	.13½
Linseed oil, raw, car lots, bbl.	gal.	1 17 –	...
Raw, tank cars (dom.)	gal.	1 12 –	...
Boiled, cars, bbl. (dom.)	gal.	1 19 –	...
Olive oil, denatured, bbl.	gal.	1 15 –	...
Sulphur, (foots) bbl.	lb	.10 –	.10½
Palm, Lagos, casks	lb.	.08½ –	...
Niger, casks	lb	.08¾ –	.08½
Palm kernel, bbl.	lb.	.09½ –	.09½
Peanut oil, crude, tanks (mill)	lb	.13¾ –	.14
Peanut oil, refined, bbl.	lb.	.17 –	...
Perilla, bbl	lb	.16½ –	16¾
Rapeseed oil, refined, bbl.	gal.	.84 –	.85
Rapeseed oil, blown, bbl.	gal.	.90 –	.91
Sesame, bbl	lb.	.13 –	.13½
Soya bean (Manchurian), bbl.	lb.	.12½ –	...
Tank, f.o.b. Pacific coast	lb.	.10¾ –	...
Tank, (f.o.b. N.Y.)	lb.	.10¾ –	.11

Fish Oils

Cod, Newfoundland, bbl.	gal.	$0 68 –	$0 70
Menhaden, light pressed, bbl.	gal.	.76 –	...
White bleached, bbl.	gal.	.78 –	...
Blown, bbl.	gal.	.82 –	...
Crude, tanks (f.o.b. factory)	gal.	.50 –	...
Whale No. 1 crude, tanks, coast	lb.	.06½ –	...
Winter, natural, bbl.	gal.	.76 –	.78
Winter, bleached, bbl.	gal.	.79 –	.80

Oil Cake and Meal

Coconut cake, bags	ton	$33 00 –	...
Copra, sun dried, bags, (c.i.f.)	lb.	.05¾ –	...
Sun dried Pacific coast	lb.	05¾ –	...
Cottonseed meal, f.o.b. mills	ton	39 00 –	40.00
Linseed cake, bags	ton	36 00 –	...
Linseed meal, bags	ton	38 00 –	...

Dye & Tanning Materials

Albumen, blood, bbl.	lb.	$0 45 –	$0.50
Albumen, egg, tech, kegs	lb.	.80 –	.85
Cochineal, bags	lb.	.35 –	.36
Cutch, Borneo, bales	lb.	.04¾ –	.05
Cutch, Rangoon, bales	lb.	.13 –	.13½
Dextrine, corn, bags	100 lb.	3 54 –	3 59
Dextrine gum, bags	100 lb.	3.89 –	3.99
Divi-divi, bags	ton	38.00 –	39.00
Fustic, sticks	ton	30.00 –	35.00
Fustic, chips, bags	lb.	.04 –	.05
Logwood, sticks	ton	28.00 –	30.00
Logwood, chips, bags	lb.	.02½ –	.03½
Sumac, leaves, Sicily, bags	ton	$70.00 –	$72.00
Sumac, ground, bags	ton	65.00 –	67.00
Sumac, domestic, bags	ton	40.00 –	42.00
Tapioca flour, bags	lb.	.05½ –	.06½

Extracts

Archil, conc., bbl.	lb.	$0.17 –	$0.18
Chestnut, 25% tannin, tanks	lb.	.02 –	.03
Divi-divi, 25% tannin, bbl.	lb.	.04 –	.05
Fustic, crystals, bbl.	lb.	.20 –	.22
Fustic, liquid, 42°, bbl.	lb.	.08 –	.09
Gambier, liq., 25% tannin, bbl.	lb.	.08 –	.09
Hematine crys., bbl.	lb.	.14 –	.18
Hemlock, 25% tannin, bbl.	lb.	.04 –	.05
Hypernic, solid, drums	lb.	.24 –	.26
Hypernic, liquid, 51°, bbl.	lb.	.14 –	17
Logwood, crys., bbl.	lb.	.19 –	.20
Logwood, liq., 51°, bbl.	lb.	.09 –	.10
Quebracho, solid, 65% tannin, bbl.	lb.	.04½ –	.05
Sumac, dom., 51°, bbl.	lb.	.06½ –	.07

Dry Colors

Blacks-Carbongas, bags, f.o.b. works	lb.	$0 16 –	$0.18
Lampblack, bbl	lb.	12 –	.40
Mineral, bulk	ton	35 00 –	45 00
Blues-Bronze, bbl	lb.	.55 –	60
Prussian, bbl	lb.	.55 –	60
Ultramarine, bbl	lb.	08 –	35
Browns, Sienna, Ital., bbl	lb.	.06 –	14
Sienna, Domestic, bbl	lb.	.03½ –	04
Umber, Turkey, bbl	lb.	.04 –	04½
Greens Chrome, C.P. Light, bbl	lb.	32 –	.34
Chrome, commercial, bbl	lb	.12 –	12½
Paris, bulk	lb.	.30 –	.35
Reds, Carmine No. 40, tins	lb.	4 50 –	4.70
Oxide red, casks	lb.	10 –	.14
Para toner, kegs	lb.	1.00 –	1 10
Vermilion, English, bbl.	lb.	1 30 –	1.32
Yellow, Chrome, C.P. bbls	lb	20 –	.21
Ocher, French, casks	lb.	.02½ –	.03

Waxes

Bayberry, bbl.	lb.	$0 28 –	$0.30
Beeswax, crude, bags	lb.	.21 –	.25
Beeswax, refined, light, bags	lb	.32 –	.34
Beeswax, pure white, cases	lb.	.40 –	.41
Candelilla, bags	lb	.24 –	.25
Carnauba, No. 1, bags	lb.	.42 –	.43
No. 2, North Country, bags	lb.	.23 –	.23½
No. 3, North Country, bags	lb.	.19½ –	...
Japan, cases	lb.	.14½ –	.15
Montan, crude, bags	lb.	.04½ –	.04½
Paraffine, crude, match, 105-110 m.p.	lb.	.04½ –	.04½
Crude, scale 124-126 m.p., bags	lb.	.03 –	03½
Ref., 118-120 m.p., bags	lb.	.03¾ –	
Ref., 125 m.p., bags	lb.	.03¾ –	...
Ref., 128-130 m.p., bags	lb.	.04¼ –	04½
Ref., 133-135 m.p., bags	lb.	.04¾ –	...
Ref., 135-137 m.p., bags	lb.	.05½ –	.05½
Stearic acid, sgle pressed, bags	lb.	.14 –	...
Double pressed, bags	lb.	.14½ –	.
Triple pressed, bags	lb.	.16 –	...

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb	$3.25 –	$3 30
F.a.s. double bags	100 lb.	3.90 –	4 00
Blood, dried, bulk	unit	4 50 –	.
Bone, raw, 3 and 50, ground	ton	27 00 –	30.00
Fish scrap, dom., dried, wks.	unit	3 75 –	10 00
Nitrate of soda, bags	100 lb.	2.62½ –	2 65
Tankage, high grade, f.o.b. Chicago	unit	4.25 –	4 50
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$4.00 –	$4 50
Tennessee, 78-80%	ton	8.00 –	8.25
Potassium muriate, 80%, bags	ton	35.00 –	36 00
Potassium sulphate, bags basis 90%	ton	45.67 –	...

Crude Rubber

Para—Upriver fine	lb.	$0.28½ –	.
Upriver coarse	lb.	.26½ –	...
Upriver caucho ball	lb.	.27½ –	.
Plantation—First latex crepe	lb.	.32½ –	...
Ribbed smoked sheets	lb.	.32½ –	...
Brown crepe, thin, clean	lb.	.30½ –	...
Amber crepe No. 1	lb.	.32 –	.

Gums

Copal, Congo, amber, bags	lb.	$0 18½ –	$0 19
East Indian, bold, bags	lb.	.22 –	.23
Manila, pale, bags	lb.	21 –	22
Pontinak, No. 1 bags	lb.	21 –	.22
Damar, Batavia, cases	lb	31 –	31½
Singapore, No. 1, cases	lb.	.34½ –	.35
Kauri, No. 1, cases	lb	.62 –	.66
Ordinary chips, cases	lb.	18 –	.20
Manjak, Barbados, bags	lb.	.09 –	.09½

Shellac

Shellac, orange fine, bags	lb.	$0.76 –	...
Orange superfine, bags	lb.	.78 –	...
A. C. garnet, bags	lb.	.76 –	...
Bleached, bonedry	lb.	.86 –	...
Bleached, fresh	lb.	.75 –	...
T. N., bags	lb.	.72 –	.74

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh. ton	$500.00 –	...
Asbestos, shingle, f.o.b., Quebec	sh. ton	$65.00 –	$85.00
Asbestos, cement, f.o.b., Quebec	sh. ton	20.00 –	25.00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	16.00 –	20.00
Barytes, grd., off-color, f.o.b. mills bulk	net ton	13.00 –	15.00
Barytes, floated, f.o.b. St. Louis, bbl.	net ton	28 00 –	...
Barytes, crude f.o.b. mines, bulk	net ton	10.00 –	11.00
Casein, bbl., tech.	lb.	.23 –	.25
China clay (kaolin) crude, f.o.b. Ga.	net ton	7 00 –	9.00
Washed, f.o.b. Ga.	net ton	8 00 –	9.00
Powd., f.o.b. Ga.	net ton	13 00 –	20.00
Crude f.o.b. Va.	net ton	8 00 –	12.00
Ground, f.o.b. Va.	net ton	13.00 –	20.00
Imp., lump, bulk	net ton	15 00 –	20.00
Imp., powd	net ton	45.00 –	50.00
Feldspar, No. 1 pottery	long ton	6 00 –	7.00
No. 2 pottery	long ton	5.00 –	5.50
No. 1 soap	long ton	7.00 –	7.50
No. 1 Canadian, f.o.b. mill	long ton	25.00 –	27.00
Graphite, Ceylon, lump, first quality, bbl	lb	.06 –	.06½
Ceylon, chip, bbl	lb.	.05 –	.05½
High grade amorphous crude	ton	35.00 –	50.00
Gum arabic, amber, sorts, bags	lb.	.15 –	.16
Gum tragacanth, sorts, bags	lb.	.50 –	.60
No. 1, bags	lb	1.75 –	1.80
Kieselguhr, f.o.b. Cal.	ton	40.00 –	42.00
F.o.b. N.Y.	ton	50 00 –	55.00
Magnesite, crude, f.o.b. Cal.	ton	14 00 –	15.00
Pumice stone, imp., casks	lb	.03 –	.05½
Dom., lump, bbl	lb	.05 –	.05½
Dom., ground, bbl.	lb.	.06 –	.07
Silica, glass sand, f.o.b. Ind.	ton	2 00 –	2.50
Silica, sand blast, f.o.b. Ind.	ton	2 50	5.00
Silica, amorphous, 250-mesh, f.o.b. Ill.	ton	17.00 –	17.50
Silica, bldg. sand, f.o.b. Pa.	ton	2.00 –	2.75
Soapstone, coarse, f.o.b. Vt., bags	ton	7.00 –	8.00
Talc, 200 mesh, f.o.b., Vt., bags	ton	6.50 –	9.00
Talc, 200 mesh, f.o.b. Ga., bags	ton	7 00 –	9.00
Talc, 200 mesh, f.o.b. Los Angeles, bags	ton	16.00 –	20.00

Mineral Oils

Crude, at Wells

Pennsylvania	bbl.	$3 75 –	...
Corning	bbl	2 15 –	...
Cabell	bbl	2 41 –	...
Somerset	bbl	2 20 –	...
Illinois	bbl.	2 37 –	...
Indiana	bbl	2 38 –	...
Kansas and Oklahoma, 28 deg.	bbl.	1 50 –	$1.60
California, 35 deg. and up.	bbl.	1 04 –	...

Gasoline, Etc.

Motor gasoline, steel bbls	gal.	$0 24½ –	...
Naphtha, V. M. & P. devd, steel bbls	gal	.23½ –	...
Kerosene, ref. tank wagon	gal.	.15 –	...
Bulk, W. W. export	gal.	.08 –	...
Lubricating oils: Cylinder, Penn., dark	gal.	.27 –	.30
Bloomless, 30@31 grav.	gal.	.20 –	.22
Paraffin, pale	gal.	.24 –	.25
Spindle, 200, pale	gal.	.25 –	.26
Petrolatum, amber, bbls	lb.	.05 –	.05½

Paraffine wax (see waxes)

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	ton	$45–50
Chrome brick, f.o.b. Eastern shipping points	ton	50–52
Chrome cement, 40-50% Cr_2O_3	ton	23–27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	40–46
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	36–41
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65–68
9-in. arches, wedges and keys	ton	80–85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9-in sizes, f.o.b. Birmingham district	1,000	48–50
F.o.b. Mt. Union, Pa.	1,000	42–44
Silicon carbide refract. brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N.Y.	ton	$200.00 –	$225.00
Ferrochromium, per lb. of Cr, 6-8% C.	lb.	.11½	.11¾
4-6% C.	lb.	.12 –	.13
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	120.00 –	...
Spiegeleisen, 19-21% Mn.	gr. ton	40.00 –	...
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb.	1.90 –	2.15
Ferrosilicon, 10-15%	gr. ton	38.00 –	40.00
50%	gr. ton	86.00 –	89.00
75%	gr. ton	150.00 –	165.00

Ferrotungsten, 70-80%, per lb. of W	lb.	\$0.85 - \$0.90
Ferro-uranium, 35-50% of U. per lb. of U.	lb.	6.00 - ....
Ferrovanadium, 30-40%, per lb. of V	lb	3.75 - 4.00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	\$6 50 - \$8 75
Chrome ore Calif. concentrates, 50% min Cr_2O_3	ton	22 00 - 23 00
C.i.f. Atlantic seaboard	ton	21 00 - 24 00
Coke, fdry, f.o.b. ovens	ton	7.50 - 8 00
Coke, furnace, f.o.b. ovens	ton	6 00 - 6 50
Fluorspar, gravel, f.o.b. mines' Illinois	ton	19.00 - 21 00
Ilmenite, 52% TiO_2	lb.	.01½- .01¾
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.33 -.......
Manganese ore, chemical (MnO_2)	ton	75.00 - 80.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N. Y.	lb.	.65 - .70
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb.	.06 - .08
Pyrites, Span., fines, c.i.f. Atl. seaport	unit	.11½ - .12
Pyrites, Span., furnace size, c.i.f. Atl. seaport	unit	.11½ - .12
Pyrites, dom. fines, f.o.b. mines, Ga.	unit	.12
Rutile, 95% TiO_2	lb.	.12 -........
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.50 - 8.75
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	8.00 - 8.25
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 - 3.75
Uranium oxide, 96% per lb. U_3O_8	lb.	2 25 - 2.50
Vanadium pentoxide, 99%	lb.	12 00 - 14.00
Vanadium ore, per lb V_2O_5	lb.	1 00 -.......
Zircon, washed, iron free, f.o.b. Pablo, Fla.	lb.	.04½- .13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	16½- 16¾
Aluminum, 98 to 99%	23 24
Antimony, wholesale, Chinese and Japanese	8½- 9
Nickel, virgin metal	28 30
Nickel, ingot and shot	30-
Monel metal, shot and blocks	32 00
Monel metal, ingots	38 00
Monel metal, sheet bars	45 00
Tin, 5-ton lots, Straits	45 00
Lead, New York, spot	8 00
Lead, E. St. Louis, spot	7 95
Zinc, spot, New York	7 55
Zinc, spot, E. St. Louis	7 20

Other Metals

Silver (commercial)	oz.	\$0.66¾
Cadmium	lb.	1.10
Bismuth (500 lb. lots)	lb.	2 55
Cobalt	lb.	2 65@ 2 85
Magnesium, ingots, 99%	lb.	1.25
Platinum	oz.	115 00
Iridium	oz.	260.00@ 275.00
Palladium	oz.	79 00
Mercury	75 lb.	69.00

Finished Metal Products

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	25.50
Copper bottoms	30.75
Copper rods	25.25
High brass wire	19 50
High brass rods	17.00
Low brass wire	21.10
Low brass rods	22 00
Brazed brass tubing	24 25
Brazed bronze tubing	29 00
Seamless copper tubing	25.25
Seamless high brass tubing	23 50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.30@11.50
Copper, heavy and wire	11 25@11.50
Copper, light and bottoms	9.25@ 9.50
Lead, heavy	5.75@ 6.00
Lead, tea	3 50@ 3 75
Brass, heavy	6 25@ 6 40
Brass, light	5.35@ 5.75
No. 1 yellow brass turnings	6.30@ 6.50
Zinc	3.50@ 4.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	\$3.29	\$3.14
Soft steel bars	3.19	3.04
Soft steel bar shapes	3.19	3.04
Soft steel bands	3.29	3.19
Plates, ¼ to 1 in. thick	3.29	3.14

Industrial

Financial, Construction and Manufacturing News

Industrial Developments

RUBBER The Lee Tire & Rubber Co., Conshohocken, Pa., has advanced manufacture to a capacity schedule of 2,500 tires a day, and will continue on this basis for an indefinite period.

The Manhattan Rubber Mfg. Co., Passaic, N. J., manufacturer of mechanical rubber products, is maintaining capacity operations at its mill, and has advanced the wages of employees 10 per cent, effective April 1.

The Allentown Leather & Belting Co., Allentown, Pa., recently organized, has commenced production at its new local plant and plans to develop capacity at an early date. Additional workers will be added to the force.

The McGraw Tire & Rubber Co., East Palestine, O., has suspended operations and notified the working force, totaling 2,500 persons that it is indefinite when the plant will reopen. Operations have been on a part-time basis for several weeks past.

The New York Belting & Packing Co., Passaic, N. J., is operating at maximum at its local mills, and will continue on this basis for some time to come. Employees have been given a wage advance of 10 per cent.

The Kelly-Springfield Tire Co., Cumberland, Md., is running full at its new local mill, as well as at its smaller plant at Akron, O., with gross output at the two plants of 7,000 tires a day, or about 50 per cent in excess of the figures at this time a year ago.

The Goodyear Tire & Rubber Co., Akron, O., is producing on an average of 30,000 to 30,500 tires per day, giving employment to a working force of 13,300 persons. This compares with a production record in April, 1920, two years ago, of 35,780 tires a day, with a working force of 33,257 persons, showing the present greater plant and labor efficiency. The operatives are now working on a 10 per cent bonus plan, recently adopted.

GLASS—Flint glass manufacturers in the vicinity of Millville, N. J., are holding to full capacity, with greatest available working forces. There will be no compulsory shut-down this year, in accordance with agreement with operatives, and the only curtailment anticipated for months to come will be caused by necessary equipment repairs.

The Illinois Glass Co., Chicago, Ill., is said to be negotiating for the sale of its plant at Minotola, N. J., recently abandoned for a new and larger plant in a neighboring district. It is expected that the local factory will be reopened at an early date.

All sheet glass and window glass plants in western Pennsylvania are holding to maximum production schedules and every effort is being made to secure additional labor. The mills will continue on the present basis for a number of months to come.

The Pennsylvania Glass Sand Co., Hancock, Md., has resumed full operations at its plant, following a brief suspension caused by a strike of about 50 of the men, who demanded a flat wage advance of \$1 a day. The company has agreed to an increase of 50 cents, and this has been accepted by the operatives.

CEMENT—All mills in the Lehigh Valley district, Pennsylvania, are continuing under maximum production schedules, and giving employment to all available men. A call is out for more operatives, and advanced wage scales have been adopted to attract workers. The Lehigh Portland Cement Co., New Castle, has announced an increase of 10 per cent, affecting about 800 men at the local mills. The Atlas Portland Cement Co., Northampton, has made a similar advance. The other smaller mills are expected to follow before the close of the month.

The Riverside Portland Cement Co., Riverside, Calif., is running under a heavy production schedule at its plant with full working force. This schedule will be continued indefinitely.

MISCELLANEOUS—The Grasselli Chemical Co. has advanced production at its plant at Grasselli, near Elizabeth, N. J., increasing the working hours from 9 to 9½ hours per day. Wages have also been advanced 3 cents an hour. The plant is giving employment to about 1,500 operatives.

The American Powder Mills, Inc., Concord, N. H., is giving employment to approximately 150 persons at its black powder and smokeless powder plants, on a full time basis. Wages have been advanced 20 per cent, effective at once.

Employees at the plant of the Long Valley Paint Co., Hancock, near Reading, Pa., have declared a strike, with demand for increased wages. The plant has been compelled to curtail production, pending a settlement.

The Diamond State Fiber Co., Bridgeport, Pa., is giving employment to more than 1,000 operatives on a full-time basis, and will maintain production at this basis for an indefinite period. Wages have recently been increased 5 cents an hour, or 50 cents a day.

Construction and Operation

Alabama

PELL CITY—The Anniston Refractories Co., Anniston, has plans for the construction of a new plant on local site for the manufacture of firebrick and refractory shapes. Six kilns will be built.

California

SAN FRANCISCO—The Glidden Co., Madison Ave., N. W., Cleveland, O., manufacturer of paints, varnishes, etc., has acquired the plant of the Natoma Rice Mills, Hubbel St., near 16th St., for a consideration of \$300,000, and will remodel and improve the factory for a new branch works. The structure is 1-story totaling 50,000 sq.ft. of space, and equipment will be installed to give employment to about 150 operatives.

RIVERSIDE—The Snowolene Refining Co., Pacific Mutual Bldg., Los Angeles, with plant at Florence Ave. and Alameda St., that city, is negotiating for a site at Riverside for the construction of a gasoline-refining plant, to be equipped for a handling capacity of 1,000 bbl. of crude oil per day. It is estimated to cost \$300,000, with machinery. F. E. Snowden and Ralph Arnold head the company.

COALINGA—The Mohawk Oil Co., recently organized to take over the plants and properties of the Coalinga-Mohawk Oil Co. and the Continental Refining Co., has plans for the construction of a new refining plant in the Santa Fe Springs district. A bond issue of \$500,000 has been sold to defray the cost. Alfred L. Meyerstein is president.

SAN DIEGO—Elbert M. Vail, president of the California Chemical Co., and Stanley H. Barrows, president of the National Kellestone Co., are planning for the joint erection of a new plant on local site for the manufacture of an oxychloride cement, produced under a special chemical process. It will cost approximately \$60,000.

SISSON—J. F. Mackey, formerly connected with the Kaiser Construction Co., has organized a company to operate a local plant for the manufacture of cement and concrete products.

VENTURA—The Seaside Refinery Co. has acquired a local site of 8 acres, for the erection of a new oil-refining plant, to cost about \$80,000, with equipment. It will be designed to handle light oils only.

Florida

JACKSONVILLE—The Non-Acid Fertilizer & Chemical Co., Lakeland, Fla., is perfecting plans for the erection of a new branch plant here to cost approximately \$85,000, with machinery. The company will also increase the capacity of its main works at Lakeland. C. W. Deen is president.

Illinois

CHICAGO—The Midwest Sugar Refining Co., recently organized, has acquired the beet sugar and glucose mills of Charles Pope, Riverdale, near Chicago, with adjoining tract of 14 acres of land. Plans are in preparation for remodeling the existing works, to include the installation of additional machinery, estimated to cost $125,000. A second plant unit will also be built at an early date, with capacity of 50,000 tons per annum, estimated to cost $1,000,000, with machinery. The plant will be arranged to refine both cane and beet sugars. Theodore W. Bunte, head of Bunte Brothers, 730 West Munroe St., confectioners, is president of the new company.

Louisiana

NEW ORLEANS—The Amalgamated Seaport Petroleum Co., organized with a capital of $25,000,000, has acquired a tract of land on the Mississippi River, near the city, and plans for the construction of a large oil refinery. Plans for the first unit are being prepared; it is estimated to cost $1,500,000, with machinery.

Maryland

BALTIMORE—The Baltimore Paint & Color Works, Inc., Frederick and Calverton Rds., will soon commence the rebuilding of the portion of its plant destroyed by fire April 11, with loss estimated at $50,000. Albert A. Shuger is general manager.

Massachusetts

EAST BOSTON—The Acme White Lead & Color Works, Inc., 266 Border St., plans for the early rebuilding of the portion of its plant destroyed by fire, April 6, with loss approximating $65,000, including equipment.

FALL RIVER—The E. S. Park's Shellac Co., South Main and Oliver Sts., will erect a new 1-story building at its plant, 50x100 ft., to cost about $20,000.

New Jersey

ARLINGTON—E. I. du Pont de Nemours & Co., Forest St., will commence the construction of a new fume stack at the nitration house at its local plant, to replace a stack recently destroyed.

CARTARET—The Cartaret Oil & Refining Co. has plans for an addition to its local oil storage and distributing plant.

New York

BUFFALO—The Federal Concrete Co. Inc., has commenced excavations for a new plant on property recently acquired at Wyoming and Kensington Aves., for the manufacture of cement and concrete products. It will consist of a number of buildings with main structure 85x110 ft., estimated to cost $35,000. W. E. Jones is president.

Ohio

WARREN—The Trumbull-Cliffs Furnace Co. will construct a battery of 47 byproduct coke ovens, Koppers type, with an auxiliary plant for gas and tar recovery, and for the production of benzol and ammonia sulphate. The project is estimated to cost $3,000,000, and bonds for this amount have been sold. William G. Mather is president.

AKRON—Plans have been completed for the construction of a plant for the production of alum for use at the municipal filtration plant to be equipped for a capacity of approximately 1,000 tons a year. M. P. Tucker is city manager, in charge.

Oklahoma

ARDMORE—The Pure Oil Co., Pure Oil Bldg., Columbus, O., will make extensions and improvements at its local oil-refining plant, including the installation of new process stills and other equipment, estimated to cost $250,000.

TULSA—The Roxana Petroleum Corp., Roxana, Ill., operating a local plant, has acquired a tract of 200 acres of land near Wichita, Kan., as a site for a new refining plant, to be equipped to handle 10,000 bbl. of crude oil per day. It is estimated to cost $3,500,000, with machinery.

WYNNEWOOD—The Texas-Pacific Coal & Oil Co. has construction under way on a new oil refining plant, and will soon commence the installation of machinery.

GUTHRIE—The Pioneer Petroleum Co. has work in progress on extensions and improvements to the oil refinery of the Carbo Refining Co., recently acquired, and will install considerable additional equipment.

Pennsylvania

SPRINGDALE—The Heidenkamp Plate Glass Corp., recently organized to acquire the local plant and business of the company of the same name, has plans in progress for the construction of a number of new buildings to increase the capacity about 50 per cent. The expansion is estimated to cost close to $1,000,000, and bonds for this amount have been sold. Frank E. Troutman is vice-president and general manager.

PHILADELPHIA—The W. J. McCahan Sugar Refining & Molasses Co., Foot of Tasker St., has commenced the construction of an addition to its sugar refinery, estimated to cost about $425,000. To carry out this project and other expansion, the company is disposing of preferred stock for $1,767,000. H. B. Young is secretary.

Tennessee

NASHVILLE—The Bon Air Chemical Co., recently organized with a capital of $1,000,000, has tentative plans under way for the erection of a new plant on local site. M. P. O'Connor heads the company.

CHATTANOOGA—The Chattanooga-Burdett Oxygen Co., 1270 Market St., manufacturer of industrial oxygen products, has plans in progress for the erection of an addition to its plant in the Alton Park section to double, approximately, the present output. It is estimated to cost $100,000. W. K. Hendricks is general manager.

KNOXVILLE—W. G. Lowe & Co., manufacturer of leather products are planning for the erection of a new 2-story plant, 35 x 125 ft., to cost about $30,000.

Texas

FORT WORTH—The Southwestern Portland Cement Co., El Paso, has acquired a tract of land on Sycamore Creek, near Fort Worth, as a site for a new cement mill. The initial plant will have a capacity of approximately 3,000 bbl. per day, and is estimated to cost close to $500,000.

HOUSTON—The Texas Co., Houston, and 17 Battery Pl., New York, has preliminary plans in progress for the construction of new units at its refining plants at Port Arthur and Port Neches, Tex., for large increase in production. The project will be carried out in conjunction with similar expansion at other refineries of the company at West Tulsa, Okla.; Casper, Wyo.; and Lockport, Ill., during the coming months. A fund of $10,000,000 has been arranged for the entire expansion.

ACME—The Certain-teed Products Corp., St. Louis, Mo., is planning for extensions in the local plant of the Acme Cement Plaster Co., utilizing gypsum deposits in this district. The Acme company was recently acquired for a consideration said to be in excess of $2,000,000, including mills in other parts of the country. It is purposed to increase the output of the local plant with the installation of considerable machinery.

MANCHESTER—The Texas Portland Cement Co., Dallas, has commenced the erection of additions to its local mill to increase the annual output to an 800,000-bbl. rating. Considerable additional machinery will be installed. The work will cost in excess of $150,000.

CADDO—The Mid-Kansas Oil Co., has plans for the rebuilding of the portion of its gasoline-refining plant, recently destroyed by fire with loss estimated at $50,000.

Vermont

RUTLAND—The Rutland Evaporator Co. has tentative plans for the rebuilding of the portion of its plant, destroyed by fire, April 1, with loss estimated at $40,000.

Washington

VANCOUVER—The Columbia River Paper Mills Corp., will break ground at once for the first unit of its proposed local mill. The entire plant, with machinery, is estimated to cost in excess of $1,000,000.

West Virginia

FAIRMONT—The Dixie Co., has commenced the construction of a new 2-story oil refining plant, 50x100 ft. A laboratory will be installed.

KENOVA—The Basic Products Co., has perfected plans for the erection of a new plant addition to be equipped for the production of lime for construction service. It is planned to have the unit ready for use early in the summer.

Canada

MONTREAL, QUE.—The National Cement Co., recently organized with a capital of $4,000,000, has plans in progress for the construction of a new cement mill on site purchased near the St. Lawrence River, to consist of a number of units, estimated to cost in excess of $1,000,000. Work will be commenced in about 60 days. Isaie Laplante, Fall River, Mass., is president, and Edmond Cote, of the same city, treasurer and general manager.

New Companies

HERMAN CHEMICAL CO OF NEW JERSEY, Jersey City, chemicals and chemical byproducts; $23,000. Incorporators: C. F. Reynolds, M. Goodman and S. Wormser. Representative: Frank J. Higgins, 15 Exchange Place, Jersey City.

MODERN DYE & CHEMICAL CO., 212 Union St., Providence, R. I., organized; chemicals and dyestuffs. George Decker heads the company.

CITIES SERVICE OIL CO., 208 South La Salle St., Chicago, Ill.; refined oils; $250,000. Incorporators: Austin H. Smith, A. Karvatt and L. K. Edmondson.

TOLU FLUORSPAR CO., Evansville, Ind.; fluorspar and kindred products, capital, $50,000. Incorporators: James F. Engle, Charles H. Parsons and Mark N. Foley, all of Evansville.

CATO TIRE & RUBBER CO., Anniston, Ala.; rubber products; $95,000. J. W. Cato, president, and W. W. Stansell, secretary-treasurer, both of Anniston.

SCHAFFER-ALLESS CHEMICAL CO., Pittsburgh, Pa.; chemicals and chemical byproducts; $100,000. Incorporators: John C. Schaffer, A. F. Cooke and Albert H. Alless, Jr., Pittsburgh. Representative: Capital Trust Co. of Delaware, Dover, Del.

WEST DISINFECTING CO., Dallas, Tex.; chemicals; $10,000. Incorporators: M. B. and I. J. Marcuse, both of Dallas.

WALSH CHEMICAL CO., St. Louis, Mo.; chemicals and chemical byproducts; $100,000. Incorporators: J. D. Poe, M. Walsh and A. G. Kirschbaum, all of St. Louis.

PONTIAC CEMENT PRODUCTS CO., Pontiac, Mich.; cement, $50,000. Incorporators: W. J. Hogan, M. A. Benson and H. A. Freeman, 22 Lexington Place, Pontiac.

EL TEJANO OIL CO., Boston, Mass.; refined petroleum products; $500,000. John A. Sullivan, president; and Arthur J. Lawrence, treasurer, 265 Newbury St., Boston.

REINEAU PROCESS CO., INC., Essex and Middlesex Turnpike, Elizabeth, N. J.; fertilizers and chemicals. Incorporators: Francis T. White, H. H. A. Meyn and Thomas McEerlean.

FLYNT PAINT & VARNISH CO., Cleveland, O.; paints, varnish, oils, etc.; $10,000. Incorporators: Wilton B. Flynt, Jr., and W. H. Kasson, both of Cleveland.

MARTIN CHEMICAL CO., INC., Brooklyn, N. Y.; chemicals and chemical byproducts; $10,000. Incorporators: M. and J. Mariella, and G. Disalvo. Representative: H. Lee, 36 West 44th St.

W. H. METZGER CO., INC., 914 South Main St., Bloomington, Ill.; insecticides and chemical compositions; $19,000. Incorporators: W. H. Metzger, Thomas S. Weldon and W. D. Alexander.

WALLACE & TIERNAN PANDO CO., Belleville, N. J.; chemicals and chemical byproducts; $25,000. Incorporators: J. C. Baker, Gerald D. Peet and William J. Orchard, 11 Mill St.

ROSS SEGUNDA OIL CO., Laredo, Tex.; petroleum products; $150,000. Incorporators: W. C. Bobb, J. F. Ross and T. C. Mann, all of Laredo.

UNITED STATES LIQUID RUBBER PAINT CO., New York, N. Y.; special paints and varnishes; $1,000,000. Incorporators: Samuel Waxman, J. A. Lehman and Sidney B. Klee. Representative: Arley B. Magee, Dover, Del.

LEATHER DYES MFG. CO., 408-10 Adams St., Newark, N. J., organized; dyes and chemicals. John O. Pilar heads the company.

NEW ENGLAND OIL, PAINT & VARNISH CO., Boston, Mass.; paints, varnishes, etc.; 1,000 shares of stock, no par value. Lyford A. Merrow, president; Herbert O. Brackett, Reading, Mass., treasurer and representative.

SPARKS RUBBER CO., Philadelphia, Pa.; rubber products; $25,000. H. L. Jenkins, Devon, Pa., treasurer and representative.

N. S. M. RESEARCH CORP., New York, N. Y.; chemicals; $10,000. Incorporators:

F. K. Fairchild, W. H. Smith and H. G. Samson. Representative: Kelly & Blinn, 200 Broadway.

SOUTHERN PORTLAND CEMENT Co., Wilmington, Del.; cement, $6,000,000. Representative: Corporation Trust Co. of America, du Pont Bldg., Wilmington.

DAVID H. TIFFANY CORP., Rochester, N. Y.; tires and other rubber products; $50,000. Incorporators: D. H. and H. R. Tiffany, and G. A. Fritsche. Representative: E. C. Redfern, Insurance Bldg., Rochester.

HUGHES & CO., INC., 910 South Michigan Ave., Chicago, Ill.; petroleum products; $50,000. Incorporators: Ernest L. Hughes, J. E. Hauronic and F. P. Page.

HOME PAINT CO., INC., Birmingham, Ala.; paints and varnishes; $25,000. Incorporators: C. R. Barrett, Howe C. Benson and K. G. Smith, all of Birmingham.

PRATT-HEWITT OIL CORP., Beeville, Tex.; petroleum products; $5,000,000. Incorporators: R. H. Hawn, Refugio, Tex.; J. W. Kubuk and Lamar Folda, Beeville. Representative: Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del.

PANAMA CITY TAR & TURPENTINE CO., Panama City, Fla.; turpentine and affiliated products; $10,000. A. M. Lewis, Panama City, heads the company.

ATHOL RUBBER CO., Detroit, Mich., rubber products; $500,000. Incorporators: Hugo Miller, Clemens H. Davis, and Hugo Scherer, Grosse Pointe Farms, Mich.

STEPHENSON-MILLER LEATHER CO., New York, N. Y.; leather, $25,000. Incorporators: C. R. Stephenson, Sr. and Jr., and W. D. Millar. Representative: Woodward, Dennis & Buehler, 261 Broadway, New York.

FLORMAN PAINT CO., Amarillo, Tex., paints and varnishes, $25,000. Incorporators: H., M. S., and L. Florman, all of Amarillo.

ROOT OIL CO., South Bend, Ind.; petroleum products; $300,000. Incorporators: Louis J. and H. J. Root, and Daniel S. Brooks, all of South Bend.

Industrial Finances

WOLF OIL CORP., Bristow, Pa., increased capital from $1,000,000 to $3,000,000 for general expansion.

NEWAYGO PORTLAND CEMENT CO., Newaygo, Mich., increased capital from $945,000 to $1,695,000 for expansion.

EUREKA GLASS WORKS, INC., 85 Hope St., Brooklyn, N. Y., increased capital from $15,000 to $150,000 for expansion.

MONTGOMERY CHEMICAL WORKS, INC., Hamtramck, Mich., has filed notice of dissolution.

LIBERTY COTTON OIL MILL, INC., Clayton, N. C., increased capital from $120,000 to $300,000 for plant extensions and general financing.

STOLL OIL REFINING CO., Louisville, Ky., increased capital from $500,000 to $650,000 for proposed expansion.

EMKEN CHEMICAL CO., 14th St., Long Island City, N. Y., has filed notice of dissolution.

Receivers for the EASTERN POTASH CO., New York, N. Y., with plant in Raritan Township, near New Brunswick, N. J., are arranging for a reorganization of the company and payment in full to creditors. It is purposed to place the plant in operation.

KENNECOTT COPPER CORP., 120 Broadway, New York, N. Y., increased capital from $15,000,000 to $25,000,000, a portion of the proceeds to be used for securing a controlling interest in the Utah Copper Co., Salt Lake City, Utah.

PHILLIPS PETROLEUM CO., Bartlesville, Okla., increased capital from 1,000,000 to 2,000,000 shares of stock, no par value, for general extensions.

H. H. Taylor, First National Bank, Kinston, N. C., and A. L. Cavenaugh, Beulahville, N. C., have been appointed receivers for the SEMINOLE PHOSPHATE CO., Goldsboro, N. C., manufacturer of fertilizers.

DEVOE & REYNOLDS CO., INC., 101 Fulton St., New York, N. Y., manufacturer of paints, varnishes, etc., increased capital from $5,000,000 to $7,000,000 for general expansion.

WATERPROOFED PRODUCTS CO., Oakland, Cal., manufacturer of waterproofing compounds, metal-preversing paints, etc., has disposed of stock for $115,000 for plant expansion.

Receivers have been appointed for the CONSTANTIN REFINING CO., Tulsa, Okla. The local oil refinery will be continued in operation.

Industrial Notes

THE OILGEAR CO., of Milwaukee, Wis., manufacturer of hydraulic presses, broaching machines, variable delivery pumps and variable speed drives, has appointed the Cleveland Duplex Machinery Co., Inc., 1224 West 6th St., Cleveland, as its representative in the northern Ohio territory.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING CO., East Pittsburgh, Pa., announces that Ray P. Jackson, manager of the materials and process engineering department, and Marsden H. Hunt, ceramic engineer, will have charge of the new high-voltage insulator plant of the Westinghouse Co. at Emeryville, Calif., near San Francisco, which will be completed and operated in several months. Mr. Jackson will be manager of the new porcelain plant and Mr. Hunt will be superintendent.

THE EUREKA STEEL PRODUCTS CO., with temporary offices at 205 New England Life Bldg., Kansas City, Mo., has been organized by A. A. Kramer, John P. Harris and F. C. Buchanan, to manufacture a new acid- and corrosion-proof alloy "Akramium."

WILLIAM A. ROGERS has been elected chairman of the board of Rogers, Brown & Co., Buffalo, N. Y., manufacturers of pig iron, ferro-alloys, etc. Other officers elected were: William S. Rogers, president; Hugh Kennedy and C. R. Holzworth, vice-presidents; David G. Williams, treasurer, and Charles H. Byron, secretary. Mr. Holzworth was formerly general manager at the plant of the St. Louis Coke & Chemical Co., Granite City, Ill.

THE CHAIN BELT CO., Milwaukee, Wis., announces that Clifford F. Messinger, for the past 3 years general sales manager, has been elected second vice-president.

THE METAL & THERMIT CORP., New York, N. Y., has appointed Charles F. Lederer general supervisor of rail welding, to assume entire charge of all technical work in the field. This company also announces that the Pittsburgh branch will move May 1 to 1514 Fayette St., N. S. In order to take care of business a modern welding shop is now being constructed at the new quarters and will be equipped with facilities for making Thermit welding repairs and relining crucibles. A large stock of Thermit equipment and materials will be carried at all times.

THE LION OIL & REFINING CO., Kansas City, Mo., moved its traffic and car accounting departments on April 1 to its El Dorado, Ark., office and all work connected with these departments will be handled directly from El Dorado.

THE CHASE METAL WORKS, Waterbury, Conn., has added an Atlanta, Ga., office to its other sales offices. J. G. Weddington will have charge of the office, which is located at 304 Rhodes Bldg., Atlanta, Ga.

PERRY & WEBSTER, INC., New York, announces a reorganization. Robert S. Perry has acquired majority stock ownership together with direction of the management and control of the methods of doing business. A. W. Karnopp has succeeded as vice-president and chief engineer in place of P. W. Webster, who no longer has any executive connection with the business activities of the company.

THE LABOUR CO. is closing its office at 8 South Dearborn St., Chicago, and is moving to its own plant at Chicago Heights, Ill.

THE WALTER A. ZELNICKER SUPPLY CO., of St. Louis, Mo., which has been located for 20 years at 325 Locust St., has moved to the Chamber of Commerce Bldg., 511 Locust St.

RICHARDS & GEIER, of New York, patent and trademark attorneys, announce the following additions to their staff: Joseph Farley, formerly an assistant examiner in the U. S. Patent Office; Henry Ruhl, trademark specialist, and Fritz Zeigler, Jr., attorney and counselor-at-law.

THE MECHANICAL APPLIANCE CO., Milwaukee, Wis., has changed its name to the Louis Allis Co.

THE CUTLER-HAMMER MFG. CO., Milkaukee, Wis., announces that the Pittsburgh office of the central district will move May 1 from the Farmers Bank Bldg., to Rooms 950 to 953 Century Building. A. G. Pierce is manager.

Coming Meetings and Events

AMERICAN ASSOCIATION OF CEREAL CHEMISTS will hold its ninth annual convention at Hotel Sherman, Chicago, June 4 to 9.

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual convention in Norfolk, Va., May 7 to 9.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York.

AMERICAN ELECTROPLATERS SOCIETY will hold its eleventh annual meeting at Providence, R. I., July 2 to 5.

AMERICAN FOUNDRYMEN'S ASSOCIATION will hold a meeting in Cleveland, O., April 30 to May 3. The Institute of Metals will hold several joint sessions during this time.

AMERICAN GAS ASSOCIATION will hold its annual convention the week of Oct. 15 at Atlantic City. An elaborate exhibition of gas-making and gas-utilization equipment is planned.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its summer meeting June 20-23 at Wilmington, Del.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W. Va., June 7, 8 and 9.

AMERICAN OIL CHEMISTS' SOCIETY will hold its annual meeting at the Eastman Hotel, Hot Springs, Ark., April 30 and May 1.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold its spring meeting May 28 to 31 in Montreal, Canada.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

AMERICAN WELDING SOCIETY will hold its annual meeting April 25 to 27 at the Engineering Societies Building, New York.

AMERICAN ZINC INSTITUTE, INC., will hold its fifth annual meeting at the Hotel Chase, St. Louis, May 7 and 8.

CANADIAN INSTITUTE OF CHEMISTRY will hold its annual meeting in Toronto, May 29 to 31.

CHAMBER OF COMMERCE OF THE UNITED STATES will hold its eleventh annual meeting in New York May 7 to 11.

INTERSTATE COTTON SEED CRUSHERS ASSOCIATION will hold its annual convention at Hot Springs, Ark., May 2 to 4.

IRON AND STEEL INSTITUTE (London) will hold its annual meeting May 10 and 11 at the House of the Institution of Civil Engineers, London, S. W. 1.

NATIONAL ASSOCIATION OF MANUFACTURERS OF THE UNITED STATES OF AMERICA will meet in annual conference May 14 to 16, inclusive, at the Waldorf-Astoria, New York City.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (NINTH) will be held in New York Sept. 17-22.

NATIONAL FERTILIZER ASSOCIATION will hold its thirtieth annual convention at White Sulphur Springs, W. Va., the week of June 11.

NATIONAL FOREIGN TRADE COUNCIL has postponed its annual conference from April 25, 26 and 27, to May 2, 3 and 4. It will be held in New Orleans, La.

NATIONAL LIME ASSOCIATION will hold its fifth annual convention at the Hotel Commodore, New York City, June 13 to 15.

NATIONAL SYMPOSIUM ON COLLOID CHEMISTRY will be held at the University of Wisconsin, June 12 to 15.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

PACIFIC DIVISION, American Association for the advancement of Science, will hold its seventh annual meeting at the University of Southern California, Los Angeles, Sept. 17 to 20, in conjunction with the summer session of the national association and a meeting of the Southwestern Division of the National Association.

SOCIETY OF CHEMICAL INDUSTRY, Canadian Section, will meet in Toronto, May 29 to 31.

SOCIETY FOR STEEL TREATING — Eastern sectional meeting will be held June 14 and 15, in Bethlehem, Pa.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: May 4—American Chemical Society, regular meeting, May 11—Société de Chimie Industrielle (in charge) American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting, May 18—Society of Chemical Industry, regular meeting, June 8 — American Chemical Society, regular meeting.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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George K. Burgess, Director Bureau of Standards

OUR industries will welcome the appointment of GEORGE K. BURGESS as director of the United States Bureau of Standards. To them this will be a well-deserved recognition of a man who has long been associated with fundamental problems in the metallurgical field, to which he has made contributions of great importance. These industries will, to be sure, regret that they must share so eminent an investigator with other industries, for, as a result of his appointment to the directorship, Dr. BURGESS will doubtless find it necessary to turn over to others many of the important metallurgical investigations he has so ably directed. But the promotion to the directorship is so eminently fitting and so well deserved that all will rejoice in his selection.

Any position of as great importance as the directorship of the Bureau of Standards is a matter of deep concern to the industries; all want to know what policy will be followed. In this case there is no cause for apprehension, for the new director has been associated with the bureau for 20 years and has been largely responsible for the development of some of its most successful work and policies. Industry can therefore feel full confidence in the continuation and enlargement of the service this institution has so splendidly given to all branches of business.

In this appointment, too, there is a recognition of the importance of fundamental research. The work done by the Division of Metallurgy under Dr. BURGESS' direction has invariably been of the type that industry welcomes. It has been planned only after conference with industrial representatives in order that it will be of maximum usefulness to industry. Yet it has always been guided by the thought that the bureau should deal with fundamentals and not with those problems of industrial research that can be managed quite as well or even better in industrial laboratories or by consulting engineers. Some of the other sections of the bureau have not been so fortunate in their plans and other branches of industry may have had some feeling that the bureau has unduly encroached upon the field of industry. It will perhaps be impossible to correct all such cases immediately, but we can look forward with confidence to the new director's judgment and his unswerving devotion to the general good. He first of all is a good scientist, but secondly is a man of sound business judgment, admired and liked by all who know him.

Chem. & Met., speaking for the industries it serves, welcomes Dr. BURGESS to his new position and assures him of unstinted co-operation and support in his new and larger responsibilities.

Selling Short On Arsenic

A REPRESENTATIVE of the Chamber of Commerce of the United States, speaking before the American Paper and Pulp Association, has emphasized the important service problems of a trade association. He emphasizes two important aspects of such association work that are particularly essential to successful progress of any trade body. The first relates to defensive efforts and the second to constructive effort for the advancement of the industry as a whole.

There is little need to discuss both the desirability and the propriety of joint action for defensive purposes in opposing unreasonable legislation or unjust practices of those within or without an industry. The chemical industries will recognize the importance of these problems, for they have been all too conspicuous recently in tariff legislation, in the regulation of industrial alcohol and in similar federal, state and municipal affairs. But there is too little emphasis placed upon the more constructive efforts of trade associations.

Representatives of the chemical industries were called together almost 2 years ago by the Department of Commerce in the hope that some satisfactory basis of co-operation might be arranged for rendering to the industry, to the government, and to the public at large, adequate statistical service. This was a constructive effort from which much was hoped, but due to the opposition of certain individuals, or the companies which they represented, the several plans proposed did not prove to be acceptable and very little progress has been made, especially in the field of heavy chemicals.

At the time the original proposals were made, it was argued that the industry would gain quite as much as the public from this statistical service, but some rather shortsighted companies failed to appreciate this point. Now we have a most conspicuous example in the arsenic situation of this erroneous view.

It seems to be well established that certain makers of calcium arsenate have contracted for deliveries which they are not in a position to make without additional purchases of white arsenic. And this is one commodity that certainly is not readily available at a reasonable price, if it be available at all. This unfortunate result might have been avoided if these companies had been advised of the current stocks, sales and production of arsenic. As it now stands, some are bold enough to forecast large losses for these manufacturers before they are able to gather together from limited supplies the necessary arsenic to complete deliveries under the contracts to which they are committed.

It would be an unusual example of the irony of fate

if it should prove that some of those companies that have opposed Secretary HOOVER'S statistical work for the chemical industry should be the very ones to suffer these losses. We sincerely hope that the rumor of losses has been greatly exaggerated and that some satisfactory commercial solution will be found. But whatever may be the outcome of this particular shortage, no one can deny that it is a convincing and conspicuous demonstration of the necessity of more regular, prompt and accurate statistics for the chemical industry compiled either by the government or by some appropriate trade association.

The Chemistry-Commerce Course At the University of Wisconsin

OUR news pages, in this issue, contain an announcement of a new course at the University of Wisconsin. The course is a courageous and progressive experiment. It is to be called the "Chemistry-Commerce Course," and is designed to give the student both a fundamental knowledge of chemistry and an acquaintance with business procedure and economics. The conception of this course is that it will train men to become purchasing agents, salesmen and executives in the chemical industry, with enough chemistry to deal intelligently with the technical problems as they come up, and yet be essentially business men.

Naturally, the graduate of such a course will not be a competent chemist and it will be incumbent on the educators in charge to make sure that these graduates understand this limitation. On the other hand, there is no doubt that the industry will benefit greatly by the induction of such men into the non-technical positions, for a sympathetic grasp of technical problems is something that is greatly needed.

There is still another phase of the question. There is no doubt that the technical man in industry, at the present time, is ill equipped for other than technical work. This is substantially proved by the very large number of men who are mired in operating routine and who will never rise above it. It is, of course, quite impossible in a 4-year technical course to take up business training as well. Yet it does seem as though the student could be given some conception of the necessity of such training, so that he might familiarize himself with it after he has completed his technical course. The technically trained man who had, in addition to his engineering, a thorough grounding in business would be superior in ability and background to the graduate of this Chemistry-Commerce Course. Yet, this new course will turn out men better equipped to deal with the problems of industry and better equipped to become executives than the technical man of today.

Therefore it is our pleasure to congratulate the department of chemistry of the University of Wisconsin, from which this new course emanates, upon the really progressive idea. It will be our prediction that graduates of this course will find themselves well equipped to fill prominent positions in chemical manufacturing industries. But it will be our mission and effort more strenuously than ever to urge upon the *technical* man the necessity of acquainting himself with the commercial and business side of industry. The two efforts go more or less hand in hand, for one can hardly doubt that future chemists and chemical engineers studying at the University of Wisconsin will have their attention more definitely focussed on business subjects simply because of the existence of this Chemistry-Commerce Course. The chances are that their curriculum may be too full to undertake such studies, but many will supply the lack that has been made apparent to them after they have completed their technical course. Therefore it will have a twofold benefit, both direct and indirect, and it remains to be seen which will be of the greater significance.

Dean's Law of Increasing Returns

WE CONFESS to leanings mathematical. Only when we got as far as differential equations did our interest lag, for then the methods appeared to become empirical, solutions were discovered by a happy chance, rather than by the logical progression of ideas. But these differentials were bread and butter to our professor in thermodynamics, who appeared to be able to start with two simple laws—he said they were simple—and prove anything in the heavens above, the earth beneath or the waters under the earth. Especially the Second Law appealed to him. He would hold it up before our wondering eyes as did the serpent the apple in the Garden of Eden. It almost sprouted a third law, which, however, we were assured was somewhat apocryphal. And then there was the principle of LE CHATELIER—"clearly comprehended in the Second Law." Wonderful; astounding; stupefying!

That principle of LE CHATELIER really is a strange thing. Our lecture notes record that "no proof, in the ordinary sense, can be given of it; it is a generalization based on experience." (Thus it is much like many beliefs, religious and spiritual, and can readily be accepted by the lay reader.) It states that every system in equilibrium tends to remain unchanged. In other words, a balanced system remains balanced. So simple it sounds foolish!

Like $\frac{dx^2}{d^2y}$, it doesn't mean much until some particular examples are cited. Suppose a certain volume of gas is compressed; its temperature forthwith increases. Q.E.D. (Figure it out for yourself.) But the mysterious and amazing part of it is that the law holds for the workings of an entire manufacturing process. And that's what we started to talk about.

During the war when potash was precious, a good friend, J. G. DEAN, was showing the Southwestern Portland Cement Co. how to make expenses from potash and sell cement as an incidental byproduct. He revised their burner settings, adjusted the zone of maximum temperature and the rate of charging so as to volatilize the maximum amount of potash from the slurry. With an eye single on potash, he found that a greater tonnage of clinker was produced, it was better burned, and yielded a sounder cement. "Come to think of it," said DEAN, "I was not so surprised as the manager. I have found that whatever you do which really improves the quality of cement will recompense you doubly—it also increases output and decreases cost."

This idea has almost been enshrined as "Dean's Law." It fits in closely with LE CHATELIER'S—and in turn is solidly founded on the ultimate authority of the second law of thermodynamics. What more could be asked? We can phrase the law in many ways, but it comes down to this: That money wisely put into a process is always returned; or that the way to do a thing best will always be found to be cheapest.

JOHN J. COYLE once showed us an electric furnace near Pittsburgh. At first it operated quite intermittently, it produced about 6,000 lb. of steel a turn, of

which 55 per cent eventually was marketed as A1 bars. After devising ways and means to operate continuously, the life of the furnace roof was increased 150 per cent; production rose to 10,000 lb. per turn, and 70 per cent of it was sound! The best way is evidently the cheapest.

You will probably remember that an enormous amount of smoke litigation has been launched against Western smelters under the belief that the solid fume in smelter smoke was damaging land, crops and live stock. Large dust chambers were forthwith constructed to settle the fume. In order to drag the gases through, more draft was needed, and the easiest way to get this was to build a higher chimney. Higher chimneys in turn gave more draft at the furnaces, which enabled the operators to build hotter fires (still more draft!), bigger furnaces and far greater output per ton of coal and per furnace. Isn't this another manifestation of Dean's law?

A last citation from the automobile industry: H. T. CHANDLER, when studying some unsatisfactory drop forgings, discovered that failure was usually located by kinked "flow lines" in the macrostructure. On redesigning the dies, solely to smooth out the flow lines, he found that the new forgings were far more reliable, and strangely enough (or was it strange?), the life of the dies had increased from 3,000 to 10,000 pieces.

There is no one way of doing things right. The way constantly shifts as circumstances change. But the right way will always be found to be an economical way. If the practice is continually revised so that the product approaches perfection, the results will return the expense and then some. This is Dean's law.

An Amazing Opportunity —Just Missed

A CORRESPONDENT has sent us a clipping from the New York *American* of April 8, 1923, which announces the vacancy in a post as chemist in the Department of Health of New York City. The requirements are that the applicant be a citizen of the United States, and that he be able to analyze accurately all food products, to detect and identify coal-tar dyes, preservatives, metallic and alkaloidal poisons, to conduct research ("perform research work" the announcement reads) in connection with the analysis of foods, and to qualify in court as an expert when prosecutions are brought for food-law violations. The candidate must have a degree from a college of recognized standing "or a certificate from such institution that the applicant has pursued for 2 years a course of study tending to qualify him for the position." The salary is $1,244 a year. Following this is the cheerful statement that "other vacancies at higher salaries occur from time to time." Now, $1,244 a year means almost $23.85 a week. Resolved into mills, it is about a million and a quarter per annum.

Alas and alack, applications closed at 4 p.m. on April 18 and we cannot tell the good news to the world in time to be of service. But there is hope for other vacancies! We should think these would occur frequently, even at the "higher salaries," because men with families are likely to starve out fast enough to provide plenty of places. Plenty of "opportunities."

A few years ago the chemists of this department joined a union under the auspices of the American Federation of Labor. We criticised such preparations to strike as unprofessional conduct. We still hold to the opinion, but we appreciate the fact that a salary of $23.85 a week might wither the sense of professional obligation in a chemist who had prepared himself to meet the requirements.

All this merely shows the confusion that is bound to follow dunderheaded ignorance in administration. No field of this world's work is more democratic than the field of science; but the theory that one man is as good as another will not work in chemistry. To expect a trained man of science to work efficiently for less than a hod-carrier's pay may be sound according to present-day Russian philosophy, but it doesn't fit in the United States. It accords with the theory of Dictatorship by the Proletariat, but it does not accord with the encouragement of education.

Sir Joseph Conquers

TO THE student of physical science the name of Sir J. J. THOMSON will always be one with which to conjure. His experimental wizardry has been both the inspiration and the despair of his followers. And so, for those who had the good fortune to hear his address at the dedication of the Sterling Chemistry Laboratory in New Haven, it was a rare treat to come into contact with his personality.

Just what Sir JOSEPH thought is another matter. Probably the enthusiasm of a thousand listeners does gratify no matter how inured to it one may be. Usually it is apparent from a speaker's general attitude that he is enjoying himself or that he isn't, that he likes his auditors or that he is out of sympathy with them, that he is instructing them or making fun of them. Sir JOSEPH'S auditors came away puzzled. On the whole he seemed to like us, but he could not help chiding us as Americans for not appreciating WILLARD GIBBS, whereas British scientists conferred on GIBBS their highest honor. Parenthetically it may be remarked that this appreciation, though sincere, was entirely academic; furthermore, the honor of really discovering WILLARD GIBBS must still rest with the great Hollander ROOZEBOOM.

Later on Sir JOSEPH gently admonished the chemists because of their lack of facility with mathematics, although it was all done with the air of a kindly and somewhat lenient parent. Throughout his all too short talk the progress in physical research was recorded in such an impersonal way that an uninformed auditor might easily have thought that the distinct pioneer and recognized leader was only a well-informed historian. Never an "I" crossed his lips.

Still another glimpse showed him to be somewhat gleefully group-satisfied because the physicist had bested the chemist in isolating and measuring the units of matter. In that connection his figure of speech is worthy of repetition, although naturally we make no effort to defend it: "Assuming that the chemist's test for a penny is no more sensitive than his test for a single molecule, the chemist would not be able to tell whether a man who possessed a million million dollars and had changed it all into pennies was really a millionaire or a pauper, so crude are even his most delicate methods of detection." Yet in almost the same breath Sir JOSEPH wondered whether physical chemistry should not really be called chemical physics, so closely do the two fields merge.

These are but a few random impressions of a great scientist, who has come to our shores, has seen our universities and scientific organizations, and has conquered our respect and admiration.

Readers' Views and Comments

An Open Forum for Subscribers

The editors invite discussion of articles and editorials in *Chem. & Met.* or on other topics of pertinent interest

Lime and Colloid Chemistry

To the Editor of Chemical & Metallurgical Engineering

SIR:—The want of complete knowledge in regard to lime was emphasized by Oliver Bowles in the issue of March 7, the article being supplemented by an editorial query, "What Causes the Variations in Lime?"

Having been engaged on colloid research, particularly in regard to the successful removal of combined sulphur from vulcanized rubber, by the addition of a substitute adsorption medium composed of an emulsoid colloid solution, it occurred to me that the problem in regard to lime could be solved by methods peculiar to colloid chemistry.

A lime from Shenandoah Valley, Va., was found to be too "short," as the plasterers termed it, when used as a finishing coat; it would not spread easily, the particles would not slide and roll under the plasterer's trowel, but seemed to hang back, as if they possessed the sharp edges of the calcite in a highly crystalline and pure limestone. Particles of lime, if crystalline, would tend to retain their form, even after calcining and hydration.

In "Applied Colloid Chemistry," Bancroft gives some interesting examples of adsorption of solid by solid. To apply this idea, we took ordinary hydrated lime, about 60 mesh, and by adding various powdered substances (covered by patent application) of about 200 mesh, a product resulted from which it was possible to make a plaster which, when dry, was firm and hard, tough and elastic. This was improved by adding another fine powder of an organic nature, as I realized that something of this kind would be present in small quantity in sea water when the lime was deposited.

The question then arose as to whether it would be possible to coat the sharp edges of unburned crystalline lime particles in the same manner. This was done. The ground waste from the Veruga marble quarry of San Diego County, Calif., which is a highly crystalline limestone and contains 97½ per cent $CaCO_3$ was ground in a Hardinge mill with a few finely powdered substances, which cost about $1.50 per ton; the product was 97 per cent lime of a quality which was equal, it is believed, to that which is being sold, according to Mr. Bowles, for $200 per ton.

To the prepared limestone is added water in sufficient quantity and in the same manner as one would with hydrated lime. It takes from 24 to 36 hours to dry, and forms a plaster that is superior to the best on the market. This adheres to planed wood, to oily, corrugated or other kind of paper; it will not crack or check.

Rooms have been plastered with the composition, which has also been applied as a rough coat with sand, in the proportion of 5 of sand to 1 of the composition. The composition plaster was then used as a finished lime, making an unusually hard and firm coat. It becomes so hard when dry that it can be polished with an agate burnisher. The composition plaster was also applied to boards outdoors in California; it has remained unaffected by 2 months' winter rains.

It seems proper to answer your editorial question, "What causes variations in lime?" by explaining that these are due to the variations in the elements present in the sea water when the deposition or sedimentation of the lime occurred. Research on lime must be carried on with recent advances in colloid chemistry in mind.

C. F. WILLARD.

San Diego, Calif.

Winged Errors In Chemical Literature

To the Editor of Chemical & Metallurgical Engineering

SIR:—Your Homeric phrase in the Feb. 21 issue, just received, επεα πτερεοντα, reminds me of the case of silver alum, so useful in chemical philosophy according to the old periodic law in representing silver as like to the alkali metals. Some years ago, when the late Vernon Harcourt was Lees reader, some workers in the Christ Church laboratory attempted to make this in the textbook manner by using strong sulphuric acid in a sealed tube. When the attempt had failed Harcourt remembered that the discoverer had corrected his mistake within a few months of the announcement at a meeting of the chemical society at which he (Harcourt) had been present. The alum was formed from alkali in the glass of the tube. In chemistry the acceptance of observations as true may depend more on the prejudice of authority rather than on evidence.

E. F. MORRIS.

Manchester, England

Magnesia as A Polishing Agent

To the Editor of Chemical & Metallurgical Engineering

SIR:—In reference to your article on "Magnesia as a Polishing Agent," page 441, March 7, 1923, and the letter of E. H. Dix in your issue of March 28 I am in a position to confirm the fact that Dr. Walter Rosenhain was the first to use such materials for polishing metals, and more specifically aluminum alloys.

I distinctly recall preparing both alumina and magnesia powders by elutriation for polishing purposes as far back as 1901, at which time I was Dr. Rosenhain's assistant. These materials were used for polishing aluminum alloys.

C. J. BROCKBANK.

Buffalo, N. Y.

Sponge Iron by New Method

Successful production of sponge iron on a commercial scale has been achieved in a direct-fired rotary kiln at Silver City, Utah. This is the outcome of extended experimentation on the part of metallurgists in the employ of the Interior Department. The furnace was that of the Tintic Milling Co.

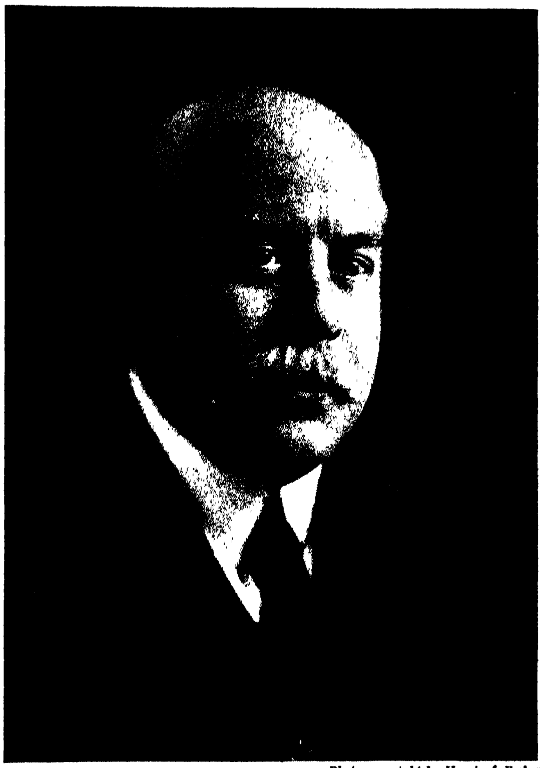
If cheaper sponge iron can be obtained, it is believed that it will find large use as a precipitant for copper.

George K. Burgess, Director, Bureau of Standards

MANY friends of Dr. Burgess are congratulating him on his appointment as director of the Bureau of Standards, made by President Harding, April 23. Ever since the resignation of Dr. Stratton—who became president of Massachusetts Institute of Technology on Jan. 1—Secretary Hoover has been considering the qualifications of several men who might be available for the post.

A proper selection is no mean task. From the point of view of the manufacturing industries, the directorship of the Bureau of Standards is the most important technical position in the government service. The director must understand their problems and plan broad investigations that will shed the most light on manufacturing difficulties. On the other hand, he must be a successful leader of men whose life work is scientific research of the utmost accuracy and precision. Beyond all this he must be able to administer the affairs of a series of great laboratories, having a budget of $1\frac{3}{4}$ million dollars annually.

That the choice finally rested upon Dr. Burgess is therefore of far more significance than a mere promotion on the staff. It is a recognition of the fact that the erstwhile chief of the Metallurgical Division is a man highly regarded by the men in industry, a leader among his fellow scientists, and an administrator of ability. The choice is a happy one. It cannot help but react favorably upon the bureau's esprit de corps, as a well won recognition of proved merit.



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DR. GEORGE K. BURGESS

It is hardly necessary to say much about Dr. Burgess to our readers. They have often seen him in action at various society and committee meetings—indeed, his appetite for travel and variety of work seems insatiable. He has been with the bureau for 20 years, and during half that time has been directing the Metallurgical Division. As befits that position, he entered largely into the work of the American Society for Testing Materials, serving on committees and directing many investigations into the properties of commercial metal. These activities the society has recognized by making him its president, a position he now holds.

Dr. Burgess is also very much interested in the Iron and Steel Division and the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers. The young American Society for Steel Treating has also enlisted his support. At home, he is active in various committees on the National Research Council, American Physical Society, Washington Academy of Science and the Philosophical Society of Washington (of which he is past president). Abroad, he is a member of the British Institute of Metals and the Société de Physique.

Descended from Puritan ancestry, he was born at Newton, Mass., Jan. 4, 1874. He studied at Boston Tech. (S.B., 1896) and in Paris (D.Sc., 1901). He taught physics at Tech., Michigan and California from 1896 to 1903; in the latter year he entered government service. On Jan. 5, 1901, he married Mlle. Suzanne Babut.

Dr. Burgess' acquaintance with the French language has borne fruit in the translation of Duheim's "Thermodynamics and Chemistry," and the publication of "Reserches sur la Constante de Gravitation." His best known book is the translation of LeChatelier's classic on "Measurement of High Temperature": indeed a later edition, enlarged and modernized by the translator, has become the standard English work on pyrometry. Temperature measurement is not included in the Metallurgical Division at the bureau—nevertheless Dr. Burgess has never permitted his interest in pyrometry to lag, nor missed a timely opportunity to emphasize the necessity of accurate heat control to modern metallurgical operations.

His contributions to the learned and professional societies and technical press are too numerous to list here. Several important monographs and professional papers from his pen have been printed by the Bureau of Standards. Beyond this, many similar publications by members of his staff undoubtedly owe their inception to Dr. Burgess, and their successful conclusion to his encouragement and seasoned advice.

His early publications naturally are concerned with methods of measuring very high temperatures. This requires a knowledge of the amount of energy radiated from a hot body, and the development of instruments to measure this radiation. Dr. Burgess bent his energies to these two great problems, and in conjunction with Messrs. Waidner, Waltenburg and Foote, issued a number of publications containing many essential data. With Messrs. Crowe and Scott he did some extraordinary work on the nature of the so-called magnetic transformation A_2 in pure iron. That his mind does not run along strictly academic and scientific lines may be inferred from his publications on open-hearth practice, sound ingots, and on rail manufacture. Recently he has acted as chairman of the joint committee investigating the effect of sulphur and phosphorus in steel.

What Must a Corporation Do To Borrow Money From a Bank?

A Brief Survey of the Procedure Followed in an Average Bank When a Prospective Borrower Is Investigated as a Credit Risk—What Does the Banker Want to Know and How Does He Go About It?

BY CHARLES WADSWORTH, 3D.
Assistant Editor of *Chemical & Metallurgical Engineering*

IN THE first article on this subject, an interview with William Post,[1] the field of operation of the commercial banker was defined. Mr. Post pointed out that the commercial banker must confine himself to liquid business. He must not tie up his depositors' money in either long-term loans or in permanent improvements, so called "fixed assets."

So, with the field defined, an analysis is in order that we may better understand the banker's relation to industrial or commercial organizations. We must study the inside workings of the machinery for granting bank credit, which means, in other words, what must you do to borrow money. Perhaps the best procedure would be to go through the process with John Smith & Co.

Before we go with Mr. Smith to the bank it will help considerably to understand two points of view. The first point is to recall that a banker is in a sense a trustee for his depositors. They intrust their money to him. It is payable on demand, and therefore a certain percentage of the deposits must be retained by the bank for such needs. The other point of view is that the banker is anxious to make reliable loans, since that is the way he makes a profit for the bank. He is a salesman with a peculiar commodity to sell. His customers often must be solicited and sold, much as those of any salesman; yet he can never lose sight of the fact that he is a trustee. This interesting dualism is frequently not recognized. Even many bankers, because of a consistent demand for bank credit, forget that they are half salesmen and adopt toward industry an attitude of self-conscious benevolence that is irksome and unjustified. Throughout the discussion you will find many points at which these two selves of the banker would be antagonistic in their desires and in some cases an obvious convention has been created to solve the problem.

HOW TO SELECT A BANK OF DEPOSIT

To return to Mr. Smith and his bank, it is first of all essential that he should have exercised considerable care in the selection of a bank. A bank is not just a bank, but it has what might be termed a personality that depends upon the policies of its directors and executives. A bank should be large enough to take care of the expanding needs of a business and yet not so large that the client's business would come to be handled in a routine manner. These limitations are not obvious ones and a business may be embarrassed if either condition arises.

Beyond the question of actual size is the question of the temper or personality of the bank. Do they handle business similar to that of Smith & Co.? Are they familiar with the credit requirements of the business and are they well disposed toward and sympathetic with that type of credit risk? Perhaps a disproportionate percentage of the bank's clientèle is in the same field. This might not be desirable, either. These questions are of less consequence to the large corporation borrowing from many banks and regarded as a good client, but they vitally concern the smaller unit. The bank of deposit is of unusual significance, because loans are supposedly confined solely to the bank's depositors. This is frequently stated as an ironclad rule, although there is an easy way out the side door which may be shown concretely as follows: It is a convention that 20 per cent of the loan shall be left as deposit in the bank (a convention not universally prac-

The Client's Shorter Catechism

CAPITAL

Authorized Subscribed Paid in

Held by Company as Treasury Stock

How Paid in Cash $ Other Property

Description of other property and how valued

Incorporated in what State and under what General Law or Special Act

Date of Charter Commenced Business

Are Stockholders liable beyond amount of stock subscribed?

Regular times of balancing books

Regular times of taking inventory

Give basis of statement whether actual inventory, by whom taken and date or if estimate, by whom made and date

What amount if any of Acct s and Bills Rec are past due extended or renewed?

State last date of taking trial balance, and if same proved

Do your plans for your fiscal year contemplate anything in the way of building operations, plant extension or investment in other fixed assets If so, please state amount to be so invested

We believe the maximum aggregate amount which we shall borrow on short credit or sale of paper the current year will not exceed $ and we hereby agree to obtain this Bank s consent before borrowing in excess of that amount

(Please sign here)

By

Date signed 191

STATE OF
COUNTY OF } ss

being duly sworn deposes and says that he is the of that he signed the foregoing statement for and in behalf of said that the said statement to the best of his knowledge is true in substance and in fact

Subscribed and sworn to before me this day of A D 191

Notary Public.

My commission expires

[1]See *Chem. & Met.*, vol 28, No. 11, p 487, March 14 1923

ticed, but nevertheless in wide observance). Thus a borrower would automatically become a depositor if he were not one already. But to return to our previous point, it can be said that in general a bank loans to its depositors and thus the bank of deposit will be in a position to exercise an important and occasionally a vital veto on the financial resources of an industrial organization. That is why the bank of deposit must be selected with care.

DON'T PLAY OSTRICH WITH THE BANK

With this background let us go with our friend Smith to negotiate a loan, his first, with his bank of deposit. If Smith is wise, he will lay all his cards on the table. More than anything else this predisposes the banker in his favor. Complete and frank answers to necessarily searching questions will often swing a borderline decision in his favor. It is a frequently occurring experience of the banker to see a marked resentment on the part of a prospective borrower at the "unreasonable inquisitiveness" of the bank's inquiry. Very frequently, too, this resentment is due to the fact that all is not wholesome with the borrower and he does not want to reveal a weakness

The first set of questions that the banker asks are those that deal with the nature of the business. This is frequently embodied in a notaried statement, a sample of which is given herewith. The questions are largely self-explanatory, but several points are worth noting. For example, there is a widespread misconception that treasury stock is the same as authorized but unissued stock. The unscrupulous promoter is responsible for this point of view. Treasury stock is actually fully paid stock bought in by the corporation. Again, the method of evaluating property is important, as considerable water can be pumped into a financial statement by overvaluation of property. This point will doubtless be the subject of some investigation by the banker. He may not be vitally interested in the actual figure but rather in the spirit of the estimate. Frequently it would be very difficult to determine the true value of real estate, for example, as this might depend on a possible purchaser in the event of sale or on an estimate of increased value, which would always be precarious.

In addition to the above questions it is desirable to know the executive personnel and that of the board of directors as well as the amounts of their individual financial interest in the venture.

All of the foregoing might be classed as preliminary investigation. Following this the banker will ask Mr. Smith to fill out a form which will be discussed later and will then commence an investigation of John Smith & Co. from the outside.

WHY THE BANKER DOES NOT KNOW THE DEPOSITOR

It may cause some surprise to realize that a banker knows as little about his depositors as would be inferred from the foregoing and following discussion. However, it is none the less a fact that, granting exceptions, he does not. It is a physical impossibility in the first place and in the second place, as one banker said, a bank will take a deposit from anyone, but lending its money to someone is a very different thing. In other words, so long as a depositor keeps out of the red, he needs little attention. In fact a firm may keep a large deposit in the bank and unless it writes checks of large denomination that have to be O.K.'d by an officer of the bank, the bank may know nothing of the deposit. Thus it comes about that a large depositor of some years' standing may ask for a loan and be amazed at the complete ignorance which the bank has with respect to its affairs.

INVESTIGATING A CREDIT RISK FROM THE OUTSIDE

Of course the first step in the outside investigation of a client is a study of the agency rating in both Bradstreet's and Dun's. This gives very little idea of anything except the order of magnitude of the business. Only a very approximate idea of the client as a credit risk can be obtained. Then follows a widespread inquiry through the bank's business connections and associates as to the character of John Smith & Co. Suppose they manufacture hardware. The people from whom they buy steel, machinery and supplies will tell the bank whether they discount their bills or whether they are slow pay. These trade estimates from firms of known reputation, together with the reports from banks that know the firm, are the most important forces in molding the banker's opinion of a credit risk.

As William Post pointed out about 15 years ago, credit reliability is based on character, capacity, capital and collateral. It is significant that character is placed first, capacity second and capital third. All information on character is obtained from outside sources, as is much of the information on capacity. The latter is also inferred from the consecutive financial statements, but it is primarily on these outside estimates that the banker will rely. From another angle it will be seen that it is logical for the banker to depend on them. They show exactly how the firm behaves in practice. It is not theory or deduction. "As a man or firm does, so he is," at least so far as the banker is concerned.

Perhaps the greatest banking genius in our generation, the late J. P. Morgan, said that he would lend some men a million on their word whereas he would not lend others 5 cents on government bonds. You cannot get data on the reliability of a man's word (which includes character and capacity) from statistics. You can and do get it from banks, business associates, from the companies with which he deals. That is the *quod erat demonstrandum*.

In addition to those sources already mentioned there is the splendid machinery of the National Association of Credit Men. Its interchange bureaus give accurate information and are invaluable in aiding bankers to obtain information on so-called foreign paper—that is, commercial paper offered for sale originating in other communities. Although this is perhaps the most useful part of the interchange bureau's work, the commercial banker does use it often to confirm opinions on local corporations and individuals.

INVESTIGATING A CREDIT RISK FROM THE INSIDE

Let us consider now the form which John Smith & Co. must fill out for the banker. Each bank has a standard form to fill out—one for individuals or partnerships and one for corporations. Herewith is reproduced a facsimile of a typical form for corporations. A somewhat detailed comment is in order, though the financial statements will not be analyzed until a later article.

The first page contains, of course, the formal application for credit, and under it the two most important sets of data—the balance sheet and profit and loss

Type of Statement to Be Filled Out by Corporation Applying for Credit

Business .... Address ....

Name (Corporate style under charter) .... Laws of state of ....

For the purpose of procuring credit from time to time from you for our negotiable paper or otherwise, we furnish you with the following statement and information which fully and truly sets forth our financial condition on the .... day of .... 19 ... which you can consider as continuing to be full and accurate unless notice of change is given you. We agree to notify you promptly of any change that materially reduces our pecuniary responsibility.

n consideration of the granting of such credit, we agree that if we at any time stop payment or become insolvent, or commit an act of bankruptcy, or if any of the representations made below prove to be untrue, or if we fail to notify you of any material change as above agreed, or if we assign any accounts or transfer or encumber any of our assets in such way as, in your opinion, to materially affect our business or financial condition, or if execution be issued on any judgment obtained against us, then all our obligations held by you shall immediately become due and payable without demand or notice, and the same may be charged against the balance of any deposit account kept by us with you, we hereby giving a continuing lien upon such balance or deposit given from time to time existing to secure all our obligations held by you.

ASSETS		LIABILITIES	
Cash on hand		Notes payable to Nat. Bk.	
Cash in National Bank		" " to other banks	
Cash in other banks		" " for paper sold through brokers	
Due from customers.		" " for merchandise	
On notes receivable (good)		" " to others	
On open accounts (good)		Accounts payable for merchandise purchased	
Due from controlled or allied concerns:		" " to others	
For merchandise sold		Due to officers, directors, employees, and stockholders	
For advances made		Deposits of money with company	
Due from officers, directors, employees, and stockholders		Accrued expenses	
Merchandise:		Mortgage debt	
Finished (how valued)		When due	
In process (how valued)		Bonded debt	
Raw (how valued)		When due	
Land and buildings (see other side), mortgages if any, in liabilities		Interest rate	
Mchy. & equip. (present value, mortgages, if any, in liabilities)		Lien on what assets	
Furniture and fixtures		Other liabilities (itemize)	
Stores, supplies, etc.			
Deferred charges			
Investment in controlled or allied concerns		Reserves (itemize)	
U. S. Government securities			
Other bonds, stocks, and investments			
Good will		Capital stock, preferred	
Patents		" " common	
Other assets (itemize)		Surplus	
TOTAL		TOTAL	

PROFIT AND LOSS ACCOUNT

Total net sales for year less returns ....

Net trading profit (after all expenses) including interest $ ....

Other income .... $ ....

Total income ....

Dividends

Amount paid ....

Rate on preferred .... Rate on common ....

Amount declared (not yet paid) ....

Deductions (itemize) ....

Amount carried to surplus ....

Depository Banks & References	Amount Credit Extended	Amount Owing Above Date

CONTINGENT LIABILITIES

Were you contingently liable on statement date ....

		Amount
1	For customers' papers discounted?	$
2	For accommodation Indorsement or Guarantee	$
3	For unused balances of Letters of Credit?	$
4	Under contracts for merchandise purchased for future delivery (How do such contract prices compare with present market)?	$

Losses by bad debts

Amount of assets pledged as collateral for money borrowed or otherwise

Are all accounts and bills receivable for merchandise sales? . .

Amount of insurance carried on 1. merchandise 2. machinery and fixtures 3. bldg. Do you exchange paper or indorse for anybody? Amount of notes and accounts receivable past due Is there any suit or litigation pending against you?

Have you an interest in any other firm or corporation? . . . .

State location of such concern and nature and extent of interest in it . . . .

Do you place commercial paper through brokers (name)? . . . .

Are your books audited by a Certified Public Accountant? . . . .

PLEASE GIVE FULL DETAILS BELOW, SPECIFYING AMOUNT OF FIRST, SECOND OR OTHER MORTGAGES—DESCRIPTION OF REAL ESTATE

Location	Description of Property	Yearly Rents	Value	Mtg's	Due & Rate	Held By	Net Equity

Date submitted 19

Have you had any serious losses through bad debts or otherwise between date of this inventory and present time .... If so please itemize ....

Signed ....

per ....

account. These two topics will be elaborated in a later article. What we are trying to do now is to get a general impression of the kind of information which the banker seeks. Below the financial statement, the client is asked to list his depository banks and the amount of credit extended by each. Such information can, of course, be easily checked, and if any attempt is made to conceal other loans it will show up in a discrepancy between cash reported in the balance sheet and the amount accounted for on the books of the bank itself.

Contingent Liabilities a Bad Sign

At the top of the reverse sheet the contingent liabilities must be listed. The existence of contingent liabilities is a most unhealthy sign from the banker's standpoint. This is easy to understand, since contingent liabilities may tie up assets as effectively as current liabilities. The term is somewhat elastic and frequently item 4, "materials purchased for future delivery," is not included. Usually the term applies to items 1 and 2. Accommodation indorsements are particularly obnoxious to the banker, for there is no way of evaluating the risk involved. In fact this item is sometimes estimated in with current liabilities in analyzing the statement.

There follows a series of questions all of which have a distinct bearing on the desirability of the credit risk. Losses by bad debts, for example, should be a relatively small percentage of the total sales. If it is higher than usual, the credit department of the company is not on the job. What portion of the assets listed in the balance sheet have been pledged as collateral. A $10,000 house with a $6,000 mortgage is not a good credit risk. Neither is a mortgaged business, whether its fixed assets are pledged for a bond issue or its receivables discounted for cash. Insurance is obviously important, for the bank cannot gamble that there will not be a fire within 90 days to impair the company's credit.

"Do you exchange paper or indorse for anybody?" Contingent liabilities again! They may not be on the books now, but day after tomorrow maybe they will. As to the next question, overdue accounts mean potential bad debts, a further check on the credit department.

"Are you in any other business?" asks the banker and with cause. John Smith & Co. may be liquid, even molten, but Jones & Brown may be on the verge of insolvency, and if John Smith & Co. have a large interest in Jones & Brown it is obvious that they are going to be much less well off than they are now. At any rate it is a wise thing for the bank to know the whole story.

Yet again Smith may have been giving his commercial paper to a broker to sell and if so the bank would like to know what broker. This will give him an additional line on the client. Commercial paper, by the way, usually refers to the promissory notes which a firm sells in the open market.

The final question, except for a listing of real estate is, "Have the books been audited by a certified public accountant?" There are two kinds of audits; the one is a simple certification that the arithmetic of the financial statement is correct and the other, based on a thorough inventory analysis and a complete study of the accounting system, means much more.

This covers in a general way the kind of information that a bank demands from prospective borrowers. I have attempted to give the various items a proper perspective in the general plan. In a subsequent article a study and analysis of the financial statements will be undertaken. Then credit can be discussed in terms of mathematics, but one must never lose sight of the fact that it is not either primarily or essentially a mathematical problem.

Some Notes on Talc

The Bureau of Mines reports that the United States is at present producing approximately two-thirds of the world's supply of talc, a mineral the uses of which are many and varied.

The widest use of talc is in the powdered form. The value of ground talc depends upon color (whiteness), uniformity, fineness of grain, freedom from grit, "slip" and sometimes freedom from lime. White talc, free from grit and iron and low in lime, ground to about 200 mesh, is used largely as a filler for paper, rubber and paint. Ground talc and soapstone are used for foundry facings, either alone or mixed with graphite. A coarser grade of talc is used in the manufacture of asphalt-coated roofing felts and paper, both as a filler and as a surfacing.

The highest grade of ground talc is used as toilet powder, whiteness, fineness of grain, freedom from grit and lime and a good "slip" being essential. Ground talc is also used in dressing and coating cloth, in making soap, rope, twine, pipe-covering compounds, heavy lubricants and polishes. Massive varieties of talc, pyrophyllite and high grades of soapstone are cut into slate pencils and steel-workers' crayons. French chalk or tailors' chalk is a soft, massive variety of talc. In China, Japan and India, massive talc is carved into grotesque images and other forms and is often sold as imitation jade.

Talc is a hydrous magnesium silicate; it is often called steatite, soapstone or potstone, and by the trade names talc clay, agalite, asbestine and verdolite. The term talc may be used to include all forms of the pure mineral, whereas steatite denotes particularly the massive, compact variety, and soapstone the impure, massive form that often contains only 50 per cent of talc. Talc ranges in color from pure white and silvery white through gray, green, apple green, gray green to dark green, also yellow, brown or reddish when impure.

As talc is a relatively low-priced commodity and its distribution throughout the world is general, the location of new plants has been materially influenced by transportation and distance from markets. Most of the paper mills in the United States are in New York and New England, and the talc deposits of New York and Vermont have therefore been most fully developed, as they can easily compete with imported English clay. There are also important deposits in California, Washington, North Carolina and Georgia.

The Search for Potash

In the search for potash supplies within the United States, the State of Utah seems to be the favorite hunting ground for mineral prospectors. Of 237 prospecting permits for potash issued up to March 1 by the Department of the Interior, 184 were in Utah. Twenty-five permits for potash prospecting in Nevada, 14 in California, 8 in New Mexico, 3 in Arizona and 1 each in Colorado, Montana and Nebraska had been issued. Technical supervision over potash mining operations is intrusted to the Bureau of Mines.

Anti-Dimming Preparations for Glass Surfaces

By H. A. Kuhn

First Lieut., C. W. S., U. S. A., Edgewood Arsenal, Edgewood, Md.

During the World War considerable research work was conducted by the Chemical Warfare Service on anti-dimming preparations for gas mask eyepieces. The essentials laid down for these anti-dimming preparations were: That they lower the surface tension of the droplets of water condensing on the eyepieces, causing them to spread into a thin film; that the preparation, spread to a thin film on the eyepiece, should be optically clear when dry, and that the film of material should not dissolve too rapidly.

An anti-dimming preparation satisfying these requirements was finally developed and adopted as the official anti-dimming material. This consisted essentially of sulphonated castor oil, sodium hydroxide, water glass and paraffin oil. Over eight million sticks, each containing about 25 grams of this material, were manufactured by various soap companies for the army during the war.

The base of this anti-dim was castor oil, which, owing to its use as a lubricant for airplane motors, was scarce and expensive. When the Chemical Research Division of the Chemical Warfare Service was reorganized in 1920, one of the problems taken up was the development of a material that would be as good as or better than the official anti-dim and that would not require castor oil as an ingredient. In addition, this new anti-dim was to be impregnated in a cloth in order to simplify the gas mask equipment. Considerable fundamental work along this line was done in the latter part of 1918 and several substitutes were suggested.

As a result of previous investigations, it was decided that an anti-dimming preparation made from sulphonated fat should be the proper mode of attack. Work was conducted along this line, using as a base rapeseed oil, cottonseed oil, corn oil, castor oil, coconut oil, peanut oil, raw linseed oil, cod oil and fish oil. Preparations were made using the sodium salt of the sulphonated oil with varying excesses of caustics and various binders, emulsifiers and restrainers to prevent drying of the preparation.

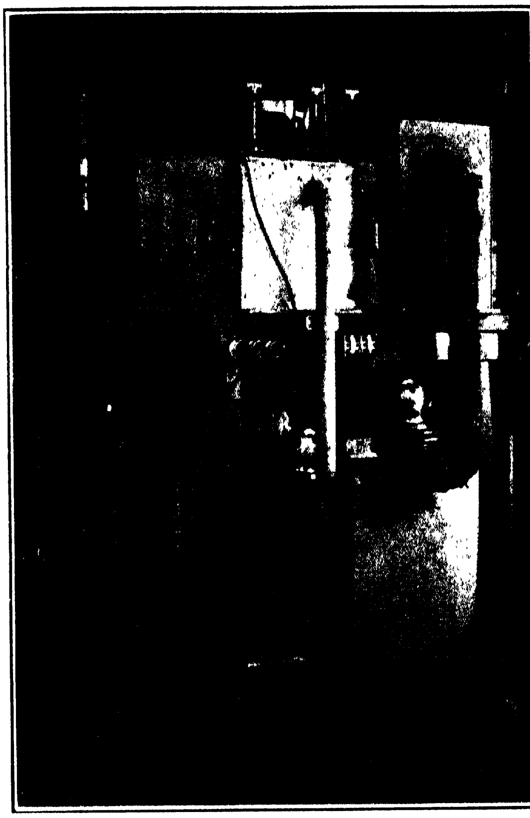
Previous investigators had developed various rapid tests for eliminating poor preparations. Several of these were based on the measurement of the lowering of the surface tension of water droplets, permitting them to spread to a film. The measurement of the spread of a drop of water, dropping a certain distance to a glass plate treated with the preparation to be tested, is typical of this type of test. Other investigators marked out squares on the laboratory windows, and by blowing steam against the treated windows and reading a chart placed some distance outside the windows, were able to secure a rough comparison between the anti-dimming power of various preparations. Other tests were carried out by testing the preparations on the eyepieces of the gas masks in use. All of these tests were limited in speed and accuracy.

TYPICAL COMPARISON OF ANTI-DIM COMPOUNDS

Note. In this test all the preparations except the Official A. D. were applied to the lenses with impregnated cloth

Time in Minutes	Hot Air Temp., Wet Bulb, Deg. C.	Hot Air Temp., Dry Bulb, Deg. C.	Relative Humidity of Hot Air, Per Cent	Cold Air Temp., Wet Bulb, Deg. C.	Cold Air Temp., Dry Bulb, Deg. C.	Relative Humidity of Cold Air, Per Cent	Difference in Temp. Between Hot and Cold Air	Condition of Lenses: No. 1 Rape Oil Soap	No. 2 Rape Oil Soap	No. 3 Rape Oil Soap	No. 4 Cottonseed Oil Soap	No. 5 Official A. D. Soapstick	No. 6 Rape Oil Soap	No. 7 Official A. D. Soapstick
Start	82 2	82 2	100	17 8	20 0	80	62 2							
10	86 7	86 7	100	23 3	25 6	83	61 1	clr	clr	clr	clr	fogd	clr	fogd
20	87 8	87 8	100	24 4	26 7	83	61 1	clr	clr	clr	SF	fogd	clr	fogd
30	87 2	87 2	100	25 6	27 8	84	59 4	clr	clr	SF	SF	fogd	clr	fogd
40	87 2	87 2	100	25 6	27 8	84	59 4	clr	clr	SF	SF	fogd	clr	fogd
Average	86 2	86 2	100	23 34	25 58	82 8	60 62							

Result
No. 1 Rapeseed Clear throughout test
No. 2 Rapeseed Slightly fogged after 20 minutes
No. 3 Rapeseed Clear throughout test
No. 4 Cottonseed Slightly fogged after 10 minutes
No. 5 Official A. D. Became cloudy after 2 minutes—fogged and covered with drops of water at end of test.
No. 6 Rapeseed Clear throughout test
No. 7 Official A. D. Became cloudy after 2 minutes—fogged and covered with drops of water at end of test.



ANTI-DIM TESTING MACHINE

To obtain more reliable comparisons the apparatus shown by the accompanying diagram and photograph was developed to test anti-dimming preparations under conditions simulating the most rigid field conditions. With this apparatus, conditions could be controlled, the factors varied, and tests readily duplicated.

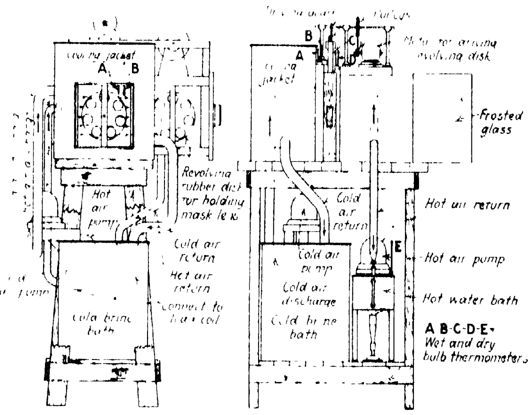
The machine for testing the anti-dimming compounds consists essentially of three parts: A chamber into which a current of warm, humid air is blown; a chamber containing cold air; and between these a revolving disk of rubber with perforations over which is clamped a 3-in. glass lens on which the anti-dim is to be tested. The disk is so placed that one side of the lens is exposed to the warm moist air while the other side is exposed to the cooler air. The back of the warm air chamber is made of frosted glass, while the front is covered by the disk holding the glass lenses. The cool air chamber is open at both ends so that a light placed behind the frosted glass plate at the back of the warm

air chamber can be seen through the lenses in the disk from the front of the cold air chamber. In this way the clearness of the lenses could be observed throughout the experiment.

As a result of a series of tests conducted in this manner, two anti-dimming preparations consisting of the sodium salt or either sulphonated rapeseed or cottonseed oil, sodium hydroxide, glycerine, sodium silicate and engine oil "F" were finally selected as superior to all others tested. Both of these proved superior to the sulphonated castor oil preparation used during the war.

A typical comparative test of several sulphonated rapeseed oil preparations, the best cottonseed oil preparation and the official anti-dim stick under unusually severe conditions is given in the tabulation.

A preparation consisting of the sodium salt of sulphonated rape oil with an excess of sodium hydroxide and a small amount of sodium silicate, glycerine and engine oil "F" was selected for final tests. The material was applied in both stick form and impregnated in a loosely knit cotton cloth. It was found that for most



SIDE OF TESTING MACHINE, SHOWING HOT AND COLD AIR CIRCULATING PUMP AND MOTOR FOR REVOLVING DISK

purposes the cloth gave a more even and permanent film.

After tests on gas masks in use under field conditions the preparation was tried on the windshields of automobiles. A shield remained practically clear after running through a dense fog for 30 minutes. One application of the material was tested by driving through a fog for about 30 minutes. Several days later it still proved effective during a light rain.

The Navy Department has tested the preparation on the pilot houses, port holes and glass bridge screens of cruisers during rains and against sea spray. It was found that the windows remained clear during the rain, although it was necessary to renew the application after each rain. When under full speed the pilot house and bridge screens are continually dashed by salt spray. Although the anti-dim at first increased visibility, the thin film of salt water dried by the sun left a deposit of salt, which after a time considerably decreased visibility through the windows and necessitated their being washed. Tests are being carried out on the lenses of range finders and other optical instruments which must be kept clear at all times. To date the tests have been very satisfactory in so far as the elimination of drops of water is concerned. Further, there has been no evidence of scratching or other injurious effects on the lens. Preliminary tests on submarine periscope lenses have been so satisfactory that 150 sticks of 100 grams each were made and will be distributed to the submarines for further tests. In its tests, the navy has used both the preparation in sticks and those impregnated on cloth. The stick form has been selected owing to the small amount of material in the cloth as compared to the large surfaces to be treated.

Improved Glass for Industrial Goggles

New Glass of Special Composition Will Stand Much Greater Impact Than Ordinary Laminated or Hardened Lenses

AT PRESENT there are two common types of goggle glass. The first is composed of two layers of glass with a film of celluloid or similar material between. The strength of the glass is not improved, but the laminated structure retards penetration of a missile after the glass is broken. However, the thickness of the double lens and the color of the celluloid reduces the light transmission of the glass, and this is objectionable.

The second method is to use the ordinary glass and harden it by a sudden uniform cooling which introduces a uniform strain. This makes it very tough. This treatment actually increases the resistance of the glass to impact or stress and has been used in the manufacture of lamp chimneys, high-pressure gage tubes and industrial goggles.

TESTS ON IMPROVED GLASS

The Bausch & Lomb Optical Co. has now developed a new glass of special composition and improved physical properties which, when properly treated, will stand much more than the ordinary laminated or hardened glass. Lenses for industrial goggles made from this special glass have stood 125 and more blows on each side from a steel ball 1.59 cm. (⅝ in.) in diameter dropped from a height of 54 cm. (21 in.). A glass which will stand ten blows on one side is considered to be satisfactory by the Bureau of Standards.

In making a comparative test, the Bureau of Standards found its regular test was not severe enough. A summary of the bureau's results is given in the accompanying table. Steel balls 1 and 1⅜ in. in diameter were dropped from increasing heights on the same side.

STRENGTH TESTS OF GOGGLE LENSES

Kind of Lens	Diameter Of Ball, In	Height, In	Average Impact, Ft.-Lb
Laminated	1	14.5	0.18
Regular or hardened	1	13 to 21.5	0.16 to 0.26
Special goggle			
Group 1	1 and 1⅜	36 to 96	1.36
Group 2	1 and 1⅜	36 to 96	1.30
Group 3	1⅜	96 and not broken	2.95

Groups 1 and 2 of the special goggle lenses were finished in a way which reduced their possible strength. In group 1 three lenses out of a group of 17 were not broken under a blow of 2.95 ft.-lb., while in group 2 one lens was not broken with this maximum blow. Group 3 shows what strength may be developed by proper handling. Only one lens was broken under an impact of 2.95 ft.-lb. which was delivered by a 1⅜-in. steel ball falling 8 ft. This is at least ten times the blow the ordinary goggle glasses will stand.

Production of Hydrogen By the Thermal Decomposition of Oil

The First of Three Articles Describing Exhaustive Experiments in Producing the Pure Gas Required by Governmental Air Services—Design, Construction and Operation of Modified Water-Gas Plant and Its Accessories

By E. R. Weaver
Chemist, Bureau of Standards

The experiments described in this article and those that will follow it were made for the purpose of determining the practicability of making hydrogen of sufficiently high purity for use in airships by the thermal decomposition of a hydrocarbon oil. The experiments were financed jointly by the Air Services of the army and the navy and were carried out at the plant of the Gas Engineering Co., of Trenton, N. J., with an existing water-gas plant which was suitably modified for the purpose of the experiments.

The method employed was essentially that of the Berlin Anhaltische Maschinenbau Aktien-Gesellschaft[1] and the good results reported by Leslie Vicroy, of the Goodyear Tire & Rubber Co., who experimented with the method during the summer of 1920, were the immediate incentive to a more complete study of the method.

General Principles of Process

This method of manufacturing hydrogen by the thermal decomposition of oil is very simple in principle. Essentially it consists merely in vaporizing a hydrocarbon oil and passing the vapors over surfaces sufficiently hot completely to decompose the hydrocarbon into its elements. The simplest way of accomplishing this, and the method employed in most of the experiments here described, is to blow air through a bed of coke, burning the resulting "blast gas" in a tower filled with checker brick, which will usually be called the vaporizer. When both coke and brick have reached the desired temperature, oil is run onto the heated brick, and the vapors pass through the column of brick and thence through the hot coke. The carbon deposited in both chambers is burned out during the next "blow" and provides a part of the fuel necessary for maintaining the required temperature.

The reactions involved in the process are almost independent of the nature of the hydrocarbon used. If any hydrocarbon is heated to a sufficiently high temperature it breaks down into simpler substances, eventually yielding hydrogen and carbon. During the decomposition methane is always produced, and it is this compound which is most difficult to decompose. The equilibrium between methane and hydrogen in contact with carbon can be represented by a curve of the general character shown in Fig. 1.

Unfortunately methane does not decompose to any considerable extent in the gas phase. This is shown by the non-luminous character of the methane flame. It is stated by Bone and Coward[2] that the decomposition of methane is a surface phenomenon exclusively, even at temperatures as high as 1,500 deg. C. Decomposition and separation of carbon take place throughout the mass of almost any other hydrocarbon, but these observers found that the carbon of methane would separate only by deposition upon a solid surface. Even under favorable conditions the rate of decomposition of methane is extremely slow. J. N. Privy[3] found it necessary to heat 22 hours at 1,200 deg. C. to approach equilibrium, and 2 hours at 1,500 deg. C. It is obviously impossible to make hydrogen commercially and to allow it hours of contact with heating surfaces. The time of contact must be reduced to a few seconds and this means that the temperature must be several hundred degrees above the equilibrium temperature corresponding to the gas composition desired. If the decomposition of methane is exclusively a reaction between solid and gas phases, its rate should be directly proportional to the area of the solid surface. The elimination of methane from hydrogen produced upon a commercial scale therefore depends upon decomposing the oil in contact with a very large surface at a very high tem-

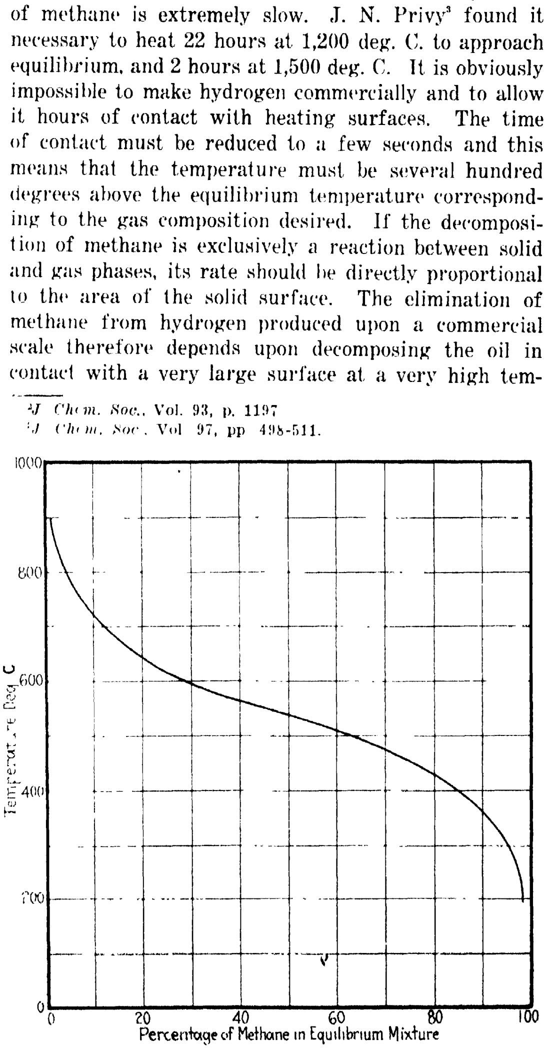


FIG. 1—EQUILIBRIUM IN REACTION, $CH_4 = C + 2H_2$

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[1]British Patent 2054 (1914). Similar processes have been proposed by several inventors; of these the Rincker-Wolter process is the best known. For a review of these methods, see "Industrial Hydrogen," by H. S. Taylor, the Chemical Catalog Co.; or "Hydrogenation of Oils," 2d Ed., by Carleton Ellis, D. Van Nostrand Co.

[2]J. Chem. Soc., Vol. 93, p. 1197

[3]J. Chem. Soc., Vol. 97, pp. 498-511.

perature; but of the three factors—temperature, surface and time of contact—temperature is by far the most important.

The excessive temperature required is the source of most of the difficulties encountered in the practical application of the method, and leads at once to something of a dilemma. On the one hand, about the only solid available at a reasonable price which will stand the necessary temperature without crumbling, sintering or taking part in undesirable reactions with oxygen, hydrogen or carbon is carbon itself. On the other hand, carbon is the one substance that might be used which it is difficult to heat to a high temperature. An inert refractory is easily heated by an oil or gas flame to a temperature of 1,600 to 2,000 deg. C. What happens in the case of carbon can be readily seen by considering a bed of coke heated by an air blast.

No matter whether carbon burns first to carbon monoxide or to carbon dioxide, the reaction between carbon monoxide and oxygen is so much more rapid than the reaction between oxygen and solid carbon that carbon dioxide is the only gas formed in large quantity so long as an appreciable amount of oxygen is present. At temperatures above 1,000 deg. C., however, the carbon dioxide reacts very rapidly and practically completely with carbon to form carbon monoxide again. The amount of heat produced in burning carbon to carbon monoxide is sufficient to raise the temperature of the products of combustion to only about 1,400 deg. C. if no heat losses occur, while the heat liberated

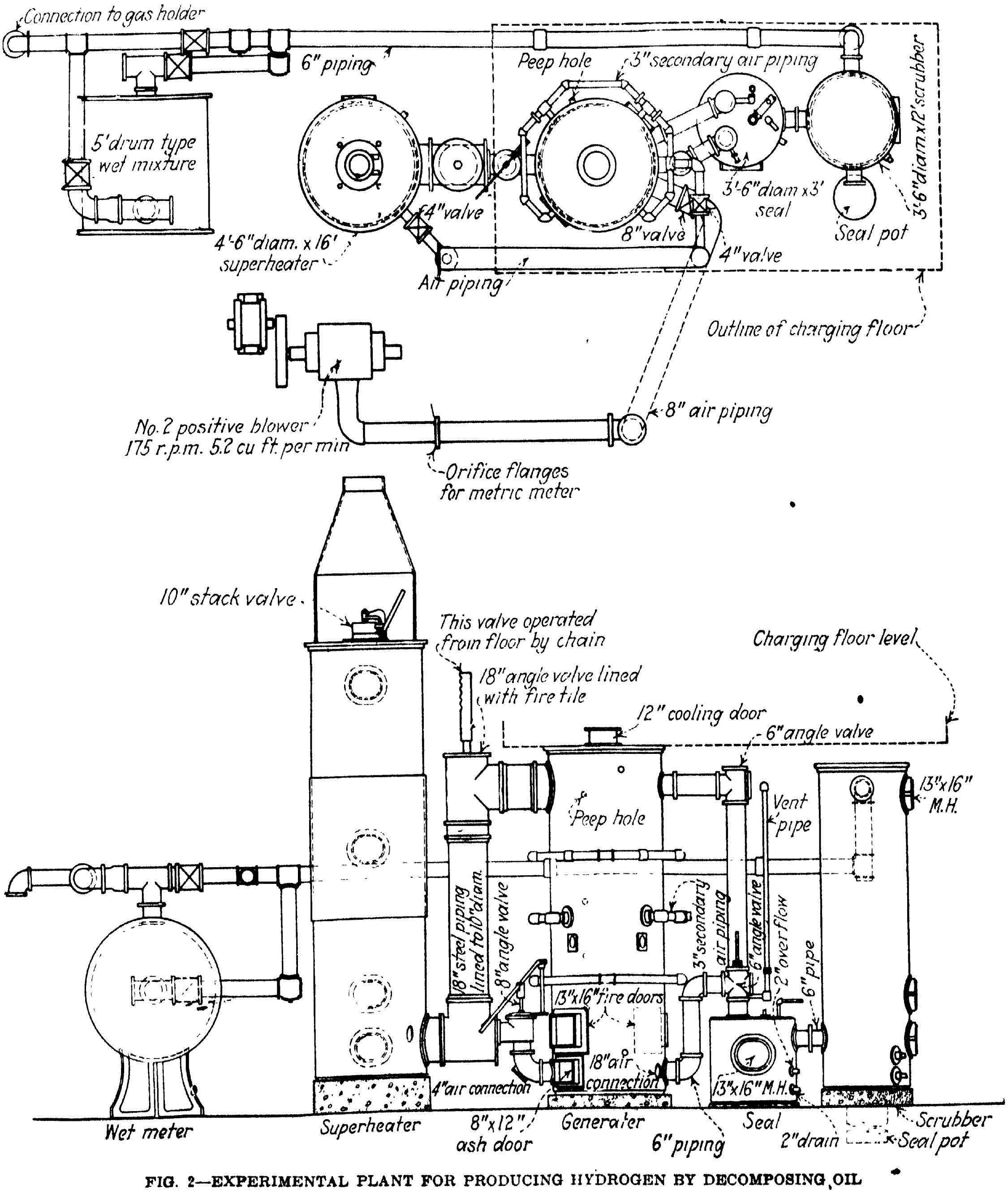


FIG. 2—EXPERIMENTAL PLANT FOR PRODUCING HYDROGEN BY DECOMPOSING OIL

in the formation of carbon dioxide is sufficient to raise the temperature of the products of combustion to about 2,500 deg. C. When air is introduced into the fuel bed at only one level, there is always a zone of increasing temperature corresponding to decreasing oxygen content in the gas stream. The maximum temperature is reached where all the oxygen is combined as carbon dioxide. Beyond that point, the temperature decreases because of the formation of carbon monoxide. It is, therefore, not merely wasteful of heat to permit unburned carbon monoxide to escape, but, in order to obtain a temperature in any region sufficiently high to decompose oil successfully, it is absolutely necessary to produce carbon dioxide in that region.

As blasting is continued from a single level and the temperature in the hottest zone increases, combustion becomes more rapid, and the width of the zone decreases to such an extent that the total heat in the coke bed available for decomposing oil may actually decrease. In order to have a sufficient depth of hot coke it is therefore necessary to introduce air at several levels at each of which the carbon monoxide formed below will be burned to dioxide. The ideal condition would, of course, be one in which air was supplied at all points in just sufficient quantity to oxidize all the carbon monoxide formed at lower levels.

The need for the checker-brick tower is also apparent. If carbon were the only solid used for heat transfer, as in the Rincker-Wolter process, it would be impossible to prevent the fuel from burning only to carbon monoxide or to prevent the blast gases leaving the plant at a very high temperature. By using the checker-brick tower it is possible to burn the blast gas completely and make it give up its heat to the brick where it is available for use.

Construction of Plant

The plant employed in the experiments consisted of a 4.5-ft. water-gas generator and two shells of about the same size as the generator, each filled with checker brick, together with blower, scrubber, meter and other accessories. The general arrangement of the plant is shown in Fig. 2. Particular attention should be called to the three sets of "secondary" inlets, by means of which air could be introduced into the generator at three levels above the grate. These inlets proved to be of the utmost importance. Without them it is practically certain that no satisfactory results could have been obtained.

It was possible to use this plant in several different ways; for example, the oil could be vaporized on either coke or checker brick and the hydrogen could be withdrawn after passage through the coke only, the checker brick only, or the coke in series with one or both of the checker-brick towers. Unfortunately, the connections were not such as to permit the sequence of operations which is later described and recommended for a large plant and which is believed to be the most efficient thermally. Several of the possible procedures were tried and the results obtained in certain unusual cases will be mentioned later; but only the method of operation described in the following paragraph gave satisfactory results, and this was the method employed in nearly all of the experiments described.

Only one checker-brick tower was employed. Air was blown upward through the generator, entered the bottom of the checker-brick tower where air was added to burn the combustible gas present, and the blast escaped through the stack valve at the top of the tower. The oil was introduced at the top of the checker brick and traversed the two shells in the direction opposite to that of the blast, the hydrogen leaving the generator at the bottom. When hydrogen of sufficient purity was no longer produced or when the generator became choked with carbon, the introduction of oil was stopped, the carbon was burned from the checker brick with air, and the cycle repeated.

Refractories. The inner linings of both generator and checker-brick tower were of fireclay blocks of good quality. The lower 3 or 4 ft. of the tower lining was protected by a layer of split carborundum brick 1¼ in. thick. At the end of the experiments, the generator lining had fused to such an extent that it would have had to be replaced if the experiments had continued. Indeed, it was the blocking of the grate by fused material from the wall of the generator lining that caused the experiments to be discontinued just when they were; but the lining of the vaporizer remained in good condition until the end of the experiments. Only the surface was glazed to a depth of a few millimeters The grate was made of 4x8-in. fireclay bars; these also remained in good condition throughout the experiments.

During the first experiments a good grade of fireclay brick was used for checkerwork. It was found that these brick had too low a melting point to permit satisfactory operation, and they were replaced, principally by silica brick. As an experiment a few special brick of several different kinds were included in the checkerwork, but all of them were less satisfactory than the silica brick.

Facilities for Observation and Control. Orifice meters were installed for measuring the flow of air to each of the four levels of the generator and to each checker-brick tower. The distribution of air to the various points was under fairly accurate control by means of these meters and throttle valves.

The oil used had to be forced into the shells, from a tank located at floor level, by means of compressed air. It was measured both by a friction-tube flow meter and by direct measurement of the oil in the supply tank by means of a glass gage and calibrated scale.

The rate of flow was governed as carefully as possible by observing the flow meter, but was necessarily subject to considerable fluctuations the effects of which are very apparent upon the curves showing the rate at which hydrogen was produced and also upon those showing the purity of the gas. The hydrogen produced was measured through a revolving-drum wet meter.

The composition of the hydrogen was recorded continuously by the thermal conductivity method, except when trouble with the sampling prevented. Analyses were also made frequently with an accurate volumetric apparatus of the Orsat type. The combustion method was generally used to determine carbon monoxide, methane and hydrogen. The carbon monoxide was occasionally determined also by absorption in cuprous chloride. All methods checked closely, and there appears to be no reason to doubt the substantial accuracy of all the important analyses.

Pyrometric Measurements. All temperature measurements of any significance in the generator and vaporizer were made with an optical pyrometer. Sight holes and

openings in the checkerwork were provided at heights of 3, 6, 9, and 12 ft. above the bottom.

Sight holes into the generator were provided at heights of about 2, 4, 6, 8 ft. above the grate. Because of obstacles which interfered with the use of the optical pyrometer, however, the holes at heights of 2 and 8 ft. were but little used. The opening 4 ft. above the grate was fitted with a stuffing box through which a 1-in. pipe with a sight cock and glass on the outer end could be rammed into the fire and the temperature of the fuel bed determined at a point at least 6 or 8 in. inside the lining. This arrangement was particularly satisfactory and it is regretted that space did not permit the use of the same device at the other sight holes.

It was the general rule, in making temperature measurements, to focus upon the hottest surface visible, since the surfaces near the shells were always cooled to some extent by radiation, and the hottest visible surface was probably never hotter than the average temperature at that level. Unfortunately, on account of smoke, no temperature readings could be made while oil was being introduced nor for a considerable time after the run. Even when the smoke had been cleared away by the air blast, the temperature observed had little significance until the porous deposit of finely divided carbon had been burned away. For that reason the frequent temperature readings taken in the earlier runs were later dispensed with and temperatures were taken for only a short time before a run.

Fuels. Two grades of oil were used, kerosene and a refined fuel oil of considerably greater density, both purchased without specification or test from the regular stock of a local dealer. As will be shown later, the composition of the oil has but little influence upon the results obtainable. Neither oil contained an important amount of sulphur. Any sulphur present is converted quantitatively to hydrogen sulphide during the reaction and is easily removed from the gas in contrast to the organic compounds of sulphur formed at the low temperatures of carburetion of ordinary water gas. Three solid fuels were tried—an ordinary gas coke, petroleum coke and retort carbon. The apparent densities of the three solid fuels in loose piles were respectively about 27, 17 and 40 lb. per cu.ft. The gas coke was used for only a few runs until it became apparent that temperatures high enough to decompose oil could not be attained without fusing the ash to a clinker almost impossible to deal with. Petroleum coke was used during most of the experiments, the retort carbon, of which only a small supply was available, being reserved for a few runs at the end.

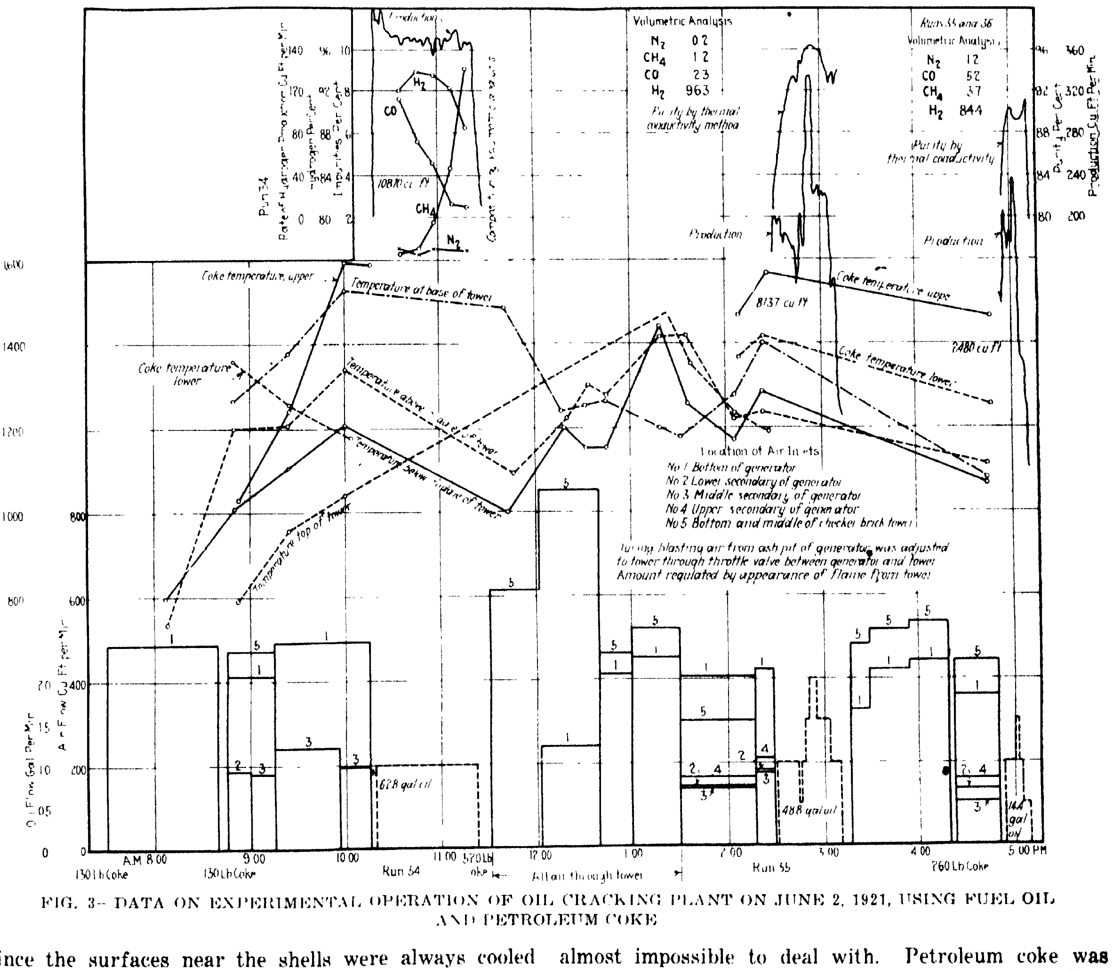


FIG. 3—DATA ON EXPERIMENTAL OPERATION OF OIL CRACKING PLANT ON JUNE 2, 1921, USING FUEL OIL AND PETROLEUM COKE

Record of Observations. The observations and all essential data taken during each experiment were plotted in colored inks on 40x50-cm. cross-section paper. A reproduction of one such sheet is shown in Fig. 3, which records the operation of the plant on June 2. The solid rectangular figures at the bottom of the sheet represent air blown into the various inlets of the generator and vaporizer; the height above the origin of the upper boundary of each rectangle represents the rate of air flow, and the area of the rectangle represents the total quantity of air delivered. Similarly the dotted

rectangles represent the rate and quantity of oil introduced into the vaporizer. The small circles connected by straight lines in the middle of the page represent observations of temperature made with the optical pyrometer. The irregular curves near the top of the sheet represent the rate of production and composition of the hydrogen made.

Details of Plant Performance

The operation of the plant as shown by the data sheet will be followed descriptively for the purpose of illustrating the methods of experimentation and control, a knowledge of which is essential to an understanding of the discussion of plant performance which follows:

On the morning of June 2, 130 lb. of petroleum coke was charged into the generator and at 7:30 the blast was started, 485 cu.ft. per minute entering the bottom of the generator, from which enough was diverted to give practically complete combustion inside the checker-brick tower (as shown by the flame at the top of the tower). At 8:40 the blast was stopped for 5 minutes while an additional 130 lb. of coke was shoveled into the generator. From 8:45 until 9 air was blown into the bottom of the generator at the rate of 408 cu.ft. per minute, into the lower secondary air inlets at the rate of 182 cu.ft. per minute, and directly into the checker-brick tower at the rate of 476 cu.ft. per minute. At about 8:50 the temperature of the lower half of the coke bed was observed to be about 350 deg. hotter than the upper, consequently the lower secondary to the generator was closed and the middle one opened to pass air at approximately the same rate. At 9:15 the direct air line to the checker-brick tower was closed to permit mixing of the blast gas and secondary air before entering the tower, and the secondary air for the checker brick was taken by bypassing a portion of that entering the bottom of the generator, the amount taken being regulated as before to give a small pale flame at the stack. This permitted 240 cu.ft. per minute to be taken into the middle of the generator. At 9:45 the secondary air to the generator was cut down to about 200 cu.ft. per minute. Observation then showed temperatures in both generator and vaporizer well above 1,500 deg. C. At 10:15 the blast was stopped, and at 10:19 kerosene was introduced into the vaporizer at the rate of 1 gal. per minute. The rate at which gas was produced is shown by the wavy line at the top of Fig. 3.

At 11:21, 62 minutes after starting, 62.8 gal. of kerosene had been used and 10,870 cu.ft. of hydrogen produced. The composition of the gas produced, as shown by volumetric analysis, is given by the four curves under the rate curve. The maximum purity obtained was 93.8 per cent 27 minutes after the beginning of the run, the impurities at that time being 5.5 per cent of carbon monoxide, 0.4 per cent of methane and 0.3 per cent of nitrogen.

The generator was then charged with 520 lb. of petroleum coke and the blast started through the checker-brick tower only, in order to burn out the deposited carbon.

The upward movement of the hot zone of carbon-dioxide formation and the sharp fall of temperature after this hot zone has passed a given level can be seen quite clearly even from the small number of temperature observations made in this case. Blowing through the vaporizer alone continued until 1:30, when the carbon appeared to be practically burned out. The blast was directed into the generator at all four levels from 1:30 to 2:29 with a change in the secondary air to the checker-brick tower at 2:17. At 2:32 oil was again turned into the machine at the rate of approximately 1 gal. per minute. The lower irregular curve at the top of Fig. 3 shows the rate at which hydrogen was produced during the run, and the upper irregular curve is the record of the purity recorder. At 2:46 the gas had attained a purity of 92.8 per cent.

Effects on Purity of Gas

If, as suspected, the principal impurity were now carbon monoxide produced at a rate independent of the rate of hydrogen production, the purity should be decreased by decreasing the rate of production. If the impurity were methane which had not been decomposed because of insufficient contact with a surface at high temperature, the purity should be improved by decreasing the rate of production. To test this point the rate of oil flow was cut to half a gallon per minute. The purity immediately dropped about half of 1 per cent, indicating carbon monoxide as the principal impurity. Without waiting to see how far this decline would go, the rate of oil flow was restored to 1 gal. per minute. The purity increased at once to 94.7 per cent. The rate was again increased to 1.5 gal. per minute. The purity again increased sharply. The rate of oil flow was increased to 2 gal. per minute, but without noticeable effect on the purity, indicating that conditions had been reached under which the effect of a further increase in rate upon methane production would more than offset its effect in diluting carbon monoxide. A sample taken at this time for volumetric analysis showed N_2 0.2, CO 2.3, CH_4 1.2 and H_2 96.3 per cent. In about 5 minutes the purity of the gas at this rate had begun to fall off appreciably, unquestionably because of the formation of more methane as the machine cooled. The rate of oil flow was cut down to 1.5 gal. per minute to check this tendency. The effort was partly successful, a decided break toward horizontal occurring in the downward purity curve. The purity continued to drop off, however, and after running 1.5 gal. for 9 minutes the rate of oil flow was reduced to 1 gal. per minute. This resulted in an immediate increase in purity of a little more than 1 per cent, followed by a gradual decline. In about 5 minutes the impurity was as great as before the change in rate. The oil was then shut off entirely, but the production of hydrogen continued for some time, the purity at first increasing as the rate of production fell off and greater time of contact cut down the amount of methane, and then decreasing as the rate fell to so low a figure that the carbon monoxide again became the dominant impurity. The decomposition of 48.8 gal. of oil in 39.5 minutes had resulted in the production of 8,137 cu.ft. of hydrogen of an average purity of about 93 per cent. Burning out the carbon from the checker brick occupied the time from 3:18 to 4:20. At 4:20, 260 lb. of coke was put into the generator, and the coke bed was then blown for 28 minutes at all levels. Observation now showed the temperatures at various places to be about 100 deg. C. lower than at the beginning of the previous run. A run was made, nevertheless, primarily to test the effect of this difference of temperature. The effect is quite apparent from the purity curve, which reached at the maximum only 91 per cent. As was to be expected from the low purities, the effect of changing rate was just the opposite of that at the beginning of the preceding run. Volumetric analysis at once confirmed the conclusion that methane was largely the cause of the low purity of the gas.

The preceding description is merely illustrative of the results obtained during 15 days' operation of the plant under many conditions. It would require too much space to give the results of all these operations in greater detail. Consequently in the articles to follow this one only the more interesting data will be presented, mostly in the form of curves showing the variations from moment to moment in the compositon of the gas produced during the runs.

Forest Products Research Carried On by Canada

The progress which has been made in forest products research in Canada is outlined in a recent bulletin issued by the Federal Department of Interior. This research work is being carried on at the Forest Products Laboratories at Montreal, and in addition special work is being conducted in a timber testing laboratory at Vancouver.

The work of the Montreal laboratories is divided into four main divisions—namely, pulp and paper, timber physics, timber tests and wood preservation.

The pulp and paper division has made detailed studies of the chemistry of Canadian woods in relation to pulp manufacture. Technical processes in the heating of pulp have been investigated. In the manufacture of sulphite pulp, experiments have been made in the penetration of cooking liquor in relation to moisture content, chips, etc. The utilization of waste sulphite liquor has been studied, also chipping, drying and baling of pulp for shipment. Other studies cover the efficiency of various newsprint splices, and the relation of humidity and temperature to moisture content of woods. Blotting paper has also been manufactured at the laboratories for the first time in Canada.

Corrosion of Rustproofed Iron and Steel

Galvanizing Is the Best Method of Protecting Against Rusting When Immersed in Fresh Water Saturated With Oxygen—Uncoated Iron and Low-Carbon Steel Corrode at About Equal Rates Under Those Conditions

By W. P. Wood
Assistant Professor of Metallurgical Engineering, University of Michigan

THE experiments and results set forth in this article are presented with the idea of supplying some further data upon the corrosion rates of some common ferrous metals when unprotected and when protected by some of the well-known rustproofing processes. This work was carried out at the instigation and with the co-operation of one of the large central power stations of the Middle West.

The main interest in this investigation was centered upon the behavior of the samples when immersed in various waters. Nothing that is stated here is calculated to have any direct bearing upon the subject of corrosion of iron and steel when subjected to atmospheric conditions. The writer believes the two types of corrosion are somewhat different and should be approached separately.

A study of the recent work upon corrosion of iron and steel reveals the fact that it is felt by most authorities upon the subject that the rôle of oxygen in producing and accelerating corrosion is an exceedingly important one. This is particularly emphasized by W. D. Richardson[1] in his exhaustive and instructive series of experiments. While studying Mr. Richardson's work, the idea occurred to the writer that it might be feasible to use pure oxygen as a constant accelerator in corrosion tests, thus accomplishing, perhaps, the results which it has been hoped by some might be reached through use of the acid tests. It is quite well recognized that an indiscriminate use of acid tests in determining relative corrosion rates often leads to erroneous conclusions. It is also appreciated that some sort of reliable accelerated test would be very useful. In all the tests hereinafter reported the waters were kept saturated with oxygen, as nearly as possible, and determinations made upon the water showed the presence of considerable entrained oxygen.

It is felt that in order to have any comparative value corrosion tests should be carried out under as rigidly controlled and uniform conditions as possible. It is also believed that too wide an application of results obtained under one set of conditions should not be made. It is just this which has led to the great confusion in corrosion work which is apparent to any one interested. For instance, data which may be entirely applicable to corrosion by immersion in slowly moving waters will not be applicable when the water is moving with a high velocity or when quiet. The results of this work are felt to be applicable in waters that are slightly agitated by a slow motion. It is not proposed that the results of this investigation will have unlimited application over a wide range of conditions.

The metals used were pure open-hearth iron, wrought iron, open-hearth steel and a steel containing about 0.21 per cent copper. Analyses of these metals are given in Table I. Each metal, uncoated, was tested in two conditions, "as received" and after receiving a rough polish upon a 200 M wheel. Most of the metal "as received" was coated with a more or less uniform amount of mill scale. The pure open-hearth iron did not possess this covering of mill scale to as marked a degree as the other metals.

The protective coatings that were investigated were those obtained by calorizing, parkerizing, sherardizing, galvanizing and an electrolytic zinc process. It was realized that calorizing is not recommended as a protection against under-water corrosion, but it was thought that it would be of interest to include this process, as aluminum is electropositive to iron and should offer much the same advantages as a rustproofing material as does zinc. The physical condition of the aluminum coating and its method of application would be important factors. Previous to coating, each sample was polished upon a 200 M wheel in order to produce uniform surface conditions for the application of the coating.

Three waters were used as corroding mediums. These were distilled water, tap water and a special boiler-feed water. Analyses of the last two waters are presented in Table II. Particular interest was attached to the behavior of the tap water, since it was obtained from a system which makes use of liquid chlorine as a purifying agent.

It was not believed that any striking differences would develop between metals coated by the same process, and therefore it was not deemed necessary to run samples of all rustproofing processes upon all the metals. The samples which were actually run may be ascertained from Table III.

The dimensions of the samples were approximately

TABLE I—CHEMICAL ANALYSES OF METALS USED IN CORROSION TESTS

Metal	C	Si	Mn	S	P	Cu	Slag
Open-hearth iron	0 028	0.014	0 014	0 027	0 003	....	....
Wrought iron	0 014	0 238	0.060	0 009	0 211	.	2.00
Copper-steel	0 124	0 073	0 346	0 035	0 009	0 215	...
Open-hearth steel	0 122	0.059	0 297	0 034	0 026		.

TABLE II—CHEMICAL ANALYSES OF TAP AND BOILER FEED WATERS

Constituents	Tap Water, Pt. Per Million	Boiler Feed, Water, Pt. Per Million
Alkalinity (as $CaCO_3$)	53 5	Neutral
Chlorine	7 6	1.8
Sodium chloride	12 6	2.9
Total solid residue	100.0	26.0
Oxygen consumed	2.7	2.1
Silica	4 0	1.2
Iron and aluminum oxides	2.6	2.8
Calcium	23.1	2.1
Calcium oxide (CaO)	32 3	2.9
Calcium carbonate	57.6	5.2
Sulphates	Nil	Nil
Dissolved and entrained oxygen	31.2	24.3

[1] *Trans.*, American Institute of Chemical Engineers, vol. 18, p. 169.

as follows: 2 in. long, 1 in. wide and ⅛ in. thick. Each test was carried out in triplicate in order to obtain reliable results and the average value of the three used in making computations. It might be stated at this point that in no case was there any wide variation among the three check samples. Each type of sample was exposed for four different lengths of time—1 month, 4 months, 8 months and 1 year. The total number of samples in each test was therefore twelve.

The dimensions of each sample were taken by means of micrometer and steel scale, after which the total area was computed. The samples were all washed in distilled water and 95 per cent alcohol and dried for one hour at 105 deg. C. in an electric oven, being subsequently stored in a dessicator until convenient to weigh them. Weighings were made correct to fourth decimal place. After weighing, the samples were placed in the water for the designated length of time, at the expiration of which they were removed and again washed, dried and weighed as before. Rust was nearly always flocculent, non-adherent and washed off very easily. In preparing the samples for immersion the idea in mind at all times was to maintain as nearly as possible uniform surface conditions.

Some exception might be taken to the statement that weighings were correct to the fourth decimal place. This criticism might be particularly applicable to the weighings made subsequent to immersion, as it was not always possible to wash off the last trace of adherent rust from the samples. Some experiments were made to determine the relative error introduced from this source and it was found that these last traces of rust, which in many cases were mere discolorations, weighed only a few tenths of a milligram, even though they appeared quite bulky at times.

In all, about seven hundred samples were run in this series of tests. The great difficulty involved was in keeping track of each sample during the entire process. Each sample was stamped with a number as soon as it was cut from the original stock. "As received" samples were stamped lightly, in order to avoid a tendency for corrosion at that point. Polished and coated samples were stamped more deeply, as the marks were subsequently nearly obliterated by the polishing and rustproofing operations. It was observed that in only a few instances did this number cause excessive local corrosion and even then the difference in weight was very slight when these samples were compared with their checks which had not exhibited the excessive corrosion around the number. Such facts all

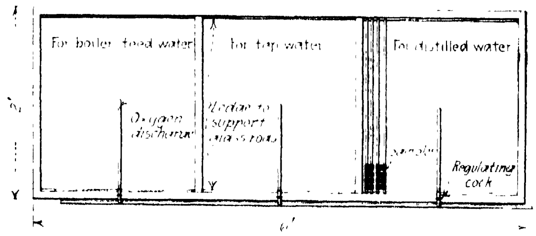


FIG. 1—SKETCH OF TANK USED IN CORROSION EXPERIMENTS

demonstrate the great importance of uniform surface conditions in corrosion phenomena.

APPARATUS

Before describing the apparatus by means of which the corrosion tests were carried out, it will probably be advisable to review some of the conditions which are known to effect corrosion and which must be taken into account in carrying out corrosion tests. These conditions were obtained from a study of the work of other investigators, more particularly the work of Heyn and Bauer.[2] In all there are about twenty-one factors[3] that influence corrosion, but the five enumerated below were considered of the most importance. They are:

1. Rise in temperature of the corroding liquid usually increases rate of corrosion.

2. An increase in depth of immersion decreases corrosion.

3. An increase in the exposed surface of the liquid increases corrosion.

4. Chemical impurities in the liquid increase the action.

5. The corrosion is usually in direct ratio to the amount of liquid present.

Most of the variables may be partly eliminated in the following manner: (1) Use same amount of liquid, (2) run tests at same temperature, (3) use same depth of immersion, (4) use pieces of metal from same stock piece. In building and locating the immersion tank the conditions enumerated were kept in mind.

A diagram of the tank used will be found in Fig. 1. As will be seen it is a three-compartment tank, 6 in. deep, built of 1-in. lumber. A narrow strip of wood was fastened around the inside of each compartment 4 in. from the bottom to support the glass rods, which

TABLE III—AVERAGE WEIGHT LOST IN MILLIGRAMS PER SQUARE CENTIMETER

Description of Samples	In Oxygenated Distilled Water 1 Mo	4 Mo	8 Mo	12 Mo	In Oxygenated Tap Water 1 Mo	4 Mo	8 Mo	12 Mo	In Oxygenated Boiler Feed Water 1 Mo	4 Mo	8 Mo	12 Mo
Open-hearth iron, ground	2	9	20	32	1	12	23	31	5	16	25	33
Wrought iron, ground	3	8	11	24	4	12	20	30	3	9	14	21
Copper steel, ground	2	11	21	30	4	11	19	26	3	13	21	31
Open-hearth steel, ground	2	17	24	30	6	10	18	26	2	10	19	24
Open-hearth iron, as received	0.6	14	23	34	4	13	24	33	3	24	13	34
Wrought iron, as received	2	11	14	22	4	10	18	30	2	8	16	24
Copper steel, as received	3	12	18	31	2	8	15	25	2	11	23	35
Open-hearth steel, as received	3	14	20	32	3	10	16	26	2	9	16	24
Open-hearth iron, calorized	Gain +1	Gain +1.5	Gain +1.4	Gain +0.7	Gain +0.2	Gain +0.5	Loss 0.1	Loss 9	0.2	1	3	5
Open-hearth steel, calorized	Gain +0.9	Gain +1.[illegible]	Loss 0.[illegible]	Loss 3	Gain +0.4	Gain +0.2	Loss 6.5	Loss 9	0.4	4	6	11
Open-hearth iron, sherardized					0.3	2	3	7	0.3	1	3	6
Copper steel, sherardized	0.2	1	3	5	0.3	1.5	4	8	1	2	5	9
Open-hearth steel, sherardized	0.2	1	3	5								
Open-hearth iron, galvanized					1	1	2	3	04	1	2	3
Wrought iron, galvanized	0.3	1	2	2.5	1	1	2	4	1	1	2	4
Open-hearth steel, galvanized	0.4	1	1.5	2.5								
Open-hearth iron, electrolytic Zn					0.4	1	4	9	0.5	1	2	4
Wrought-iron, electrolytic Zn	0.1	1	1	3	0.4	1	2	4	0.5	1	2	3
Open-hearth steel, electrolytic Zn	0.2	1	1	3								
Open-hearth iron, parkerized					0.4	2	4	5	0.3	3	7	11
Copper steel, parkerized	0.4	1	3	4	0.5	1	5	5	0.4	3	9	14
Open-hearth steel, parkerized	0.5	4	10	15								

[2] *Mitteilungen aus dem Königlichen Materialprufungsamt*, 1908-1912.

[3] A. F. Wendler. An unpublished manuscript on corrosion.

in turn supported the samples. Commercial oxygen was supplied by tanks and was brought into each compartment through a steel pipe manifold and glass delivery tubes; its flow was regulated by a rubber hose connection and a stock cock. Oxygen was regulated in such a manner that about one bubble per second rose from each delivery tube. This bubbling produced a slight but constant agitation of the water in the tank. A space about 6 in. square was left in the center in which no samples were placed.

Since it has been shown that light has an effect upon rate of corrosion, each compartment of the tank was supplied with a tight-fitting wooden cover. These covers also prevented objects from falling upon the samples and, most important of all, maintained the atmosphere over the surface of the water much richer in oxygen than normal, a condition maintaining a more uniform and larger concentration of oxygen in the water. Table II gives data on the amount of oxygen carried in one test. No doubt the concentration varied largely at times.

Samples were laid flat in order to eliminate the variations in corrosion rate by varying depths of immersion. A depth of 2 cm. of water was maintained over the upper surface of the samples. Evaporation losses were made up by occasional additions of pure distilled water. In placing samples in the tank care was taken to make a uniform distribution in order to offset any local conditions obtaining in various parts of the tank.

The tank was placed in a room where the average yearly temperature variation was not over 15 deg. F. from the average yearly temperature of 70 deg. F. The tank never received the direct rays of the sun; moreover, the sun shone in the room only a short time during each day.

The flow of oxygen was kept practically constant over the entire year. There were, of course, some unavoidable breaks occasioned by leaks in the delivery system or in the valves on the oxygen tanks. On the average one tank of oxygen would last about 3 weeks.

Results for Uncoated Metals

Results are presented in Table III, which give total losses for the periods noted. Rate of corrosion may be had by dividing those figures by 30, 120, 240 and 360 respectively.

During the first few months of the test nearly all of the samples were corroding at a more rapid rate than they were during the last months of the year. This is probably due to the accelerating effect of the oxygen being gradually overcome by the formation of a protective coating of flocculent rust which does not entirely inhibit corrosion but regulates its rate. There seems to be no evidence that the composition of the water has any general effect in bringing about this primary acceleration.

It is seen that all four metals are corroding at not widely varying rates at the end of the year, the point of interest lying in the fact that the open-hearth iron is corroding more rapidly than any of the others about 80 per cent of the time. This is in accordance with the observations of Richardson, and is due to the large amount of oxygen present.

Wrought iron and steel corrode at about the same rate under the circumstances here present. The writer feels that this is about the situation which will be found generally where these two metals are concerned.

There is some difference in the corrosion phenomena between the polished and unpolished samples. The majority of the "as received" samples corrode more slowly at first than the polished samples, probably due to the protective skin of oxide. This effect is transient and at the end of a year the samples are all corroding at about the same rate and have similar surface conditions.

Samples in tap water were watched with interest on account of the chlorine content of the water, but the effect of the chlorine is apparently not very pronounced. It seems to accelerate corrosion of wrought iron, but it is believed that the increased corrosion would not be large.

Whether the introduction of a few tenths of 1 per cent of copper will suppress corrosion of iron and steel when immersed in water is still being debated in some quarters. As far as results of these tests are concerned the copper does not appear to affect the corrosion in any way. In general, small variations in the composition of iron and steel are practically without effect as influencing corrosion by immersion.

Probably the most vital thing to be observed in corrosion experiments is the tendency toward pitting. Loss in weight provides a means for comparative study, but the pitting tendencies of a metal are what determine its actual value. This point is stressed by most authorities upon the subject. An examination of the uncoated samples in this investigation failed to establish any notable differences in this respect among the four metals tested. The only statement which can be made is that the samples immersed in tap water (which, it is remembered, carries dissolved chlorine) showed slightly more tendency to form pits than the samples immersed in the other waters.

Rustproofed Samples

Calorized Samples.—Calorized samples acted in a very erratic and unexpected manner. All the samples with the exception of those in boiler feed water showed a gain in weight for 4 months. After that an appreciable loss in weight began. The preliminary gain was probably due to the oxidation of aluminum upon the surface of the samples.

After 8 to 12 months' immersion the samples showed very noticeable evidence of corrosion, the weight in most cases approaching or becoming less than the weight of the original sample. Great variations in this respect were noted. The most serious aspect of this corrosion was a very pronounced tendency toward pitting. This is no doubt due to the uneven surface of the calorized metal.

While the results of this investigation did not indicate a very desirable behavior of calorized metal when immersed in water, there were certain aspects which would lead to the conclusion that if the aluminum coating could be smoothly and evenly applied, it would furnish an excellent corrosion-resisting surface.

Sherardized Samples.—Sherardized samples all showed a more or less steady increase in the rate of corrosion, but the corrosion was less marked in distilled water. Corrosion was extremely localized—not one sample showed an even corrosion all over its surface. Rust would soon perforate the sheet or pipe which had been thus "protected."

Galvanized Samples.—These samples showed much the best resistance to corrosion. At first they lost weight as rapidly as the other rustproofed samples, but

afterward the rate of corrosion became constant and very slow. The most important thing in connection with these samples was this: Careful examination failed to reveal any evidence of local action or pitting. In fact the samples which were immersed for a year did not give any visible evidence of the long immersion.

Electrolytic Zinc Process.—Next to the galvanized samples, these exhibited the best average results. At first corrosion was not very marked, but about half the samples speeded up after the first 6 months. At the end of a year some of the samples were corroding very rapidly and the protective coating had disappeared over large areas. Corrosion appeared to start over much broader areas than in sherardized samples. No serious tendency toward pitting was observed.

The Parkerized samples exhibited erratic behavior similar to that evidenced by the calorized samples. Some samples showed steadily increasing and very decided corrosion. Others were nearly as good as galvanized metal. In some the dark-colored coating had entirely disappeared. However, there was no tendency toward pitting.

It was very evident that large variations were present in the thickness and character of the coating. If these conditions were investigated and uniformity established, it is possible that this coating might have a distinct value, under some circumstances, as a protective coating for iron and steel articles when immersed in water.

SUMMARY

1. The presence of oxygen apparently causes an exaggerated initial corrosion in iron and low-carbon steel.

2. The presence of a small amount of chlorine in tap water causes a slight but not serious increase in corrosion rates of immersed metals.

3. The composition of iron and steel does not affect noticeably the corrosion rate when metal is immersed in water. This applies particularly to the presence of copper.

4. Different surface conditions of a metal tend to become equalized over a period of time and the corrosion rate to become steady and uniform when the metal is in the presence of large amounts of oxygen.

5. The presence of large amounts of oxygen does not appear to increase the tendency toward pitting in a corroding piece of iron or steel.

6. Galvanizing seems to offer the best means of preventing the corrosion by immersion of iron and steel.

New Type Vertical Retort

A new style construction of the Glover-West vertical retort has been prepared in the course of the reconstruction of eighty vertical retorts at the Belfast, Ireland, plant. The *Gas Journal* (London), of March 28, page 821, describes the modified form as follows: "The retorts will be increased in length by the addition of a steaming chamber at the base. In this chamber, which takes the form of an enlargement of the retort section, the steam, introduced for the purpose of water-gas generation in the retort, is raised in temperature, at the expense of the residual heat of the coke, to that necessary for the water-gas reaction. By the adoption of the new principle, the yield of gas in this installation will be increased by 2 million cu.ft., and the labor cost per setting, remaining constant, will be correspondingly less per 1,000 cu.ft. of gas made."

Legal Notes

BY WELLINGTON GUSTIN
Of the Chicago Bar

Demurrage Charges Held to Be Taxable

Are Part of Payment for Transportation, Though Made Primarily to Discourage Detention of Cars

In two cases, the Procter & Gamble Co. versus United States and the Buckeye Cotton Oil Co. versus United States, the Federal District Court held that demurrage charges for failure to load and unload cars within the "free time" permitted by the rules of railroad companies were taxable as a part of the charge for transportation, under the revenue acts of 1917 and 1918 imposing a tax on the amount paid for transportation, since "demurrage" is a terminal charge, a part of the charge for transportation, even if the purpose of demurrage is primarily to prevent the detention of cars.

The cases arose under the revenue acts, title 5, sections 500-503, of the act of 1917, and title 5, sections 500 to 502, of the revenue act of 1918, imposing a tax on the amount paid for transportation, and involved the question of whether demurrage charges to load and unload cars within the "free time" permitted by the rules should be included as part of the cost of transportation and thereby subject to tax. Article 2 of regulation 49 provided that the word "transportation," as used in title 5 of the revenue acts mentioned, included "receipt, delivery, elevation, transfer in transit, ventilation, refrigeration, icing, storage, demurrage, towing, lighterage, trimming of cargo in vessels, wharfage, handling of property transported, feeding and watering live stock, and other incidental services and facilities." Plaintiffs contended that a charge for demurrage was not taxable as a part of the charge for transportation. (281 Federal 1014.)

Insufficient Memorandum of Sale

Rules Set Forth Relating to Correspondence and Oral Evidence Under Statute of Frauds

Controversy over a sales contract between the Western Metals Co., of Cleveland, Ohio, and the Hartman Ingot Metal Co., of Chicago, emphasizes some valuable information to buyers and sellers. The former brought suit against the latter and obtained judgment, but this has been reversed by the Appellate Court and then affirmed by the Supreme Court of Illinois, 303 Ill. 479.

On Nov. 2, 1918, the presidents of the two corporations met by chance in Cleveland in the office of a mutual acquaintance. There was some talk then regarding a sale by the former to the latter of a quantity of scrap brass. Following this conversation the former sent the latter a confirmation of a sale upon a printed blank for 25 tons of red brass borings at 20c. per lb. and 25 tons of clean light brass at 13c. per lb., calling for shipment within 3 months with regular terms. In response to this the Ingot Metal Co. sent a letter refusing to accept any shipments of metal until such time as notice was given, owing to a badly congested condition at the plant. On Nov. 11 the Western Metals Co. asked the alleged buyer to notify it when conditions would make a ship-

ment possible. No reply was made to this letter. On Dec. 4 the claimed seller again wrote the alleged buyer advising that it was shipping 50 tons scrap covered by the contract. The buyer wired that it would refuse to accept the shipment. On the same day it notified the seller by letter that it would under no circumstances receive any materials until it had notified seller to make shipment.

On Dec. 9 the seller replied by saying it would comply with the request for a short time, but would not withhold shipment much beyond Jan. 1. On receipt of this letter the alleged buyer replied that no shipments were to be made until specific instructions were sent to that effect. On Jan. 3 the seller requested shipping instructions at once. Four days later the alleged buyer replied as follows:

"On account of the government canceling orders on all purchases they have made, we are likewise canceling all written orders we have given our trade. We might have given you a verbal order, and this would be under the same ruling as all written orders we have given others."

Following receipt of this letter the Western Metals Co. began suit in Chicago for breach of contract. The Hartman Ingot Metals Co., defendant, pleaded the statute of frauds of both Ohio and Illinois and denied liability generally. A jury returned a verdict for $4,500 in favor of the seller and judgment was rendered thereon. The higher courts have now reversed this judgment.

Statute Requiring a Writing

That an oral contract of sale was made in Cleveland by the presidents of the opposing corporations was established by the jury and the judgment of the trial court. But the appellate courts found that the action was barred because of the provisions of section 4 of the uniform sales act, commonly called the statute of frauds. This section provides:

"A contract to sell or a sale of any goods . . . of the value of $500 or upward shall not be enforceable by action . . . unless some note or memorandum in writing of the contract or sale be signed by the party to be charged or his agent in that behalf." Hurd's Rev. Statutes, 1921, page 2855.

The seller contended that this sale of brass was not within the statute and therefore the law applied was erroneous. The court said it was not necessary, in order to take the contract of sale out of the statute, that there be a formal written contract, nor is it necessary that the written memorandum be complete in one writing. It is now established that a complete contract, binding under the statute of frauds, may be gathered from letters, writings and telegrams between the parties relating to the subject matter of the contract and so connected with each other that they may be fairly said to constitute one paper relating to the contract, though only one of the writings may be signed by the party to be charged.

No particular form of language is necessary to constitute the memorandum requisite to satisfy the requirements of the statute. Any kind of a writing, from a solemn deed down to mere hasty notes or memoranda, from which the intention of the parties may be gathered, as in other contracts, will be sufficient.

It is equally well established, says the court, that the signed writing or writings must refer expressly to the other writing, or the several writings must be so connected, either physically or otherwise, as to show by internal evidence that they relate to the same contract. (32 L. R. A. 127.) A paper signed by the party to be charged cannot be incorporated in a paper not signed by him by a reference in the latter. The signed paper must refer to the unsigned paper in clear and distinct terms. (27 Corpus Juris, 263.)

Oral evidence is inadmissible to connect the several papers or show that they relate to the same transaction. Oral evidence can only bring together the different writings, it cannot connect them. They must show their connection by their own contents. The connection must be apparent from a comparison of the writings themselves. (25 Ruling Case Law 680.)

What Oral Evidence May Show

After the several writings connect themselves together into one complete memorandum, parol proof is proper to show that the several writings apply to the subject matter of the suit, and not to some other sale. This is equally so in case the complete memorandum is contained in one writing. The rule with respect to the admission of parol proof is the same, whether the memorandum is to be found on one paper or on several papers which connect themselves together. The wisdom of the rule forbidding the use of oral evidence to show the connection between the several papers is apparent, says the court.

On this point it says: "If it is necessary to use oral evidence to show that the papers are parts of one contract of sale, then the contract becomes partly oral and partly written and we have then introduced all the mischiefs which the statute of frauds and perjuries was intended to prevent. The line must be established somewhere, and that line has been wisely established at a definite point. If we break across this line and permit the use of some oral evidence to connect the writings, then we introduce into the law confusion and uncertainty, because no one will know how much oral evidence will be permitted to join the several writings in a given case."

Going over the correspondence in the case at bar, the court said such admitted the existence of a contract of the sale. That this sale was made was not questioned in the Supreme Court. The question presented was whether this correspondence makes out a memorandum of this contract of sale, complete in all its terms, and signed by the buyer. The court found that the letters nowhere made the slightest reference to the confirmation, nor did the buyer ever admit the confirmation correctly stated the terms of the contract. Conceding that its letters admit the existence of the oral contract sale, there was nothing in the letters, nor in any paper to which the letters refer, that states any of the terms of the contract, says the court.

Finally, it is unquestionably the law that the memorandum upon which it is sought to charge a party to a contract must state the contract with such certainty that its essentials can be known from the signed writing, or by some reference to parol proof to supply the essential elements of the contract or to supply the connecting links between the signed writing and some other writing or writings.

In this case the correspondence offered in evidence did not meet these requirements, and the court so found, affirming the Appellate Court judgment which had reversed the trial court judgment for the seller.

Machinery and Appliances for Production and Control

Equipment News

From Maker and User

Materials and Accessories for Chemical Industries

Gasoline Shovel

The Pawling & Harnischfeger Co. of Milwaukee has brought out a 1-yd. gasoline shovel mounted on corduroy traction, which should have a wide application in shovel work. Shovel users will be interested in this new machine, because it is one-man operated, does away with fuel and water hauling and starts and stops instantly without requiring overtime work for firing.

This shovel is similar in design to ¾-yd. machine that was brought some

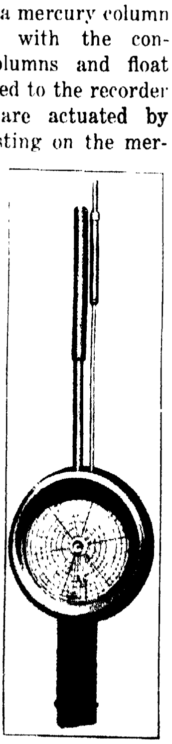
NEW 1-YD. SHOVEL

years ago by the Pawling & Harnischfeger Co. and that is in use all over the United States. One of the principal features of the gasoline shovel is its crowding motion, which has proved successful on the ¾-yd. machine. The pinion on the shipper shaft is driven by a heavy steel chain from a set of planetary gears mounted in the forward drum of the machine. This mechanism can shake the dipper very rapidly, which is extremely necessary when operating in clay. It also can force the dipper into the toughest soil.

This machine can be used with dragline bucket, clamshell, pile-driving rig or crane hook. The Aluminum Co. of America, American Agricultural Chemical Co., Lincoln Clay Products Co., American Brass Co. and many industrial companies are using these machines with good success. Like the smaller machines, it is built throughout in a thorough manner, being made principally of steel; forged alloy shafts being used for heavy duty parts. Gears are all of steel with cut teeth. The traction is one of the most important parts of the machine and is of heavy construction. The track links are of single piece special steel castings joined by alloy steel pins. There are two pair of driving and idler sprockets on each machine and the corduroys are non-cloggable even in the heaviest going.

Economy Recorder

The Uehling Instrument Co., Paterson, N. J., has developed and placed on the market a new combined barometer and vacuum recorder primarily for determining (1) the absolute back pressure in steam turbine and condensing plants, (2) the barometric pressure, (3) the condenser vacuum, (4) the existence of air leakage into the condenser, etc., and (5) the ability of the condenser to handle the load. This combined recorder consists merely of two float chambers, one of which is connected with a barometric mercury column and the other with a mercury column in communication with the condenser. These columns and float chambers are secured to the recorder case. The pens are actuated by means of floats resting on the mercury in the two chambers. The movements of the floats correspond exactly to the changes in barometric pressure and in vacuum



The measurement of barometric pressure and vacuum by means of mercury columns is standard for power plant testing, and therefore the readings of the combined barometer and vacuum recorder are at all times accurate and reliable. There is no necessity for calibrating the recorder against mercury column testers as is customary with instruments utilizing diaphragms, tube springs and multiplying lever mechanisms.

The recorder draws automatically and continuously the barometer and vacuum records on the same chart. The barometer record is used as a base line for reading the absolute back pressure directly off the chart. As long as the two curves, barometer and vacuum, vary simultaneously and proportionately, everything is as it should be. However, should the vacuum fall when the barometer remains constant, either considerable air is leaking into the condenser or the condenser is not able to handle the load.

By means of the recorder chart the operator is at all times able to ascertain whether his turbine or condenser is operating as efficiently as it should, and to know whenever air is leaking into the system, thereby impairing the vacuum and causing an unnecessarily high turbine steam consumption. The existence of air leakage is instantly revealed, and thus can be located and eliminated by the operator before an appreciable waste or heat loss is incurred. The instrument records any part of the total range of 0 to 31 in. Vacuums from 25 to 31 in. and the corresponding absolute back pressures, or vacuums from 20 to 31 in., etc., may be recorded with great accuracy over nearly the full face of the chart, the remainder of the chart being used for recording, on a contracted scale, the lower vacuums down to atmospheric pressure.

Catalogs Received

STURTEVANT MILL Co., Boston, Mass.—Catalog 77H, descriptive of the Sturtevant Moto-Vibro Screen, an inclined vibratory screen, featuring the different ways which this can be installed.

STURTEVANT MILL Co., Boston, Mass.—Booklet. Description of the Sturtevant Acidulating Unit installed at the Armour Fertilizer Works, Columbus, Ga.

LOUIS ALLIS Co., Milwaukee, Wis.—Catalog on the Watson Multi-Speed Motor, a motor which operates on a polyphase alternating current having adjustable speed through field control over a range of from two to four speeds.

Book Reviews

Books on Mineral Resources

Two excellent booklets have recently been published by our English cousins, books that will prove welcome to all who have interest in the sources and statistics of metal and mineral production. One is printed by the Imperial Mineral Resources Bureau (H. M. Stationery Office, London, 218 pages, price 4s. 3½d.), and presents a digest of statistical and technical information relative to the production of silver, especially during the war period (1913-1919). It is one of a long series of such tracts recently published. Turning its pages one is struck with the evident care used in its compilation and the comprehensiveness and conciseness of the volume.

No less valuable should be the monograph on Copper Ores, written by Robert Allen and published by the Imperial Institute (published by John Murray, Albemarle St., W., London; 220 pages, price 7s. 6d.). This is one of a series published by the Institute giving a general account of the occurrences and commercial utilization of the more important minerals.

EL ARTE DE LOS METALES. Translated, from the Spanish of *Alvaro Alonzo Barba*, by *Ross E. Douglass* and *E. P. Mathewson*. New York: John Wiley & Sons, Inc. 288 pp. illus. Price $3.50.

The eminence of Dr. Mathewson in the profession of metallurgy will tend to enhance the popularity of this translation, made in collaboration with Ross E. Douglass, of what is recognized as the oldest published treatise on American metallurgy. Barba, the author, was at one time an ecclesiastic at Potosí, Bolivia—noted during many centuries for its fabulously rich silver mines; the book was first published in Spain in 1640. Translations, into English, French and German, have been made at various dates, but these are incorrect, inaccessible and lacking in a proper interpretation of the technology of Barba's day. Students of metallurgy, particularly those who have followed the history of mining in South America, should be grateful to the translators, both of whom are unusually well qualified to present an English version without mutilation of the original sense.

Book I discusses "The Manner in Which Ores Are Begotten, and the Things That Accompany Them." In it are described such considerations as the smell and taste of earths, and their recognition thereby, a defence of the opinion that sulphur and mercury are the components of metals, and sundry other quaint arguments and views. Book II deals with the amalgamation of silver and gold ores; Book III, the treatment by cooking (pan amalgamation); Book IV, the reduction of ores by smelting, and Book V describes the practice of refining and parting. The greater part of the treatise, therefore, forms a thesis on a subject in which the author had gained much experience and formed sundry basic conclusions, many of which were in error and not a few were influenced by religious views. The translators have peppered the English version with comments, in brackets, which will prevent the metallurgically uninitiated from accepting too readily many of the conclusions. The volume is illustrated by several informative cuts that show the equipment used by metallurgists in the seventeenth century and thereabouts. It should find a place in every library of mining and metallurgical works of reference, as a record of what was being done and the standard and practices of technology in those far-off times.

A. W. ALLEN.

TECHNICAL ANALYSIS OF STEEL AND STEEL WORKS MATERIALS. By *Frank T. Sisco*. McGraw-Hill Book Co., Inc., New York. 6x9¼ in., 543 pp., with 28 illustrations in the text and 26 tables. Price $5.

Of all the branches of analytical chemistry, the analysis of steel undoubtedly has received the greatest amount of attention, judging from the large number of books already published. To write a book of any considerable novelty is a matter of some difficulty. However, the author has produced a book which marks a distinct departure from the manuals of steel analysis previously published.

This book is written from the standpoint of the rapid and accurate analysis of steel and steel works materials for commercial purposes.

The first quarter of the book, Part 1, is devoted to the design, equipment and operation of the laboratory. It is the first adequate discussion of these topics from a practical standpoint that has come to the attention of the reviewer and is a distinct contribution to the literature of the subject. The chapters on "The Qualifications and Selection of Laboratory Employees," "The Organization and Efficient Operation of the Steel Works Laboratory," and "Errors in Routine Analysis and Their Control" will be of considerable interest to those who have charge of laboratories, and valuable to beginners in such positions. The chapter on "Record Keeping and Costs for Steel Works Laboratory" will prove of considerable assistance in those laboratories where such matters are too frequently neglected.

Part 2 deals with "The Analysis of Plain and Alloy Steels." The methods as a whole are well selected and carefully worked out in detail. The chapter on "The Determination of Carbon in Plain and Alloy Steels" is excellent.

Part 3 is devoted to "The Analysis of Steel Works Materials" and includes the analysis of pig iron, cast iron, the ferro-alloys, ores, fluxes, refractories and slags.

The English in a few places is a little "sloppy," as "a new 5-gal. bottle syphoned from a carboy of solution." In standard works previously published, Ehrlenmeyer is invariably capitalized, likewise Meyer and Gooch. The author always uses the above terms uncapitalized, and yet capitalizes Nesbitt. It would be preferable to adhere to the standard practice in such matters.

This book is commended to the attention of university and college professors teaching analytical chemistry. Students who contemplate entering the field of metallurgical work should read this book. The rapidity and accuracy with which work is done in a steel laboratory will be quite a revelation to them.

Superintendents and managers in steel works would be considerably enlightened, doubtless, by reading Part 1.

G. W. WALKER.

Metallurgical Transactions

JOURNAL OF THE INSTITUTE OF METALS, vol. 28. Edited by *G. Shaw Scott*. The Institute, 36 Victoria St., London, S. W. 1; 1,008 pages. Price to non-members, 31s 6d.

JOURNAL OF THE IRON AND STEEL INSTITUTE, vol. 106. Edited by *George C. Lloyd*. The Institute; and Spon & Chamberlain, 123 Liberty St., New York, 457 pages. Price, $9.50.

These publications are much alike in general plan. Each gives over about half its space to abstracts of current technical literature in its respective field. The first half of each book is occupied with the papers read before the fall meeting, together with contributed discussion. Both institutes are now paying a great deal of attention to the advanced phases of physical metallurgy, metallography and the properties of heat-treated alloys—the Institute of Metals even more than the older association. It is an interesting speculation whether this is a true reflection of the weight of importance which the "practical" and "theoretical" aspects of the art are held by the members of societies, or whether it is only an evidence that the advanced students find more time and urge to write about their doings than the ambitious operator.

At any rate, either type of man will find great stimulation in many articles in both books. By that same token the books will not be overly interesting to the rule-of-thumb operator. But even the chemical engineer can find much to interest him. Thus, the May Lecture of the Institute of Metals was by Sir Ernest Rutherford, on "The Relation of the Elements," which dips even as deep as the structure of the atomic nucleus.

The other volume contains a paper by J. H. S. Dickenson with this imposing title: "Some Experiments on the Flow of Steels at a Low Red Heat, With a Note on the Scaling of Heated Steels." In it, and its appended discussion, will be found some very interesting history of the Claude synthetic ammonia process—how they tried first one metal, then another, each catalyzing tube following the other out through the roof in fragments until the proper alloy was finally discovered.

E. E. THUM.

Synopsis of Recent Literature

Solder for Aluminum*

Most of the metals commonly used in solders, except magnesium, are electropositive to aluminum, so that any metals used in making a soldered joint of aluminum act electrolytically in the presence of moisture as positive galvanic poles, accelerating the corrosion of the aluminum. Magnesium cannot be utilized advantageously even though it is electronegative to aluminum, because the metal disintegrates rapidly in the presence of moisture. Soldered joints of aluminum which are to be exposed to moisture should be protected against corrosion by a paint or varnish.

Various compositions of zinc-tin and zinc-tin-aluminum solders give the best results. The tensile strength of a good aluminum solder is about 7,000 lb. per sq.in., for those with higher tensile strength have, in general, their temperature of complete liquation too high for soldering purposes. As a rule the strength of an aluminum-soldered joint depends upon the type and upon the workmanship.

*Abstract of circular of Bureau of Standards, No. 78. The complete paper may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 5 cents.

Pulsations in Gas Flow

For the purpose of studying the nature of pulsation and to discover some practical means of reducing or eliminating it or of compensating for its effects on the devices used for measuring fluid flow, a joint investigation was undertaken by Ohio State University and the A.S.M.E. The results are reported in a paper in *Mechanical Engineering* for April, 1923, by Horace Judd and Donal B. Pheley.

The investigation was confined to the venturi meter, the orifice, the flange nozzle meter and the pitot meter, using air flow from a small compressor discharging into a 3-in. line.

The apparatus used for this investigation was chosen with great care and the experiments were conducted so carefully that the authors regard it as highly probable that the basic principles established would be fundamental for gas, steam and water as well as air and also for other sizes and kinds of installations.

The conclusions reached as a result of the investigation may be summarized as follows:

NATURE OF PULSATIONS

a. Pulsations in a pipe line, originating from a reciprocating system, or a similarly disturbing system, consist of sudden changes both in the velocity and in the pressure of the fluid.

b. The pressure change is the most apparent and is probably the greatest factor in producing errors in metering devices.

c. The pressure change is in the form of a wave front resembling a traveling sound wave of low frequency.

d. The pressure wave travels in the pipe with the velocity of sound.

e. The velocity of the pulsation is independent of the velocity or quantity of fluid flowing.

f. Pulsations in air flow are similar to the compression waves set up by water hammer. Both travel at the velocity of sound in the fluid and are independent of the velocity of flow.

g. The effect of this pulsation on a flow meter is to increase its reading, often causing an error of great magnitude. The magnitude of this error depends upon the frequency of pulsation, nominal static pressure of the fluid, type of meter used and adjacent fixtures in the pipe line.

h. With orifice meters and flange nozzle meters the pulsating error increases as the diameter of the orifice, or nozzle, approaches the diameter of the pipe.

i. The throttling or modification of the manometer connections to the meter does not appreciably reduce the error.

j. The point of attachment of manometer connection has no great effect on the error due to pulsating flow.

k. The pulsation error at the center of the pipe is 35 per cent less than that at the wall of the pipe.

l. A meter on a "dead-end" connection will usually show a positive error of considerable magnitude.

m. The pulsation must be eliminated or greatly reduced in order to have the meter read without objectionable error.

PRACTICAL ELIMINATION OF PULSATIONS

n. Because of the high velocity of the pulsation, an excessive length of pipe line would be necessary to destroy the pulsation.

o. Throttling is effective but requires a pressure drop of 6 in. of mercury to reduce the error to 5 per cent.

p. Abrupt volume enlargements in the pipe line will eliminate the error, if of sufficient capacity. A volume capacity of 20 cu.ft. is required for an error within 2 per cent.

q. Generally speaking, for the same capacity, a volume of relatively large diameter is more effective than one of small diameter.

r. No relation was found between the compressor displacement and the capacity of the volume chambers.

s. The combination of throttling with volumes forming the "muffler" device probably is the most effective device for the mechanical elimination of pulsations.

t. The pulsating bag, or diaphragm, and the fan, or revolving baffles, are partly successful in eliminating the pulsations, but their installation is thought to offer serious practical objections.

u. The effectiveness of any of these quieting devices seems to depend upon their ability to dissipate or change the energy of pulsation, which is effected chiefly through a drop in pressure.

v. The device that will destroy the pulsating energy with the least obstruction to the flow of the fluid is the most desirable.

w. The effectiveness of the meter element itself in quieting the pulsation depends upon the degree of restoration of the pressure beyond the meter. The greater the percentage of restoration the higher the percentage of error shown for any given type of meter.

ADJUSTMENT OF ERROR OF PULSATION

x. It is probably not feasible to correct any meter by means of a correction factor owing to the disturbing effects which may arise from slight changes in the installation and running conditions.

y. The experimental establishment of a pulsating correction factor and its relation as shown in the formula proposed in the complete paper is not considered feasible with our present experimental knowledge of the laws of pulsating flow.

z. It seems probable that each installation where pulsating flow is pres-

Important Articles In Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem. & Met.* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. Those that are of unusual interest will be published later in abstract in this department; but since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage. The magazines reviewed have all been received within a fortnight of our publication date.

MAKING ALCOHOL FROM WASTE MOLASSES. D. Jessurun. *Sugar*, April, 1923, p. 173.

USE OF CALCIUM CHLORIDE AS A PROTECTION AGAINST FREEZING CONCRETE. P. Cottringer and H. S. Kindel. *Concrete*, April 1923, pp. 150-156.

LA VISCOSE. SA PRÉPARATION ET SES PROPRIÉTÉS. André Graire. *Chimie et Industrie*, March, 1923, pp. 454-162.

LA THEORIE THERMIQUE DE LA DISTILLATION ET DE LA RECTIFICATION DE L'AIR. P. Mion. L. Gay. *Chimie et Industrie*, March, 1923, pp. 463-468.

TESTING THE QUALITY OF LUBRICATING OILS. Winslow H. Herschel. *Proc. of the Eng. Soc. of Western Penn.*, vol. 38, No. 10, pp. 503-41.

THE FUNDAMENTALS OF COLLOIDS AS APPLIED TO PAINTS AND VARNISHES. E. W. Fasig. *Can. Chem. & Met.*, pp. 90-92, April 1923.

OXIDATION OF HYDROCARBONS, WITH SPECIAL REFERENCE TO THE PRODUCTION OF FORMALDEHYDE. T. S. Wheeler and E. W. Blair. Part II. Action of Oxygen on Methane. *J. Soc. Chem. Ind.*, vol. 88, p. 92T, March 16, 1923.

COMPARATIVE EFFICIENCY OF FISH MEAL. D. B. Dill. *Am. Fertilizer*, vol. 58, No. 7, April 7, 1923.

SOIL CHEMISTRY—RELATIONS BETWEEN THE ACTIVE ACIDITY AND THE LIME REQUIREMENT OF SOILS. E. T. Wherry. *J. Wash. Acad. Sci.*, vol. 13, No. 6, March, 1923.

FERROCONCRETE AND ITS APPLICATIONS TO GAS-WORKS CONSTRUCTION. J. Twist. *Gas Journal* (London), April 11, p. 105.

ent would present its own peculiar problem for which an individual study and consideration of the existing conditions would be necessary for a satisfactory solution.

The complete paper contains illustrations of apparatus, indicator and photo-pulsometer diagrams, tables giving the data obtained in the investigation, and a bibliography of the subject. It also discusses the possibility of adjustment of errors at considerable length.

Recording Gas Calorimeter

The research sub-committee of the British Institution of Gas Engineers has reported on the Fairweather recording calorimeter. This investigation has gone into great detail regarding this instrument and its possibilities. The *Gas Journal* (London) is presenting this report serially beginning with its issue of Feb. 21.

Executive Control of Steam Costs

The efficient production and utilization of the steam in the paper mill is a problem of primary importance. Rising costs of coal, labor and power equipment make the elimination of waste absolutely essential. F. H. Childs, in the *Paper Trade Journal* of March 29, 1923, clearly shows where losses occur, and also demonstrates their possible prevention. The lack of co-operation between engineer and executive is apparently the chief cause of neglect to remedy the conditions, which are in many cases extremely bad. Dollars and cents furnish the only possible yardstick whereby the executive may appreciate the significance of the engineer's data.

In facing the problem there are three phases to be considered: First, to find out where one stands in relation to the results that others are getting; second, to find out quickly and economically what is wrong if results are unsatisfactory; and third, to devise, at reasonable expense, methods for controlling costs in the future. The degree of efficiency of generation and distribution is determined with comparative ease. Assuming a reasonable boiler efficiency and knowing the amount of coal burned in the year, it is possible to calculate what the probable steam production for the year is. The steam required in various operations is next figured. To estimate consumption of various units it is agreed that none can vary greatly if reasonably good practice is assumed. Such items as steam for power can be calculated very closely, while such operations as that of drying can be approximated with reasonable accuracy. Cooking stock or heating process water are more difficult to approximate, but still it is possible to make a close estimate. Once located, losses may be largely eliminated.

As an example of efficient management it is shown that with a mill producing 10,000 tons of paper per year, the possible saving amounts to upward of $70,000 if conditions are changed from those of ordinary mill practice to those of most modern and efficient practice. With coal costing $6.50 per ton, it is shown that $70,000 would be saved in a mill that had an actual boiler efficiency of 50 per cent but a possible efficiency of 80 per cent and whose actual drying efficiency was 50 per cent, whereas the theoretical efficiency was 90 to 100 per cent. **Careful control of the drying operation by maintenance of conditions found to be most satisfactory after experiments at wet and dry ends, and operatior of the** boiler plant at the most efficient load and with the best possible utilization of fuel, are the only measures that must be taken in this particular case to effect the savings named.

Review of Recent Patents

American Patents Issued April 17, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,451,711—Vulcanized Rubber Solution. W. B Pratt, Wellsley, Mass., assignor to E. H. Clapp Rubber Co., Boston, Mass.

1,451,734—Leaching of Copper Ores and Recovery of Copper. Joseph Irving, Bisbee, Ariz.

1,451,739—Apparatus for Refining Crude Oil. John Mayes, Wichita, Kan.

1,451,755—Method of Producing a Protective Coating on Objects of Magnesium or of Magnesium Alloys. C. B. Backer, Bergen, Norway.

1,451,786—Process for the Purification of Phosphoric Acid by Crystallization. W H Ross, C. B Durgin and R M Jones, Washington, D. C., assignors to the people of the United States.

1,451,839—Evaporating Apparatus. H S. Mellott, Morenci, Mich., assignor to By-Products Recovery Co., Toledo, Ohio.

1,451,843—Manufacture of Resinous Condensation Products. H Plauson, Hamburg, Germany.

1,451,847—Electrically Heated and Controlled Steam Boiler. W. H Rowe, Jacksonville, Fla.

1,451,850—Mercurial Composition. H McC Spencer, Newark, N. J., assignor to Seydel Chemical Co., New York.

1,451,883—Means for Ventilating Drying Ovens. A Maehler, Chicago, Ill.

1,452,009—Process for Utilization of Ammonia. J. F Wait, New York City.

1,452,016—Slime Pulp Thickener. C. Allen, El Paso, Tex.

1,452,024—Rotary Compressor. H A Campbell, Oakland, Calif.

1,452,027—Catalyzer for the Synthetic Manufacture of Ammonia and Manner of Producing Same. I W Cederberg, Stockholm, Sweden, assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway.

1,452,061—Gas Expansion and Absorption Process. J C. Bertsch, Tulsa, Okla.

1,452,083—Black Azo Dyestuffs. A. L. Laska and A Zitscher, Offenbach-on-the-Main, Germany, assignors to Chemische Fabrik Griesheim-Elektron, Frankfort, Germany.

1,452,086—Process for the Manufacture of Solid Plastic Material From Casein. F. G Maries, Kingston, England.

1,452,129—Dyeing Machine. F. C. W Stelter, Astoria, N. Y.

1,452,145—Apparatus and Method for Carrying Out Catalytic Oxidization of Ammonia With Oxygen. I. W. Cederberg, Berlin, Germany.

1,452,151—Continuous Thickening Process. A. L. Genter and G. C. Jones, Salt Lake City, Utah, assignors to the General Engineering Co., Salt Lake City and to A. L. Genter.

1,452,166—Apparatus for Drying Char. H E Niese, Morristown, N J., assignor to the American Sugar Refining Co., New York City.

1,452,185—Alkali-Metal Product and Process of Producing the Same. H. W. Charlton and R. N. Shreve, New York City, assignors to American Potash Corp. of New York City.

1,452,186—Accelerating Agent in Potash Recovery. Same inventors and assignees as 1,452,185.

1,452,206—Means for Dehydrating Alcoholic Liquids. M. D Mann, Roselle, N. J., assignor to S B. Hunt, Mount Kisco, N Y.

1,452,218—Pulverizing Mill. R. E. H. Pomeroy, Canton, Ohio.

1,452,226—Boll Weevil Destroyer. M. A Spencer, Yonkers, N Y., assignor of one-half to B E. Nussbaum, Muskogee, Okla.

1,452,253—Liquid and Vapor Separator. H G Nevitt, Tampico, Mexico.

1,452,288—Water-Softening Apparatus. J E Caps, Wilmette, Ill.

1,452,309-310—Asphalt Structure and Composition. Gustav Monrath, New York City, assignor to Barber Asphalt Paving Co., Philadelphia Pa.

1,452,315—Process for Bleaching Barytes. J. B Scheuer, Lanett, Ala.

1,452,322—Method of Segregating Olefines. L. C Stewart, Midland, Mich., assignor to the Dow Chemical Co., Midland, Mich.

1,452,380—Liquid Fuel Furnace. C. G. Hawley, Chicago, Ill.

1,452,388—Process and Apparatus for Centrifugal Separation. C. A. Porter and O C. Brewster, Casper, Wyo., assignors of one-half to P. Sullivan and G R Hagens, both of Casper, Wyo.

1,452,389—Paper Waxing and Sizing Composition. F L Pullen, Oldtown, Me.

1,452,445—Silicate Composition. Léon Seidman, New York City.

1,452,450—Burner for Metaldehyde. C. Tommasi H. Dannell and A. Busch, Basel, Switzerland, assignors to Elektrizitatswerk Lonza, Gampel, Switzerland.

1,452,478—Process of Making Nickel Formate. C. Ellis, Montclair, N J.

1,452,481—Manufacture of 1.4 Naphthol Sulphonic Acid. J. Baddiley, J. B. Payman and E G. Bainbridge, Manchester, England, assignors to British Dyestuffs, Ltd., Manchester, England.

Complete specifications of any United States patent may be obtained by remitting 10c to the Commissioner of Patents, Washington, D. C.

Rubber Accelerator—Patents have been issued to Sidney M. Cadwell, assignor to the Naugatuck Chemical Co., for a process of vulcanizing rubber by means of an accelerator comprising certain derivatives of thiuramdisulphide containing substituted alkyl and aryl groups. One of the most satisfactory derivatives, dimethyldiphenylthiuramdisulphide, is prepared from monomethylaniline (480 parts), carbon disulphide (170 parts) and iodine (285 parts), dissolved in alcohol and allowed to stand. The product which is formed crystallizes out after standing about 2 hours and is filtered, washed with a

little alcohol and dried. In carrying out the invention described in this patent, 100 parts of rubber, 10 parts of zinc oxide, 3 parts of sulphur and 1 part of dimethyldiphenylthiuramdisulphide are mixed in the mill at the ordinary temperature and for the usual time. After the mixing is accomplished, the material is vulcanized for 10 minutes or longer under 40 lb. steam pressure. (1,445,621. Feb. 20, 1923.)

Preparing Oxalic Acid—A catalytic process for the oxidation of carbohydrate material to oxalic acid by means of nitric acid in the presence of phosphoric acid and a vanadium catalyst has been described by George Kolsky, of Mamaroneck, N. Y. According to the procedure he outlines, an aqueous solution of phosphoric acid in about 50 per cent concentration is introduced into the carbohydrate material (sugar, glucose, starch, dextrine, etc.), together with an appropriate amount of nitric acid. It is said that a satisfactory reaction mixture might contain equal amounts by weight of water, nitric anhydride and phosphoric anhydride. The reaction is carried out preferably in the presence of vanadium pentoxide or other similar catalyst at a temperature range of 30 to 70 deg. C. After cooling the resulting mixture of oxalic acid and spent liquor, the crystallized acid is removed by centrifugal action or filtration and the spent liquor is denitrated by raising its temperature and blowing air through it. The denitrated spent liquor is then brought into absorptive contact with the fumes evolved during the oxidizing step and the fumes and the air from the denitration, to form a mixture of phosphoric and nitric acid suitable for re-use in the process. (1,446,012. Feb. 20, 1923.)

Chlorhydrins of Organic Liquids—Benjamin T. Brooks, assignor to the Chadeloid Chemical Co., describes a process for the manufacture of chlorhydrins of various liquid or solid organic substances, preferably oils containing one or more chemically unsaturated groups, such as the olefine group or ring structures which behave similarly to the olefine group. By this process, unsaturated petroleum oils (either the lighter or heavier distillates), unsaturated hydrocarbons of the terpene type and unsaturated fatty acids or their esters (such as those of oleic or linoleic acid) are converted into the corresponding chlorhydrins. Of the terpene compounds, the commonest and cheapest is ordinary spirits of turpentine. Apparently the presence of other substances which are chemically inert, such, for example, as saturated petroleum hydrocarbons, benzol, carbon tetrachloride, etc., do not interfere with the reaction—in fact, they may be of advantage in some cases. Thus certain solid or semi-solid fatty oils or other organic substances, such as cinnamic acid, stilbene, etc., may be successfully treated by dissolving the substance in an inert solution, such as gasoline, kerosene, benzene or carbon tetrachloride. These organic substances are treated with an aqueous solution of hypochlorous acid, but not in the high concentration which has been described in previous published work. It is difficult or impossible to carry out the process economically on a large scale when the solutions contain more than about 3 per cent of hypochlorous acid. In the present invention, the unsaturated organic liquid is continuously subjected to the action of a cold dilute aqueous solution of hypochlorous acid in an exceedingly dilute solution. It is possible to carry out the reaction smoothly and with sufficient rapidity to meet the requirements of commercial large-scale operation even when aqueous solutions containing 0.25 per cent of hypochlorous acid are employed. In the preparation of the aqueous solution of hypochlorous acid, the chlorine is passed into a dilute solution of an alkali carbonate or bicarbonate. Since it is well known that carbonic acid is a stronger acid than hypochlorous acid, in fact will displace the latter from its salts, the hypochlorous acid does not become fixed in the form of hypochlorite salts, but remains in a free or uncombined state and is therefore available for direct combination with the unsaturated substances to form the desired chlorhydrins. (1,446,873. Feb. 27, 1923.)

Effect of Alkalinity on Lithopone—One of the most baffling sets of facts that the paint technologist has to face is the great variation in consistency obtained when equal volumes of different pigments are incorporated in equal volumes of the same vehicle, such as oil or varnish. But even more baffling to the paint technologist is the fact that often when equal volumes of different lots of lithopone are incorporated in equal volumes of the same vehicle, mixtures are obtained which vary widely from one another in consistency. The consistency of a mixture of a pigment with an appropriate vehicle, such as oil or varnish, is dependent upon the ease with which the pigment is wet by the vehicle. Different brands or lots of lithopone have often been found in practice to differ widely in the ease with which the pigment is wetted by a particular vehicle. Many of the commercial brands of lithopone are difficultly wetted by many desirable oils and varnishes, or, as the paint mixer says, lithopone "fights" these vehicles during the mixing operation. On the other hand, occasionally a highly alkaline lithopone is found which is wetted by the vehicle with reasonable ease, but then thickening or livering reactions of the resulting mixture are generally encountered.

Frank G. Breyer and Clayton W. Farber, assignors to the New Jersey Zinc Co., have discovered that the ease with which lithopone incorporates with a vehicle or is wetted by it is largely proportional to the degree of alkalinity manifested by the lithopone. Most commercial lithopone at the present time will give a neutral or slightly acid water solution. It is believed that this property accounts for the difficulty experienced in incorporating it with the vehicle. However, there are certain brands of lithopone which give a strongly alkaline water solution; particularly is this true of those lithopones in which magnesium oxide has been added with a view of improving the light resistance. Such strongly alkaline lithopones exhibit marked tendencies to liver and thicken on standing or aging and are objectionable on this account. It has been found that the alkalinity of the lithopone therefore must vary over a relatively narrow range. The most desirable range of alkalinity and that covered by this patent is a product which when subjected to a precision alkalinity test with methyl orange as an indicator requires between 2 and 4 cc. of $N/50$ sulphuric acid for titration to a faint pink color of 100 cc. of a clear filtrate obtained from a mixture of a 50-gram sample of the product with 250 cc. of distilled water agitated for 5 minutes at a temperature between 65 and 75 deg. F. (1,446,637. Feb. 27, 1923.)

Manufacture of Arsenic Acid and Arsenical Compounds—In the manufacture of arsenic acid it is usually the custom to heat arsenic trioxide in nitric acid. Oxidation by means of chlorine in an acid aqueous medium is proposed by Carleton Ellis and Vernon T. Stewart, of Montclair, N. J. For example, 1 part of a commercial grade of white arsenic is mixed with 7 parts by weight of water and the mixture is heated to boiling. Chlorine gas is bubbled through until a sample shows permanently blue with starch and potassium iodine in the presence of sodium bicarbonate. Iron may be removed by treating with sodium acetate and filtering off the basic acetate formed. The resulting solution of arsenic acid may be treated directly with milk of lime to form tricalcium arsenate or with lead oxide or hydroxide to form lead arsenate. (1,447,203. March 6, 1923.)

Soluble Arsenic Compound—The effective poisoning ingredient in an arsenic compound designed for use in sprays, dips, poison baits, etc., is the arsenious oxide and it is therefore important that a maximum amount of this ingredient be obtained in solution. Heretofore, according to the patent of Joseph F. Cullen, assignor to the United States Smelting, Refining & Mining Co., the maximum amount of available arsenious oxide has been about 30 per cent by weight, and to secure this amount at least equal molecular proportions of alkali to white arsenic have been required. In the process described in this patent 2,500 lb of caustic soda is added to 7,500 lb. of water, in a suitable container, and immediately thereafter 10,000 lb. of a good grade of white arsenic is added. On agitation, the heat of reaction is sufficient to dissolve all of the arsenious oxide. Using these quantities of ingredients, approximately 1,250 gal. of concentrated solution containing 50 per

cent of arsenious oxide, 37½ per cent of water and 12½ per cent of alkali expressed as caustic soda is obtained. This solution contains approximately 8 lb. of arsenious oxide to the gallon, whereas most concentrated solutions now on the market contain not over 4 lb. of arsenious oxide to the gallon. Usually the concentrated solution will be shipped directly to the place of use, where it may be further diluted to meet the needs of the particular requirement. Or a solid compound can be obtained by evaporation of this concentrated solution. The compound thus obtained is said to be completely soluble in water. (1,446,160. Feb. 20, 1923.)

Production of Diarylguanidines—If an alcoholic ammoniacal solution of diarythiourea is mixed with finely comminuted lead oxide at a temperature below boiling point of the solution, diarylguanidine is produced. In order to remove the latter substance from the solution it must be treated with acid, filtered and precipitated with caustic alkali. The method in general applies to all di-substituted guanidines. Excellent yield and purity of product are claimed to have been effected by this method invented and patented by Y. Young, of Caldwell, N. J., and E. G. Croakman, of Buffalo, N. Y. They have assigned the rights to the National Aniline & Chemical Co., of New York. (1,446,818. Feb. 27, 1923.)

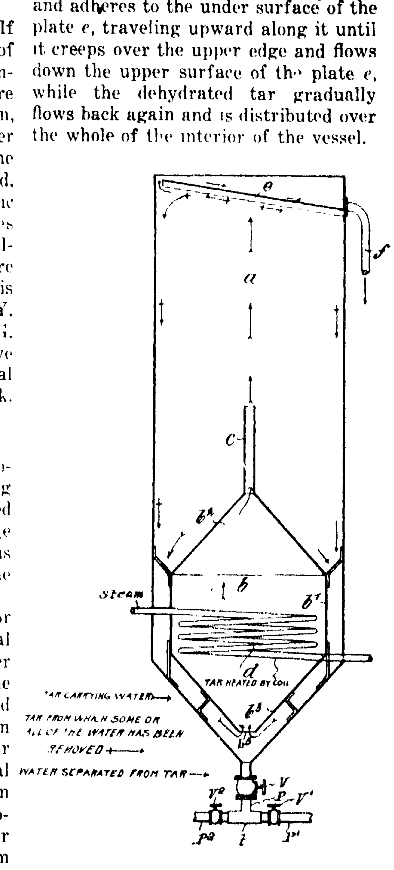
Dehydrating Coal Tar—In this invention, for the purpose of separating water from coal tar, the tar is projected upward in a stream so as to impinge against a separating surface. This separates out the water carried in the tar mechanically.

The apparatus comprises a separator a, cylindrical and formed with a conical bottom, the vessel being of greater height than transverse dimensions. The height of the vessel may be two and one-half to three times its diameter. In the lower end of the vessel is fitted a tar heater b, which comprises a cylindrical portion b' and a conical upper portion b^2 with or without an upwardly projecting outlet tube c. The tar container b is also formed with a conical bottom b^3 to correspond with the conical bottom of the vessel a.

The conical bottom b^3 is open at its lower end at b^5 and the upper conical portion b^2 or outlet tube c is open at its top so that, when the vessel a is filled to or just above the top of baffle e, the contents of the tar container b communicate with the contents of the vessel a. The container b is fitted with a heating coil d for heating the container and the upper end of the vessel a is fitted with an inclined transverse separating plate e which is spaced at its upper edge as shown from the vessel a. Above the lower end of the transverse plate e, the vessel a may be provided with a drain pipe f.

In operating this apparatus the tar to be dehydrated can be run in through the valved pipe p', valve v and v' being open, and valve v^2 being closed. The pipe p at the bottom of the tapered part at the bottom of tank a has a valve v. This pipe may be connected to a T-pipe t, to the two ends of which are connected a supply pipe p' and an exit pipe p^2 or a wholly separate pipe may enter the tank a at any suitable point for admitting the tar to be treated.

The tar contained in the tar container b is heated by means of the heating coil d and thus given a considerable upward tendency so that a stream of tar is projected upwardly through the tube c with a sufficient velocity to impinge against the separating plate e, whereupon the water carried with the tar is separated therefrom as liquid water and adheres to the under surface of the plate e, traveling upward along it until it creeps over the upper edge and flows down the upper surface of the plate e, while the dehydrated tar gradually flows back again and is distributed over the whole of the interior of the vessel.



Practical experience has shown that satisfactory results are obtained when the tar is heated to a temperature of 50 to 65 deg. C. In the course of 20 to 24 hours the water contained in the tar was, in a particular run of the process, reduced to about 3 to 4 per cent, which is generally admitted to be sufficient for all practical purposes.

When sufficiently dehydrated the tar can be run out by opening valves v and v^2. The pipe p^2 will conduct the treated tar to a storage vessel or elsewhere. (1,448,593. Paul Jaworski, Bismarckhutte, Germany. March 13, 1923.)

Liquid Fuel—This combustible is obtained by mixing in appropriate apparatus, at the convenient pressure and temperature, the following three ingredients: nitro-benzol, alcohol, preferably ethyl alcohol, and nitrous ether. These are mixed in such proportions as to form a homogeneous mixture. The proper proportions are as follows: Nitrobenzol, 0.75 per cent; ethyl alcohol, 99 per cent; nitrous ether, 0.25 per cent. To this mixture is added a dye soluble in alcohol, such as the rosaniline or fuchsine hydrochlorate, the result being a liquid of greasy nature, scarlet red color, intense, penetrating and persistent odor similar to that of the bitter almonds, boiling at 80 deg. C., and having a specific gravity of 0.80.

It is claimed for this fuel that its heating and dynamical efficiency is greater than that of the fuels used now and that it produces in the explosion a high temperature and pressure which are maintained until the combustion is completed. It is also claimed that it has the advantages of producing light and aromatic residues free from acetic acid; of not promoting the formation of carbon in the cylinders; of being a high rust protective and lubricant on account of its oleaginous and ethylic nature, thus tending to protect the engine organs; of being more economical than any of the other combustibles now used, and of not being dangerous, for it is not flammable at the usual temperature. (1,448,245. Miguel Llomparty Valdés and Vicente Baullaoy Villar, Havana, Cuba. March 13, 1923).

Composition for Rendering Paper Greaseproof—Casein and emulsified coconut oil form the basis of a greaseproofing composition patented by Wilbur L. Wright, of Fulton, N. Y., the proportions being as follows: Casein, 100 parts; emulsified coconut oil, 100; water, 1,000; ammonia, 10 parts. The casein is dissolved in the ammonia diluted with part of the water, the oil and remainder of the water are added, and the resulting mixture is heated to 175 deg. F. until a homogeneous product is obtained. (1,449,718. March 27, 1923.)

Reactivating Spent Catalyzers—It has been found that finely divided spent nickel or other catalyzers may be regenerated by subjecting them to a resurfacing treatment -for example, by grinding or abrading the spent catalyzer, admixed with oil, in a ball mill whereby the particles are freed from their inert or inactive surfaces. The present invention covers an additional treatment, the resurfacing being described in a co-pending application, Serial No. 222,007. The resurfaced catalyzer particles are heated to 200 to 250 deg. C. in admixture with a relatively small amount of oil and a stream of hydrogen is passed through until the maximum increase in activity, as determined by test, is obtained. Due to the large amount of catalyzer in proportion to the oil present, it seems probable that the activation is due to the replacement of absorbed gases on the catalyzer by hydrogen. (1,447,689. William D. Richardson, of Chicago, assignor to Swift & Co. March 6, 1923.)

Men in the Profession

A. W. AMBROSE, assistant director of the Bureau of Mines, resigned recently to become associated in an executive capacity with the Empire Companies, with headquarters at Bartlesville, Okla. Mr. Ambrose was superintendent of the government experiment station there until 1920, when he went to Washington as chief petroleum technologist. From 1914 to 1919 he was associated with California, Texas and Louisiana oil companies.

G. A. BOLE, superintendent of the Ceramic Experiment Station of the Bureau of Mines at Columbus, Ohio, was in Washington last week to discuss the refractories program with bureau officials.

JOHN DAVIS, a member of the Bureau of Mines staff, who has been stationed in Washington, has been selected to take charge of the helium production plant at Fort Worth, Tex.

M. D. HERSEY, of the Pittsburgh Station of the Bureau of Mines, is in Washington in connection with the bureau's work on oxygen-oil explosive mixtures.

Dr. IRA N. HOLLIS, who for the past 10 years has been president of Worcester Polytechnic Institute, has tendered his resignation to the board of trustees of the Institute, to take effect some time within the next 3 years, or as soon as his successor is chosen. Dr. Hollis plans to retire from teaching in order that he may devote some time to literary work.

E. J. McCONE, general manager of the Buffalo *Commercial*, was the principal speaker at the banquet held during the convention of the Electric Steel Founders' Research Group at East Aurora, N. Y., on April 13 and 14, at which were present representatives and executives of the five electric steel foundries forming the group. Mr. McCone spoke on the subject of "Americanization of the Employer."

R. A. MILLIKAN addressed the Physics Club of the Bureau of Standards, April 18, on "The Penetrating Radiations of the Upper Air."

GEORGE C. MITCHELL, an official of the Pope-Gosser China Co., Coshocton, Ohio, has been elected president of the United States Potters' Association, succeeding Frank P. Judge, Jr., Salineville, Ohio. Other officers elected were: B. E. Salisbury, Onondaga Pottery Co. Syracuse, N. Y., first vice-president; D. William Scammel, Maddock Pottery Co., Trenton, N. J., second vice-president; Guy C. Crooks, Crooksville China Co., Crooksville, Ohio, third vice-president, and Charles F. Goodwin, East Liverpool, Ohio, re-elected secretary-treasurer.

LANDON C. MOORE, a consulting chemist of Dallas, was in Washington last week.

R. B. MOORE, chief chemist of the Bureau of Mines, has been made a member of the American Philosophical Society of Philadelphia in recognition of his services in "promoting useful knowledge."

MAX PHILLIPS, of the Color Laboratory of the Bureau of Chemistry, presented as an informal communication before the Washington Chemical Society, April 12, a brief outline of the indirect method that he has developed for making thymol from cymeme. The first method usually employed for making hydroxyl derivatives from hydrocarbons gives an isomer in this case, and therefore is not applicable. Phillips' method involves the following steps: Nitration, reduction to an amine, sulphonation, preparation of the azide, removal of this group, and then substitution of the hydroxyl for the sulphonic acid group, giving thymol as the product.

WILLIAM F. G. SWANN, professor of physics at the University of Minnesota, visited the Cryogenic Laboratory of the Bureau of Mines on April 19. Other visitors to the laboratory included Dr. J. W. MARDEN, of the Westinghouse Lamp Co., and Prof. W. A. NOYES, of the University of Illinois.

CLAUDE F. TEARS, of Star Lake, N. Y., formerly chemical engineer with the Texas Oil Co. in New York City, has recently accepted a similar position with the Universal Oil Production Co. of Chicago, Ill.

Sir JOSEPH JOHN THOMSON was guest of honor at a dinner at the Union League Club in Philadelphia on April 12.

E. G. WILMER, president of the Goodyear Tire & Rubber Co., Akron, Ohio, has been elected chairman of the board of directors and executive committee. G. M. STADELMAN, heretofore vice-president, has been elected president to succeed Mr. Wilmer.

Obituary

JOHN J. HEROLD, late superintendent of the Ohio Pottery Co., died at his home in Zanesville, Ohio, on Wednesday, April 18. He had been in poor health for a number of years, and had not been active in business for several months. Mr. Herold was born 1871 in Carlsbad, Austria.

Dr. S. S. WHEELER, president of the Crocker-Wheeler Co., died suddenly of angina pectoris April 30 at his home in New York City.

Society Calendar

AMERICAN ASSOCIATION OF CEREAL CHEMISTS will hold its ninth annual convention at Hotel Sherman, Chicago, June 4 to 9.

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual convention in Norfolk, Va., May 7 to 9

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York.

AMERICAN ELECTROPLATERS SOCIETY will hold its eleventh annual meeting at Providence, R. I., July 2 to 5

AMERICAN GAS ASSOCIATION will hold its annual convention the week of Oct. 15 at Atlantic City An elaborate exhibition of gas-making and gas-utilization equipment is planned.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its summer meeting June 20-23 at Wilmington, Del

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W Va., June 7, 8 and 9.

AMERICAN OIL CHEMISTS' SOCIETY is holding its annual meeting at the Eastman Hotel, Hot Springs, Ark, April 30 and May 1.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold its spring meeting May 28 to 31 in Montreal, Canada.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

AMERICAN ZINC INSTITUTE, INC., will hold its fifth annual meeting at the Hotel Chase, St. Louis, May 7 and 8.

CANADIAN INSTITUTE OF CHEMISTRY will hold its annual meeting in Toronto, May 29 to 31.

CHAMBER OF COMMERCE OF THE UNITED STATES will hold its eleventh annual meeting in New York May 7 to 11.

INTERSTATE COTTON SEED CRUSHERS ASSOCIATION will hold its annual convention at Hot Springs, Ark., May 2 to 4.

IRON AND STEEL INSTITUTE (London) will hold its annual meeting May 10 and 11 at the House of the Institution of Civil Engineers, London, S. W. 1.

NATIONAL ASSOCIATION OF MANUFACTURERS OF THE UNITED STATES OF AMERICA will meet in annual conference May 11 to 16, inclusive, at the Waldorf-Astoria, New York City.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (NINTH) will be held in New York Sept. 17-22

NATIONAL FERTILIZER ASSOCIATION will hold its thirtieth annual convention at White Sulphur Springs, W. Va., the week of June 11.

NATIONAL FOREIGN TRADE COUNCIL will hold its annual conference May 2, 3 and 4 in New Orleans, La

NATIONAL LIME ASSOCIATION will hold its fifth annual convention at the Hotel Commodore, New York City, June 13 to 15.

NATIONAL SYMPOSIUM ON COLLOID CHEMISTRY will be held at the University of Wisconsin, June 12 to 15.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

PACIFIC DIVISION, American Association for the advancement of Science, will hold its seventh annual meeting at the University of Southern California, Los Angeles, Sept. 17 to 20, in conjunction with the summer session of the national association and a meeting of the Southwestern Division of the National Association

SOCIETY OF CHEMICAL INDUSTRY, Canadian Section, will meet in Toronto, May 29 to 31.

SOCIETY FOR STEEL TREATING — Eastern sectional meeting will be held June 14 and 15, in Bethlehem, Pa.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St, New York City: May 4—American Chemical Society, regular meeting, May 11—Société de Chimie Industrielle (in charge) American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting, May 18—Society of Chemical Industry, regular meeting. June 8 — American Chemical Society, regular meeting.

Industry and Trade

Current News and Market Developments

News Section

April 30, 1923

CHEMICAL & METALLURGICAL ENGINEERING

Tenth Avenue at 36th Street, New York

H. C. PARMELEE, *Editor*

Market Section

The Summary of the Week

Merger of the Archer-Daniels Linseed Co. and the Midland Linseed Products Co., was announced last week. The new company will have a larger linseed crushing ca acity than any other company in the world.

Leading producers of prussiate of soda have announced lower prices for May deliveries, which in turn has weakened the spot market.

Formaldehyde has worked into a stronger position as the result of cleaning up resale lots which had depressed the market.

Declines in the metal markets has been reflected in prices for metal salts and practically all the latter are easier with an open decline of 2c. per lb. in the case of tin oxide.

Reports that phenol production will soon be increased have put a check on buying in speculative circles.

Potash company will conduct an educational campaign to stimulate the consumption of potash in the fertilizer trade.

China wood oil sold on spot at 40c. per lb., which is a new high for the movement and the highest price on record in our markets.

Arsenic continues to be one of the live spots in the chemical market, but prices are too high to interest buyers.

Southern Tariff Association and various farmers' organizations have protested against an investigation by Tariff Commission on duties on vegetable oils as applied for by organization representing soap and paint manufacturers.

The Treasury Department is preparing a list of standards of strength of coal-tar products as imported. prior to 1914. These standards will be used as a basis of assessing duties on present imports.

D. H. Blair, Commissioner of Internal Revenue, announces the names of the committee from the industrial alcohol industry to consult with and advise the Prohibition Unit.

Expansion of English Chemical Industry

THE steady increase in production of chemicals in England is set forth in a report issued by H. B. Allin Smith, Assistant Trade Commissioner, from the office of the Commercial Attaché at London. This report states that English production of some heavy chemicals previously drawn from abroad is now under way and is expanding as plant and staff can be extended or precarious trade at the present time warrants. Calcium carbide plant is established, one by the British Carbide Factories, Ltd., with 2,000 tons capacity per annum, and another by the British Cellulose & Chemical Manufacturing Co., Ltd., at Spondon, capacity 40,000 tons yearly. The latter has an acetic acid plant also, but importations have been cheaper heretofore than local recovery from carbide.

The report further states that ammonium sulphate manufacture is developing through Brunner, Mond & Co. Their new Billingham factory, now under construction, for the recovery of atmospheric nitrogen, is to be fully operating this year, producing 100 tons of 100 per cent ammonia daily, or 150,000 tons of sulphate annually. A gradual extension to 300 tons is planned, equivalent to 450,000 tons of sulphate each year. The March *Chemistry and Industry* states that "in conjunction with a contact nitric acid plant, the Billingham factory goes far to diminish our dependence on Chilean saltpeter. It enables Britain to become an exporter of a bulk product of which we were formerly exporters."

Alkali and bleach are being made by the Greisheim Electron Co. and the United Alkali Co. Among heavy chemicals, the war production by the latter of dinitrophenol expanded its plant to a capacity of 100 tons week.y.

The growing British dyestuffs industry is an outlet for chlorine, made by the firm of Castner-Kellner and the United Alkali Co., Ltd.

A few words may be said about these more specialized branches of the industry, which of course cannot be divorced from the fundamental foundation of heavy chemical supplies. Britain is said to be making good progress in establishing these, through the governmental support provided by the dyestuffs act and the protective measure known as the safeguarding of industries act.

An estimate is made that, of fine chemicals, essences, perfumery and medicines, about 2½ tons is now made in Britain for every ton made before the war. W. & J. Bush & Co., Boots & Co. and others have led in research since protective measures have supported them. Aspirin, salicylic acid, saccharin, chloramine-T, novocaine and ethylenechlorhydrin are now British made.

Especially in dyestuffs have the chemical staffs and research facilities been broadened. It is said that fully 80 per cent of dyestuffs consumed in Britain today are wholly British made, compared with 10 per cent, or about 2,000 tons only, in 1914. Leaders in this business are the British Dyestuffs Corporation (with governmental connections), Read, Holliday & Sons, British Alizarine Co. and Clayton Aniline Co.

Chemical Imports for 1922 Increased 24 Per Cent in Value

Heavy Arrivals of Oxalic Acid in Last Quarter—Imports of Sodium Cyanide More Than Doubled—Falling Off in Coal-Tar Crudes

IMPORTS of chemicals during 1922 show a healthy gain in sympathy with the general trend of increased domestic industrial activity. Aggregate value of imports of chemicals and allied products for the year increased 24 per cent, from $80,763,600 in 1921 to $100,603,700 in 1922.

Owing to the incomparability of the individual commodities included under the main groups, only a very general idea of the trend can be procured from an analysis of the import and export statistics for the years 1921 and 1922. Of the groups for which any comparisons can be made, explosives, the group recording the most important expansion in exports (80 per cent), showed the smallest in imports (11 per cent). On the other hand our foreign shipments of paints, pigments and varnishes actually diminished 5 per cent while our receipts advanced 55 per cent. Fertilizers, another group of the exports having but a small gain (3 per cent), took a big jump in imports (47 per cent). Crude drugs and essential oils exceeded 1921 shipments by 10 per cent in value, while receipts swelled 42 per cent. Foreign sales of perfumery and cosmetics also were greater than foreign purchases of these articles, having gained 33 per cent, and imports, 28 per cent. Imports of medicinal and pharmaceutical preparations increased 23 per cent; exports but 11 per cent. The least change of all the groups was still in general chemicals (which includes coal-tar and heavy chemicals), and although the figures indicate a loss (4 per cent) in exports, they likewise show but a small gain (less than 3 per cent) in imports.

Decrease in Coal Tars

The aggregate value of imports of all coal-tar chemicals decreased slightly, from $11,225,700 in 1921 to $11,012,800 in 1922. The total receipts of coal-tar crudes dropped 11 per cent, from $5,281,400 in 1921 to $4,740,400 in 1922, noticeable declines occurring in all the classes except in tar and pitch. Naphthalene fell 30 per cent in quantity and 60 per cent in value, from 4,495,800 lb ($135,900) to 3,144,300 lb. ($54,000); dead or cresosote oil increased 25 per cent in quantity but decreased 10 per cent in value, figures for which are 33,239,400 gal. ($4,756,600) in 1921 and 41,567,500 gal. ($4,240,400) in 1922. The biggest reduction of this class was in benzene (90 per cent), which fell from 1,722,000 lb. ($42,370) to 172,500 lb. ($1,220); none was received from Sept. 22 to Oct. 31; 57,108 lb. ($381) arrived in November, and but 45 lb. ($8) in December.

Receipts of intermediates in 1922 surpassed those of 1921 by 867,300 lb. ($65,300); total receipts for the year 1922 were 2,136,700 lb. ($422,150). Arrivals of carbolic acid totaled 686,300 lb., valued at $102,300 in 1922. Were it possible to procure comparative figures for finished coal-tar products for the years under discussion it is believed that they would indicate, for the whole group, but a little change in tonnage. While slightly larger quantities of alizarin and derivatives, and colors, dyes, stains and color acids probably came in during the year 1922 than during 1921, on the other hand considerably smaller amounts of indigo, both natural and synthetic, and of coal-tar medicinals, were received. Alizarin and derivatives rose from 375,100 lb. ($510,000) in 1921 to 479,900 lb. ($701,900) in 1922.

General Chemical Comparisons

Although the quantity of oxalic acid received during 1922 was 3 per cent in excess of that of 1921, the value was reduced approximately 30 per cent. It will be observed from a study of the following figures that the majority of the oxalic acid arrived since Sept. 22:

	Lb.	Value
October	324,319	$24,564
November	460,514	44,117
December	488,950	56,723
Total since Sept 22	1,273,783	125,404
Total for year	1,294,236	127,757

There was 1,741,000 lb., $132,600, of arsenious acid or white arsenic; 112,700 lb., $40,450, of citric acid; 629,000 lb., $171,600, of tartaric acid, and 1,260,000 lb., $12,200, of sulphuric acid imported during the period Sept. 22 to Dec. 31, 1922. Imports of arsenic sulphide dropped in value but increased in quantity during 1922, figures for which are 6,686,600 lb., $531,300, in 1921, as compared with 7,630,500 lb., $472,000 in 1922.

Bleaching powder, one of the heavy chemicals recording the biggest advance in exports (123 per cent), showed a noticeable decrease in amounts imported—about 30 per cent. On the other hand, imports of glycerin advanced 30 per cent but exports only 20 per cent. Imports of crude iodine in 1922 failed to reach the 1921 level of 646,000 lb. ($1,430,600) by 294,000 lb. ($406,000) or nearly one-half of the total imports of 1921. Demand for citrate of lime during 1922 jumped over 1,000 per cent until a total of 15,982,000 lb. ($2,223,000) was reached. Receipts of potassium cyanide and potassium nitrate, crude and refined, in 1922, were below 1921, while those of other potassium compounds, carbonate, hydrate, hydroxide, bitartrate, and other potassium compounds, n.e.s., surpassed 1921. Sodium compounds also reflected an expansion, sodium cyanide more than doubling, from 8,708,000 lb., value $913,100, to 15,705,000 lb., value $1,306,000.

A noticeable feature of the trend of the import trade of fertilizers is the high percentages of gains in quantities but the much lower gains in values. The largest increases were in potassium sulphate (418 per cent in quantity and 237 per cent in value), and in manure salts (400 per cent in quantity and 153 per cent in value).

Calendar

The following important technical meetings are scheduled for the immediate future:

INTERSTATE COTTON SEED CRUSHERS ASSN. Hot Springs, Ark, May 2-5

AMERICAN ELECTROCHEMICAL SOCIETY New York City, May 3-5

AMERICAN CHEMICAL SOCIETY Regular meeting, New York, May 4

AMERICAN ZINC INSTITUTE St. Louis, May 7-8

AMERICAN ASSN OF ENGINEERS Norfolk, May 7-9

AMER SOCIETY MECHANICAL ENGRS. Montreal, May 28-31

CANADIAN INSTITUTE OF CHEMISTRY Toronto, May 29-31

SOCIETY OF CHEMICAL INDUSTRY Canadian Section Toronto, May 29-31

AMER. ASSN CEREAL CHEMISTS Chicago, June 4-9

AMER LEATHER CHEMISTS ASSN. White Sulphur Springs, W. Va., June 7-9

NAT'L FERTILIZER ASSOCIATION White Sulphur Springs, W Va, June 11-16

NATIONAL LIME ASSOCIATION New York City, June 13-15

SOCIETY FOR STEEL TREATING Eastern Sectional Meeting Bethlehem, Pa, June 14-15

AMER INST. CHEMICAL ENGRS. Wilmington, Del, June 20-23

AMER SOC FOR TESTING MATERIALS Atlantic City, June 25-29

Begin Nitrate Inquiry Soon

Selection of a chemist to have charge of the investigation of the Department of Commerce into the nitrate situation is expected to be announced soon. This will be part of the general inquiry to be made with regard to a number of products for which the United States is largely dependent upon imports.

The nitrate inquiry will include the advances of chemistry in the production of synthetic nitrate, from the standpoint of the economic results obtained rather than purely from the theoretical chemical point of view. The cost of production in Chile, the relative cost of synthetic production in the United States and actual or possible control of prices by foreign combinations will be looked into. Investigations also will be made in Germany. Possibilities of synthetic production at Muscle Shoals and at other suitable sites, by various methods, will be studied.

Preliminary steps have been taken for an investigation into tanning extracts, while the complete program will include inquiries into iodine, potash, quinine and other commodities.

Washington News

Move to Reconsider Duties on Oils Draws Protest

Vigorous protest has been voiced by the Southern Tariff Association and various farmers' organizations against an investigation by the Tariff Commission of duties on linseed oil, coconut oil, peanut oil, soya bean oil and other vegetable oils regarding which an application for reductions of 50 per cent in duties under the flexible tariff has been filed.

A delegation of ten called on the commission April 23 and a delegation of twenty visited the commission April 24 to register a protest against the application. The commission did not grant a formal hearing to the delegations, as under its rules hearings on applications are to be held only after a preliminary investigation of the application by the commission itself and a formal call for a hearing where all interested parties may appear, but the protestants met the commissioners individually and conferred with members of the commission's staff.

The application for a reduction in the duties was filed by the Bureau of Raw Materials for American vegetable oils and fats industries in the interest of soap and of paint and varnish manufacturers and of large consumers of these commodities.

Representatives of farmers' associations who protested against a formal investigation looking to changes in rates declared that financing of the crops would be made difficult were the duties to be thrown into a condition of uncertainty and that there would be a reduction in acreage.

The application has not passed through the preliminary stages of investigation and the action of the commission will not be determined until after a report is received from its advisory board, which is now considering the case.

To Stimulate Use of Potash in Fertilizers

No stone will be left unturned by the Potash Importing Corporation of America when it begins its operations on May 1 to stimulate the use of potash fertilizers. An effort will be made to increase the percentage of potash in fertilizer mixtures. It is recognized in Germany that American consumption of potash must be restored to its pre-war volume if the industry in that country is to thrive.

The American corporation, which is understood to have been financed entirely in this country, will be the official distributing representative of the German syndicate. The objective of the corporation will be to increase potash consumption in the United States to the point where the potash taken out of the soil by crops is replaced each year. It is realized that this will have to be done gradually and that it carries with it an educational campaign, the object of which will be to convince the American farmer of the value of potash fertilizers.

Strength Standards Adopted for Coal-Tar Imports

List of About 100 Standards Prepared—Will Be Submitted to Trade for Criticism

The Treasury Department is preparing to issue in the immediate future a list of standards of strength of commercial imports of coal-tar dyes, chemical and other products as brought in before July 1, 1914.

A conference on this subject was held April 23 among Ernest W. Camp, director of the Customs Division; Dr. H. C. Knight, in charge of the customs laboratory at New York; Dr. Peter Feberger, dye specialist at the laboratory, and W. N. Watson, color specialist of the Chemical Division of the Tariff Commission.

The 1922 tariff act provides that coal-tar products shall be assessed for duty on the basis of the commercial strength of imports previous to July 1, 1914. Many dyes and other products are now imported in more concentrated form than previous to the outbreak of the war in Europe. In such cases the specific duty of 7 cents per pound will be multiplied in accordance with the increase in strength. The ad valorem duty naturally will not be affected.

Samples have been gathered from various sources by the customs laboratory in its investigations and a list of about 100 standards has been prepared, covering the bulk imports. No effort will be made to list each individual color or product, but the standards will be arranged by types.

The list will be submitted to the trade for criticism for about 10 days before it is officially promulgated.

German Potash Industry Not Dependent on Ruhr Coal

The German potash industry is not dependent upon Ruhr coal. In January of 1922 more than 97 per cent of its fuel requirements were met with brown coal. At the time of the entry of France into the Ruhr, a slightly larger percentage of black coal was being used, but it was less than 5 per cent of total requirements. Such black coal as is needed for operating the railways belonging to the industry and its blacksmith forges can be supplanted easily by imported coal. There is, however, some black coal production on the properties of the potash companies. It happens that brown coal is so distributed in Germany as to be the logical fuel for the potash works.

Alcohol Committee Named

Commissioner Blair Makes Known List of Men Who Will Consult With Internal Revenue Bureau

Appointment of an advisory committee representing various phases of the industrial alcohol industry to consult with officials of the Internal Revenue Bureau and the Prohibition Unit regarding regulations and practices affecting the industry has been announced by D. H. Blair, Commissioner of Internal Revenue.

The organization of this committee is the result of a conference with the commissioner held several weeks ago by representatives of various organizations of producers, distributors and consumers of industrial alcohol, who asked that a special division to handle such matters be created, separate from the Prohibition Unit, or that an advisory committee be named. Attention was called by this delegation to the fact that the legitimate needs of industrial alcohol have been submerged beneath exercise of the police powers to suppress liquor violations, whereas the Volstead act provides for encouragement of the proper use of industrial alcohol.

The committee will consult with Commissioner Blair and with Prohibition Commissioner R. A. Haynes before any regulations affecting industrial alcohol are issued, and will give advice regarding means of facilitating legitimate use of the product.

Members of the committee named by Commissioner Blair are:

Dr. H. E. Howe, Washington, D. C., editor of the *Journal of Industrial and Engineering Chemistry*, representing the American Chemical Society.

William A. Sailor, Baltimore, president of Sharpe & Dohme and president of the American Drug Manufacturers Association.

E. J. Schieffelin, New York City, representing the National Wholesale Druggists Association.

Samuel C. Henry, Chicago, representing the National Association of Retail Druggists.

Prof. J. H. Neal, University of Illinois, Urbana, representing the American Pharmaceutical Association and the faculties of pharmaceutical colleges.

Martin Ittner, chief chemist, Colgate & Co., Jersey City, N. J., representing the American Manufacturers of Toilet Articles.

Frank A. Blair, New York City, president of the Proprietory Association.

M. C. Whitaker, New York City, president of the U. S. Industrial Chemical Co.

R. H. Bond, Baltimore, manager, McCormick & Co., representing the Flavoring Extract Manufacturers' Association.

Charles L. Reese, chemical director, E. I. du Pont de Nemours & Co., president of the Manufacturing Chemists' Association.

U. S. Largest Producer and Consumer Of Rosin and Turpentine

How Consuming Demand Is Divided According to Trades—Exports Below Standards of Pre-War Years

AN investigation into the turpentine and rosin industries has recently been completed by V. E. Grotlisch, of the Bureau of Chemistry. This report states that the United States furnishes between 60 and 65 per cent of the world's supply of turpentine and from 70 to 75 per cent of the world's rosin. The principal reason for the difference between the two is the fact that in Russia, Finland, Sweden, Norway and Poland wood turpentine is produced chiefly by the destructive distillation of wood, in which process no rosin is recovered. In Sweden a so-called turpentine and a so-called liquid rosin are recovered as byproducts in the manufacture of paper pulp. A relatively small quantity of so called spruce turpentine is recovered at several paper mills in this country.

The United States not only produces most of the world's turpentine and rosin but also uses a larger part of it than any other country. Roughly, it consumes between 35 and 40 per cent of the total world supply of turpentine and about 30 per cent of the rosin. As indicated by recent data collected by the Bureau of Chemistry, this consumption is distributed approximately as follows:

	Per Cent
Turpentine	
Paint and varnish industry	15
Shoe, floor and other polishes	6
Automobiles, wagons, cars, etc. (painting)	3
Medicinal and pharmaceutical preparations	2
Other industrial uses	1
For thinning down paint and varnish, and other miscellaneous purposes	10
Rosin	
Soap making	42
Paper and paper sizing	25
Paint and varnish	17
Rosin oil, pitch and printing ink	6
Linoleum and similar coverings	3
All other uses	7

In England, at present the second largest consumer of naval stores, the distribution of consumption is probably similar to that of the United States.

Exports of turpentine have shown decided increases since the war, the average for 1919 and 1920 being more than 10,000,000 gal. On the other hand, the average exports of rosin for 1919 and 1920 were 665,000 round barrels less than they were during the war. For the calendar year 1921 there were exported 9,267,959 gal. of turpentine and 560,864 round barrels of rosin, which, deducted form a total production of approximately 24,751,000 gal. and 1,684,000 round barrels, respectively, left for domestic purposes about 15,483,000 gal. of turpentine and 1,123,000 round barrels of rosin. In 1922 there were exported approximately 9,864,000 gal. of turpentine, including 495,000 gal. of wood turpentine, and 799,000 bbl. of rosin.

The exports of naval stores from the United States to Belgium, Germany, Holland and Italy in 1921 showed a decided increase, which, however, was offset by a decrease in the exports to most of the other countries listed, particularly Great Britain and the South American countries. In 1922, on the other hand, exports of turpentine to Belgium, Germany and Holland again decreased, but there was a corresponding increase in the exports to the rest of the world. Argentina, Australia and Japan were the only important countries importing American rosin which took less in 1922 than in 1921. Exports to the rest of the world showed a decided increase.

The increase since the outbreak of the war in American exports of rosin to the Scandinavian countries is interesting. This is due not only to an increase in their consumption of this commodity but also to a decrease in their importations from Germany, and, to a less extent, from Holland and Belgium. In other words, the Scandinavian countries are buying more of their American-made naval stores in the United States instead of second hand from German dealers in Hamburg and Bremen and Belgian and Dutch dealers in Antwerp and Rotterdam. A large proportion of the naval stores imported from the United States by Belgium and Holland are re-exported into Germany, passing through Rotterdam and Antwerp, whence it is shipped by river and canal to the German manufacturing districts in the Rhine Valley.

Linseed Companies Merge

Announcement was made last week that plans had been completed for the consolidation of the Archer-Daniels Linseed Co. and the Midland Linseed Products Co. J. W. Daniels, president of the Archer-Daniels Linseed Co., will serve as president for the new company and in general the management of the latter will be in the hands of the present officials of the Archer-Daniels Linseed Co. E. C. Warner, president of the Midland Linseed Products Co., will retire.

Bakelite Phenol Production Soon Available

The Bakelite Corporation of New York is erecting a plant for the manufacture of phenol near Cleveland, Ohio, and expects to be in a position to produce a surplus beyond its own needs, which will be available in a short time at as moderate prices as conditions will permit. According to an announcement made last week the phenol enterprise is the direct result of the protection afforded by the new tariff.

Trade Notes

Parsons & Petit, 63 Beaver St., New York, have issued a card on the subject of nitrate of soda. Statistical figures showing production and world's consumption, together with prices for a period of years, make this chart interesting and valuable to the trade.

It is reported that the California Cyanide Co., which is a subsidiary of the Air Reduction Co., will start producing cyanide and hydrocyanic acid in its California plant by Aug. 1.

Dr. Frank J. Monaghan, Health Commissioner of New York City, has set aside the week beginning May 7 as Paint-Up and Clean-Up Week for the city.

Advertising soap as "medicated" or as being made for or by a "medical association" when such statements are not true is declared by the Federal Trade Commission to be an unfair business act. The commission has therefore issued a cease and desist order directed to the Williams Soap Co., of Indianapolis, Ind.

W. D. Schwartz, of the L. H. Butcher Co., New York and San Francisco, accompanied by Mrs. Schwartz, sailed on the S.S. "Majestic," April 21, for England and the Continent. He will visit principals and factories in nine countries, for whom his company acts as sales agent for colors, minerals and chemicals.

Inquiries are being received in this country from German sources for prices on Chilean saltpeter. No explanation has been forthcoming as to why reputable German firms should be interested in making nitrate purchases in this country.

The rate on sulphate of ammonia from Seaboard, N. J., to New York, for export, is not unreasonable or otherwise unlawful, the Interstate Commerce Commission has ruled in connection with a case brought by the Seaboard Byproduct Coke Co. against the Delaware, Lackawanna & Western R.R.

B. H. Handy, assistant sales manager, Semet-Solvay, Syracuse, N. Y., was in New York last week.

C. W. Nichols, president of the Nichols Copper Co., has resigned the office of vice-president of the General Chemical Co.

The Oil Trades Association of New York held an informal luncheon at Angelo's restaurant on Thursday, April 26. Dennis E. Bergen, president, presided.

F. D. Lockwood, dealer in chemicals and oils, 115 Broadway, has been in Baltimore on a business trip.

E. F. Drew & Co., dealers in chemicals, will move their offices on April 30 to the Barrett Building, 40 Rector St.

H. H. Dow, president of the Dow Chemical Co., Midland, Mich., was in New York last week.

George W. Fortmeyer

Vice-president of the National Lead Co., who has served in the white lead industry for sixty-seven years, is honored by his co-workers on his eighty-fourth birthday.

THURSDAY, April 20, was the occasion of a celebration in honor of one of the best known and most highly regarded members of the white lead industry. It was the eighty-fourth birthday of George W. Fortmeyer, vice-president of the National Lead Co. and general manager of the Atlantic branch of the company. During the course of the day Mr. Fortmeyer was called to the office of President Cornish and on his return he found his own office thronged with officials and employees of the company who had assembled to celebrate the day and to honor their associate and leader.

A. C. Saunders, cashier of the company and a veteran of many years in the "National" employ, in a very fitting speech presented Mr. Fortmeyer with an oil painting of himself, done by Frank B. McCarthy, of the sales force of the company. Mr. Fortmeyer was visibly affected by the gift and by the many congratulations which he received from his co-workers. He expressed his thanks in a brief speech in which he took occasion to pay tribute to the spirit of harmony and co-operation that prevails among the workers in the Atlantic branch. Mr. McCarthy also spoke briefly and came in for much praise because of the excellent likeness of Mr. Fortmeyer which he had transferred to canvas.

Mr. Fortmeyer was born in New York and when a very young man he became associated with Colgate & Co. From that time up to the present has been identified with the white lead and linseed oil industries, until he has amassed the enviable record of 67 active years in those lines. As Mr. Saunders said in his presentation speech, Mr. Fortmeyer is more like 48 than 84, since he is very active physically and in addition to the manifold duties of his position, still finds time to devote to outside activities.

In the latter part of last year Mr. Fortmeyer completed his thirteenth year as president of the Linseed Association of New York and was re-elected for the ensuing year. Mr. Fortmeyer was one of the founders of this association and he played a prominent part in bringing it to the high plane of efficiency which it now enjoys. At the last annual meeting of the association, when Mr. Fortmeyer was re-elected to the presidency, a valuable gift was presented to him by the members and on different occasions they have paid tribute to the esteem in which they hold him and to the work he has done to make the association a recognized authority in the markets of the world.

Although he is now an honorary member of the Paint, Oil and Varnish Club of New York, Mr. Fortmeyer's activities for many years made him one of the most prominent members of that organization. He was president of the club in 1895-1896 and served on various important committees in later years.

New Chemistry Course on Commercial Subjects

University of Wisconsin Stresses Economic Phases of Chemical Industry in Studies to Start This Fall

A new course, called the "chemistry-commerce course," is to be launched at the University of Wisconsin this fall. Its purpose is to meet the requirements of men who wish to fit themselves for commercial positions in the chemical and related industries. The growing importance of chemistry in commerce has led to this step. The idea is to combine sound training in various branches of economics with several courses in chemistry. The chemical training is planned mainly to give a man sufficient knowledge to understand the basic technical features of the industries with which he may come in contact.

In the course in commercial chemistry, which runs throughout the junior year, only so much of the technical side will be presented as is necessary for a background. Emphasis is to be placed on the economic or commercial aspect. It is the expressed intention to give a student a wide acquaintance with commercial processes and materials of commerce rather than a detailed technical knowledge of a few. For those who desire more technical treatment, courses in industrial chemistry will be open as electives. Such problems as those of plant location and transportation will be especially studied. Another feature is to be a study of market reports and analysis of the factors causing fluctuations in the price of materials in the chemical markets.

Besides the broad range of economic subjects covered, embracing in all fourteen courses, the curriculum includes several in mathematics, foreign languages and English. In addition, a number of electives have been provided in order that a student may broaden his education in the direction he chooses.

H. D. Ruhm Named to Head New York Paint Club

The committee on nominations, of which H. J. Schnell is chairman, will submit the following names for election at the May meeting of the Paint, Oil & Varnish Club of New York: President, H. D. Ruhm; vice-president, C. J. Roh; secretary, H. G. Sidebottom, and treasurer, G. H. Tomlinson. Executive committee: E. V. Peters, chairman; A. G. Fairweather, R. W. Murray, H. G. Sidford, A. L. Somers and Frank Waldo. The arbitration committee proposed by the committee consists of G. W. Fortmeyer, chairman, D. E. Breinig, J. B. Bouch, Jr., H. Gates and Eugene Merz. R. O. Walker will head the twenty-six delegates that will be chosen to represent the New York organization at the national convention next October.

June A.I.C.E. Meeting to Be Held at Wilmington, Del.

The fifteenth semi-annual meeting of the American Institute of Chemical Engineers is to be held June 20 to 23 at Wilmington, Del. The headquarters for the meeting is to be the Hotel Dupont, where about 150 guests are expected. Each day of the meeting includes in its program the reading of technical papers, plant inspection and some social activity.

The papers to be presented, about twenty-three in number, embrace a wide range of interesting subjects. The papers on decolorizing materials, char, silica gel and fullers earth and those on corrosion promise to be noteworthy.

Among the plants to be visited are those of the Bond Bottle Seal Co., the American Vulcanized Fiber Co., the Bancroft Co. (cotton finishing), the Electric Hose & Rubber Co. and several departments of E. I. du Pont de Nemours & Co. In the latter plant an opportunity is to be afforded to see the Jackson laboratory, probably the most famous color laboratory in the world.

Social activities have not been neglected in the preliminary arrangements. A general social gathering, golf and an automobile trip to Pierre S. du Pont's residence at Longwood have been provided. At Mr. du Pont's home there is to be a garden party, a visit to the conservatories and dinner.

Chemical Trade Commissioner Urged for Germany

The Department of Commerce has under consideration the addition to its staff of trade commissioners in Berlin of an economist especially experienced in chemicals. It has practically been decided to expand in this direction if a man of proper qualifications can be secured. Domestic producers of dyes and chemicals have urged the department recently to secure more reports on conditions in the industry in Germany. If the suggestion is adopted, the agent will operate from Berlin.

Chemicals and Allied Products Show Gains in Export Trade

Statistical Review of Export Movement for 8-Month Period Ended Feb. 28

A GAIN of 19 per cent was made in the exports of chemicals and allied products for the 8 months July 1, 1922, to Feb. 28, 1923, as compared with July 1, 1921, to Feb. 28, 1922. Foreign sales for the months of January and February, 1923, represented expansions of 14 and 19 per cent respectively over the corresponding months of 1922, rising from $9,685,859 in January, 1922, to $10,944,830 in January, 1923, and from $8,692,116 in February, 1922, to $10,374,895 in February, 1923. One noticeable feature in the February trade, 1923, is a loss of 5 per cent from the January trade, although this may be partly accounted for by the difference of 3 days in the length of the months. The aggregate value of the groups and commodities with the percentages of increase or decrease for the 8 months, July 1, 1921, to Feb. 28, 1922, as compared with July 1, 1922, to Feb. 28, 1923, were:

Under the first group, "chemicals and allied products," are included coal-tar products (which expanded 44 per cent in value), medicinal and pharmaceutical preparations (24 per cent in value), acids and heavy chemicals, sodium compounds (26 per cent in value), pigments, paints and varnishes (32 per cent in value), fertilizers (1 per cent increase in quantity, but 8 per cent decrease in value), explosives (55 per cent in quantity and 38 per cent in value), perfumery, cosmetics and toilet preparations (34 per cent in value) and pyroxylin products (62 per cent in value). All future analyses of imports and exports will be based on this grouping. Soaps of all kinds and tanning materials and extracts are excluded.

Decrease occurred in the exports of formaldehyde, glycerin, soda ash, sal soda, ammonium sulphate and phosphate rock except the high-grade hard rock.

	July 1, 1921-Feb 28, 1922	July 1, 1922-Feb 28, 1923	Per Cent of Increase or Decrease
Chemicals and allied products	$51,842,166	$58,305,753	12
Naval stores, gums and resins	9,642,219	14,222,046	48
Crude drugs, roots, etc	461,252	605,071	31
Ginseng	1,227,093	2,083,306	70
Peppermint oil	219,132	199,417	—9
Other essential oils	335,323	371,941	14
Logwood extract	393,301	247,298	—37
Other vegetable dye extracts	369,325	264,067	—33
Sulphur or brimstone	3,461,447	4,437,676	28
Sulphur, refined	20,146	84,314	318
Metal polishes	200,710	208,175	4
Linseed oil	196,330	281,284	28
Bones, hoofs, etc	71,711	172,024	140
Glue of animal origin	205,229	302,114	47
Glue of vegetable origin	13,704	46,288	238
Gelatin	20,308	132,561	552
Beeswax	12,866	17,689	37
Wax manufactures	248,559	243,573	—2
Matches	168,774	157,258	—7
Total	**$69,300,925**	**$83,340,825**	**19**

Government to Investigate Production Costs Abroad

C. R. DeLong, chief of the Chemical Section of the Tariff Commission; M. G. Donk, a chemical expert of the section, and Eben M. Whitcomb, one of the commission's accountants, will sail for Europe May 3 to investigate costs of production abroad of various chemicals regarding which applications for changes in duties under the flexible tariff section have been docketed.

The party plans to spend 3 weeks in England investigating barium dioxide and potassium chlorate. Their subsequent schedule calls for 2 weeks in Norway investigating sodium nitrite; 6 weeks in Germany investigating various chemicals, and later trips to Holland on oxalic acid and to Switzerland on barbituric acid. This schedule is tentative as to the time in each country.

Mr. DeLong will leave the party in Germany and make a trip of inspection through France and probably other countries on the Continent. He will return after 2 months abroad. Other members of the Chemical Section staff will embark in June and join the original party. The total schedule of work for the chemists in Europe cannot be completed before the middle of August, it is estimated, and may be extended by the addition of other investigations while they are abroad.

Equipment Statistics to Be Gathered Monthly

A new statistics service in the chemical industries has been inaugurated by the Chemical Equipment Association. Data are to be gathered through the co-operative efforts of members of this organization, representing manufacturers of equipment and materials in practically every field. This will embrace industries which are strictly chemical or metallurgical in nature as well as a great many which are related to these.

According to a statement made by P. D. Schenck, president of the association, following a recent consideration of statistical activities by the board of directors, "Chemical equipment is in effect a barometric register of general industrial conditions both at home and abroad. In many ways the absorption of chemical equipment and materials is as reliable and specialized an index to general industrial conditions as the production of pig iron was considered to be before the war, or as the Federal Reserve Bank's discount rates are now regarded.

"It is not yet generally realized that the membership of the Chemical Equipment Association, now recognized by the government and by industry in general as the speaking voice of American chemical equipment and materials manufacture, supplies essential equipment to practically every basic industry in the United States and abroad. There is scarcely an article of common consumption, in diet, in clothing, in transport, in the essentials or semi-essential accessories of life, that is not produced in some degree through the use of standard or special equipment and materials manufactured by the membership of this association."

The collection of comparative statistics on the absorption of chemical equipment and materials by industries and by sections is to be a monthly activity. By industries, the information collected each month discloses the manufacturing fields most active in the absorption of equipment and materials, both as to domestic absorption and as to foreign absorption. By geographical sections of the United States, the information also discloses the principal concentrations of industrial activity in the way of replacements, in factories, new construction operations and expansion projects of various sorts. The information further reveals general trade and business conditions of other sorts than those strictly pertaining to the absorption of chemical equipment.

News Notes

A unique celebration is to be held in France on May 27, to be known as "Laboratory Day." The occasion is that of the centenary of the birth of Pasteur. Research laboratories and research workers are to profit from contributions received on that day.

Reduction of wasteful variety in manufactured goods is being sought with considerable success by the U. S. Chamber of Commerce. Paper, rubber, leather and fabricated iron, as in pipe and agricultural implements, are the industries in which results have been accomplished. For instance, certain paper makers report a cut to 55 per cent of former lines, with consequent increased production at lower cost.

Synthetic camphor production by a new process is to be begun at Feugen, Austria, in the near future. The Chamber of Commerce of Vienna has confirmed a report to this effect. Anton Gawalowski of Feugen is the inventor of the new process.

Desulphurization of coke by steam is one of four important research problems being carried on at Carnegie Institute of Technology. The Bureau of Mines is co-operating in this work, which also includes a study of the correlation of the coal beds of western Pennsylvania through their microscopic constituents. The two other studies involve fundamental research on the corrosion of alloys and an investigation of low-temperature Pennsylvania coal tars

Fertilizer men who are to meet at the convention of the National Fertilizer Association at White Sulphur Springs, W. Va., June 11 to 17 are arranging an extensive program. The subjects covered will include cost accounting systems, chemical and manufacturing problems, sales methods, transportation problems, etc. The officers of the association are now arranging the details and promise a meeting which will be of unusual interest to everyone identified with the fertilizer industry.

Viscosity of cellulose as determined by the cuprammonium method is being investigated by the Cellulose Division of the A.C.S. All firms or individuals having constructive information dealing in any way with the subject are urged to communicate with E. B. Benger, chairman, E. I. du Pont de Nemours & Co., Newburgh, N. Y.

"Dyewood Products" and **"Early Chemical Symbols"** were the two topics discussed at the April 23 meeting of the Stamford Chemical Society. R. H. Wisdom and E. H. Smith were the respective speakers.

Ceramic engineering will be taught at the Georgia School of Technology if the project now under way is consummated. The ceramic industries of the state are interested in the founding of the new course, for which a fund of $26,000 is sought. The idea of the new institution is to develop the clay resources of the state in a comprehensive and intelligent manner.

Five fellowships in the school of mines, University of Alabama, are to be offered during the school year 1923-24. The work, which will be done in conjunction with the U. S. Bureau of Mines, has been divided into two sections. One deals with the beneficiation of various iron ores, the other with problems of coal washing.

American oil chemists meeting at Hot Springs, Ark., April 30 and May 1 have arranged two very busy days. Besides the usual committee reports, seven technical papers are slated for the occasion.

Ethylene as an anesthetic for general use possesses superior properties, according to Dr. W. E. Brown, who has used it in a Toronto hospital. Mixed with nitrous oxide and oxygen it produces partial analgesia, or loss of pain, without loss of consciousness.

Multiple unit cars used for the transportation of chlorine gas cannot be classed as tank cars, according to C. F. Gerry, in a report submitted in the case of the Mathieson Alkali Works. This means that present freight charges are regarded as fair by the Interstate Commerce Commission.

Synthetic ammonia is to be produced in Spain by the Claude process, according to a recent Reuter dispatch. M. G. Claude is installing a factory there for a Spanish syndicate. The original plant is designed to use from 3,000 to 4,000 cu.m. of hydrogen a day—the output of the nearby electrolytic soda plant of the Electroquimica de Felix Co.

Swiss carbide plants having a yearly capacity of close to 120,000 tons are being closed down. Since only about 10,000 tons is used annually within the country, the present export crisis is affecting the industry vitally. The cement industry is likewise hard hit due to the present high price of coal and to its dependence on export markets.

Facts and Figures That Influence Trade in Chemical Products

Market Conditions

Current Prices Imports and Exports The Trend of Business

Domestic Buying Movement in Chemicals Has Become Less Active

Good Export Inquiry Continues for Some Selections—Higher Producing Costs Strengthen Acetone and Acetate of Lime—Tin Oxide Reduced in Price—Lower Prices for May Deliveries of Prussiate of Soda

REPORTS of a slowing up in buying were prevalent throughout the week. This was especially true of buying for domestic consumption. In several cases the decline in activity is due to the fact that consuming trades are well covered for nearby wants. In other cases lessened activity in the trades is responsible for their absence from the materials markets. The fertilizer chemicals have passed their active season and no active buying is to be expected. Reports from the rubber trade say that a drop in tire production is in contemplation to obviate a sharp decline at the middle of the year. Reports from the tanning trade state that April business was not so good as that of March and a report from Milwaukee says that tanning plants are running only about 50 to 60 per cent of capacity.

Export Buying Holds Up

The movement of alkalis into export channels is holding up well and considerable business is being placed in the case of many heavy chemicals. From statistics made public last week it is seen that caustic soda is being shipped to a large number of foreign markets. Total shipments of caustic soda to foreign countries during February were 7,405,064 lb. of which 5,022,031 lb. went to Argentina, Canada, Brazil, Cuba and Japan, these countries being named in their relative position according to quantities taken by them. The value of export shipments in February figures out at slightly in excess of 3.40c. per lb., according to declared valuations.

Price Changes

There was no decided price movement during the period. Chemicals depending on wood distillation were stronger under higher producing costs. Lessened competition helped to firm up other quotations, notably bichromates, oxalic acid, and formaldehyde. Lower selling prices for metals have taken the edge off most of the metal salts and some of the latter are openly quoted at lower figures. Prussiate of soda was easier due to lack of buying and selling pressure on the part of holders. Arsenic, which is one of the most interesting items at present, failed to show any new developments and buyers are holding off evidently with the hope of covering their needs later on at more attractive price levels. Copper sulphate is weakened both by declines in the metal and by heavy offerings of imported grades at relatively low prices.

Acids

Acetic Acid—Higher costs for raw materials have been the feature of this market. A very strong undertone existed and the outlook is regarded as favoring a higher price level for a long time to come. There is very little competition from resale lots and the present price schedule is firm at $3.17½ for 28 per cent, $6.35 for 56 per cent and $12.05@$12.85 for glacial.

Citric Acid—Inquiry has continued fairly active but actual business has been restricted by the scarcity of stocks. Domestic makers are well sold ahead and are shipping out regularly on old contracts. They are holding prices steady and apparently are not trying to take advantage of the differential held by imported offerings. Prices are given at 49c. per lb., although it is admitted that this price is largely nominal for prompt deliveries. Imported holds at 52@53c. per lb. with shipments in some cases quoted above that level.

Gallic Acid—There is no indication of price changes for this acid. Sellers say values are established on a steady basis. Trading is along quiet lines with nothing to disturb routine conditions. Technical grades are quoted at 45@50c. per lb.

Hydrofluoric Acid—Consuming interest is not pronounced and while fundamental conditions are strong, producers are not inclined to advance prices in the slow season and continue to offer on a basis of 7@8c. for 30 per cent and 11@12c. for 48 per cent.

Oxalic Acid A few odd lots were offered in the spot market at 13¼c. per lb. and even late in the week there were reports that 13¼c. could be done on a firm bid. Yet there seems good evidence that spot goods have been well depleted and the general asking price is 13½c. as an inside figure with an upward range according to seller. Reduced offerings of imported both on spot and for shipment have strengthened prices for domestic and 13c. is held as an inside price for round lots at the works. At present there is no competition in domestic oxalic but a new producer is expected to begin offering next month.

Sulphuric Acid—Limited stocks in the possession of first and second hands give a firm appearance to prompt deliveries and in many quarters prices are given as nominal due to inability to take on new business for spot and nearby deliveries. Prices quoted are $9.50@$11 for 60 deg. in tanks and $16@$16.50 for 66 deg.

Tartaric Acid—Reports on the activity of the market vary. Some sellers say that consumers bought freely in anticipation of higher prices and are now well covered for considerable periods ahead. Other reports say inquiry remains good. Reports agree that values are firm and holdings limited. Asking prices are 36c. per lb. for both domestic and imported.

Potashes

Bichromate of Potash—While demand during the week was quiet, stocks in sellers' hands are reported to have been reduced by recent deliveries and sellers are competing less keenly for business. Prices now range from 10¾c. to 11c. per lb. at the works.

Caustic Potash—A quiet market ruled throughout the period. Buyers are interested only when prices are in their favor and there was a lack of shading in the spot market with imported 88-92 per cent quoted at 8¼@8½c. per lb., and the inside figure applying on shipments. The price of domestic makers is maintained at 8½c. per lb. carlots at the works.

Muriate of Potash—Advices from Germany state that higher price schedules are to be put into effect on May shipments. The influence of these reports in domestic markets is lessened by free offerings of Alsatian muriate and prices at present are by no means

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	179.23
Last week	178.31
April, 1918 (high)	286.00
April, 1919	231.00
April, 1920	261.00
April, 1921 (low)	140.00
April, 1922	158.00

The firmer position of sulphuric acid is reflected in the advance of 92 points in the weekly index number. Copper sulphate was lowered but as the decline was moderate the price change had no important bearing on the general situation.

firm. While quotations of $35 per ton are given as representing the market it is an open secret that this price is being shaded materially in actual transactions.

Nitrate of Potash—The market for saltpeter has been gaining in strength and an advance of one-half cent per lb. was announced by leading sellers in the past week. For a long time imported material has been underselling domestic makes and kept selling prices for the latter at close to production cost. Recently imports began to decline and with diminished competition the domestic market has moved up to a position more favorable for sellers.

Permanganate of Potash—Prices have been very irregular with conflicting views held by sellers. Shipments were not quoted as freely as a week ago. Spot goods are reported to have sold at 23c. per lb., but this is far from a general quotation, as 23½@24c. is held by many sellers and stocks afloat were generally held at 23c. per lb. It is evident that prices depend on seller with no decided price trend in either direction.

Sodas

Bichromate of Soda—Contract orders take up enough of production to prevent selling pressure and even concessions in order to equalize freight rates are now seldom met with. Prices at the works are firm at 7½@7¾c. per lb. for round lots with up to 8c. per lb. asked for smaller amounts. Spot stocks also are not present for sale and the local market is represented by quotations of 7¾@8c. per lb.

Caustic Soda—Export inquiry remains prominent and considerable amounts have been sold for May shipment. Standard brands are generally quoted at 3.45c. per lb. f.a.s. but sales are said to have been made at 3.40c. per lb. f.a.s. and outside brands have sold at 3.35c. per lb. with intimations that 3.30c. could be done for the last half of May. Home demand is less active as the majority of consumers are covered. Prices for standard goods hold at 2½c. per lb. for carlots at the works, basis 60 per cent.

Chlorate of Soda—Seasonable buying is holding the market in a steady position. Imported material holds at 6½c. per lb. and upward on a quantity basis. Prices of domestic producers are unchanged at 6½c. per lb. at works. New business is not heavy and no price disturbances are looked for from that direction.

Cyanide of Soda—Cyanide is said to have found a greater outlet this season in the color trade as a substitute for prussiates and demand from that source is still noted. The market is barely steady, as general consuming demand is not active and imported grades are competing and undoubtedly the latter would be more of a factor if consumers were convinced of their quality. Prices are 20@21c. per lb. for imported and 22½@23c. per lb. for domestic.

Nitrate of Soda—A fair amount of business is being done in spot and prompt delivery, but futures are not attracting attention in spite of quotations for later shipments at prices under those ruling for spot goods. Spot prices vary according to seller and if resale lots are taken into consideration the range may be given as $2.60 to $2.65 per 100 lb. On futures as low as $2.50 per 100 lb. has been quoted.

Prussiate of Soda—A sale of 5 tons of yellow prussiate on spot was reported at 18c. per lb. The market has been easy, however. In the first place demand has been very slow and holders of stocks have been forced to cut prices in order to move holdings. In the second place some large producers have announced prices of 17½c. per lb. works, on round lots for May shipment.

Miscellaneous

Acetate of Lime—Higher producing costs have resulted in an advance of one-half cent per lb. for this material. Producers say that raw material and labor costs made it impossible to continue former quotations and they are now asking 4@4.05c. per lb. Demand is good especially on the part of domestic buyers.

Acetone—Following the lead of acetate of lime a stronger market exists for acetone and prominent factors have marked up their prices to 24½c. per lb. at works, which is equivalent to a delivered price, New York, of 25c. per lb.

Arsenic—Inquiry is persistent, but most buyers are bidding at levels which are too low to effect sales. Reports on asking prices are irregular, as quotations of 12½c. per lb. for shipments are heard, whereas bids at that figure have gone unfilled. In fact some sellers say they can place large amounts at 13c. per lb. but can find no reliable offerings at that level for any nearby positions. The spot market is quiet as far as sales go, with 15½c. per lb. as the prevailing asking price. Reports on increased production are having some effect on buyers. Based on production for the first quarter of the year, the domestic output for 1923 is estimated to reach a total of 22,000 tons of refined white arsenic

Copper Sulphate—Prices for domestic makes are none too steady as a result of lower prices for the metal and because of continued weakness in imported. Demand has been slowed up by the downward trend of values, although contract deliveries are said to be ordered out promptly. There is no fixed quotation for imported sulphate on spot or for shipment. Sales are going through on firm bids and at different levels. Spot material can be picked up at 5½c. per lb. and possibly less and shipments have been offered under the 5½c. level. Standard makes of domestic are more firmly held, but some reports credit sales at 6c. per lb. and up to 6½c. per lb. is asked.

Formaldehyde—A few odd lots are said to be held in the spot market which are a matter of negotiation and on which 14½c. per lb. might still be done. But the absorption of resale goods has again placed the market in the hands of producers and general asking prices are 15@16c. per lb. according to seller.

Tin Oxide—Weakness in the metal market has brought out lower prices for tin oxide and prominent sellers were offering at 50c. per lb. There was no change in the asking price for tin crystals or bichloride of tin.

Sulphur—First-hands report a satisfactory volume of business in refined sulphur and prices are steady. Larger quantities than formerly are moving into agricultural channels. Commercial sulphur, in bags, held at $1.35 per 100 lb., and $1.70 per 100 lb. in cooperage. The roll held at $2 in bags and $2.15 in cooperage. Flowers settled at $3 in bags and $3.35 in barrels. The flour in bags is available at $2.25. Crude sulphur is steady at $18@$20 per ton, New York. At the mines $16 is the ruling quotation, bulk basis.

Alcohol Demand Fair

Offerings of denatured alcohol by outside interests were not so much in evidence and producers here saw no reason to come down in their ideas as to prices. Business was not active, but satisfactory considering the season of the year. Denatured special No. 1, 190 proof, held at 33c. per gal. in drums, and 39c. per gal. in barrels. The No. 1 completely denatured, 188 proof, in drums, was available at 41c. per gal Formula No. 5, denatured, was unchanged at 32c., in drums. U. S. P. ethyl spirits, 190 proof, was offered by first-hands at $4.70 per gal. Cologne spirit held at $4.75. Methanol was firm but nominally unchanged at $1.18 per gal., in barrels, basis 95 per cent, and $1.20 per gal., in barrels, 97 per cent.

New Use for Salt and Sodium Arsenate

An increased demand for low-grade salt and for sodium arsenite for use in the campaign against the barberry bush may be expected. This bush spreads the black-stem rust to the wheat fields. Because of that fact, the Department of Agriculture is making a drive on it. Ten pounds of common rock salt applied to the center of the crown of the bush is sufficient to kill the plant. A gallon of the stock solution of sodium arsenite will make 50 gal. of solution, of which 2 gal. poured in the center of the crown of the bush is sufficient for its eradication, the department states.

The department also is recommending increased use of copper sprays and barium water sprays in potato growing. It is pointed out that the expenditures for these sprays ordinarily would constitute only a small part of the profit that would come from the increased yield and from the better composition of the tubers.

Coal-Tar Products

Crude Naphthalene Higher Abroad—Phenol Production to Be Augmented—Benzol Quiet—Solvents Scarce

CABLES from England reported a higher market on crude naphthalene, and, according to private advices, production abroad appears to be sold up for the next 2 months. This news led traders here to hold out for full prices quite regardless of the state of trade. Actual buying by the consuming trades was inactive, but, with leading producers in this country behind in deliveries, this situation did not discourage operators. The announcement that the largest consumer of phenol would soon enter the producing field on a scale broad enough to be in a position to offer supplies in the open market took much of the "snap" out of the speculative element and business in outside goods naturally fell away. However, prices did not ease off any.

There were no new developments in the cresylic acid situation. The committee appointed recently for the purpose of handling the application for a reduction of 50 per cent in the prevailing rate of duty held another meeting, but nothing definite was accomplished. Owing to the fact that dyes and coal-tar products are being shipped to this country in a more concentrated form the Treasury Department is considering the proposition of assessing duty in accordance with the increase in the strength.

Coal-Tar Crudes, Etc.

Benzene—Demand has been disappointing but with the motoring season not yet under way, producers are inclined to mark time. The undertone of the market at the close was barely steady. Benzene, 90 per cent. in tanks, was available on contract at 27c. per gal. The pure, water-white, was nominally unchanged at 30@32c. per gal.

Cresylic Acid—The past week witnessed the arrival of 131 drums from British ports. Demand was quiet and prices for the imported redistilled were unsettled. On duty-paid material there were sellers at $1.25@$1.35 per gal., a decline of 10c. from the nominal price named a week ago. Domestic production is well sold ahead and first hands refused to name a flat price. Contract deliveries are going out against purchases at close to 78c. per gal.

Naphthalene—The feature in the market was the stronger position in crude in the British markets. Cables received late in the week quoted 4c. per lb. on good quality crude for April-May shipment, which compares with 3⅞c. per lb. a week ago. Some traders go so far as to say that English producers, with few exceptions, are sold up over the summer positions. Demand in New York from distributors was good, but actual consuming call was not up to expectations. Flake was nominally unchanged at 9½c., immediate delivery, with balls at 9¾@10c. per lb., round-lot basis.

Phenol—While offerings of resale material were light and prices ruled firm, interest in this material fell off somewhat. The announcement that new production would soon come on the market discouraged speculative activity. U.S.P. phenol on spot sold at 55@57c. per lb., but before the close asking prices on resale lots ranged from 57@58c. per lb. Producers took on "regular" contract business at 28c. per lb.

Aniline Oil—Prices were repeated by first hands on the 16c. round-lot basis, immediate delivery. Trading was moderate only.

Salicylic Acid—Trading in salicylic acid was not so active as a week ago, but, with stocks materially reduced, the market presented a firm undertone in all directions. The technical variety brought 47c. per lb. On the U.S.P. grade 50c. per lb. represented the market.

Paranitraniline — Producers reported a firmer market, but did not alter prices. Leading makers quote 75c. per lb.

Solvent Naphtha—Demand exceeds the supply and prices named in producing circles were only nominal. The current production is sold up. Nominal prices range from 37@40c. on the water-white, in drums.

Adopt Standards for Paint

Reduce Number of Shades and Eliminate Odd-Sized Containers

Reduction in the number of shades and tints of paints, stains and varnishes and elimination of a number of odd sizes of containers were agreed upon Wednesday at a conference of manufacturers, distributors and large consumers with the Division of Simplified Practices of the Department of Commerce. This was the outgrowth of a preliminary conference on this subject held last September.

Plans agreed upon provide that all ⅛-gal. cans of all types be discontinued and all sizes of containers smaller than ½ pt. except for stains, gold and aluminum paints and household enamels. Two- and three-pound cans are to be eliminated. Pints are to be eliminated in house paints, flat wall paints and porch paints. All sizes less than gallons are to be eliminated for barn and roof paints and shingle stains. Oblong or square varnish cans are to be eliminated in sizes smaller than gallons.

Shades and tints are to be limited as follows: Floor paints, 8; house paints, 32; flat wall paints, 16; enamels, 10; porch paints, 6; roof and barn paints, 4; shingle stains, 12; carriage paints, 8; oil stains, 8; varnish stains, 8; spirit stains, 14; all of the foregoing being exclusive of black and white; oil colors, including black but counting the several shades of a single color as one color, 32; architectural varnish, interior and exterior, 10; marine varnish, 4; miscellaneous, including all not specified in the foregoing, such as japan driers, asphaltum, etc., 28.

Rubber Latex Forges to Front

The use of rubber latex in tire fabrication is no longer impossible. Recent developments in the art of using this latex promise great improvements in rubber manufacture, according to C. B. Seger, chairman of the board of the United States Rubber Co. Because of the new processes developed it is purposed to begin the import of latex on a large scale at once. In outlining the use of the new material Mr. Seger said:

"Sprayed rubber, the result of a new method of producing crude rubber from original latex, insures a pure and absolutely uniform product for the first time since rubber was discovered.

"Heretofore all rubber produced and sold on the market has been coagulated out of rubber latex, by means either of smoke or chemicals.

"Rubber produced by old primitive native methods of heat and astringent smoke over slow fire is contaminated with smoke and other combustion products. Nor can there be any assurance of uniform quality.

"When rubber is produced by treating latex with acetic acid, rubber contains acid residues. Acid tends to destroy some of the valuable natural properties of latex.

"New spraying process takes latex, sprays it into a snow-white mist and brings this snow-white mist into contact with pure superheated air, driving the water out of the latex—and nothing else.

"Sprayed rubber is 100 per cent pure solids from virgin latex. No acid, no smoke. It is dry and pure and remains so.

"Sprayed rubber has greater strength, because it contains all natural strength of rubber of original latex unimpaired by chemicals or destructive effect of machine working. It is uniform in quality, something never before obtained."

Finds Nitrate Refining Process

A large saving in labor costs and a much better product is secured by the application to Chilean nitrates of a new process of refining, according to a report which has been received by the Department of Commerce from Santiago.

The process is the invention of M. Davieusart, a French chemical engineer. He recently demonstrated his process before a gathering of engineers at Santiago.

Vegetable Oils and Fats

Cottonseed Steadies—Linseed Futures Unsettled—China Wood at New High—Tallow Closes Lower

THE feature was the decline in tallow prices which took place late last week. The lower London market frightened holders and brought out actual business at a decline of ⅛c. Cottonseed oil steadied on support in the nearby positions, refiners evidently taking on May contracts because of the strong statistical position of the old crop months. Arrivals of foreign linseed oil were reported, which helped out the spot situation. On futures traders were disposed to hold off for lower prices. China wood sold at 40c. per lb., on spot, a belated short being the buyer. Coconut oil was offered at 9c., sellers' tanks, coast.

Linseed Oil—Spot oil was tight in all directions and prices were maintained on the basis of $1.17 per gal., in barrels, carload lots. June oil, domestic, held at $1.14, with July forward at $1.10. Foreign oil, June shipment from the other side, sold at $1.02@$1.03, duty paid, bulk basis. On futures the undertone was easier, the larger consumers holding off because of the good crop prospects in this country and the feeling that Argentine offerings of seed will not diminish for some time to come. The fact that the Argentine has shipped 26,500,000 bushels of seed since the first of the year has convinced many in the trade that a record crop was produced in that country. According to the Department of Agriculture the area in the United States this coming season will be almost doubled. This preliminary estimate on the flaxseed crop is based on a report covering "intended plantings" and will be subjected to many changes. There were offerings of Argentine seed afloat at $2.40 per bu., c.i.f. New York. During the past week India exported 448,000 bushels of seed, indicating that the new crop is moving. Linseed cake for export was nominal at $34.50@$36 per ton, f.a.s. New York, as to seller and position. Importations of seed from the Argentine assumed large proportions last week and mills are gradually catching up on deliveries.

Cottonseed Oil—Refiners were buyers of nearby refined in the option market and sold distant futures in an effort to hold prices down. However, the market developed a firmer undertone, reflecting the strong statistical situation and unfavorable news on weather conditions in the cotton belt. The estimate on "intended plantings" of cotton, showing an increase of 12 per cent in the acreage, had little influence upon the market. The report which was issued about a week ago by the Department of Agriculture was very much in line with private estimates. Crude oil sold at 10c. per lb., tank cars, f.o.b. mills, southeast and Texas, with offerings light. Bleachable oil was quiet but steady at 10½c., f.o.b. mills, Texas common points. Cash trade in refined oil was less active. Lard was unsettled in the west. Hogs held at $7.60@$8.00 per 100-lb., Chicago, with receipts liberal. Lard compound was unsettled at 13½c. per lb., carload lots, f.o.b. New York. Oleo stearine sold at 10½c. per lb

China Wood Oil—A parcel of 50 barrels sold on spot at 40c. per lb., a new high for the movement. May-June closed at 30c., with July forward at 26½@26¾c.

Coconut Oil—No large sales went through last week. The market held at 9½c., sellers' tanks, New York, and 9c., sellers' tanks, f.o.b. Pacific coast ports. The undertone was barely steady. Copra was nominally unchanged. South Seas sun-dried, in bags, held at 5½c., coast and 5⅝@5¾c. New York, c.i.f. basis.

Corn Oil—Sales of crude oil were reported at 10½c., sellers' tanks, f.o.b. middle western points.

Olive Oil—Sulphur oil, prime green, was raised to 10¼@10½c. per lb. in some quarters, in sympathy with the higher primary markets.

Palm Oils—Demand slow and market closed easy on the drop in tallow. Lagos for shipment 8½c. per lb. Niger for summer positions closed at 8@8¼c. nominal.

Rapeseed Oil—English refined on spot was offered at 84½c. On April-May shipment from the other side 85½c. per gal. was asked.

Soya Bean Oil—May shipment from the Pacific coast was offered at 10½c., duty paid, sellers' tanks. On futures 10⅞c. was asked. Bulk oil in bond, May-June shipment from the Orient, closed at 7.90c. per lb., c.i.f. New York.

Fish Oils—The nominal quotation for crude menhaden oil for future delivery was 53c. per gal., tank car basis, f.o.b. works. No new business came to light. The market was barely steady at the close. Newfoundland tanked cod oil was unchanged at 68@70c. per gal.

Tallow and Greases—Sales of extra special tallow at 8⅝c. per lb., ex plant, a drop of ⅛c. for the week, completely upset the market. At the regular London weekly auction prices declined 2 shillings per 112-lb. Yellow grease was easy at 8¼@8⅜c. per lb., New York.

Procter & Gamble Suit Dismissed

The Federal Trade Commission announces the dismissal of its formal complaint against the Procter & Gamble Distributing Co., of Cincinnati, Ohio. The practice complained of was that of guaranteeing against price decline in the sale of soaps.

Miscellaneous Materials

Varnish Gums—There were sellers of Batavian damar on spot at 30@31c. per lb. Cables were firm and import prices were virtually on a parity with the New York market. Trading was described as routine only. In high-grade kauri gums prices were firmly maintained because of the light offerings from the primary centers, production being disappointing.

Fluorspar—Steady prices were the rule. Acid grades, 98½ per cent or better, settled at $27.50@$28 per ton, delivered.

Casein — Recent importations, together with freer offerings from domestic sources, eased the market. There were sellers of nearby material at 22@23c. per lb. Spot casein was available at 23@24c. per lb.

Barytes—The market on prime floated barytes held at $28 per ton, f.o.b. St. Louis. Trading at these prices has been moderate only. The New York market was unchanged at $42 per ton, asked.

Shellac—Offerings were freer and T. N. on spot sold down to 70c. per lb. Unsettled primary markets brought out a little pressure. Bleached, bone dry, settled at 84@86c. per lb. Superfine orange on spot closed at 77@78c. per lb.

Naval Stores—Prices again went off in the market for spirits and final quotations of $1.42@$1.43 per gal. were little more than nominal. The recent sharp uplift in prices restricted buying, while new season's offerings continue to come forward. Rosins were in steady demand and prices were maintained on the $6.25 basis for the "B" grade.

Glycerine — Chemically pure was barely steady at 18c. per lb., in drums. Dynamite was available at 16½c. in the middle west, while operators in New York territory quoted 16½c. Crude soap-lye, basis 80 per cent, loose, held at 10½c., with no sales reported. On the saponification 11⅜c. was asked at middle-western points, carlots, loose.

White Lead—The recent decline in pig lead to the 8c. basis brought out no changes in the market for pigments. Corroders, however, were no longer so bullish in their ideas. Standard dry white lead (basic carbonate) held at 9⅜c. per lb., casks, carload basis.

Zinc Oxide—Easier prices again prevailed for the metal without affecting the market for zinc oxide. Producers continued to quote American process lead free at 8c. per lb., carload lots. Red seal, French process, was traded in on the 9⅜c. carload basis. Demand, taken as a whole, was less active.

Unreasonable Rate on Muriate

The Interstate Commerce Commission has found the rate on muriate of potash in carloads from Wilmington, Cal., to Bay City, Mich., and to Niagara Falls, N. Y., to be unreasonable. Reparation was awarded to the Diamond Match Co., the complainant.

The Swiss Dye Industry

In 1922 the exports of aniline dyes from Switzerland totaled 3,872,800 kg., with a value of 55,257,000 francs, thus exhibiting very little change as compared with the previous year. On the other hand, the exportation of artificial indigo made good progress and totaled 3,460,800 kg., with a value of 13,158,000 francs, as against 1,182,900 kg., with a value of 9,497,000 francs in 1921. The chief purchaser was China, with 9,948,000 francs; that country requires large quantities of artificial indigo for her cheap cotton fabrics. Although the quantity of exported indigo has almost trebled, the value has not gone up by more than four-tenths, as competition on the world's markets has been very keen of late. The second best customer for Swiss artificial indigo was Japan, which, however, took a much smaller amount, this country having itself developed a considerable dye-making industry in recent years. The principal buyers of Swiss aniline dyes were: France (13.9 million francs), Great Britain (13.1), United States (12.7), Belgium (2.5), Italy (2.0) and Japan (1.4).

Will Smoke Protect Orchards?

Orchard protection by smoke clouds may become a commercial possibility. Arrangements to measure the effectiveness of such clouds in preventing nocturnal cooling have been made recently by the Weather Bureau, as a result of requests from fruit growers and others. Further tests will be made at Edgewood Arsenal in co-operation with the Chemical Welfare Service of the army. Prof. H. H. Kimball and Prof. J. W. Smith of the Weather Bureau will be in charge of this work. It is proposed to set up instrument shelters over a large area, and to cover a part of this area with a smoke screen on nights favorable for frost. Temperature readings in both the covered and uncovered areas will be made and compared.

It is believed that several tests of this kind will establish the feasibility of this method of frost protection and make it possible for the Weather Bureau to decide whether it is economical and practical.

Alcohol Interests to Produce Potash and Fertilizer

Two Baltimore concerns, the United States Chemical Co. and the research department of the United States Industrial Alcohol Co., are planning improvements which are estimated at not less than $1,000,000.

The reclamation plant, which manufactures potash for agricultural purposes, is to be enlarged and its capacity increased.

The plans include the erection of a fertilizer factory, which will utilize directly the potash produced there and will be a complete mixed fertilizer producing unit.

Imports at New York

April 20 to April 27

ACIDS—400 csk. citric, Palermo, Order, 20 cs stearic, Rotterdam, M W Parsons, 140 cs formic, Rotterdam, R. W. Greeff & Co, 40 dr. cresylic, Glasgow, Order; 60 kegs hydrosulphite, Liverpool, Kuttroff, Pickardt Co, 24 dr. cresylic, Liverpool, Jordan Bros., 67 dr. cresylic, Livorpool, Order, 3 bbl acetic, Genoa, Bush, Beach & Gent

ALCOHOL—80 bbl. denatured, Arecibo, C Esteva, 25 bbl. do, Arecibo, M Felgel Bros

ALUM—75 csk, Hamburg, Order

AMMONIUM—15 pkg. carbonate, Liverpool Brown Bros. & Co.

ARGOLS 27 csk. Liverpool, Royal Baking Powder Co.

ARSENIC—130 csk, Liverpool, Order, 100 bbl., Tampico, American Metal Co., 50 cs., Rio de Janeiro, Order.

ASPHALTUM—428 sk, Havana, Lamson Asphalt & Chemical Co.

BORAX — 16 bbl., Cienfuegos, Knauth Bros

BRONZE POWDER — 21 cs., Bremen, Gerstendorfer Bros., 17 cs, Bremen, B. F Drackenfeld & Co.; 15 cs, Bremen, Fuchs & Lang Mfg. Co

CASEIN 210 sk, Wellington, Asia Banking Corp., 267 bg, Havre, National City Bank, 667 bg., Buenos Aires, Nat'l City Bank, 1,251 bg., Buenos Aires, Bank of America, 1,231 bg., Buenos Aires, Order

CHALK 900 pkg, Antwerp, Bankers Trust Co, 822,998 kilos, Dunkirk, Taintor Trading Co, 508,073 kilos, Dunkirk, J. W Higman Co

CHEMICALS—5 csk., Hamburg, Pfaltz & Bauer, 3 cs, Hamburg, Merck & Co., 105 pkg, Hamburg, Order

COPRA 1,203 bg, Kingston, Franklin Baker Co, 150 bg, Port Antonio, Order

COPPER SULPHATE—160 csk., Marseilles, Order; 200 csk., Liverpool, Order, 60 csk., Marseilles, Order

COLORS — 29 pkg., Bremen, Hensel, Bruckmann & Lorbacher, 68 csk earth, Bremen, L H. Butcher Co, 16 csk. ultromarine, Liverpool, Fezandie & Sperrle, 2 cs aniline, Hamburg, H. A. Metz & Co, 6 csk. do, Hamburg, Franklin Imp & Exp Co, 10 csk. do., Hamburg, E C. Foster; 5 csk. do., Hamburg, H. R. Jahn; 26 csk. aniline, 2 dr do, 2 bbl do., 1 cs. do, Genoa, Wetterwold & Pfeister; 4 pkg aniline, Genoa, H R. Ackermann, 1 bbl aniline, Genoa, Am. Aniline Products Co; 101 cs. dyes, Genoa, National Aniline Chem. Co, 12 bbl aniline, Genoa, Bachmeier & Co., 17 bbl aniline colors, Genoa, Order, 18 csk. earth, Havre, Reichard-Coulston, Inc.; 8 csk colors, Havre, Italian Discount & Trust Co, 58 csk earth, Rotterdam Heller & Merz Co, 8 pkg. aniline, Rotterdam, Wetterwold & Pfeister; 11 pkg. aniline, Rotterdam, H A Metz & Co, 200 pkg red, Havre, Heemsoth, Basse Co., 12 csk. aniline, Havre, Sandoz Chem. Works 5 csk do, Havre, Order, 7 cs. do, Havre, Irving Bank, 3 csk. aniline, Liverpool, Order; 203 pkg. earth, Leghorn, Reichard-Coulston, Inc, 88 bbl earth, Leghorn, Order; 64 csk. ocher, Marseilles, Bankers Trust Co.; 100 csk. ocher, Marseilles, Metropolitan Trust Co; 488 csk. ocher, Marseilles, Reichard-Coulston, Inc; 60 csk ocher, Marseilles, Order

DEXTRINE—250 bg, Rotterdam, Stein, Hall & Co

DIVI-DIVI — 818 bg., Curacao, Selma Merc Corp.

FERTILIZER—20 bg chemical, London, C. Schwake & Co.

FERRO-CHROME — 546 csk, Gothenburg, C Hardy & Ruperti, 15 csk. Gothenburg, Heydemann & Co

GLAUBERS SALT 168 pkg, Hamburg, Roessler & Hasslacher Chem. Co

GLYCERINE—70 dr, Marseilles, Order, 58 dr, Buenos Aires, Core & Herbert.

GUMS—395 bg yacca, Port Adelaide, W. Schall & Co; 13 bg. copal, London, S. Winterbourne & Co., 100 bg gum, London, Anglo Egypt. Bank; 24 bg. tragacanth, London, Order; 36 bg. copal, London, Order; 100 cs. damar, Batavia, W. Schall & Co, 500 cs damar, Batavia, Order; 100 cs. damar, Singapore, Chase Nat'l Bank; 447 cs elemi, Manila, H. Dobler.

IRON OXIDE—72 csk., Liverpool, J. A. McNulty; 10 csk., Liverpool, Toch Bros.; 10 csk. Liverpool, Order.

LYCOPODIUM—4 pkg., Danzig, Rapaport Food Products.

LOGWOOD—1,743,588 lb., Hayti, Oakes Mfg. Co.

MAGNESIUM—250 bg. calcined, Rotterdam, H. J Baker & Bro; 140 csk. calcined, Glasgow, Brown Bros. & Co., 250 bg carbonate, Glasgow, Order.

MYROBOLANS — 7,635 pkt, Calcutta, Order.

NAPHTHALENE 720 bg., Liverpool, Order.

QUEBRACHO — 411 bg., Buenos Aires, Columbia Trust Co.

OILS—**Cod**—300 csk, St. Johns National Oil Products Co.; 200 csk., St Johns, R. Badcock & Co. **Fusel**—17 bbl., Riga, Order **Linseed**—176 bbl., Rotterdam, Elbert & Co., 177 bbl, Rotterdam, Welch, Holme & Clark Co., 141 bbl, Rotterdam, F D Lockwood; 570 bbl., Rotterdam, Nat'l Lead Co., 141 bbl., Rotterdam, Meteor Products Co., 115 bbl., Rotterdam, Bur-Mac Chemical Co, 100 bbl, Rotterdam, Nat'l City Bank, 1,688 bbl., Rotterdam, Order, 8,219 bg., Buenos Aires, Order; 300 bbl., Copenhagen, Order **Olive Foots** (sulphur oil)—100 csk, Leghorn, Am Co for Int'l Commerce **Palm**—214 csk., Rotterdam, Order; 189 csk, Liverpool, Niger Co, 34 csk., Liverpool, Fourth St. Nat'l Bank, 99 csk., Liverpool, Order **Palm kernel**—48 bbl, Liverpool, E. F Drew & Co. **Rapeseed**—10 bbl, Rotterdam, Order.

PLUMBAGO—200 bbl., Colombo, H. P Winter & Co, 384 bbl. Colombo, Brown Bros. & Co., 483 bbl, Colombo, H. W Peabody & Co.; 20 bbl., Colombo, Nat'l City Bank, 443 pkg., Colombo, First Federal Foreign Banking Association

POTASSIUM SALTS 2,000 bg. sulphate, Bremen, A Vogel; 256 csk. salts, Hamburg, Superfos Co., 2,000 bg muriate, 2,500 bg sulphate, 4,000 bg. manure salt, Hamburg, Order, 18 bbl. prussiate, Hamburg, Order, 200 dr. permanganate, Hamburg, Order, 40 dr. permanganate, London, R. W Greeff & Co.; 60 kegs prussiate, Liverpool, Order.

PHOSPHATE—300 bg. bone, Antwerp, Hollinghurst & Co., 500 bg do, Antwerp, Order

SAL AMMONIAC — 20 bbl, Hamburg, Roessler & Hasslacher Chem. Co.

SEEDS—**Linseed**—28,866 bg., Rosario, Spencer Kellogg & Sons, 44,221 bg., Rosario, Order, 19,730 bg, Rosario, Am. Exchange Nat'l Bank; 6,234 bg, Rosaria, Am. Linseed Co.; 24,899 bg., Rosario, Am Linseed Co; 32,688 bg., Villa Constitucion, Order, 32,552 bg., San Nicolas, Order.

SHELLAC — 10 cs., Hamburg, Irving Bank-Col. Trust Co.; 516 pkg, 30 pkg button, 150 pkg. garnet, Calcutta, Bank of British West Africa; 500 bg., Calcutta, Irving Bank-Col. Trust Co, 200 bg., Calcutta, N Y. Trust Co, 109 bg, Calcutta, Lee, Higginson & Co; 100 bg., Calcutta, N. Y. Trust Co.; 2,036 pkg., Calcutta, Order.

SILVER SULPHIDE—Antofagasta, Am Smelting & Refining Co.

SODIUM SALTS—300 csk. hyposulphite, Hamburg, Order; 22 csk. perborate, Hamburg, E. Suter & Co.; 6,320 sk. sulphate, Antogafasta, Graham, Rowe & Co; 15,281 bg nitrate, Iquique, Baring Bros & Co, 336 cs. salts, Havre, Nat'l City Bank, 23 csk. prussiate, Liverpool, H. J. Baker Bros.

STARCH—250 bg. potato, Rotterdam, J. Wertheimer & Sons; 250 bg do., Rotterdam, G. J Kluyskeus, 500 bg. Starch, Rotterdam. Spier, Simmons Co

STRONTIUM NITRATE—37 csk., Hamburg, Order.

SUMAC — 20 csk. extract, Glasgow, American Dyewood Co

TALC—1,000 bg, Genoa, Italian Discount & Trust Co

TALLOW — 180 bbl., Vancouver, Van Iderstine Co.; 23 bbl., Ponce, Swift & Co., 295 csk., Buenos Aires, Bank of the Manhattan Co.

TARTAR—600 bg, Buenos Aires Tartar Chem. Co.; 199 sk, Marseilles, Royal Baking Powder Co.; 110 sk., Marseilles, C. Pfizer & Co.

WAXES—21 bg. bees, London, Order; 16 bg. bees, San Antonio Order; 62 bg. bees, Talcahuano, Order; 40 cs. bees, Havre, Salomon Bros.; 50 bg. bees, Singapore, A. M. Allison & Co.; 25 bg. bees, Havana, W. H. Bowdlear Co.; 25 bg. bees, Havana, Order.

ZINC WHITE—25 bbl., Marseilles, Order.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available. In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb.	$0.38 - . . .
Acetone, drums	lb.	.25 - .25½
Acid, acetic, 28%, bbl.	100 lb.	3.17½ - 3.92½
Acetic, 56%, bbl.	100 lb.	6.35 - 6.37
Glacial, 99½%, bbl.	100 lb.	12.05 - 12.85
Boric, bbl.	lb.	.11 - .11½
Citric, kegs	lb.	.49 - .50
Formic, 85%	lb.	.14½ - .17
Gallic, tech	lb.	.45 - .50
Hydrofluoric, 52%, carboys	lb.	.12 - .12½
Lactic, 44%, tech., light, bbl.	lb.	.11½ - .12
22%, tech., light, bbl.	lb.	.05½ - .06
Muriatic, 18° tanks	100 lb.	.90 - 1.00
Muriatic, 20°, tanks	100 lb.	1.00 - 1.10
Nitric, 36°, carboys	lb.	.04½ - .05
Nitric, 42°, carboys	lb.	.06 - .06½
Oleum, 20%, tanks	ton	18.50 - 19.00
Oxalic, crystals, bbl.	lb.	.13½ - .13¾
Phosphoric, 50%, carboys	lb.	.07½ - .08½
Pyrogallic, resublimed	lb.	1.50 - 1.60
Sulphuric, 60°, tanks	ton	9.50 - 11.00
Sulphuric, 60°, drums	ton	13.00 - 14.00
Sulphuric, 66°, tanks	ton	16.00 - 16.50
Sulphuric, 66° drums	ton	20.00 - 21.00
Tannic, U.S.P., bbl.	lb.	.65 - .70
Tannic, tech., bbl.	lb.	.45 - .50
Tartaric, imp. crys., bbl.	lb.	.36 - . . .
Tartaric, imp., powd., bbl.	lb.	.36 - . . .
Tartaric, domestic, bbl.	lb.	.36 - . . .
Tungstic, per lb.	lb.	1.10 - 1.20
Alcohol, butyl, drums, f.o.b. works	lb.	.26 - .28
Alcohol ethyl (Cologne spirit), bbl.	gal.	4.75 - 4.95
Ethyl, 190 p'f, U.S.P., bbl.	gal.	4.70 - . . .
Alcohol, methyl (see Methanol)		
Alcohol, denatured, 190 proof		
No. 1, special bbl.	gal.	.39 - .41
No. 1, special, dr.	gal.	.33 - .35
No. 1, 188 proof, bbl.	gal.	.40 - .42
No. 1, 188 proof, dr.	gal.	.34 - .36
No. 5, 188 proof, bbl.	gal.	.38 - .40
No. 5, 188 proof, dr.	gal.	.32 - .34
Alum, ammonia, lump, bbl.	lb.	.03½ - .03¾
Potash, lump, bbl.	lb.	.03 - .03½
Chrome, lump, potash, bbl.	lb.	.05½ - .05¾
Aluminum sulphate, com., bags	100 lb.	1.50 - 1.65
Iron free bags	lb.	.02¼ - .02½
Aqua ammonia, 26°, drums	lb.	.06½ - .07½
Ammonia, anhydrous, cyl.	lb.	.30 - .30½
Ammonium carbonate, powd. casks, imported	lb.	.09½ - .10
Ammonium carbonate, powd. domestic, bbl.	lb.	.13 - .14
Ammonium nitrate, tech., casks	lb.	.10 - .11
Amyl acetate tech., drums	gal.	3.50 - 3.75
Arsenic, white, powd., bbl.	lb.	.15½ - .16
Arsenic, red, powd., kegs	lb.	.14½ - .15
Barium carbonate, bbl.	ton	78.00 - 80.00
Barium chloride, bbl.	ton	90.00 - 95.00
Barium dioxide, drums	lb.	.18 - .18½
Barium nitrate, casks	lb.	.08 - .08½
Barium sulphate, bbl.	lb.	.04 - .04½
Blanc fixe, dry, bbl.	lb.	.04½ - .04¾
Bleaching powder, f.o.b. wks., drums	100 lb.	2.15 - . . .
Spot N. Y. drums	100 lb.	2.60 - 2.70
Borax, bbl.	lb.	.05½ - .05¾
Bromine, cases	lb.	.28 - .30
Calcium acetate, bags	100 lb.	4.00 - 4.05
Calcium carbide, drums	lb.	.04½ - .04¾
Calcium chloride, fused, drums	ton	22.00 - 23.00
Gran. drums	lb.	.01½ - .01¾
Calcium phosphate, mono, bbl.	lb.	.06½ - .07
Camphor, cases	lb.	.88 - .90
Carbon bisulphide, drums	lb.	.07 - .07½
Carbon tetrachloride, drums	lb.	.10 - . . .
Chalk, precip.—domestic, light, bbl.	lb.	.04½ - .04¾
Domestic, heavy, bbl.	lb.	.03½ - .03¾
Imported, light, bbl.	lb.	.04½ - .05
Chlorine, liquid, cylinders	lb.	.06 - .06½
Chloroform, tech., drums	lb.	.35 - .38
Cobalt oxide, bbl.	lb.	2.10 - 2.25
Copperas, bulk, f.o.b. wks.	ton	16.50 - 20.00
Copper carbonate, bbl.	lb.	.19 - .20
Copper cyanide, drums	lb.	.47 - .50
Copper sulphate, crys., bbl.	100 lb.	6.00 - 6.25
Cream of tartar, bbl.	lb.	.25½ - .26½
Epsom salt, dom., tech., bbl.	100 lb.	1.90 - 2.15
Epsom salt, imp., tech., bags	100 lb.	1.10 - 1.25
Epsom salt, U.S.P., dom., bbl.	100 lb.	2.50 - 2.60
Ether, U.S.P., drums	lb.	.13 - .15
Ethyl acetate, com., 85%, drums	gal.	.80 - .85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 - 1.00
Formaldehyde, 40%, bbl.	lb.	.14½ - .16
Fullers earth—imp., powd., net ton		$30.00 - $32.00
Fusel oil, ref., drums	gal.	3.55 - 4.05
Fusel oil, crude, drums	gal.	2.30 - 2.40
Glaubers salt, wks., bags	100 lb.	1.20 - 1.40
Glaubers salt, imp., bags	100 lb.	1.00 - 1.25
Glycerine, c.p., drums extra	lb.	.18 - .18½
Glycerine, dynamite, drums	lb.	.16½ - .16¾
Iodine, resublimed	lb.	4.55 - 4.65
Iron oxide, red, casks	lb.	.12 - .18
Lead:		
White, basic carbonate, dry, casks	lb.	.09½ - .10
White, basic sulphate, casks	lb.	.09½ - . . .
White, in oil, kegs	lb.	.12½ - .14
Red, dry, casks	lb.	.11½ - .12
Red, in oil, kegs	lb.	.13½ - .15
Lead acetate, white crys., bbl.	lb.	.13½ - .14
Brown, broken, casks	lb.	.12 - . . .
Lead arsenate, powd., bbl.	lb.	.23 - .24
Lime-Hydrated, bbl.	per ton	16.80 - 17.00
Lime, Lump, bbl.	280 lb.	3.63 - 3.65
Litharge, comm., casks	lb.	.10¾ - .11
Lithophone, bags	lb.	.07 - .07¼
in bbl.	lb.	.07½ - .07¾
Magnesium carb., tech., bags	lb.	.08 - .08½
Methanol, 95%, bbl.	gal.	1.21 - 1.23
Methanol, 97%, bbl.	gal.	1.23 - 1.25
Nickel salt, double, bbl.	lb.	.10½ - . . .
Nickel salts, single, bbl.	lb.	.11½ - . . .
Phosgene		.60 - .75
Phosphorus, red, cases	lb.	.35 - .40
Phosphorus, yellow, cases	lb.	.30 - .35
Potassium bichromate, casks	lb.	.10½ - .11
Potassium bromide, gran., bbl.	lb.	.16½ - .23
Potassium carbonate, 80-85%, calcined, casks	lb.	.06½ - .07
Potassium chlorate, powd.	lb.	.07½ - .08
Potassium cyanide, drums	lb.	.45 - .50
Potassium, first sorts, cask	lb.	.09 - .09½
Potassium hydroxide (caustic potash) drums	100 lb.	8.25 - 8.50
Potassium iodide, cases	lb.	3.65 - 3.75
Potassium nitrate, bbl.	lb.	.06½ - .07½
Potassium permanganate, drums	lb.	.23 - .24
Potassium prussiate, red, casks	lb.	.77 - .79
Potassium prussiate, yellow, casks	lb.	.37 - .37½
Salammoniac, white, gran., casks, imported	lb.	.07 - .07½
Salammoniac, white, gran., bbl., domestic	lb.	.07½ - .08
Gray, gran., casks	lb.	.08 - .09
Salsoda, bbl.	100 lb.	1.20 - 1.40
Salt cake (bulk)	ton	26.00 - 28.00
Soda ash, light, 58% flat, bags, contract	100 lb.	1.60 - 1.67
Soda ash, light, basis, 48%, bags, contract, f.o.b. wks.	100 lb.	1.20 - 1.30
Soda ash, light, 58%, flat, bags, resale	100 lb.	1.75 - 1.80
Soda ash, dense, bags, contract, basis 48%	100 lb.	1.17½ - 1.20
Soda ash, dense, in bags, resale	100 lb.	1.85 - 1.90
Soda, caustic, 76%, solid, drums, f.a.s.	100 lb.	3.35 - 3.45
Soda, caustic, basis 60%, wks., contract	100 lb.	2.50 - 2.60
Soda, caustic, ground and flake, contracts	100 lb.	3.80 - 3.90
Soda, caustic, ground and flake, resale	100 lb.	3.72½ - . . .
Sodium acetate, works, bags	lb.	.05½ - .06½
Sodium bicarbonate, bbl.	100 lb.	2.00 - 2.50
Sodium bichromate, casks	lb.	.07½ - .08
Sodium bisulphate (niter cake)	ton	6.00 - 7.00
Sodium bisulphite, powd., U.S.P., bbl.	lb.	.04½ - .04¾
Sodium chlorate, kegs	lb.	.06½ - .07
Sodium chloride	long ton	12.00 - 13.00
Sodium cyanide, cases	lb.	.20 - .23
Sodium fluoride, bbl.	lb.	$0.09½ - $0.10
Sodium hyposulphite, bbl.	lb.	.02½ - .03
Sodium nitrite, casks	lb.	.08½ - .09
Sodium peroxide, powd., cases	lb.	.28 - .30
Sodium phosphate, dibasic, bbl.	lb.	.03½ - .04
Sodium prussiate, yel. drums	lb.	.17½ - .18
Sodium silicate (40° drums)	100 lb.	.80 - 1.25
Sodium silicate (60°, drums)	100 lb.	2.00 - 2.25
Sodium sulphide, fused, 60-62%, drums	lb.	.04½ - .04¾
Sodium sulphite, crys., bbl.	lb.	.03½ - .03¾
Strontium nitrate, powd., bbl.	lb.	.09½ - .10
Sulphur chloride, yel. drums.	lb.	.04½ - .05
Sulphur, crude	ton	18.00 - 20.00
At mine, bulk	ton	16.00 - 18.00
Sulphur, flour, bag	100 lb.	2.25 - 2.35
Sulphur, roll, bag	100 lb.	2.00 - 2.10
Sulphur dioxide, liquid, cyl.	lb.	.08 - .08½
Talc—imported, bags	ton	30.00 - 40.00
Talc—domestic powd., bags.	ton	18.00 - 25.00
Tin bichloride, bbl.	lb.	.13½ - .14
Tin oxide, bbl.	lb.	.50 - .52
Zinc carbonate, bags	lb.	.14 - .14½
Zinc chloride, gran, bbl.	lb.	.06 - .07
Zinc cyanide, drums	lb.	.37 - .38
Zinc oxide, lead free, bbl.	lb.	.08 - .08½
5% lead sulphate, bags	lb.	.07½ - . . .
10 to 35% lead sulphate, bags	lb.	.07 - . . .
French, red seal, bags	lb.	.09½ - . . .
French, green seal, bags	lb.	.10½ - . . .
French, white seal, bbl.	lb.	.12 - . . .
Zinc sulphate, bbl.	100 lb.	2.50 - 3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb.	$0.70 - $0.80
Alpha-naphthol, ref., bbl.	lb.	.85 - .95
Alpha-naphthylamine, bbl.	lb.	.36 - .38
Aniline oil, drums	lb.	.16 - .16½
Aniline salts, bbl.	lb.	.24 - .25
Anthracene, 80%, drums	lb.	.75 - 1.00
Anthracene, 80%, imp., drums, duty paid	lb.	.70 - .75
Anthraquinone, 25%, paste, drums	lb.	.70 - .75
Benzaldehyde U.S.P., carboys	lb.	1.40 - 1.45
Benzene, pure, water-white, tanks and drums	gal.	.32 - .35
Benzene, 90%, tanks & drums	gal.	.27 - .30
Benzene, 90%, drums, resale	gal.	.30 - .33
Benzidine base, bbl.	lb.	.85 - .90
Benzidine sulphate, bbl.	lb.	.70 - .75
Benzoic acid, U.S.P., kegs	lb.	.72 - .75
Benzoate of soda, U.S.P., bbl.	lb.	.57 - .65
Benzyl chloride, 95-97%, ref., drums	lb.	.45 - . . .
Benzyl chloride, tech., drums	lb.	.35 - . . .
Beta-naphthol, subl., bbl.	lb.	.55 - .60
Beta-naphthol, tech., bbl.	lb.	.23 - .23½
Beta-naphthylamine, tech.	lb.	.80 - .90
Carbazol, bbl.	lb.	.75 - .90
Cresol, U.S.P., drums	lb.	.25 - .29
Ortho-cresol, drums	lb.	.28 - .30
Cresylic acid, 97%, resale, drums	gal.	1.30 - . . .
95-97%, drums, resale	gal.	1.25 - . . .
Dichlorbenzene, drums	lb.	.07 - .09
Diethylaniline, drums	lb.	.50 - .60
Dimethylaniline, drums	lb.	.42 - .43
Dinitrobenzene, bbl.	lb.	.19 - .20
Dinitroclorbenzene, bbl.	lb.	.22 - .23
Dinitronaphthalene, bbl.	lb.	.30 - .32
Dinitrophenol, bbl.	lb.	.35 - .40
Dinitrotoluene, bbl.	lb.	.20 - .22
Dip oil, 25%, drums	gal.	.25 - .30
Diphenylamine, bbl.	lb.	.50 - .52
H-acid, bbl.	lb.	.85 - . . .
Meta-phenylenediamine, bbl.	lb.	1.00 - 1.05
Michlers ketone, bbl.	lb.	3.00 - 3.50
Monochlorbenzene, drums	lb.	.08 - .10
Monoethylaniline, drums	lb.	.95 - 1.10
Naphthalene, crushed, bbl.	lb.	.08 - .09
Naphthalene, flake, bbl.	lb.	.09½ - .10
Naphthalene, balls, bbl.	lb.	.10 - .10½
Naphthionate of soda, bbl.	lb.	.58 - .65
Naphthionic acid, crude, bbl.	lb.	.55 - .66
Nitrobenzene, drums	lb.	.10 - .12
Nitro-naphthalene, bbl.	lb.	.30 - .35
Nitro-toluene, drums	lb.	.15 - .17
N-W acid, bbl.	lb.	1.25 - 1.30
Ortho-amidophenol, kegs	lb.	2.30 - 2.35
Ortho-dichlorbenzene, drums	lb.	.17 - .20
Ortho-nitrophenol, bbl.	lb.	.90 - .92
Ortho-nitrotoluene, drums	lb.	.10 - .12
Ortho-toluidine, bbl.	lb.	.14 - .15
Para-amidophenol, base, kegs	lb.	1.20 - 1.30
Para-amidophenol, HCl, kegs	lb.	1.25 - 1.35
Para-dichlorbenzene, bbl.	lb.	.17 - .20
Paranitraniline, bbl.	lb.	.74 - .75
Para-nitrotoluene, bbl.	lb.	.60 - .65
Para-phenylenediamine, bbl.	lb.	1.45 - 1.50
Para-toluidine, bbl.	lb.	.95 - .98
Phthalic anhydride, bbl.	lb.	.35 - .38
Phenol, U.S.P., drums	lb.	.57 - .58
Picric acid, bbl.	lb.	.20 - .22
Pyridine, dom., drums	gal.	nominal
Pyridine, imp., drums	gal.	2.50 - 2.75

Resorcinol, tech., kegs	lb.	$1.40 - $1.50
Resorcinol, pure, kegs	lb.	2.00 - 2.10
R-salt, bbl	lb.	.55 - .60
Salicylic acid, tech., bbl	lb.	.47 - .48
Salicylic acid, U.S.P., bbl	lb.	.50 - .52
Solvent naphtha, water-white, drums	gal.	.37 - .40
Crude, drums	gal.	.22 - .24
Sulphanilic acid, crude, bbl	lb.	.18 - .20
Thiocarbanilide, kegs	lb.	.35 - .38
Toluidine, kegs	lb.	1.20 - 1.30
Toluidine, mixed, kegs	lb.	.30 - .35
Toluene, tank cars	gal	.30 - .35
Toluene, drums	gal.	.35 - .40
Xylidines drums	lb.	.45 - .47
Xylene, pure, drums	gal.	.75 - .85
Xylene, com., drums	gal	.37 - ...
Xylene, com., tanks	gal.	.32 - ...

Naval Stores

Rosin B-D, bbl	280 lb.	$6.25 - 6.35
Rosin E-I, bbl	280 lb.	6.35 - 5.46
Rosin K-N, bbl	280 lb.	6.40 - 6.50
Rosin W.G.-W W., bbl	280 lb	6.80 - 7.80
Wood rosin, bbl	280 lb	6.20 -
Turpentine, spirits of, bbl	gal	1.42 -
Wood, steam dist., bbl	gal	1.36 -
Wood, dest. dist., bbl	gal	1.10 - 1.15
Pine tar pitch, bbl	200 lb	- 6.00
Tar, kiln burned, bbl	500 lb	- 12.00
Retort tar, bbl	500 lb	- 11.00
Rosin oil, first run, bbl	gal	.45 -
Rosin oil, second run, bbl	gal	.48 - ...
Rosin oil, third run, bbl	gal.	.52 -
Pine oil, steam dist	gal	.80 - ...
Pine oil, pure, dest. dist	gal	.75 - ...
Pine tar oil, ref.	gal	.48 - ...
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal.	.32 - .32½
Pine tar oil, double ref., bbl	gal.	- .75
Pine tar, ref., thin, bbl	gal.	- .25
Pinewood creosote, ref., bbl	gal.	... - .52

Animal Oils and Fats

Degras, bbl	lb.	$0.03½ - $0.04
Grease, yellow, bbl	lb	.08½ - .08¾
Lard oil, Extra No. 1, bbl	gal.	.92 - .94
Neatsfoot oil, 20 deg. bbl.	gal.	1.28 - 1.32
No. 1, bbl	gal.	.92 - .94
Oleo Stearine		.10½ -
Red oil, distilled, d.p. bbl	lb	.11½ -
Saponified, bbl	lb	.11½ -
Tallow, extra, loose	lb	.08½ -
Tallow oil, acidless, bbl	gal	.95 - .97

Vegetable Oils

Castor oil, No. 3, bbl	lb	$0.14 -
Castor oil, No. 1, bbl	lb	.14½ -
Chinawood oil, bbl.	lb	.40 -
Coconut oil, Ceylon, bbl	lb.	.10½ - .10¾
Ceylon, tanks, N.Y.	lb	.09½ -
Coconut oil, Cochin, bbl	lb	.10½ - ...
Corn oil, crude, bbl	lb	.12½ -
Crude, tanks, (f.o.b. mill)	lb	.10½ - .10¾
Cottonseed oil, crude (f.o.b. mill), tanks	lb	.10 - .10½
Summer yellow, bbl	lb	.12½ - .12¾
Winter yellow, bbl.	lb	.13½ - .13¾
Linseed oil, raw, car lots, bbl	gal	1.17 -
Raw, tank cars (dom.)	gal	1.12 -
Boiled, cars, bbl (dom.)	gal.	1.19 - ...
Olive oil, denatured, bbl.	gal	1.15 -
Sulphur, (foots) bbl	lb	.10 - .10½
Palm, Lagos, casks	lb	.08½ - ...
Niger, casks	lb	.08½ - .08¾
Palm kernel, bbl	lb	.09½ - .10
Peanut oil, crude, tanks (mill)	lb	.13½ -
Peanut oil, refined, bbl.	lb	.17 -
Perilla, bbl	lb	.16½ - .16¾
Rapeseed oil, refined, bbl	gal	.84 - .85
Rapeseed oil, blown, bbl	gal	.90 - .91
Sesame, bbl	lb	.13 - .13½
Soya bean (Manchurian), bbl	lb	.13½ - ...
Tank, f.o.b. Pacific coast	lb	.10½ -
Tank, (f.o.b. N.Y.)	lb	.11 -

Fish Oils

Cod, Newfoundland, bbl	gal	$0.68 - $0.70
Menhaden, light pressed, bbl.	gal	.76 -
White bleached, bbl	gal	.78 -
Blown, bbl.	gal.	.82 -
Crude, tanks (f.o.b. factory)	gal	.53 - ...
Whale No. 1 crude, tanks, coast	lb	.06½ - ...
Winter, natural, bbl	gal	.76 - .78
Winter, bleached, bbl	gal	.79 - .80

Oil Cake and Meal

Coconut cake, bags	ton	$32.00 - ...
Copra, sun dried, bags, (c.i.f.)	lb	.05½ - ...
Sun dried Pacific coast	lb	.05½ - ...
Cottonseed meal, f.o.b. mills	ton	39.00 - 40.00
Linseed cake, bags	ton	6.00 - ...
Linseed meal, bags	ton	38.00 - ...

Dye & Tanning Materials

Albumen, blood, bbl	lb.	$0.45 - $0.50
Albumen, egg, tech, kegs	lb.	.80 - .85
Cochineal, bags	lb	.35 - .36
Cutch, Borneo, bales	lb.	.04½ - .05
Cutch, Rangoon, bales	lb.	.13 - .13½
Dextrine, corn, bags	100 lb.	3.64 - 3.69
Dextrine, gum, bags	100 lb	3.99 - 4.09
Divi-divi, bags	ton	38.00 - 39.00
Fustic, sticks	ton	30.00 - 35.00
Fustic, chips, bags	lb.	.04 - .05
Logwood, sticks	ton	28.00 - 30.00
Logwood, chips, bags	lb.	.02½ - .03¼
Sumac, leaves, Sicily, bags	ton	$70.00 - $72.00
Sumac, ground, bags	ton	65.00 - 67.00
Sumac, domestic, bags	ton	40.00 - 42.00
Starch, corn, bags	100 lb	2.97 - 3.07
Tapioca flour, bags	lb.	.05½ - .06½

Extracts

Archil, conc., bbl.	lb.	$0.17 - $0.18
Chestnut, 25% tannin, tanks	lb.	.02 - .03
Divi-divi, 25% tannin, bbl	lb.	.04 - .05
Fustic, crystals, bbl.	lb	.20 - .22
Fustic, liquid, 42°, bbl.	lb.	.08 - .09
Gambier, liq., 25% tannin, bbl.	lb.	.08 - .09
Hematine crys., bbl.	lb.	.14 - .18
Hemlock, 25% tannin, bbl.	lb.	.04 - .05
Hypernic, solid, drums	lb.	.24 - .26
Hypernic, liquid, 51°, bbl	lb.	.14 - .17
Logwood, crys., bbl	lb.	.19 - .20
Logwood, liq., 51°, bbl	lb.	.09 - .10
Quebracho, solid, 65% tannin, bbl	lb.	.04½ - .05
Sumac, dom., 51°, bbl.	lb.	.06½ - .07

Dry Colors

Blacks Carbongas, bags, f.o.b. works	lb	$0.16 - $0.18
Lampblack, bbl	lb	.12 - .40
Mineral, bulk	ton	35.00 - 45.00
Blues Bronze, bbl	lb.	.55 - .60
Prussian, bbl	lb.	.55 - .60
Ultramarine, bbl	lb	.08 - .35
Browns, Sienna, Ital., bbl	lb	.06 - .14
Sienna, Domestic, bbl	lb.	.03½ - .04
Umber, Turkey, bbl	lb.	.04 - .04½
Greens-Chrome, C.P. Light, bbl	lb.	.32 - .34
Chrome, commercial, bbl	lb.	.12 - .12½
Paris, bulk	lb.	.30 - .35
Reds, Carmine No. 40, tins	lb	4.50 - 4.70
Oxide red, casks	lb.	.10 - .14
Para toner, kegs	lb.	1.00 - 1.10
Vermilion, English, bbl	lb.	1.30 - 1.32
Yellow, Chrome, C.P. bbls	lb	.20 - .21
Ocher, French, casks	lb	.02½ - .03

Waxes

Bayberry, bbl	lb.	$0.28 - $0.30
Beeswax, crude, bags	lb.	.21 - .25
Beeswax, refined, light, bags	lb.	.32 - .34
Beeswax, pure white, cases	lb.	.40 - .41
Candelilla, bags	lb.	.24 - .25
Carnauba, No. 1, bags	lb.	.42 - .43
No. 2, North Country, bags	lb.	.23 - .23½
No. 3, North Country, bags	lb.	.19½ - ...
Japan, cases	lb.	.14½ - .15
Montan, crude, bags	lb.	.04½ - .04¾
Paraffine, crude, match, 105-110 m.p.	lb.	.04½ - .04¾
Crude, scale 124-126 m.p., bags	lb.	.03½ - .03
Ref., 118-120 m.p., bags	lb.	.03½ - ...
Ref., 125 m.p., bags	lb.	.03¾ - ...
Ref., 128-130 m.p., bags	lb.	.04½ - .04¾
Ref., 133-135 m.p., bags	lb.	.04½ - ...
Ref., 135-137 m.p., bags	lb.	.05½ - .05¾
Stearic acid, sgle pressed, bags	lb.	.13½ - ...
Double pressed, bags	lb.	.14½ - ...
Triple pressed, bags	lb.	.15½ - .16

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb	$3.25 - $3.30
F.a.s. double bags	100 lb	3.85 - 3.90
Blood, dried, bulk	unit	4.25 -
Bone, raw, 3 and 50, ground	ton	27.00 - 30.00
Fish scrap, dom., dried, wks.	unit	nominal
Nitrate of soda, bags	100 lb.	2.60 - 2.65
Tankage, high grade, f.o.b. Chicago	unit	3.25 - 3.50
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$4.00 - $4.50
Tennessee, 78-80%	ton	8.00 - 8.25
Potassium muriate, 80%, bags	ton	35.00 - 36.00
Potassium sulphate, bags basis 90%	ton	45.67 - ...

Crude Rubber

Para—Upriver fine	lb.	$0.28 -
Upriver coarse	lb.	.26 -
Upriver caucho ball	lb.	.26½ -
Plantation—First latex crepe	lb.	.32 -
Ribbed smoked sheets	lb.	.32 - ...
Brown crepe, thin, clean	lb.	.30 - ...
Amber crepe No. 1	lb.	.31½ - .32

Gums

Copal, Congo, amber, bags	lb	$0.18½ - $0.19
East Indian, bold, bags	lb	.22 - .23
Manila, pale, bags	lb.	.21 - .22
Pontinak, No. 1 bags	lb.	.21 - .22
Damar, Batavia, cases	lb	.30½ - .31
Singapore, No. 1, cases	lb.	.34½ - .35
Kauri, No. 1, cases	lb.	.62 - .66
Ordinary chips, cases	lb.	.18 - .20
Manjak, Barbados, bags	lb.	.09 - .09½

Shellac

Shellac, orange fine, bags	lb.	$0.74 -
Orange superfine, bags	lb.	.76 - ...
A. C. garnet, bags	lb.	nominal
Bleached, bonedry	lb.	.84 - ...
Bleached, fresh	lb.	.72 - ...
T. N., bags	lb.	.70 - .71

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh. ton	$500.00 - ...
Asbestos, shingle, f.o.b., Quebec	sh. ton	$65.00 - $85.00
Asbestos, cement, f.o.b., Quebec	sh. ton	20.00 - 25.00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	16.00 - 20.00
Barytes, grd., off-color, f.o.b. mills bulk	net ton	13.00 - 15.00
Barytes, floated, f.o.b. St. Louis, bbl.	net ton	28.00 -
Barytes, crude f.o.b. mines, bulk	net ton	10.00 - 11.00
Casein, bbl., tech	lb.	.23 - .25
China clay (kaolin) crude, f.o.b. Ga.	net ton	7.00 - 9.00
Washed, f.o.b. Ga.	net ton	8.00 - 9.00
Powd., f.o.b. Ga	net ton	13.00 - 20.00
Crude f.o.b. Va.	net ton	8.00 - 12.00
Ground, f.o.b. Va.	net ton	13.00 - 20.00
Imp., lump, bulk	net ton	15.00 - 20.00
Imp., powd.	net ton	45.00 - 50.00
Feldspar, No. 1 pottery	long ton	6.00 - 7.00
No. 2 pottery	long ton	5.00 - 5.50
No. 1 soap	long ton	7.00 - 7.50
No. 1 Canadian, f.o.b. mill	long ton	25.00 - 27.00
Graphite, Ceylon, lump, first quality, bbl	lb.	.06 - .06½
Ceylon, chip, bbl.	lb.	.05 - .05½
High grade amorphous crude	ton	35.00 - 50.00
Gum arabic, amber, sorts, bags	lb.	.15 - .16
Gum tragacanth, sorts, bags	lb.	.50 - .60
No. 1, bags	lb.	1.60 - 1.65
Kieselguhr, f.o.b. Cal.	ton	40.00 - 42.00
F.o.b. N.Y.	ton	50.00 - 55.00
Magnesite, crude, f.o.b. Cal.	ton	14.00 - 15.00
Pumice stone, imp., casks.	lb.	.03 - .05½
Dom., lump, bbl.	lb.	.05 - .05½
Dom., ground, bbl.	lb.	.06 - .07
Silica, glass sand, f.o.b. Ind.	ton	2.00 - 2.50
Silica, sand blast, f.o.b. Ind.	ton	2.50 - 5.00
Silica, amorphous, 250-mesh, f.o.b. Ill.	ton	17.00 - 17.50
Silica, bldg. sand, f.o.b. Pa.	ton	2.00 - 2.75
Soapstone, coarse, f.o.b. Vt., bags	ton	7.00 - 8.00
Talc, 200 mesh, f.o.b., Vt., bags	ton	6.50 - 9.00
Talc, 200 mesh, f.o.b. Ga., bags	ton	7.00 - 9.00
Talc, 200 mesh, f.o.b. Los Angeles, bags.	ton	16.00 - 20.00

Mineral Oils

Crude, at Wells

Pennsylvania	bbl	$3.75 - ...
Corning	bbl	2.15 -
Cabell	bbl	2.41 -
Somerset	bbl	2.20 -
Illinois	bbl.	2.27 -
Indiana	bbl	2.28 -
Kansas and Oklahoma, 28 deg.	bbl.	1.40 -
California, 35 deg and up	bbl.	1.04 -

Gasoline, Etc.

Motor gasoline, steel bbls	gal.	$0.23½ - ...
Naphtha, V. M. & P. devd, steel bbls.	gal	.22½ -
Kerosene, ref. tank wagon.	gal.	.14 -
Bulk, W. W. export	gal.	.07½ -
Lubricating oils		
Cylinder, Penn., dark	gal.	.27 - .30
Bloomless, 30@31 grav	gal.	.20 - .22
Paraffin, pale	gal.	.24 - .25
Spindle, 200, pale	gal.	.25 - .26
Petrolatum, amber, bbls	lb.	.05 - .05½
Paraffine wax (see waxes)		

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	ton	$45-50
Chrome brick, f.o.b. Eastern shipping points	ton	50-52
Chrome cement, 40-50% Cr_2O_3	ton	23-27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	40-46
2nd quality, 9-in. shapes, f.o.b. wks.	1,000	36-41
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65-68
9-in. arches, wedges and keys	ton	80-85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48-50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	48-50
F.o.b. Mt. Union, Pa.	1,000	42-44
Silicon carbide refract. brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N.Y.	ton	$200.00 - $225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11½ - .11¾
4-6% C	lb.	.12 - .13
Ferromanganese, 76-82% Mn, Atlantic seabd. duty paid	gr. ton	120.00 - ...
Spiegeleisen, 19-21% Mn	gr. ton	40.00 - ...
Ferromolybdenum, 50-60% Mo, per lb Mo	lb.	1.90 - 2.15
Ferrosilicon, 10-15%	gr. ton	38.00 - 40.00
50%	gr. ton	86.00 - 89.00
75%	gr. ton	150.00 - 160.00

Ferrotungsten, 70-80%, per lb. of W	lb.	$0.85 -	$0 90
Ferro-uranium, 35-50% of U per lb. of U... ...	lb.	6.00 -	.
Ferrovanadium, 30-40%, per lb. of V.........	lb.	3 75	- 4 00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points........ ...	ton	$6.50 -	$8 75
Chrome ore Calif. concentrates, 50% min Cr_2O_3.	ton	22 00 -	23 00
C.i.f. Atlantic seaboard...	ton	21 00 -	24 00
Coke, fdry, f.o b. ovens ...	ton	7 00	7 50
Coke, furnace, f.o.b. ovens...	ton	6 00 -	6 50
Fluorspar, gravel, f.o.b. mines' Illinois... ...	ton	19 00	21 00
Ilmenite, 52% TiO_2. ...	lb.	01¼	01½
Manganese ore, 50% Mn, c i f Atlantic seaport. .	unit	33 -	.
Manganese ore, chemical (MnO_2)	ton	75.00 -	80 00
Molybdenite, 85% MoS_2, per lb. MoS_2, N. Y. . .	lb	.65 -	70
Monazite, per unit of ThO_2, c i f., Atl. seaport....	lb.	.06 -	08
Pyrites, Span., fines, c.i.f. Atl seaport	unit	11½-	12
Pyrites, Span, furnace size, c i f Atl seaport. .	unit	11½-	12
Pyrites, dom fines, f.o.b. mines, Ga....... . .	unit	.12	
Rutile, 95% TiO_2 . . .	lb.	.12 -	
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8 50 -	8 75
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	8 00 -	8 25
Uranium ore (carnotite) per lb of U_3O_8	lb	3.50 -	3 75
Uranium oxide, 96% per lb. U_3O_8	lb	2 25 -	2 50
Vanadium pentoxide, 99%. .	lb.	12 00 -	14 00
Vanadium ore, per lb. V_2O_5 .	lb.	1 00 -	.
Zircon, washed, iron free, f.o.b. Pablo, Fla.......	lb.	.04½-	13

Non-Ferrous Materials

	Cents per Lb
Copper, electrolytic.	16½ 16¾
Aluminum, 98 to 99%..	23 24
Antimony, wholesale, Chinese and Japanese	8 - 8¼
Nickel, virgin metal.	28-30
Nickel, ingot and shot.	30-
Monel metal, shot and blocks.	32.00
Monel metal, ingots	38 00
Monel metal, sheet bars...... .. .	45 00
Tin, 5-ton lots, Straits	44 50
Lead, New York, spot.....	8 00
Lead, E St. Louis, spot	7 75
Zinc, spot, New York	7 35
Zinc, spot, E. St. Louis	7.00

Other Metals

Silver (commercial).	oz.	$0 67¼
Cadmium	lb.	1.00
Bismuth (500 lb. lots).. . .	lb.	2.55
Cobalt	lb.	2 65@2 85
Magnesium, ingots, 99%.....	lb.	1 25-
Platinum.......	oz.	115.00
Iridium	oz.	260 00@275 00
Palladium....	oz.	79.00
Mercury	75 lb.	69 00-

Finished Metal Products

	Warehouse Price Cents per Lb
Copper sheets, hot rolled...........	25.50
Copper bottoms	30.75
Copper rods.	25.25
High brass wire	19 50
High brass rods.	17.00
Low brass wire...................	21.10
Low brass rods..................	22 00
Brazed brass tubing..............	24.25
Brazed bronze tubing	29.00
Seamless copper tubing	25 25
Seamless high brass tubing.	23.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible.........	11.30@11.50
Copper, heavy and wire	11 25@11.50
Copper, light and bottoms..........	9.25@ 9.50
Lead, heavy......................	5.75@ 6.00
Lead, tea.........................	3.50@ 3.75
Brass, heavy.....................	6.25@ 6.40
Brass, light	5.35@ 5.75
No. 1 yellow brass turnings	6.30@ 6.50
Zinc..........	3.50@ 4.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes..............	$3.29	$3.14
Soft steel bars.................	3.19	3.04
Soft steel bar shapes...........	3.19	3.04
Soft steel bands...............	3.29	3.19
Plates, ¼ to 1 in. thick..........	3.29	3.14

Industrial

Financial, Construction and Manufacturing News

Construction and Operation

Alabama

PELHAM—The Superior Lime & Hydrate Co, recently organized, will immediately commence construction of a new plant on local site just acquired, to be equipped for a capacity of about 15,000 bbl. of hydrated lime per month It is estimated to cost close to $70,000, with machinery. The company is headed by H G. Bridgewater and W D. Lewis, Jr, P O Box 2311, Birmingham Ala

Arizona

WINKLEMAN—The Arizona Portland Cement Co., Phœnix, has acquired a tract of about 16 acres of land near Winkelman, and plans the construction of a new cement mill. It will consist of a number of buildings with power house, estimated to cost approximately $1,000,000, with machinery. Loren C. Barton, Corporation Bldg, Los Angeles, is assistant general manager, in charge

California

SAN DIEGO—The Vitrified Products Corp will commence the construction of a main 2-story building, 80x120 ft, for its proposed new plant in the Old Town district, to be equipped for the manufacture of vitrified sewer pipe and kindred hollowware. The installation will include a complete grinding and screening department; molding room; firing department and power house. The plant will cost $175,000 with machinery. Victor Kramer is president, and George W. Kummer, secretary and general manager.

LOS ANGELES—The California Cyanide Co, recently organized, has acquired property at Cudahy City, near Los Angeles, for the construction of its proposed plant, and purposes to break ground for the initial buildings at an early date. It will cost in excess of $500,000, with machinery. The company is headed by F W. Braun, president, the Braun Corporation, 363 New High St. The Air Reduction Sales Co., 342 Madison Ave., New York, is also interested in the new organization

Florida

KELSEY CITY—The Royal Palm Rubber Co, West Palm Beach, lately formed with a capital of $100,000, has acquired property on the Dixie Highway, and will have plans drawn at once for a new plant, to cost approximately $55,000, with machinery. William Manly King, West Palm Beach, is architect. C F. Laughlin is president; and Gordon Ware, West Palm Beach, secretary.

LAKELAND—The Non-Acid Fertilizer & Chemical Co. will hold in abeyance the construction of its proposed plant in the vicinity of Jacksonville, recently announced.

Georgia

AINSLIE—The Southern Portland Cement Co., Macon, Ga., recently organized under Delaware laws with capital of $6,000,000, will break ground in 60 days for its proposed new cement mill on local site, comprising a tract of 30 acres lately purchased. The plant will consist of a number of buildings, estimated to cost close to $1,000,000, with equipment. A power plant will be constructed. W. Jordan Masse, head of the Bibb Brick Co., Macon, is president.

Kansas

ANTHONY—The Anthony Salt Works, Inc., is perfecting plans for the rebuilding of its local plant, recently destroyed by fire with loss estimated at $250,000, including buildings and machinery. The new works will include a power house, and is estimated to cost a like amount.

Louisiana

SHREVEPORT—The Red River Refining Co. has preliminary plans under way for the construction of a new refining plant, estimated to cost about $500,000. A department will be established for the production of lubricating oils The company has recently increased its capital from $1,000,000 to $3,000,000, for general expansion.

LOREAUVILLE—The local refinery of the Vida Sugar Refining Co, Iberia parish, has been acquired by new interests headed by John O Bonin and John E Schwing. It is purposed to organize a company to operate the plant and plans are in progress for additions and improvements including the installation of machinery for increased output.

NEW ORLEANS—The American Tar & Turpentine Co, Broad St, will soon take bids on a general contract for the rebuilding of the portion of its plant, recently destroyed by fire with loss estimated at close to $100,000, with machinery The new structure will cost approximately a like amount.

Maine

RUMFORD—The Oxford Paper Co. has plans for the installation of additional equipment at its plant for considerable increase in production estimated to cost approximately $250,000

Massachusetts

HOLYOKE—The Chemical Paper Co. will make improvements at its plant to cost about $22,000.

FALL RIVER—The E S Parks Shellac Co., 844 South Main St. has awarded a contract to Joseph M Darling, Jr., 41 North Main St, for the erection of a 1-story addition, 50x100 ft., estimated to cost about $20,000.

Michigan

GRAND HAVEN—G. E. Burt, Muskegon, Mich, is organizing a new company to establish a local plant for the manufacture of a recently perfected processed product, similar to celluloid, to be known as kyloid. Plans for the works will be ready at an early date

IONIA—The Michigan Porcelain Tile Works, Inc., has authorized plans for enlargements in its plant to include the installation of additional equipment. The company has recently increased its capital from $100,000 to $150,000, for expansion. R A. Hawley is president; and Harvey E. Kidder, secretary and treasurer.

Mississippi

MOSS POINT—The Southern Paper Co. has broken ground for the construction of a new plant unit to cost in excess of $1,000,000 with machinery. It is purposed to more than double the present output.

Missouri

SPRINGFIELD—The Kream Olive Soap Co. has completed plans for the construction of a new plant on Glenstone Rd., comprising two 2-story structures, 40x110 ft. and 40x75 ft. respectively. Both buildings will be used for soap manufacture.

NEVADA—The National Asphalt Refining Co., recently organized with a capital of $1,500,000, has plans in progress for the construction of a new refining plant, on local site, estimated to cost approximately $400,000, with equipment.

ELSBERRY—The Crystal Carbonate Lime Co. has tentative plans for the rebuilding of the portion of its plant, recently destroyed by fire with loss estimated at about $65,000, including equipment.

New Jersey

NEWARK—The Eberhard Faber Rubber Co., 202-14 New St., has awarded a contract to Edward M. Waldron, Inc., 27 Central Ave., for the construction of an addition to its 4-story plant, 60x105 ft., estimated to cost $80,000.

ELIZABETH—The Standard Oil Co. of New Jersey, 26 Broadway, New York, has plans in preparation for the construction of a new oil-treating and filtering plant at its Bayway refinery, estimated to cost $200,000, with equipment. J. R. Carringer is superintendent.

NEWARK—The Capston Mfg. Co., 132 Union St., has acquired the factory on Plum Point Lane, formerly occupied by the Gulf Refining Co., consisting of a number of buildings, for the establishment of a new plant for the manufacture of oils greases, soaps, etc. The structures will be remodeled and machinery installed at once.

TRENTON—The State Highway Commission will have plans prepared in the near future for the construction of a state-operated cement manufacturing plant, as provided in a recent legislative bill, approved by Governor Silzer. An appropriation will be arranged.

New York

LONG ISLAND CITY—The Patterson-Sargent Co., Wason and Hamilton Sts., Cleveland, O., manufacturer of paints, varnishes, etc., has awarded a contract to the Guarantee Construction Co., 140 Cedar St., New York, for a 4-story and basement addition, 60x135 ft., at its plant on Hunters Point Ave., estimated to cost $500,000.

CORNING—The Roulette Glass Co., recently organized with a capital of $3,000,000, is reported to have plans in progress for the construction of a new plant for the manufacture of bottles and other hollow-ware. Dr. G. S. Goff is pres'dent, and Thomas F. Rogers, secretary, both of Corning.

BUFFALO—Pratt & Lambert, Inc., 79 Tonawanda St., manufacturer of varnishes, oils, etc., has filed plans for the erection of three 2-story additions to its plant to cost about $10,000.

BROOKLYN—A. Werbelovsky, 83 Meserole St., manufacturer of glass products, has completed plans for a new 2-story factory, 54x100 ft., at 57-59 Scholes St., estimated to cost $50,000.

Ohio

TOLEDO—The Ajax Rubber Co., Inc., Breunig Ave., Trenton, N. J., is planning for the erection of a new plant on local property recently acquired, estimated to cost in excess of $200,000, with machinery. Horace De Lisser is chairman of the board.

Oklahoma

DELAWARE—The Henderson Gasoline Co., is planning for the rebuilding of the portion of its refining plant, destroyed by fire, April 10, with loss estimated at $50,000, including equipment.

Pennsylvania

WILLIAMSPORT—The Keystone Glue Co. will make extensions and improvements in its plant, including the construction of a new power plant, estimated to cost about $200,000, with machinery.

EDGELY—The first unit of the new local mill of the Megargee Paper Co., Modena, Pa., will consist of a 3-story structure, 112x180 ft.; two 2-story buildings, 180x220 ft. and 75x200 ft. respectively; and a number of 1-story structures and power plant, the latter to have a capacity of 4,000 kw. As soon as this unit is completed, expected by the close of the year, work will be commenced on a second unit of approximately like size. The plant will cost in excess of $500,000, with machinery.

South Carolina

SPARTANBURG—The Farmers' Fertilizer Works has tentative plans under consideration for the rebuilding of the portion of its plant, recently destroyed by fire with loss estimated at about $25,000, including equipment.

Texas

TEXAS CITY—The Texas Sugar Refining Co., recently organized, has awarded a general contract to John Monks & Sons, 438 Broadway, New York, engineers, for the erection of the first unit of its new refinery on local site, to be equipped for a capacity of 500 tons per annum. It will cost in excess of $600,000.

BROWNWOOD—The HeLous Gasoline Co., Dallas, Tex., has commenced the erection of a new gasoline refining plant on local site, estimated to cost close to $250,000, with machinery.

BRECKENRIDGE—The Texas Carbon Industries, Inc., recently organized, has commissioned C. K. Springfield, engineer, Austin Street Railroad Co., Austin, Tex., to prepare plans for the construction of a new plant on local site for the manufacture of carbon black, estimated to cost about $175,000, with machinery. Bert Blair, Mexia, Tex., is president.

ELECTRA—The Texhoma Oil & Refining Co. has commenced the construction of a new local casinghead gasoline plant, to be equipped to handle 1,500 bbl. of oil per day. It will cost about $75,000. The initial unit will be enlarged at a later date.

Virginia

NORFOLK—The Norfolk Sugar Refining Co., recently formed with a capital of $3,500,000, is selecting a site on the waterfront for a new refining plant, estimated to cost in excess of $1,000,000, with machinery. Plans will be completed for the first unit at an early date. J. B. Morgan, Southern Produce Bldg., and R. B. Tucker, 112 Brooke Ave., head the new organization.

New Companies

PEERLESS CHEMICAL CO., INC., Richmond, Va.; chemicals and chemical byproducts, $20,000. Ernest W. Farley, president; and Thomas J. Starke, secretary, both of Richmond.

KLOR-N CHEMICAL CORP., Buffalo, N. Y.; chemicals and chemical byproducts, $10,000. Incorporators: J. M. and D. L. Chernaik, and F. J. O'Neill. Representative: Moore & Killian, Gluck Bldg., Niagara Falls, N. Y.

COLONIAL INSECTECIDE CO., Boston, Mass., chemicals and insecticides; $5,000. Frederick S. Gore, president, and A. M. Cape, Allston, Mass., treasurer and representative.

STANDARD ABRASIVE CO., Jersey City, N. J., abrasive products, grinding materials, etc., $25,000. Incorporators: Marshall Van Winkle, Jr., Herman A. Ahlers, Jr. and Benjamin L. Drapeau, 419 Pacific Ave., Jersey City.

ROULETTE GLASS CO., Dover, Del., glass products, $3,200,000. Representative: Capital Trust Co. of Delaware, Dover, Del.

MISKO REFINERIES, INC., Laredo, Tex., construct and operate oil-refining plants, $200,000. Incorporators: O. W. Killam, S. P. Coblentz and W. T. Killam, all of Laredo.

GLOBE GASOLINE CO., Glasgow, Ky.; construct and operate oil and gasoline refineries, $200,000. Incorporators: W. J. Oliver, Robert Carlye and L. W. Jones, all of Glasgow.

NORTH SHORE FIBRE CO., INC., Lynn, Mass., fiber products, $10,000. John J. Sullivan, president; and George P. Batchelder, 116 Euclid Ave., Lynn, treasurer and representative.

EUKOL CHEMICAL CO., INC., New York, N. Y.; chemicals and chemical byproducts, $250,000. Incorporators: C. McBride, F. Katz and J. Polansky. Representative: N. L. Goldstein, 30 Church St., New York.

SPRINGFIELD LEATHER PRODUCTS CO., Springfield, O., operate a leather tannery; $120,000. Incorporators: John M. Cole and Lee Bayley, both of Springfield.

TRI-ME LABORATORIES, INC., Indianapolis, Ind.; chemicals and chemical byproducts, $50,000. Incorporators: Walter J. Le Saulnier, Russell V. Duncan and A. S. Burdick, all of Indianapolis.

WALTHAM PAPER MILL, INC., Waltham, Mass., paper products; $50,000. Harold A. Allen, president and treasurer; and R. W. Allen, secretary, both of Waltham.

NORFOLK TALLOW CO., INC., Norfolk, Va.; soaps, greases, etc.; $25,000. E. L. Field, president, and J. W. Field, secretary, both of Norfolk.

LINDEMANN LABORATORY, INC., Wallington, N. J.; chemicals and chemical byproducts; 2,000 shares of stock, no par value. Incorporators: John W. Heflin, E. Maurice Thyvaert and Otto Lindemann, 25 Kossuth St., Wallington.

APEX RUBBER PRODUCTS CO., Akron, O.; rubber goods, $25,000. Incorporators: N. O. Mather and Lloyd A. Fasett, both of Akron.

ACCO OIL CO., Tulsa, Okla., refined petroleum products; $50,000. Incorporators: C. L. and C. C. Anderson, Tulsa, and Y. R. Brooks, Okmulgee, Okla.

TOWER GASOLINE & REFINING CO., Wilmington, Del.; refined petroleum and byproducts; $1,000,000. Representative: Corporation Service Co., Equitable Bldg., Wilmington.

LEA MFG. CO., Waterbury, Conn.; lacquers, electroplating materials, etc.; $50,000. Incorporators: R. S. Leather, F. W. Carroll and John F. Barry, 91 Waterville St., Waterbury.

KIDWELL & BASCOM, INC., New York, N. Y.; chemicals; $14,000. Incorporators: P. H. Bascom, C. H. Kidwell and R. F. Bacon. Representative: P. D. Reed, 50 Union Sq., New York.

GREAT LAKES REFINING CO., Detroit, Mich.; 200,000 shares of stock, no par value; refined petroleum products. Incorporators: J. P. Shillaber, W. Leslie Miller and William H. Granse, 901 Blaine Ave., Detroit.

MURAL CO., INC., New Brighton, S. I.; paints, oils, varnishes, etc., $50,000. Incorporators: J. A., E. D. and A. P. King. Representative: Richard Kelly, 233 Broadway, New York.

SOUTHWESTERN OIL CORP., Dover, Del.; refined petroleum products, $1,000,000. Representative: Arley M. Magee, Dover.

NESTLER PRODUCTS CORP., New York, N. Y., rubber products, $10,000. Incorporators: J. C. Kimball and B. Cahn. Representative: J. Blumenthal, 1475 Broadway, New York.

Industrial Finances

TUCKER CHEMICAL MFG. CO., INC., Paducah, Ky., increased capital from $25,000 to $75,000, for expansion.

HARRITON GLUE CO., 71 Greene St., New York, N. Y., increased capital to $25,000, for increased operations.

SUNSET PETROLEUM CO., Houston, Tex., increased capital from $30,000 to $100,000, for general expansion.

CHELSEA FIBRE MILLS, INC., 212 5th Ave., New York, N. Y., reduced capital from $2,600,000 to $2,000,000.

GILLILAND OIL CO., 111 Broadway, New York, N. Y., reorganized, is arranging for a bond issue of $10,000,000, of which $5,400,000 will be used for extensions and improvements in plants and for the purchase of additional properties. P. J. Hurley is president and general manager.

EMERALD PETROLEUM CO., Washington, Pa., increased capital from $500,000 to $1,000,000 for expansion.

STANDARD SOAP CO., Emeryville, Calif., increased capital from $500,000 to $1,000,000, for extensions in plant and business.

Foreign Trade Opportunities

Parties interested in any of the following opportunities may obtain all available information from the Bureau of Foreign and Domestic Commerce at Washington or from any district office of the bureau. The number placed after the opportunity must be given for the purpose of identification.

COTTONSEED CAKES in whole cargoes or large parcels. Copenhagen, Denmark. Agency.—6087.

CRUSHING AND PULVERIZING PLANT for the manufacture of lime, of a capacity of 2 to 5 tons per day. San Jose, Costa Rica. Purchase. Quotations, c.i.f. Puntarenas or Limon. Terms: Payment against documents.—6136.

MANGANESE ORE in quantity of 60,000 tons annually. Paris, France. Purchase. Quotations, c.i.f. French port. Correspondence, French.—6150.

ASPHALT—Good grade of asphalt for street paving. Santos, Brazil. Purchase and agency. Quotations, c.i.f. Brazilian port. Correspondence, Portuguese or French.—6155.

CYANIDES OF SODA AND POTASH. Rhodesia, South Africa. Agency. Quotations, c.i.f. Portuguese East Africa.—6162.

ROSIN AND TURPENTINE. Mannheim, Germany. Agency. Quotations, c.i.f. Rhineport or Rotterdam. Terms: Cash upon receipt of sh'pment.—6163.

CHEMICALS, pharmaceutical products, and toilet preparations. Rio de Janeiro, Brazil. Agency.—6164.

ALUMINUM AND LEAD, 99 per cent pure, in pigs or bars for foundry work, muriatic acid in drums, and sheet iron in all sizes and thicknesses. Sao Paulo, Brazil. Purchase. Quotations, c.i.f. Santos.—6165.

TURPENTINE of medium and best quality, in shipments of from 50 to 100 bbl. Rotterdam, Netherlands. Purchase or agency. Quotations, c.i.f. Netherlands port. Terms: Cash against documents.—6166.

SPRAYING MATERIALS for the various fruits grown in South Africa. Johannesburg, South Africa. Agency and purchase. Quotations, f.o.b. New York.—6167.

PERFUMERY AND TOILET PREPARATIONS, drugs and chemicals, fancy goods, electrical appliances, automobile accessories and specialties, and tools of these trades. Melbourne, Australia. Agency. Terms: Cash against documents.—6168.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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"Tut-ankh-Amen's Vengeance" And Its Commercial Parallel

NEWSPAPER announcements of the illness and subsequent death of Lord CARNOVAN were followed by wild stories and rumors suggesting the vengeful spirit of King TUT-ANKH-AMEN as the direct cause. Although we attempt to laugh off such foolishness, back it comes, this time sponsored by the senescence of Sir ARTHUR CONAN DOYLE. If this curious mental attitude confined itself to explaining the Earl's untimely death, we might ignore it as a form of harmless idiocy; but it has more sinister phases. As exemplified by the anti-Darwinism of WILLIAM JENNINGS BRYAN, for example, it has been the signal for direct attack against modern science in school and college. This is serious, to be sure, although ultimately it should stimulate scientific men to a united effort in defence of science and scientific research.

There is a phase of this superstition, or a credulity that is closely allied to it, which affects us more directly. It is the peculiar lure of speculation that leads the investor into the realm of the questionable enterprise and the "blue-sky" security. Given two opportunities, one a legitimate, carefully planned manufacturing venture and the other a plain, hungry wildcat, a goodly share of the investing public will flock to the wildcat if for no other reason than the seductive superlatives in its promoter's prospectus.

Striking examples of wild gambles of this sort have recently been unearthed in the government's investigations of the use of the mails by fake oil-stock promoters' schemes. At a round-up at Fort Worth, Tex., such notable crooks as "Doc" COOK of North Pole fame and his "high-powered" publicist, S. E. J. COX, were hauled in along with the evidence that they had mulcted the public out of more than $6,000,000. The acting United States Attorney-General in charge of the prosecution has stated that credulous investors in this country are daily contributing over $100,000 to just such flagrant swindles.

This is the sort of superstition that always has been and is still a real menace to progress. It is the old drive to get something out of nothing. It is not begotten of ignorance so much as it is of stupid credulity. The crooks do not appeal to the hard-headed men of business; they cast their nets for the dull, weary people who can't produce with their heads and therefore must labor long and arduously with their hands. Or for women without experience in the ways of the world who know only that some get rich and some don't, but can't imagine any other reason for it than luck or chicanery. How to establish a beneficent guardianship for these easy marks who lack the wit to manage their own affairs is a never-ending problem. Perhaps a later and wiser generation of law-makers or law-givers will solve it.

In the meantime many of our technical men are producing ideas for legitimate enterprises that are needed in industry and are sound in conception, with abundant potential earning power. They are desirable in every way, but are held back by the lack of funds required to launch them. They are kept in check while this very stream of wealth seeking "investment" according to the illusions of its owners passes over the falls and under the bridge into the pockets of adventurers. It never comes back.

We are not interested in the notions of the oratorical WILLIAM JENNINGS BRYAN as to the faith of our fathers or in the number of ghosts Sir ARTHUR sees and hears. But we are interested in a more energetic and vigilant administration of justice in dealing with those who prey upon the innocent or ignorant and in the maintenance of higher standards in the licensing of corporations. We need both reforms.

Profit Sharing In a Small Plant

SOMETIMES we have been guilty of thinking of profit-sharing schemes as sort of frills that only the large, rich organizations can afford. They seemed to be something rather intangible that belonged in the realm of overhead and were properly charged off to good will and advertising. Recently, however, we have been forced to revise our notions, for our attention has been called to a successful system of profit sharing which a small Eastern manufacturer of chemicals has carried on uninterruptedly for more than 17 years. Although perhaps not entirely novel, the system is so interesting and its results so unique that we should like to share its story with our readers.

The scheme is based, of course, on a contract between the employer and his workmen. In return for the worker's promises to do his work quickly and carefully and to give his employer 2 months' notice before leaving, he receives a certain proportion of the company's profits. One-half of this sum is given in cash to the employee and the other is deposited to his credit in a savings bank. The employer, however, is the sole trustee of the savings fund, although it is never allowed to revert to him. If the employee dies the fund is given over, with interest, to his family. In case of sickness the employer can divert a part, or all of it, to the employee, and in addition to this relief the worker is kept on the payroll at half pay. Should the employee leave the company or be discharged for cause, the fund is distributed among the other participants at the next division of profits.

In 1905, when the system was begun, there were

twenty-one profit sharers; today there are forty-two. *During these 17 years the employees received $40,464. The first payment was 10 per cent of the total payroll and the last was 21.3 per cent, although in each case the proportion of the total profit was the same. What do these figures show? Do they prove that the bargain has been a good one? A* letter from the general manager of the plant addressed to the National Industrial Conference Board answers these questions quite conclusively. In this connection the employer writes:

"Inasmuch as my profits compared to the wages paid have increased, it seems to be obvious that the efficiency of my workers has improved; but above all, my own observation has convinced me that the morale of my employees is much superior to the average and that they are more contented and more willing, by far, than is usual in similar establishments. In fact I am satisfied that this bargain has been a good bargain—a good one for both parties to it—and that the extra money I have paid out has been well and profitably invested."

If this story has a moral, and we believe it has, it is simply this: What's good for a large manufacturer is usually good for the small one provided that it is based on sound principles and is wisely applied. Profit sharing is fundamentally a good policy and it makes no difference whether it is carried out on a large or a small scale. The results are the same.

Putting a Value On Education

IN A LATE number of *Commerce and Finance* E. J. BODMAN, a banker of Little Rock, Ark., contributed an article on agricultural education, a subject in which he takes a live interest. If all the farmers of Arkansas, he says, had secured from their crops and animals the same results as those obtained last year by the 3,000 pupils taking farm training at rural schools in that state, Arkansas' farm income would have been increased by no less than $217,532,000. He further declared that of all the people of the United States that have performed distinguished services and have been rewarded with high honors there was but one person out of each 150,000 who had had no schooling; one out of each 37,500 who had had a common school education, one out of each 1,724 who had completed high school, and one out of 187 who had a college degree. Of 5,000,000 persons with no schooling only 31 had attained distinction, whereas no less than 5,678 out of 1,000,000 persons with a college degree had done so. There are 277 times as many college graduates in the United States who have achieved great wealth as there are wealthy men without such a degree.

So much for that. We all know that it is right and proper to be good boys and to study hard and to mind teacher. It goes without saying. But here is a complaint from an eminent professor of physical chemistry. "I'm getting fed up with seniors," he exclaimed. "They're so sophisticated they are not interested in anything simple. They don't know anything—but they don't realize that. When I get a clear, succinct exposition of a difficult problem and give it to my post-graduate students they chortle with delight. Seniors don't want to know anything that may be expounded in simple words. I have to use abstruse terminology with them to keep their attention. They eschew curiosity, which ought to be their most precious possession. It is a quality without which it is useless to approach physical chemistry. My post-graduate students, on the other hand, are like children. They want to know why and *to sense every reason. They're busy and they want to do something, to accomplish something. They don't want frills; they're after facts. I have to work harder with them, and this involves using the simplest language I can find.*"

There are three kinds of men: Those who will get the means to solve their problems and satisfy their curiosity, whether they have the "chance" or not. They are supreme. Secondly, we have those who profit by their opportunities. But the third and largest class consists of those who merely take what comes. They have no curiosity. They are not worth educating. Their proper place is in the yard-gang, digging ditches, or at the filing cabinet in the office. There is no place for them in our profession.

An Idealists' Plaything

WHEN you stop to think of it, you will remember that many of the greatest of our scientific discoveries were made with absurdly simple apparatus. Doubtless FARADAY'S whole experimental laboratory could be duplicated for the cost of one intricate testing machine. It's the experimenter rather than the equipment that counts.

All of which is somewhat trite and obvious, yet strangely enough seemingly ignored by excellent agencies for fostering research. Some of the investigations are started, evidently on the theory that if enough men get interested in it, and enough tests are made, enough variables introduced and eliminated, then somehow from this Irish stew will come the effusive odor of inspiration.

It just doesn't work that way! Some thinker who doesn't need to be co-ordinated will devise a little model —only a wooden block sliding on a stick—to illustrate the plastic flow of a metallic crystal and presto, the whole mechanism of fatigue failure is explained! Not only qualitatively, but quantitatively. Properly designed, it predicts the action of a metallic specimen with uncanny precision. Undoubtedly the model might well say for itself, "I could have foretold the whole of the results of the tests which have taken you years to make."

The steady plodder who runs exhaustive (and exhausting) tests can truly retort that only by comparison with his determinations does the model acquire credence. True enough. But such a model as Professor JENKIN'S (described elsewhere in this issue) helps us to understand the true mechanism of fatigue, and demonstrates most tangibly the more or less abstruse conclusions of the theorist. It points to conclusions which can be readily checked. It guides experimentation. It furnishes quick and highly probable indications of what would happen under unusual conditions: unbalanced stresses, occasional heavy shocks, periods of rest, duplicate heat treatments—problems which would take unthinkable patience and enormous expense to solve by direct attack.

Another great use for such a toy is to illustrate the action of ideally perfect material. It reproduces the essential actions, meanwhile eliminating the influence of many obscure variables, whose very existence may be unsuspected. Too often a deal of work is done on

metal which is of unknown origin and doubtful uniformity. The results apply to that particular experimental piece, but have questionable generality. Thus we come to the dilemma of the committee which tested the effect of sulphur in rivet steel. They examined minutely several steels, well-made steel too, uniform as near as might be except for sulphur. Some differences in physical properties were measured, but these variations are probably due to something besides sulphur! What that something is, is a mystery. In other words, unknown material was examined with microscopic exhaustiveness; mere repetition of tests is futile.

It might not be amiss for some experimenters to look up from their testing machines long enough to insist upon material as uniform as their tests or to devise a toy model, a mechanical equivalent. Meantime Professor JENKIN'S plaything approaches the ideal ductile crystal so closely that if a sample of metal under fatigue test does not agree with the predicted action, we shall suspect abnormal metal rather than mistaken theory.

Fluorspar Resources— Past, Present and Future

THREE principal uses of fluorspar are for flux, for enamel and opalescent glass, and for chemical operations, such as the manufacture of hydrofluoric acid and fluorides. For fluxing purposes it is customarily required that not less than 80 to 85 per cent of calcium fluoride be present in the spar. The glass and enamel grade is usually expected to be 95 per cent or better. But for chemical uses, manufacturers generally specify spar of 98.5 or 99 per cent purity. All three of these grades are available in reasonable quantities today, although the American production, which in the past has commonly maintained the bulk of the supply of the world, is now being supplemented to some extent by imports. Those that have studied this subject most are convinced that within 5 or 10 years there is likely to be a decided shortage of the better grades of domestic fluorspar. All three of the principal groups of users will do well, therefore, to consider the situation at once, not waiting until the shortage, forecast today, actually confronts them.

These untoward prospects have already induced some of the large consumers to purchase important deposits or to take options on territory where such deposits are believed to be available. The government has also interested itself in the question and has undertaken to determine what foreign sources of flourspar there may be that are worthy of future consideration. But there is room for the chemical and metallurgical industries to attack this problem, particularly from the technologic viewpoint.

One of the most important problems will be the preparation for using lower grade spar for chemical purposes, in place of the very high grade now required. Perhaps today an 85 per cent spar cannot readily replace the 98 per cent material for the manufacture of fluorides, but the time may soon come when the increase in cost involved in this use of lower grade material will be less than the difference in the market prices of the two grades. And this may be expected soon unless special means for concentration and refining are developed by the mining industry.

The only alternate source of fluorine is cryolite, and present prospects are that cryolite of first quality will not be available at a more attractive price than high-grade fluorspar. These are practically the only two minerals known that contain fluorine in quantity sufficient to make them interesting to the fluorine-using industries. The logical conclusion from these facts is that the use of lower grade material will eventually come, first as a matter of economy, and a little later as a matter of necessity.

In the case of enamel manufacture and fluxing, there are undoubtedly other means of gaining substantially as satisfactory results as are now obtained with fluorspar. In some glass and enamel, cryolite is already used by many in preference to the combination of fluorspar and feldspar. But still further progress in an entirely different direction, by the use of other types of enamels, may be essential. It is none too soon to begin investigation of alternative possibilities.

Present conditions indicate that foreign sources of supply may be found where high-quality spar can be mined in such large quantities as to offset completely any prospective shortage from domestic sources. Although the location and extent of such deposits are as yet unknown, it is not until this possibility has been thoroughly investigated that we need be at all alarmed about the future. Even though such resources are developed, however, it will be a distinct advantage to industry to have an alternative procedure through the operation of metallurgical, enameling and chemical processes, without the necessity for using imported spar. It all comes down to our old story: Improvements in technology are to be preferred to dependence solely upon foreign resources.

Indexing Technical Journals

A CORRESPONDENT writes suggesting that we arrange for the compilation of a composite index of all that has appeared in *Chem. & Met.* and its predecessors, covering a period of the last 20 years. To us such a plan presents two serious disadvantages: The cost, although not by any means prohibitive, would be out of all proportion to the value to our readers, since it is only occasionally that reference is made to what is contained in the older volumes. Further, the plan is unattractive because it makes no provision for the future. If such a task is undertaken only every 20 years, it is clear that a sudden burden of work would be involved for which a special provision would be required. On the other hand, if the index were kept up to date, week by week or month by month, its inaccessibility to the average reader would make it valueless. Five or 10 years after one composite index had been published a limited though vehement demand for another would arise. The expense would be considerable and, we believe, unjustified.

Most of the trouble in tracing articles in back numbers is due to the necessity of handling the volumes in order to consult the index. We believe that reference would be facilitated if, in addition to the index bound in each volume, subscribers could purchase, for a nominal sum, bound or unbound copies of additional indexes, covering a period, say, of 5 years. Some of our readers have been doing this in the past. If there are others that desire this service, we should be glad to have a sufficient number of extra copies of our next index printed and reserved for special distribution. It seems probable that such a combined index, kept continually up to date, would prove a valuable addition to the technical bookshelf.

Readers' Views and Comments

An Open Forum for Subscribers

The editors invite discussion of articles and editorials in *Chem. & Met.* or on other topics of pertinent interest

The Purpose Of a Standard

To the Editor of Chemical & Metallurgical Engineering

SIR:—It seems to me that the three fundamental functions outlined in the editorial[1] on "The Purpose of a Standard" are very clearly and succinctly presented. I have no criticism to offer on any one of them. However, it seems to me that the list is incomplete. Is not a principal purpose, if indeed not the most important purpose, the industrial economy which results to consumer and producer alike by concentrating production and utilization on specific products, whether they be defined by purchase specifications, by nomenclature or by denominational standards?

Subsidiary to the important purpose of bringing about industrial efficiency are such matters as: conserving and actually making use of the advances in the industry; simplifying the processes of production and distribution; and cutting down selling costs.

The attached list of fourteen advantages of industrial standardization was compiled for a different purpose than the editorial, but it occurred to me that it might be of interest to your readers in this connection.

P. G. AGNEW,
Secretary
American Engineering Standards Committee.

New York City.

Industrial Significance of Standardization

1. Stabilizes production and employment, since it makes it safe for the manufacturer to accumulate stock during periods of slack orders, which he cannot safely do with an unstandardized product.

2. Reduces selling cost. This is generally overlooked. Possibilities of reduced costs are generally even greater in distribution than in production.

3. It enables buyer and seller to speak the same language, and makes it possible to compel competitive sellers to do likewise.

4. In thus putting tenders on an easily comparable basis, it promotes fairness in competition, both in domestic and in foreign trade.

5. It lowers unit costs to the public by making mass production possible, as has been so strikingly shown in the unification of incandescent lamps and automobiles.

6. By simplifying the carrying of stocks, it makes deliveries quicker and prices lower.

7. It decreases litigation and other factors tending to disorganize industry, the burden of which ultimately falls upon the public.

8. It eliminates indecision both in production and utilization—a prolific cause of inefficiency and waste.

9. By concentrating on fewer lines, it enables more thought and energy to be put into designs, so that they will be more efficient and economical.

10. By bringing out the need of new facts in order to determine what is best, and to secure agreement on moot questions, it acts as a powerful stimulus to research and development, and it is thus in decided contrast to crystallization resulting from fixity of mental attitude.

11. It is one of the principal means of getting the results of research and development into actual use in the industries.

12. It helps to eliminate practices which are merely the result of accident or tradition, and which impede development.

13. By concentration on essentials, and the consequent suppression of confusing elements intended merely for sales effect, it helps to base competition squarely upon efficiency in production and distribution and upon intrinsic merit of product.

14. Standardization is increasingly impotent for the maintenance and development of foreign trade. There is strategy in nationally recognized "American" specifications.

15. The efficiency of competing countries, increasing through national standardization programs, is liable to transfer competition from foreign markets to our own shores.

16. Joint effort in bringing about standardization within and between industries almost invariably leads to better understanding and to beneficial co-operation along other lines—a step toward the integration of our industries.

[1] Vol. 28, No. 11, p. 479, March 14, 1923.

Some Recent Technical Developments in Great Britain

An enterprising Sheffield steel manufacturer is about to place on the market a stainless silver, which is the result of recent research, probably inspired by the success of stainless steel. The wastage and labor involved in cleaning silver articles are quite comparable to those now saved by stainless steel, but the difficulty has been that in order to obtain the hall mark, the silver content of an article must exceed 92½ per cent, which leaves a smaller margin for additional ingredients than has been found desirable in the production of stainless steel. It is stated that the new silver will remain bright for about 2 years without cleaning.

Attention has also been drawn to the claims for "Usco" alloy for furnace castings made by the International Combustion Engineering Co., Ltd. The properties of this material are stated to be such that while costing about 50 per cent more than cast iron, it will last from three to ten times as long at temperatures between 800 and 1,000 deg. C.; further, that the melting point is materially higher and while giving a practicable foundry mixture, the castings have high tensile strength and do not crack in use.

Although steam heating or oil or water circulation is generally considered as standard for temperatures up to 500 deg. F., a simple device such as the Stirling stove, made in Sheffield, England, deserves to be better known and appreciated. The underlying principle is the use of a number of special inclined steam tubes, the lower ends of which project through the back wall of the stove into the furnace, which burns coke. Each tube is a separate unit into which a small and definite quantity of water has been introduced before it is closed up. When heated up in the furnace, each tube is filled with steam at a high temperature, which gives up its heat to the stove. This, on condensing, runs back again to the furnace, the process being continuous so long as the fire is kept going. The cost of tubes and furnace ironwork to maintain 350 deg. F. in a stove 6x5x5 ft. is about $175 and the fuel consumption would be about 500 lb. of coke per week. The principle should be capable of adaptation to other items of chemical equipment.

Methods of Air Drying

A Discussion of the Theory and Practical Difficulties as Well as Comparison of the Different Methods of Drying Air

BY EDWIN C. HOLDEN
Consulting Engineer, Baltimore, Md.

THE number of metallurgical, chemical and other manufacturing processes requiring an atmosphere of anhydrous or exceedingly low-moisture air for advantageous operation is constantly increasing, and it is probable that there are many such for which the possibility of obtaining dry air has never been considered, but which would be greatly improved by anhydrous or at least arid working conditions.

In the following notes the attempt is made to give theoretical and practical data on the various methods of air drying which may assist a plant manager to decide upon the practicability of dry air for his requirements. For the same reason British units are used wherever convenient.

The drying of air or other gases, as here discussed, is defined as the reduction of the quantity of water vapor present per unit of volume and mass, or its complete removal, as distinguished from air-conditioning processes wherein the percentage of humidity is controlled by change of temperature without changing the mass relations, or where, by washing, steam injection, wet filters, etc., the aqueous saturation is increased.

AIR-DRYING METHODS

There are four possible methods of drying air—namely, by contact with deliquescent or dehydrating salts or acids; by compression with cooling, condensation and separation of condensate; by refrigeration with condensation and separation of condensate, and, finally, adsorption by substances with ultra-microscopic porosity.

Heating air, while it reduces the percentage saturation, does not reduce the mass ratio of vapor to air, and therefore does not come within our definition of air drying.

I—Drying by Reagents

Desiccation by exposure to caustic or other deliquescent salts is effective to the limits corresponding to the vapor pressures over them when equilibrium is attained.

The important chemical desiccators and their aqueous vapor pressures are given in Table 1.

TABLE I

Vapor Pressure in mm. of Mercury Over	At 0 Deg. C.	At 25 Deg. C.	At 50 Deg. C.
KOH			0.007
$CaBr_2$	0.09	0.18	0.19
$CaCl_2$*	0.07	0.34	1.34
NaOH	0.04	0.15	1.15
$ZnCl_2$		0.85	2.19
$ZnBr_2$	0.28	1.16	6.34

According to Baxter† the weight of water in milligrams in a liter of air after being dried by various agents is

H_2SO_4 at 50 deg. C.	0.003
KOH at 50 deg. C.	0.007
NaOH at 25 deg. C.	0.16
$CaBr_2$ at 25 deg. C.	0.2
$CaCl_2$* at 25 deg. C.	0.36
$ZnCl_2$ at 25 deg. C.	0.8
$ZnBr_2$ at 25 deg. C.	1.1

*Meaning $CaCl_2$, $CaCl_2 \cdot H_2O$.
†*J. Am. Chem. Soc.*, vol. 38, p. 840, and vol. 38, p. 2038.

Phosphorus pentoxide (P_2O_5) is the most effective desiccator. According to Morley‡, it leaves not more than 1 mg. of water in 40,000 liters of air. Because of its cost it is applicable only to laboratory work, and even with it absolute dryness is not theoretically obtainable.

With the other salts an atmosphere approaching equilibrium is obtained by passing the air through a bed or tube newly charged with the lump salts. The latter gradually lose efficiency as the surfaces take up moisture, and the lumps finally break down or coalesce in a sticky mass, so that the operation is intermittent and the spent material is corrosive and inconvenient to handle.

These difficulties and the cost of the reagents are the practical limitations to this method of drying, but it has until recently been the most satisfactory practice in the air products manufacturing industry.

DRYING BY SULPHURIC ACID

Sulphuric acid of 65.4 deg. Bé. (90 per cent) or stronger has an aqueous vapor pressure below 0.5 mm. of mercury even at 100 deg. C. It is, therefore, an excellent desiccating agent when complete contact is obtained and if the acid be replaced before dilution below 90 per cent at 100 deg. C. or 89 per cent at 80 deg. C.

Concentrated sulphuric acid is an excellent desiccating agent in the laboratory, where there is usually ample time for diffusion to attain equilibrium. The objections to it as a commercial desiccator are the high cost of 66 deg. Bé. acid, the impossibility of quickly obtaining complete contact without sprays, the danger of entrainment of acid mist from sprays, the corrosive action of the acid as it becomes weaker than 50 deg. Bé., the necessity of acid-proof cooling coils and large quantities of cooling water to remove the evolved heat of solution and thus maintain the lowest possible aqueous vapor tension, and, finally, the high heat consumption and costly equipment required to reconcentrate the acid. For commercial plants 60 deg. Bé. acid should be used, as higher grade acid is usually made to meet strict specifications as to purity and sells at a high price per unit of H_2SO_4 content.

Fig. 1 is a chart showing the vapor pressure and moisture content in an atmosphere over acid of varying strengths and temperatures. It emphasizes the importance of low temperature and indicates the possibilities of sulphuric acid as an industrial drier. The heat due to the latent heat of condensation of the vapor varies from 1,073 B.t.u. at 32 deg. F. to 1,007 B.t.u. at 150 deg. F. plus the heat of dilution, which varies with the dilution limits.

Fig. 2 gives the curves for the heat of dilution as calculated by Thomsen, and Knietsch's determinations, which are considerably higher. They indicate that diluting from 60 to 50 deg. Bé. each pound of water

‡*Amer. J. Sci.*, vol. 30, p. 441 (1885).

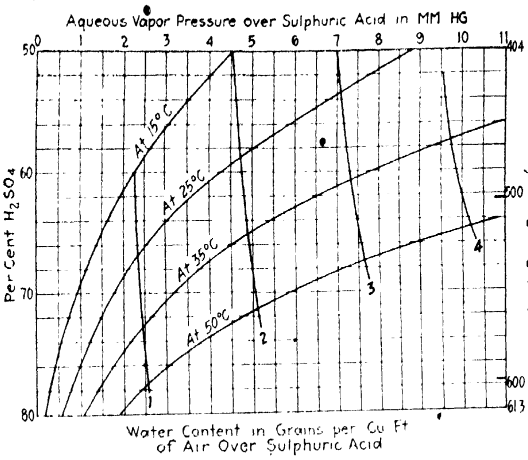


FIG. 1 VAPOR PRESSURE AND MOISTURE CONTENT IN AN ATMOSPHERE OVER ACID OF VARYING STRENGTHS AND TEMPERATURES

evolves 480 B.t.u., according to Knietsch's higher values. Each pound of water absorbed will dilute 4 lb. of 60 deg. Bé. acid to 50 deg. Bé. From these data both the acid and cooling requirements can be determined, and it is evident that drying on a commercial scale to from 1 to 2 grains per cubic foot is practicable.

The difficulties above noted have proved serious enough, however, to prevent any wide application of the sulphuric acid method of vapor absorption even in the vacuum process of ice manufacture where the conditions are favorable.

II—Drying by Compression

Compression followed by cooling and condensation produces a compressed air saturated, if enough moisture be present, to the dew point at the temperature of the air receiver or condenser, any excess of moisture present being condensed and settled out in the receiver. Upon isothermal re-expansion to atmospheric pressure, the percentage saturation due to the remaining vapor will be equal to 100 divided by the number of atmospheres absolute pressure at the condenser.

In Fig. 3 the curve *A* shows the moisture content per cubic foot of free air after drying by compression to the pressures indicated, cooling to 70 deg. F. and removing the condensate. The curves *B* and *B′* give the horsepower developed in single- and two-stage compressors respectively per 1,000 cu.ft. of air per minute when compressing to the pressures shown. Curves *C* and *C′* give the power developed in single- and two-stage compressors respectively in removing 1 lb. of water per minute from air saturated at 70 deg. F. If the air is originally saturated only to 70 per cent, the first half atmosphere of compression will be above dew point and a much larger volume of air is compressed per pound of water removed and in that case over 200 hp. is developed per pound of water removed per minute at one atmosphere pressure and 276 hp. per pound of water removed per minute when reducing the residual moisture to one grain per cubic foot.

It is evident that drying by compression is fairly effective at high pressures with low-temperature condensers of ample size to prevent entrainment of mist, but it is also apparent that the cost of drying by compression would be prohibitive unless such compression is incidental to some other process.

In Fig. 4 the power and drying conditions are given for high pressures using four-stage compressors. It will be noted that the resultant effluent moisture is about 0.25 grain per cubic foot at 500-lb. compression and that the further removal of moisture is then very gradual with increasing pressures.

In operations such as liquid air or oxygen manufacture where pressures up to 200 atmospheres are used, each cubic foot of compressed air saturated at, say, 70 deg. F. contains 7.98 grains of moisture, but this represents 200 cu.ft. of original free air with moisture reduced to 0.039 grain per cu.ft., or 0.49 per cent saturation. The compression and cooling have removed 99.5 per cent of the original moisture. The remaining quantity of moisture would, however, be prohibitive in the liquefying process, as the ice formed would quickly stop the refrigerating coils. The compression condensation which removes most of the moisture must, therefore, be followed by a more efficient desiccating method in order to approach an absolutely anhydrous condition.

III—Drying by Refrigeration

The vapor pressure and therefore quantity in a given volume of saturated air varies functionally with its temperature, hence lowering the temperature of air causes condensation of the excess of water in the air at its original temperature over its dew-point content at the lower temperature.

TABLE II

Temp., Deg. F	Vapor Pressure, In Hg	Gr Per Cu Ft	Volume Displaced, Per Cent
—40	0 0039	0 072	0 024
—20	0 0126	0 166	0.042
—10	0 0222	0 285	0 074
0	0 0383	0 481	0 128
+10	0 0631	0 776	0 211
20	0 1026	1 235	0 343
30	0 164	1 935	0 548
40	0 247	2.849	0 825
50	0 360	4 076	1 203
60	0 517	5 745	1 728
70	0 732	7 980	2 446
80	1 022	10 934	3 416
90	1 408	14 790	4.706
100	1 916	19.766	6 404
110	2 576	26 112	8 610

For convenient approximations, Table II gives in abridged form the standard psychrometric tables, including the vapor pressure, and weight of water per cubic foot in saturated air and the corresponding volumes of dry air displaced at various temperatures.

Thus if it be desired to refrigerate to a dryness of 2 grains per cubic foot, it is evident we must refrigerate

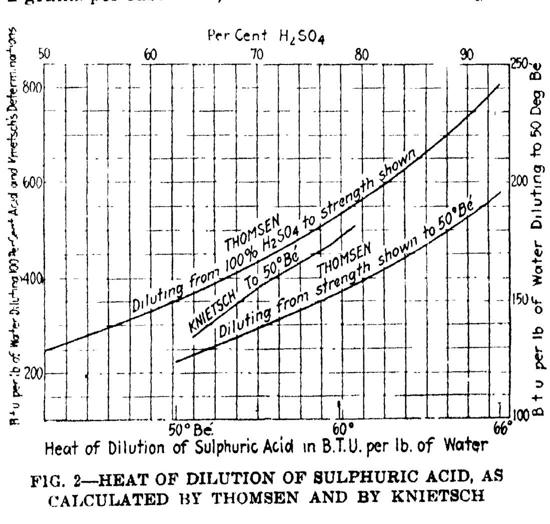


FIG. 2—HEAT OF DILUTION OF SULPHURIC ACID, AS CALCULATED BY THOMSEN AND BY KNIETSCH

below 31 deg. F., and for 1 grain below 16 deg. F. To determine accurately the total quantity of water to be removed allowance must also be made for the shrinkage in air volume proportional to the change in absolute temperature as given in the last column of Table II.

The power required for refrigeration is best indicated by an example:

The theoretical power required to make a heat transfer from a cool to a warmer body is:

$$\text{Hp.} = \frac{778}{33000} Q \frac{T_1 - T_2}{T_1}$$

in which

Q = B.t.u. refrigeration per minute.
T_1 = Inlet absolute temperature, deg. F.
T_2 = Outlet " " deg. F.

Let it be required to refrigerate 1,000 cu.ft. of air per minute at 65 deg. F. and 70 per cent saturation, or 4.75 grains moisture per cubic foot, to saturated air at 25 deg. F. which contains 1.55 grains per cubic foot.

$$T_1 = 65 + 460 = 525$$
$$T_2 = 25 + 460 = 485$$

The air weighs 75 lb., of which 0.678 lb. is water vapor. The cold air has contracted to 924 cu.ft. containing 0.204 lb. of vapor.

Q = for the air 74.32 lb. × 0.2375 × 40 = 706.1 B.t.u.
+ for vapor 0.678 lb. × 0.45 × 40 = 12.1 B.t.u.
+ for ice 0.678 − 0.204 = 0.474 lb.
× (1072 + 144) = 576.4 B.t.u.

Total = 1294.6 B.t.u.

It is evident from the above components of Q that more than half of the thermal work is consumed in cooling the dry air and less than 45 per cent by the water actually removed.

$$\text{Hp.} = \frac{778}{33000} \times 1295 \frac{40}{525} = 2.33$$

To this must be added the factors for the efficiency of boilers and engines or generators and motors and refrigerating compressors, radiation losses and the power consumed by circulating pumps and fans to move the air through the system.

The most efficient modern ice plants make 16 tons of ice per ton of coal. Based on reducing the water temperature 40 deg. F. in making ice, the process involves the transfer of 4,089 B.t.u. per minute requiring 7.36 hp. per ton of coal per 24 hours. Based on the same efficiency it will require 634 lb. of coal per 24 hours to refrigerate the assumed air current of 1,000 cu.ft. per minute. To this must be added not less than 2 motor horsepower for fans to overcome the air resistance of the system.*

Johnson gives an excellent discussion of refrigeration applied to drying blast in his "Blast-Furnace Construction," in which he concludes, by entropy diagram calculations, that to refrigerate 1,000 cu.ft. of air per minute from 85 deg. F. and 70 per cent saturation to 25 deg. F., with condenser temperature at 85 deg. F. will require:

With single-stage refrigeration	11.56 hp.
With two-stage refrigeration	7.95 hp.
With two-stage refrigeration and regeneration	4.97 hp.

Each refinement adds to the first cost of the plant, and the elaborate regenerating towers required in the last scheme would also add seriously to the power required to blow the air blast through the system, so that the ultimate relative economy is not what it appears from the above figures.

As the temperature of refrigeration is lowered the value of $\frac{T_1 - T_2}{T_1}$ and therefore the power required rapidly increases and Johnson's curve gives the follow-

*In his dry blast at the Isabella furnace Mr. Gayley allowed 75 hp. for circulating fans and brine pumps when the blast was 34,000 cu.ft. per minute.

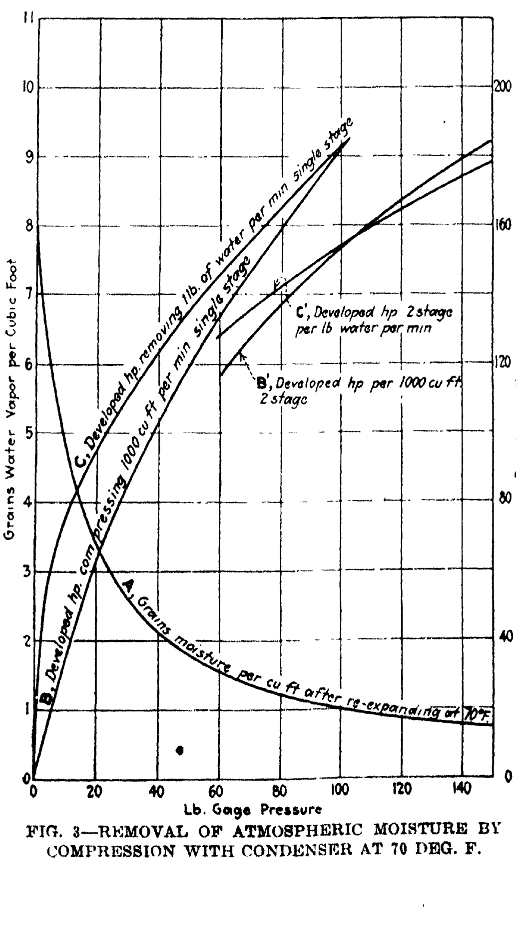


FIG. 3—REMOVAL OF ATMOSPHERIC MOISTURE BY COMPRESSION WITH CONDENSER AT 70 DEG. F.

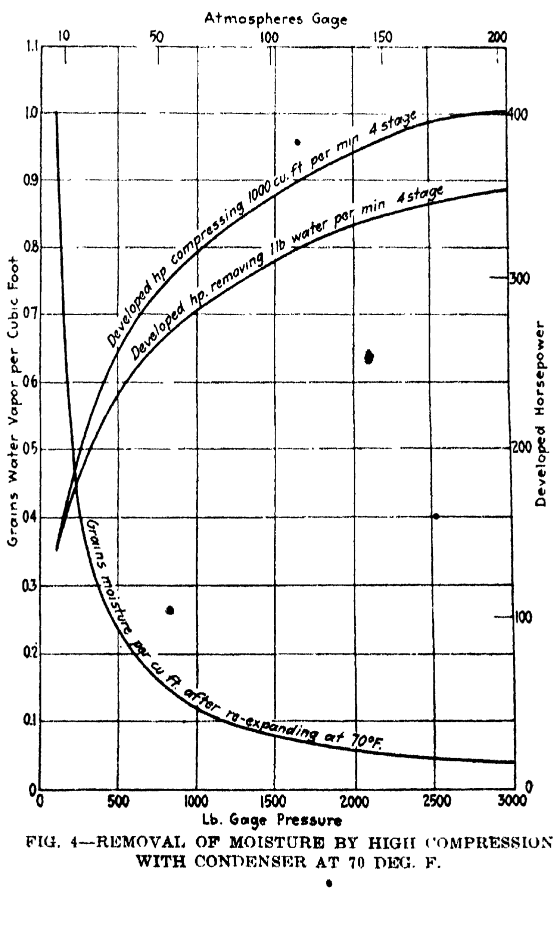


FIG. 4—REMOVAL OF MOISTURE BY HIGH COMPRESSION WITH CONDENSER AT 70 DEG. F.

ing figures for the horsepower required per pound of water removed per minute in refrigerating air below 40 deg. F. by direct expansion, single-stage refrigerator with condenser temperature at 70 deg. F.

	Hp.		Hp
At 40 deg. F	6	At 20 deg. F	24
32 deg F	10	15 deg F	35
30 deg. F	12	10 deg F.	50
25 deg. F.	17	5 deg F	68

The same relative increase in power consumption would apply also to the more economic type plants, and it is evident that the economic limit of refrigerating temperature and resulting dryness is soon reached because of the rapid increment in power required with each degree drop.

IV—Drying by Adsorption

Adsorbents are bodies having ultra-microscopically porous structures which possess such intense capillarity that they will selectively adsorb and condense within their pores vapors from air or other gases under conditions of temperature and pressure above the normal liquefying points of the vapors, the action being selective in inverse order to the vapor pressures. The action is purely mechanical, although it results in the separation of chemicals when vapors of different tensions are present, and the adsorbed vapors can be recovered in concentrated form from the adsorbent by the application of heat.

Natural substances such as clay, fullers earth, bauxite, alumina, charcoal, etc., when properly activated have this property in varying degrees, but as the pore structure and effective capacities of natural substances are widely variable, they do not meet the exacting requirements of uniform pore size, high capacity, durability and ease of reactivation necessary in most commercial processes.

Silica gel is an artificially prepared porous form of pure silica which appears to fulfill these requirements. It is made in different types for varying service. For water vapor adsorption the "type C" gel will take up 30 per cent of its weight of water vapor and still remain sensibly dry. After saturation it is reactivated by heat without change in its structure or efficiency.

Vapor pressures over activated adsorbents have not, to the writer's knowledge, been accurately measured. The work done with silica gel indicates that the vapor tension over activated gel is lower than over concentrated sulphuric acid and higher than over P_2O_5.

In a compression oxygen plant a filter of 175 lb. of granular silica gel running to the "break point" (i.e., until appreciable quantities of moisture escape the gel) ran over 200 hours on a net flow of 120 cu.ft. of free air per minute at 50 atmospheres pressure and 68 deg. F., as against the normal practice of the plant using lump caustic potash, when it did not average better than 50 hours run.

A more severe test was a 5-hour run on the same air stream as above, except that the preliminary washing towers for the removal of CO_2 were cut out and the gel adsorbed CO_2 as well as moisture, although the gel cells were within 20 deg. F. of the critical temperature of carbon dioxide. The possibility of removal of CO_2 by gel by slight refrigeration of the adsorber cells to develop a little more surface tension in the liquid CO_2 is thus indicated. The gel would be reactivated for CO_2 by simple decompression.

For the partial drying of large volumes where it is allowable to leave 0.1 grain or more of moisture in each cubic foot, silica gel is used in pulverized form in a counter-current series of applications in order to economize on the quantity of gel and of activating heat required. Vapor equilibrium is obtained almost instantly when proper contact is assured, as the total time of air-gel contact in a three-stage laboratory size plant is less than one second.

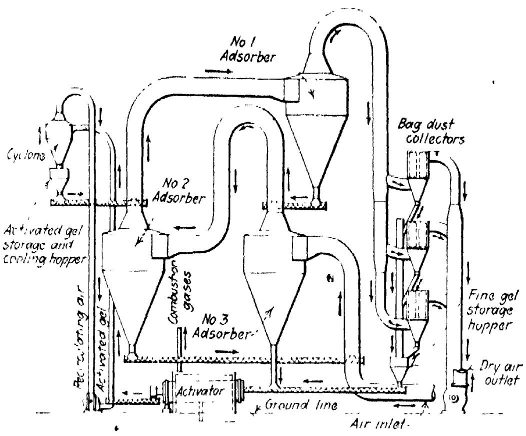


FIG. 5—DIAGRAMMATIC LAYOUT OF A CONTINUOUS THREE-STAGE COUNTER-CURRENT GEL ADSORPTION PLANT

Fig. 5 is a diagrammatic layout of a continuous three-stage counter-current gel adsorption plant such as is used for large volume air drying down to 5 per cent humidity or over. The active gel is fed into the inlet of adsorber No. 1, where it gives the air, which has already been twice treated, its final drying. The slightly saturated gel is then dropped out of adsorber No. 1 and fed into No. 2 and thence into No. 3 adsorber, where it meets the untreated humid air and receives its saturating load of moisture and is fed to the activator, which is either of the horizontal rotary indirect drier type as shown, or a multiple hearth turret furnace which is used to advantage for fractional activation. The air passing counter-current to the gel through Nos. 3, 2 and 1 adsorbers then goes through a battery of standard bag dust collectors to remove traces of gel escaping adsorber No. 1 and then through a multivane fan which balances the resistance of the whole system and delivers the dried air at a slight pressure.

The gel ratio depends upon the humidity of the inlet air, the temperature of the operation and the dryness required. Thus with a ratio of 0.75 lb. of gel per 100 cu.ft. of air, the following results are obtained at the respective outlet temperatures given using the type C gel:

Outlet Temp., Deg F.	Per Cent of Total Moisture Removed
80	92.6
85	86 6
90	82.0
95	78.6
100	75 5
105	72 9

The per cent adsorption can be controlled by varying the gel ratio, or by the use of cooling coils to lower the outlet temperature.

The power and heat required to perform the operation vary with the duty required. In a large installation the gross requirements for each 1,000 cu.ft. per minute flow are between 70 and 90 kw.-hr. and 3 to 5,500,000 B.t.u. per 24 hours, depending upon the original atmospheric humidity and the final dryness required.

What Is the Life of Silica Gel?

Experimental Results Show Possibility of Repeated Activation of the Gel After Adsorption*

VARIOUS gases have been recovered in the past by the use of silica gel. The process for the manufacture of phosgene may be cited as an example of this. In this process, a mixture of phosgene and nitrogen is obtained and the phosgene is recovered by passing the mixture through silica gel at 0 deg. C., whereby phosgene is adsorbed by the gel and the nitrogen allowed to pass through. The phosgene is then driven out by heat and condensed. Silica gel has also been used in small-scale plants for the adsorption of nitrogen peroxide. Because of its increasing use as an adsorption medium for gases, quite extensive tests have been carried out on this substance, with very interesting results. The object of these tests was primarily to find out how many times the gel could be used successively without diminishing its adsorptive power. Series of runs were made with water, benzene, nitrogen peroxide and nitric acid, respectively.

TABLE I.

Run No.	Wt. of Gel Before Adsorption, G.	Wt. of Gel After Adsorption, G.	Amt. H_2O Adsorbed G	Amt. H_2O Adsorbed Per Cent	Water Expelled On Activation G.	Water Expelled On Activation Per Cent
1–14	206.0	• 245 7	39 7	19 3	40 0	100.6
15–28	203.2	238 3	35 2	17 3	35 3	100.0
29–42	204 3	238 1	33 6	16 4	33 5	99.5
43–56	205·6	238.0	32 6	15 9	35 3	100 0
1 56	204 8	240 0	35 3	17 2	36 0	100 0

TABLE II

Run No.	Wt. of Gel Before Adsorption G.	Wt. of Gel After Adsorption, G	Amt C_6H_6 Adsorbed G	Amt C_6H_6 Adsorbed Per Cent	Benzene Expelled On Activation G.	Benzene Expelled On Activation Per Cent
1-20	210.0	246 5	36 5	17.5	36 6	100 4
21–40	208 9	245.1	36 2	17 4	36 1	99.7
41–60	210 5	244.9	34 4	16 4	34 2	100 1
61 83	210 2	244 4	34 2	16 3	34 3	100 4
1-83	209 8	245 2	35 3	16 8	30 3	100 2

TABLE III.

Run No.	Wt. of Gel Before Adsorption, G.	Wt. of Gel After Adsorption, G.	Amt NO_2 Adsorbed G	Amt NO_2 Adsorbed Per Cent	NO_2 Expelled On Activation G.	NO_2 Expelled On Activation Per Cent
1–15	39 21	63 70	24 52	62.60	24.48	99.8
16–30	39.94	63 85	24 04	60.20	24.03	99.7
31–45	39 28	64.92	24 65	65 27	25.68	100 0
46–63	38 69	64 52	25 84	66.80	25 87	100.0
1 63	39 22	64 26	25 05	63 86	25 05	99 9

TABLE IV.

Run No.	Wt. of Gel Before Adsorption, G.	Wt. of Gel After Adsorption, G.	Wt. HNO_3 Adsorbed G	Wt. HNO_3 Adsorbed Per Cent	Wt HNO_3 Expelled By Activation G.	Wt HNO_3 Expelled By Activation Per Cent
1	24.35	40.87	16 52	67 8	16.51	99 0
1-5	24.28	39.43	15 10	62 0	14 91	100.0
6–10	24.31	38 47	14 18	58 3	14 39	100.0
11–15	24.16	38.64	14 49	59.9	14.51	100.2
16-19	24 17	37 98	13 82	57.6	13 81	99.9
1–19	24 25	38 67	14 42	59 6	14 38	100 0

Simple Apparatus Used for Water Series

In conducting the test with water, the apparatus consisted of a flow meter, a sulphuric acid drier and containers for the water and the gel. The silica gel used was 8 to 14 mesh, made by the Davison Chemical Co.

To activate the gel the glass tube containing it was fitted into a malleable iron pipe, with suitable connections for the passage of air. This was heated to a temperature of 200 deg. C., while a slow current of dry air was passed through to remove the adsorbed material. The condensed vapors were collected and weighed.

Air bubbled through water at 20 to 25 deg. C., thereby humidified to a uniform degree, was then passed through the activated gel in the tube. This vapor was passed through at a uniform rate, until the saturation point was reached. In most cases the time required was from 12 to 15 hours. Having reached this saturation point, the tube was weighed, then reactivated and weighed again. Results obtained appear in Table I.

These data show that the amount of water adsorbed drops off slightly, being 9.3 per cent of the weight of the silica gel for the first fourteen runs and 15.9 per cent for the last fourteen runs. Considering the occurrence of experimental errors in these runs, it is probable that extremely high figures obtained in runs 2, 7 and 13 were in error. Omitting these values, the average adsorption for the remaining eleven runs was 18.5 per cent. The gel itself showed no evidence of disintegration and was apparently in as good condition after the last run as it was at the beginning of the series.

On benzene runs made with the same lot of silica gel as in the runs on water, but with the flow of air through the apparatus lowered somewhat, it was found possible to saturate the gel in 4 to 5 hours, keeping the benzene at room temperature (20 to 25 deg. C.). The results shown in Table II point out the fact that the adsorption in the first forty runs (17.45 per cent) was somewhat higher than that obtained in the remaining forty-three runs (16.35 per cent). The gel was apparently as good at the end as at the beginning.

To obtain satisfactory adsorption with nitrogen peroxide, it was necessary to pack the tube and the nitrogen peroxide container in ice. The gas was allowed to pass through the gel until the nitrogen-peroxide vapors could be seen issuing from the top of the tube. The length of time required for this varied from 2 to 3 hours. Since silica gel was used at Edgewood Arsenal to adsorb nitrogen peroxide during its manufacture there, particular interest was attached to the determination of the life of silica gel when used on this material. The results shown in Table III show a variation in the amount of nitrogen peroxide adsorbed from 60 to 68 per cent of the weight of silica gel used. The average of all runs was 63.86 per cent. The variations shown are probably caused by experimental error. The gel apparently had not deteriorated in any respect at the end of these runs, and it was apparent that its power of adsorption was equally as high at the end as at the beginning. Because of the fact that the gas used was impure it was thought advisable to follow the nitrogen-peroxide run with nitric acid.

These runs were made in the same general manner as in the case of the NO_2. Commercial 70 per cent HNO_3 was used in this series. The temperature employed in carrying out this test was from 20 to 25 deg. C. It was found necessary to run the air through the gel at the rate of 1,000 cc. per minute, over a period of about 16 hours, for the gel to reach the saturation point. Tabulated results of the experiments appear in Table IV.

*Abstract of a report on work done in the research laboratories of the U. S. Chemical Warfare Service at Edgewood Arsenal. This work, done by E. M. Faber and H. G. Olson, was supervised by W. A. Taylor, chief of the organic department.

Easier Reading Mercury Thermometers

While mercury thermometers are necessary from the standpoint of accuracy, fault has been found because they are read with difficulty. The C. J. Tagliabue Co. is marketing a new type of tube which corrects this fault by showing a broad red band from the top of the mercury column to the top of the tube.

Production of Synthetic Vanillin By the Ozone Process

Design, Construction and Operation of Equipment for Commercial Manufacture by a Method Which Appears to Hold Many Interesting Possibilities

BY BURTON G. WOOD
Chemical Engineer Los Angeles, Calif

THE OXIDATION of isoeugenol to vanillin by means of ozone takes place rapidly at ordinary temperatures. In fact the reaction is so rapid that it must be retarded or an undesirably large amount of resin will be formed. The process is subject to a basic patent[1] in this country, but it is doubtful if any yield could be obtained if the process therein described were followed literally.

In 1904 the Ozone Vanillin Co. was formed in this country for the purpose of manufacturing synthetic vanillin by the ozone process. The company was equipped with a wide variety of expensive equipment. However, the plant never attained efficient production and was abandoned when, seemingly, on the very point of success.

In a previous article in this magazine (vol. 28, No. 9, p. 399, Feb. 28, 1923) Mr. Wood outlined the properties of synthetic vanillin and discussed in a general way the various processes that have been proposed for its manufacture. He points out that the chief commercial methods depend upon the oxidation of isoeugenol, a product obtained from clove oil. Although the ozone process described in this article is not at present in commercial operation in the United States, it is the belief of the editors that the interesting discussion points out a number of very promising possibilities.

The general plan of the process is shown in Fig. 1. The ozonized air is drawn through the isoeugenol rather than being blown through it, because of the difficulty in designing an ozone machine that would withstand the pressure. The blower cannot be placed between the ozone room and the oxidizing tower, because the ozone will attack the impellers of the blower and cause a loss of ozone as well as rusting the blower unless it is kept well coated with oil. Another reason for drawing rather than blowing the air is that the tower top is likely to open up with a slight inside pressure, while a slight suction will tend to keep it tight. Accordingly the best place for the blower is at the final end of the apparatus, making it act as a vacuum pump or so-called negative blower.

The ozone room should preferably be separated from the rest of the plant. A room 10x20ft. is large enough to accommodate eight machines of 4 kva. capacity each, or capable of using 32 kva. One air-cooled transformer of 4 kva. is placed under each ozone machine. In case one machine is out of commission, it is not necessary to close down all of them, or if this machine be temporarily disconnected, the transformer does not become inefficient due to partial load, as would be the case if only one large transformer were used. Ventilation should be made at the top of the room. In fact, it is well to have an ordinary exhausting fan to keep the air circulating and the room free from ozone, particularly if it is necessary to have a man working around one of the machines. The breathing of ozone even for a short time is very painful.

The generation of ozone is one of the first difficulties met in this process. Many of the patented machines designed for laboratory use fail to give satisfactory results when used on the large scale demanded by this process. The writer, after experimenting with a number of standard type machines, finally evolved a commercial-sized unit that gave excellent results. On the large machine using plates 22 in. square it was found possible to maintain a yield of 65 grains of ozone per kva. when drawing air across the plate at the rate of 3 cu.ft. per plate per minute. Precautions were taken to prevent the formation of any salts on the face of the plate. Each machine was built to use 4 kva. of power with a tension of 9,000 volts. The maximum yield obtained with this machine was 3 oz. of vanillin per kva.

The ozonized air is carried from the ozone room to the oxidation apparatus in a 3-in. pipe, which is an ordinary iron pipe lined with a shellac coating. All turns in the lines are made with tees and the idle end of the tee fitted with a 1-in. valve. The 3-in. line runs to the bottom of tower 1 (see Fig. 1). This tower is made of 24-in. sewer pipe set on a cement foundation. Its height is 18 ft. A 1½-in. outlet pipe is set in the base. The tower is partly filled with splash plates or balls that will break the flow of the air. It is desirable, of course, to get all of the ozone from the air, and this is not an easy task. Between tower 1 and tower 2 there is a check valve. The second tower is exactly the same as the first one; the pipe between the two towers runs from the top of the first to the bottom of the second one. Tower 3 is made of the same size pipe as the other towers, but is only 8 ft. high. This tower is also filled with packing except at the lower section. A small bronze circulating pump lifts the material from the bottom to the top of this tower. The pipe between tower 2 and tower 3 runs from the top of the second

[1] U. S. Pat 553,039.

tower to within 2 ft. of the bottom of the third. The last tower is made of iron and filled to within 2 ft. of the bottom with iron splash plate or old iron fitting. This tower is also equipped with a small circulating pump. The pipe from tower 3 to tower 4 runs from the bottom of tower 3 to within 2 ft. of the bottom of the fourth tower. The blower is connected to the top of tower 4, and there is a 3-in. relief valve between the tower and the blower. The valve is always opened just before the blower is shut down. The blower should best be belt driven, so that if a line should become clogged, the belt will slip off, thus giving relief to the system and at the same time indicating trouble. The top of each tower should be air tight. This can be accomplished by putting a 2-in. plank cover in the top and then packing the joints with cotton and finally coating them with water glass.

Operating Procedure

The operation of this apparatus is carried out as follows: Tower 1 is filled with 150 lb. of isoeugenol and 100 lb. of sodium bisulphite (40 per cent) solution. Tower 2 is filled with 100 lb. of isoeugenol and 75 lb. of the bisulphite solution. Tower 3 is charged with 40 gal. of 10 per cent sodium carbonate solution. Into tower 4 is poured 40 gal. of 10 per cent sodium hydroxide solution. As previously explained, the function of towers 1 and 2 is to take the ozone from the air. As soon as the ozonized air comes in contact with the isoeugenol, the latter is oxidized to vanillin and the vanillin enters into combination with the sodium bisulphite and passes from the reaction sphere. As the ozonized air passes through towers 1 and 2, some sulphur dioxide is given off and collected by the air. The sulphur dioxide is absorbed in tower 3 and in turn carbon dioxide is given off. The air then passes to tower 4 and the isoeugenol vapor and carbon dioxide are removed by the sodium hydroxide. The air, then free from ozone, isoeugenol, sulphur dioxide and carbon dioxide, is discharged through the blower.

Tower 1 contains the largest amount of absorbed vanillin, tower 2 the next amount, and a considerably smaller quantity will be found in towers 3 and 4. To towers 1 and 2 every hour there is added a certain amount of 25 per cent sodium bisulphite solution. Furthermore, the rapid passage of the air causes a large

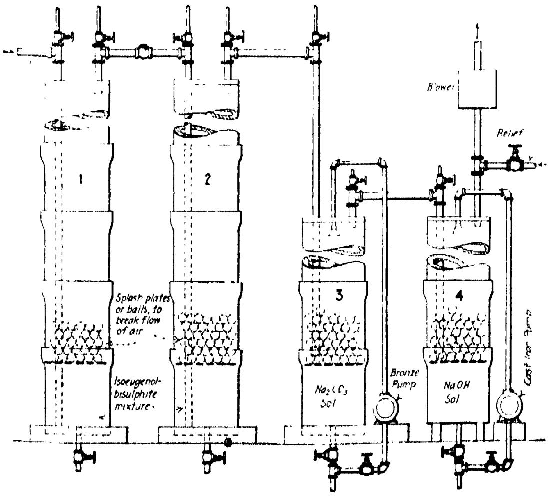


FIG. 1—APPARATUS FOR ISOEUGENOL OXIDATION BY OZONE PROCESS

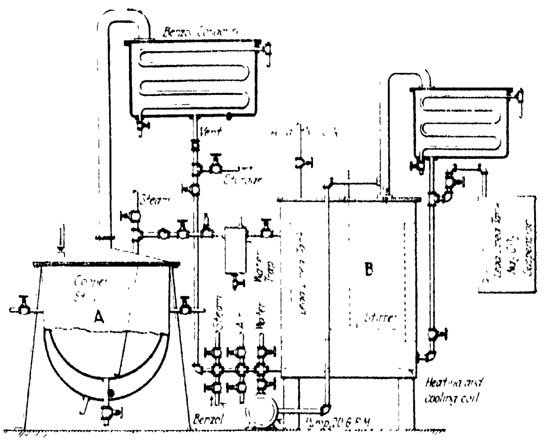


FIG. 2—DECOMPOSITION AND EXTRACTION APPARATUS

loss of water from the towers which must be replaced from time to time. Unless this is done, the bottom of the towers will become clogged with crystals of sodium sulphite.

It is essential that the sodium bisulphite and vanillin react immediately after the latter is formed from the isoeugenol. Otherwise the vanillin will be turned to resin and lost.

After 8 hours of running, the apparatus is shut down and the bisulphite and oil will separate from each other. The bisulphite liquid is then drawn into the decomposer and extractor shown in Fig. 2.

Extraction of the Vanillin

The decomposer and extractor consists essentially of two parts, the still *A* and the lead-lined decomposing tank *B*. The bisulphite liquid is drawn into tank *B*, which is provided with a stirring apparatus. The charge is measured and a sample titrated against Congo red, in order to determine the amount of sulphuric acid necessary to decompose the bisulphite compound and the remaining bisulphite. It is necessary to heat the liquid to 80 deg. C. to insure complete decomposition of the vanillin-bisulphite compound and at the same time to expel all of the sulphur dioxide. The stirrer is then started and 30 per cent sulphuric acid is admitted slowly through a top opening until the required quantity has been added. Heating is accomplished by a coil or a booster of live steam may be used. As soon as the temperature of the liquid reaches 80 deg. C., the sulphur dioxide begins to come off. This is absorbed in a suspension of sodium carbonate or a saturated solution of this salt. After the sulphur dioxide is about all expelled, air is blown through the solution to remove last traces.

After this point it is necessary to make sure that the liquid is slightly alkaline, and for this purpose it is titrated with sodium carbonate solution. Any sulphuric acid present materially affects the color of the product, for there is always some trace of isoeugenol, which chars in the presence of sulphuric acid, especially under heat in the still.

As soon as the sodium carbonate has been added, the water is turned on in the cooling coil and the temperature is brought down to below 75 deg. C. Benzol is then admitted till it overflows into the water trap. The alkaline vanillin solution is now pumped from the bottom of the tank and sprayed on the benzol. As soon as the water shows only traces of vanillin, more benzol

is admitted through the bottom of the tank *B* until the copper still *A* is about half filled. The still is run for a while, the benzol distilled being run into *B* at the bottom and thus washing the liquid free from vanillin. When the liquid in *B* has been exhausted of its vanillin content, the benzol is bypassed and run into a receiving tank. Water is now admitted through the bottom of *B* and thus all of the benzol is washed into the still. Toward the end the water trap has to be used frequently.

The crude vanillin is now drawn into a receiver, where it is crystallized into a very light brown mass. It smells strongly of the oil. The extracted liquid in *B* is then run to waste. When the sodium bisulphite liquid in the absorber has reached proper strength, it is returned to the process, in this way avoiding much of the loss.

Preliminary and Final Crystallizations

The crude vanillin is dissolved in a wood lead-lined tank in fifteen parts of hot water containing about 5 per cent of a filterchar. After boiling for about 5 minutes the mass is pumped through an aluminum filter using a rotary pump capable of operating at 60 lb. pressure at a rate of 20 gal. per minute. The mass is pumped into an aluminum crystallizer. The product from the second crystallization is very much improved in both odor and color. It has only a slight yellow color and practically no odor except when heated on the point of a knife. The water from the second crystallization is used as dissolving water for the first. The first two crystallizations may be made with ordinary water, but the third and last should be made with distilled water absolutely free from iron.

In this final crystallization the water is heated to 90 deg. C., and the vanillin is added while stirring. The stirrer should not have a speed of over 10 to 12 r.p.m. As soon as the vanillin is all dissolved, the stirrer is stopped and the solution allowed to cool very slowly until the first needles are well formed. The stirrer is then started and the cooling hastened by the use of cooling water in the outside jacket. Continuous stirring from the time the crystals are dissolved will produce flat plates rather than desired needle crystals. The melting point and other qualities will be the same as the needle crystals. However, the trade seems to have the idea that vanillin crystals must be needle shaped. If there is a trace of iron in the water, it will give the vanillin a slight yellow color, which shows up especially on being dried. When thoroughly dry, vanillin has a melting point of about 83 deg. C., although a small amount of moisture, 2 to 4 per cent, will lower the melting point to 81 to 82 deg. C.

Magnesite Production Increases in 1922

The production of crude magnesite in the United States in 1922 was 32 per cent greater than 1921. It amounted to 63,487 short tons, valued at $650,742, according to figures compiled by J. M. Hill, of the U. S. Geological Survey. Practically all of the magnesite mined in 1922 was obtained from the California deposits, of which the two producing the most were that of the Western Magnesite Co. at Red Mountain and that of the Sierra Magnesite Co. at Porterville.

During 1922 prior to Sept. 22, when the tariff act took effect, the imports amounted to 112,159 tons, valued at $1,750,636, as compared with 42,486 tons, valued at $592,491, for the 12 months of 1921. There were no exports of the crude or calcined magnesite to balance the imports in 1922. The exports of magnesia products such as pipe and boiler covering were valued at $223,686. Of the domestic magnesite used in the year more than 90 per cent was sold in the calcined form, at an average of about $40 per ton. The remainder, sold for chemical uses, brought about $11.50 per ton.

The assurance of good prices upon the passage of the new tariff act greatly stimulated the domestic industry.

"Wood Alcohol" and "Methanol"

Practice of New Nomenclature Gains Headway—Should Cut Down Accidental Poisoning

The National Wood Chemical Association, through the assistance of W. A. Hamor, assistant director of research for the Mellon Institute, has recently issued a clear-cut statement regarding the nomenclature of wood alcohol. This statement, sent out by F. J. Goodfellow, secretary of the association, is as follows:

"Methyl alcohol, or methyl hydroxide, which is commonly known as wood alcohol, is a clear, colorless and poisonous liquid obtained by the distillation of hard wood. In its crude state it is readily identified by a heavy, pungent odor; but, when refined for commercial use, this odor is almost wholly eliminated. Enough odor usually remains, however, to distinguish it from ethyl (grain) alcohol. Wood alcohol, when ingested in any of its grades and in any solution, is dangerously poisonous. However, there is no conclusive evidence that its external application or ordinary exposure to its vapors is injurious. Cases of poisoning among workmen in wood-distillation plants are almost unknown.

"On account of the large number of casualties attributed to drinking liquor containing wood alcohol, the importance of surrounding its use with every precaution to protect human life has attracted attention for many years, and as a result, numerous protective and restrictive measures have been adopted. One of these measures is the proposal to discontinue from usage the name 'wood alcohol' and use the scientific term 'methanol.' This term came into scientific usage as a result of the action of the International Conference of Chemical Nomenclature, which met in Geneva, Switzerland, in April, 1892. One of the resolutions adopted at this conference was as follows: 'The alcohol and phenols will be called after the name of the hydrocarbons from which they are derived, terminating with the suffix ol; as, for example, methanol, ethanol, etc.'

"Soon after that time the term methanol found its way into German textbooks, but until 1920 did not come into favor with the American chemical profession. In that year the late Dr. Charles Baskerville published several articles wherein he advocated a general adoption by chemists of the correct scientific term methanol. Also Dr. E. J. Crane stated in 1922, for the committee of the American Chemical Society on occupational diseases in chemical trades, that the usage of the word methanol was favored, although not required.

"At the present time, in the New Standard Dictionary, as well as in most of the scientific and trade journals, the word methanol is in common usage. The subject is of such universal importance that the suggestion is made to all interested persons to co-operate in the effort to establish the name methanol for the better protection of those who are not educated along chemical lines."

The Steam Accumulator

The Ruths Accumulator, as Used in Europe, Points the Way to Boiler Plant Economies for Users of Process Steam

BY ISMAR GINSBERG
Consulting Chemical Engineer, New York City

CHEMICAL and metallurgical plants, paper mills, rubber factories and other establishments in which steam is used as such in the manufacturing process, must contend with the problem of variable steam demand and production. The steam plant is generally designed to meet the conditions of maximum steam demand, with the result that during most of its operation it is running below capacity. In these plants, where steam is used in the chemical process, the demand for steam as motive power may be comparatively small, while the consumption of steam in the actual manufacturing process is quite large and at the same time intermittent. It is needless to remark that steam plants that are run below their capacity in this manner do not operate with the highest attainable efficiency.

This condition is accentuated in paper mills perhaps more than in any other kind of plant, and it was therefore to be expected that the solution of the problem should come from the paper industry. One solution lies in the Ruths heat or steam accumulator, an apparatus of comparatively simple construction, which has given very good results in the Swedish paper mills, where it has been used for some time. Dr. Ruths is a Swede, and although the invention is camparatively new, it has already spread to various English plants as well as to those on the Continent. The importance and practical utility of the apparatus is substantiated by no less an authority than Philip T. Dodge, president of the International Paper Co., who in a recent address said that he deemed the Ruths heat accumulator of paramount importance to every paper manufacturer—in fact to every industry where there is large and variable steam consumption. He added that the International Paper Co. was installing one apparatus at once and that the other mills of the company will be so equipped later on.

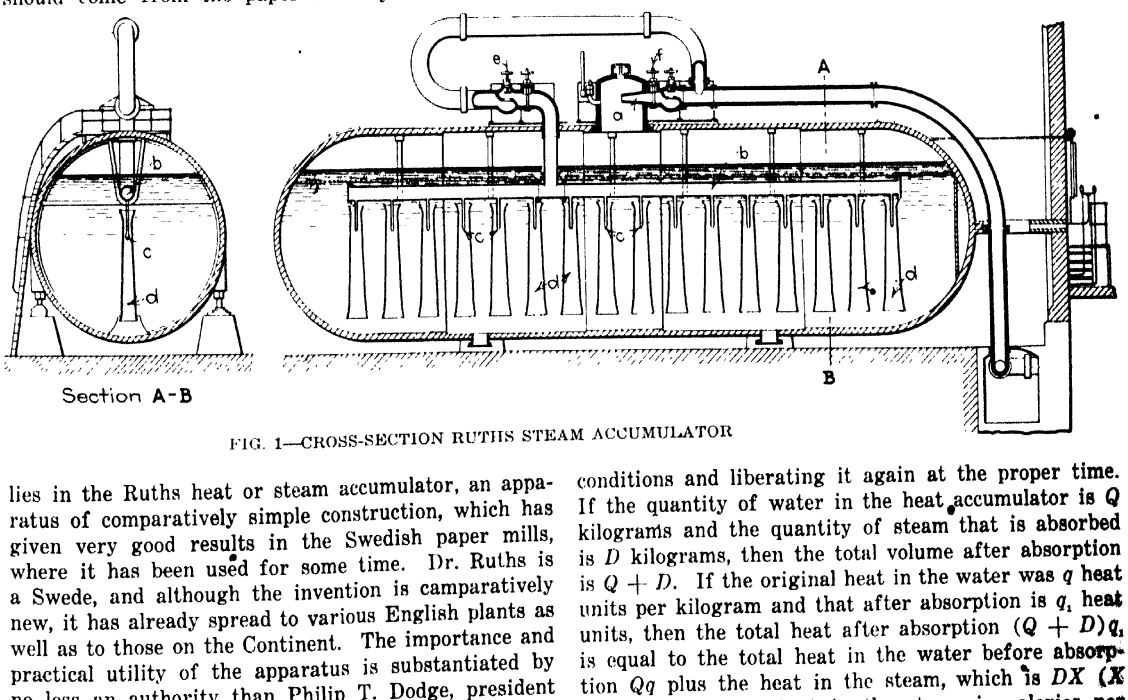


FIG. 1—CROSS-SECTION RUTHS STEAM ACCUMULATOR

THE HEAT ACCUMULATOR IN PRINCIPLE

This heat or steam accumulator is nothing more than a great tank, filled with water to about nine-tenths of its capacity and so thoroughly insulated that it is cold on the outside no matter what the temperature is within. The heat accumulator is connected with the steam line in the plant. When the boiler plant, which is built for minimum capacity when the heat accumulator is used, produces steam in excess of what the plant requires, this excess steam is stored in the heat accumulator. On the other hand, when the plant draws more steam from the boiler plant than it can produce, then the steam that was stored in the heat accumulator in the former case is released and made available for use in the plant. The action is entirely automatic and is accomplished by the difference in pressure on the steam lines actuating double-acting automatic regulating valves. The advantages of a boiler plant which can be operated in this manner, always at its full capacity no matter what the load may be, are great. The apparatus delivers the steam, after storing it for variable lengths of time as the conditions of operation vary, at almost the same pressure at which it was originally produced. In one test the steam was stored for about 3 weeks and practically all of it was recovered from the accumulator, the loss being only 2 per cent.

ABSORPTION AND RELEASE OF STEAM

The steam accumulator is therefore an apparatus that acts like the flywheel in an engine. It stores energy and delivers it when required. It is a hot-water apparatus, the water absorbing the steam under certain conditions and liberating it again at the proper time. If the quantity of water in the heat accumulator is Q kilograms and the quantity of steam that is absorbed is D kilograms, then the total volume after absorption is $Q + D$. If the original heat in the water was q heat units per kilogram and that after absorption is q_1 heat units, then the total heat after absorption $(Q + D)q_1$ is equal to the total heat in the water before absorption Qq plus the heat in the steam, which is DX (X being the heat content in the steam in calories per kilogram). The complete equation will then read, disregarding heat losses, as follows:

$$Qq + DX = (Q + D)q_1.$$

On the other hand, when steam is being removed from the heat accumulator, which of course results in the pressure within the apparatus being diminished, the magnitude of this diminution can be determined from the following equation:

$$Q_1q_1 - D_1X_m = (Q_1 - D_1)q_2.$$

In this equation no account is taken of the losses that take place during cooling. Consequently the symbol X_m

denotes the heat content in the steam leaving the accumulator.

Construction of the Accumulator

The construction of the accumulator may be seen from Fig. 1. The apparatus is made in cylindrical form and is provided with hemispherical ends. The safety nozzle is shown at *a*, and has for its purpose the limiting of the rapidity of the removal of steam, so as to prevent the boiling over of the contents of the accumulator when great quantities of steam are suddenly removed from the apparatus or when a tube breaks. Thus the introduction of water into the outgoing steam pipes is avoided.

The charging arrangement consists of a horizontal distributing pipe *b*, which is located near the water surface and which extends along almost the entire length of the accumulator. To this distributing pipe charging necks or outlets, *c*, are fastened at equidistant points and dimensioned so that equal quantities of steam can stream through all these outlets. The charging outlets are surrounded by tubular casings, *d*, formed to produce diffusion of the steam. These tubular casings extend downward until they almost touch the bottom of the accumulator. This method of charging produces good circulation of the water within the accumulator, so that the maximum difference of temperature noted within the water mass is only 0.2 deg. C. The double-acting valve controlling the charging of the apparatus is seen at *e*, and that controlling the discharge of the apparatus is seen at *f*. The apparatus is also provided with one or two safety valves, an air valve, mud blow-off cocks and the ordinary manholes and hand-holes.

Location of the Apparatus

Fig. 2 shows the location of the accumulator in a typical steam line. The connection is made in parallel with the steam line L_1 in which the steam demand is extremely variable. The connection between the Ruths accumulator and the boiler is made through the automatic double-acting valve *U*, which opens at a very slight pressure rise, a condition which ensues just as soon as the production of steam is greater than the requirement. When the plant is consuming all the steam that the boilers produce, then the valve *U* closes automatically due to drop in pressure on the boiler side of the valve and the total production of the steam plant is rendered available. Furthermore, the steam accumulated in the Ruths apparatus is also allowed to flow into the line L_1 and through the bypass and double-acting valve D_1 into L_2 and L_3 as well.

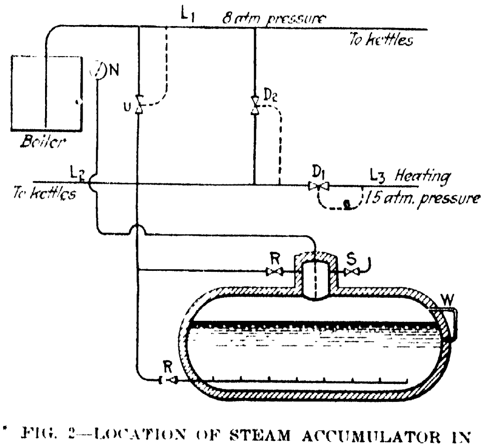


FIG. 2—LOCATION OF STEAM ACCUMULATOR IN STEAM MAIN

There are other methods of arranging this heat accumulator in the piping system of the plant, but this need not concern us here. Each method must fulfill the operating conditions of the plant. Special regulatory devices are provided as well at the power-producing machines and at the overflow valves, which allow the excess steam to flow toward the heat accumulator. All the instruments may be located on a main instrument board, so that the entire operation of the apparatus can be observed and controlled from a single point.

This apparatus has been used in several large paper mills in Sweden and accurate operating data are available on its efficiency. The efficiency of boiler plant operation is considerably increased by installing an accumulator and it is stated that in one Swedish mill the efficiency was increased to 80 per cent and more. The fuel saving has been claimed to vary between 15 and 23 per cent. The largest accumulator is installed in the paper mill of A. B. Kaukas in Wilmanstrand, Finland. The diameter of this apparatus is 5 m., the length 19.5 m. and the capacity 345 cu.m. The accumulator load is 12,000 kg. of steam. The plant operates four B. & W. boilers, each possessing 393 sq.m. of heating surface. Before the accumulator was installed the boiler plant consisted of 20 fire-tube boilers, run by seventy firemen. Now only four firemen are required. The efficiency of the plant is 83 per cent.

National Research Council Provides Informational Bulletins

A useful activity of the Research Information Service of the National Research Council in Washington is the compilation and issuance in convenient form of significant facts concerning scientific research and its industrial relations.

Often the facts assembled to meet the immediate needs of an individual engineer-investigator, firm or association are of sufficiently widespread interest and general value to justify mimeographing, printing or publishing. Informational reports thus prepared by the Information Service ordinarily are available either at cost or free.

Among the compilations which have been made available by Research Information Service or by other divisions or committees of the National Research Council of special interest to engineers are:

Bulletin 3. List of "periodical bibliographies and abstracts of the scientific and technological journals of the world."

Bulletin 9. "Funds available in 1920 in the United States of America for the encouragement of scientific research."

Bulletin 16. "Research laboratories in industrial laboratories in the United States, including consulting research laboratories."

Bulletin 22. "Mechanical aids for the classification of American investigators, with illustrations in the field of psychology."

Reprint 9. "Reading list of scientific and industrial research and the service of the chemist to industry."

Reprint 33. "Informational needs in science and technology."

Reprint 35. "American research chemicals."

Reprint 40. "The usefulness of analytic abstracts."

Several lists of scientific and technological bibliographies also have been issued. Among them are lists of published or unpublished bibliographies of corn and corn products, colloid chemistry, geology and geography, astronomy, mathematics and physics.

Fatigue in Metals*

Theory of Fatigue Demonstrated by Use of Model—Results Predicted by Model Agree With Test Data—Use of This Model to Form Basis of Accurate Strength Calculations and Introduce Fatigue Limits Into Steel Specifications

BY C. F. JENKIN

ABOUT a year ago I was asked to read this paper. About 6 months ago I wrote a paper, knowing that I should be very busy this autumn, and made a model to illustrate a small point in it. But as I played with the model to learn how to use it, it grew too strong for me and took command, and for the last 6 months I have been its obedient slave—for the model explained the whole of my subject—Fatigue. The model destroyed my first paper, and I have been obliged to write a new one in haste, putting it off from day to day as the model taught me new things. The written paper has suffered, but I hope you will find my account of the model more interesting than the tentative theories which filled the old paper. But in any case, I can speak of nothing else.

A simple form of model is shown in Fig. 1. It is made up of three or more "units" fastened together top and bottom. The units are all similar. Each is made up of three pieces—a block A with a rod fixed in it, a block B sliding freely on the rod, and a block C sliding on the rod stiffly, the friction being adjustable. Blocks B and C are connected by a spring. The model may be constructed in many other ways. The only requirements are (1) that it shall be elastic up to a point and then slip with solid friction; (2) that all the units shall not slip at once as the load on the model is increased. This latter requirement may be met in two ways—either by making the friction different in the different units, or by making the springs of different strengths. The former method is the simpler, and is used in all the models I shall speak of today.

The model may be adjusted so as to have different properties by varying the friction in the different units and also by pushing up or pulling down some of the blocks C, so as to give the units initial compression or tension. The model will set itself so that the compression and tension forces will balance.

Let us choose a three-unit model for the first test and give No. 2 unit twice the friction of the two others, and give No. 1 unit a small tension, and No. 3 unit an equal compression, so that the model will still be in equilibrium. Let us imagine that the model is put in a static testing machine with an extensometer attached and tested in tension. At first it stretches elastically, then No. 1 slips, and later No. 3 slips, and finally No. 2 slips. No larger force can be applied. The load-extension diagram given by the extensometer would have the form shown in Fig. 2. This figure is easily constructed. The three lines at 45 deg. are the load-extension lines for the three equal springs. They slope up to the points at which they slip and then are horizontal. The graph for the whole model is found by adding the co-ordinates of all three. If the model were made up of more units, the graph would be less angular. P is the limit of proportionality (elastic limit). YP is the yield point, FL is the fatigue limit. How this is found I shall explain later. Now compare this with Fig. 5, which is a load-strain graph for hardened, but untempered, 225,000-lb. steel.

Next, let us set the model differently. Give No. 2 unit a certain tension and Nos. 1 and 3 a compression of half that amount. The load-strain graph is shown in Fig. 3. Compare this with Fig. 6, which is the load-strain graph for a well-tempered steel.

Next, let us take a model of ten units, and give eight of the units nearly equal friction and the remaining two slightly less. As I pull this model, the weakest unit slips first, then the next. As each slips, more load is thrown on the rest, and when the first of the eight nearly equal units slips, the extra load will cause the next to slip at once, and they will all slip—Jack-run-for-mustard. The graph for this model is shown in Fig. 4. Compare this with Dalby's photographic model for mild steel—Fig. 7.

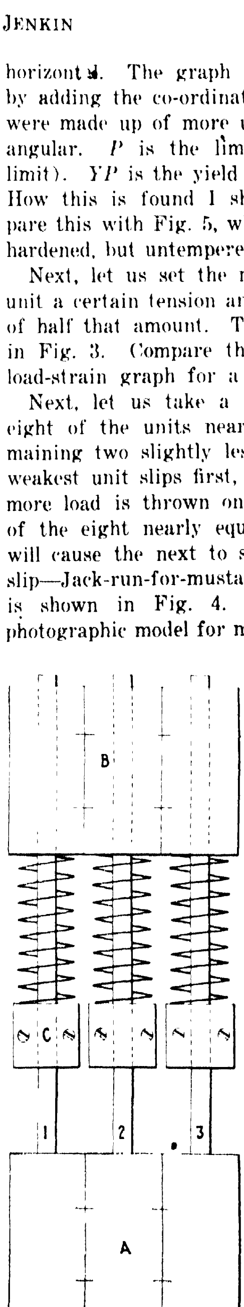


FIG. 1—MODEL REPRESENTING THREE CRYSTALS

In this explanation I have assumed that when the unit slips it becomes weaker, and so throws more load on the rest. I return to this point later.

But there is another very pretty point to notice. Watch the model closely. The units tend to move in little jerks, not quite smoothly, owing to the difference between the static friction and the sliding friction. These little jerks appear in Dalby's photograph of the steel.

If we compress Model No. 2, we shall get the lower curve in Fig. 3. Note that the elastic limits are different in compression and tension. If we carry the test on these models round a cycle we shall get the hysteresis loops shown in Figs. 2 and 3. These have the typical shape of metal hysteresis loops; curved rising lines and straight falling lines. The model will thus represent any of the typical

*Paper read before the Royal Aëronautical Society on Dec. 7, 1922, and reprinted from *The Engineer*, vol. 134, p. 612.

steels very closely—up to the yield point. I have not made it go higher for reasons that I shall explain later.

Now let us see what it does when tested under alternating loads. To start with, apply a large alternating strain to the three-unit model. All the units slip backward and forward, but as the amplitude of the motion is reduced, first one, then another, and finally all the units cease slipping. The amplitude now is the largest which the weakest unit will stand without slipping. The motion is elastic, and, as Bauschinger first stated, the metal will stand this motion indefinitely. We have found the fatigue limit. When the model comes to rest, the units are all stress-free. They are all in what may be called the central position. The fatigue limit points marked *FL* in Figs. 2 and 3 were found in this way.

The truth of Bauschinger's theorem—the identity of elastic range and fatigue range—has been confirmed by Bairstow[1]; also by Gough[2]. Gough invented a test which has turned out to be of the greatest value. A mirror is fixed on the end of the Wöhler test piece and adjusted to run truly in a plane perpendicular to the axis of rotation. The spot of light is reflected by this mirror on to a scale, and as the specimen is loaded this spot moves down the scale. If the deflections are plotted against the load, the graph is a straight line as long as the metal is elastic. Thus the limit of proportionality in Gough's rotating test indicates the fatigue limit. The accuracy of this test has been repeatedly confirmed both by Gough and Lea for many metals. This test gives a method of finding the fatigue limit in a few minutes on a single test piece.

Let Gough's test be applied to a copper test piece. Under static test, copper is not elastic for even the smallest load. The stress-strain curve bends off from the origin without any straight portion. The model representing copper has the maximum possible initial stresses in the units, so that one begins to slip the moment any load is applied. Applying the alternating load to the model, the units will slip into central positions, and we shall find a fatigue range as before. But this test will leave the units in a stress-free condition, and we ought therefore after the test to find the copper elastic. This remarkable result was found experimentally by Gough, and at my suggestion he repeated the test, raising the range gradually first to one-quarter, then to one-half, then to three-quarters of the full range. In this way, the elastic limit of the copper was found to be raised first to one-quarter, then one-half, then to three-quarters of the full range. Thus the experiment exactly confirmed the prophecy based on the model.

The same experiment is now being tried on hardened 225,000-lb. steel. The stress-strain curve—Fig. 5—we have already seen bends off almost from the origin. By applying an alternating stress the steel should be made elastic up to the fatigue limit, according to my theory.

The fatigue limit we have been discussing above is for equal tension and compression loads, but there are infinite series of fatigue limits for unequal loads. How can their magnitudes be found? Suppose that an alternating stress were applied to the model unsymmetrically, so that the tension were greater than the compression. This might be increased till the weakest unit began to slip backward and forward. When that occurred we should have reached the fatigue limits for these particular unequal loads, and the range [or algebraic difference between maximum and minimum load] is the same as before. We may go on making such tests, making the motion more and more unsymmetrical, and the range will remain the same till a new limiting condition intervenes—viz., that the maximum tensile stress must not exceed the ultimate strength of the test piece. This condition reduces the range of stress which can be applied by limiting the magnitude of the larger load. The graph representing the *range* of stress plotted against the *inferior* stress will therefore consist of two straight lines—one horizontal at the range for the weakest unit and the other at 45 deg. through the ultimate strength—see Fig. 9. This graph, according to the textbooks, should be Gerber's parabola—shown in the figure. The model appears to fail here. But compare the graph with the actual results shown in Fig. 8 from Bairstow's paper. The model is clearly right and Gerber wrong.

Before considering further properties of the model,

[1]*Phil Trans Roy. Soc.*, vol 210; see also abstract on p. 820 of this issue.
[2]*The Engineer*, Aug 12, 1921.

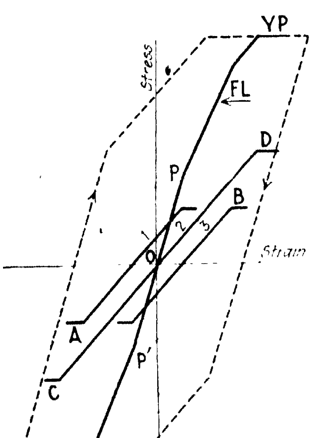


FIG 2

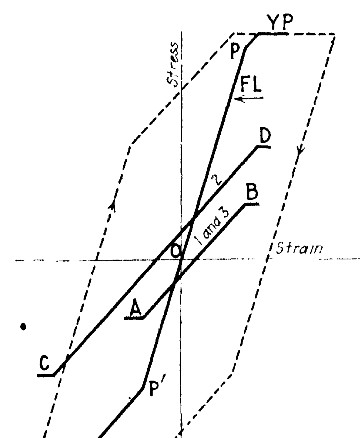


FIG 3

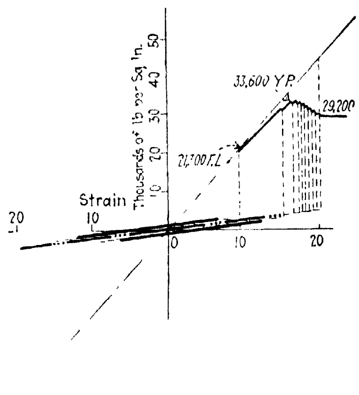
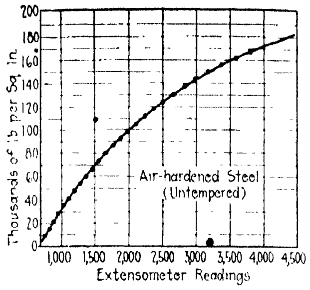
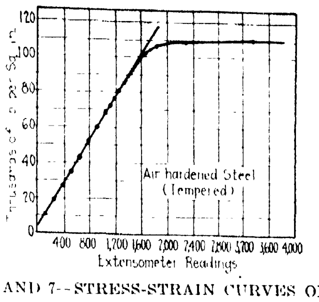


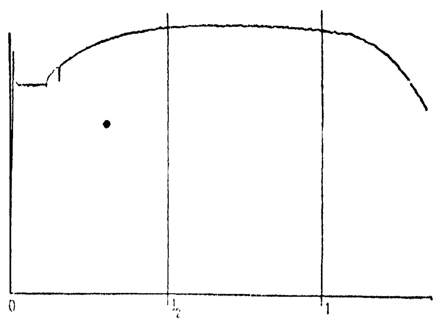
FIG. 4

FIGS. 2, 3 AND 4—ELASTIC PROPERTIES SHOWN BY MODEL

Fig. 2—Crystals of different strength under various internal stresses. **Fig. 3—A few very strong crystals containing large tensions.** **Fig. 4—Crystals nearly all of same strength and internal stress.**







FIGS. 5, 6 AND 7—STRESS-STRAIN CURVES OF METALLIC TEST PIECES

Fig. 5—Quenched high alloy steel. Fig. 6—High alloy steel quenched and tempered. Fig. 7—Mild steel (photographic record by Dalby).

let us see whether there is anything in the metal which can behave as the units in the model behave. The crystals are obviously the units. Ewing and Rosenhain[3] have shown that they are elastic up to a point and then slip along slip planes. They also pointed out that the slip planes lie at all angles with the line of action of the load, so that the resolved shearing stresses along the planes will have all values from a maximum in planes at 45 deg. to zero in planes perpendicular to the load. Thus the crystals will not all slip at once, but one after another. Thus we see that the known properties of the crystals exactly correspond with the assumed properties of the model. Finally, Ewing and Humfrey[4] showed that when slipping backward and forward takes place the slipping surfaces wear, and a crack is ultimately formed, which grows till final fatigue failure occurs. Thus our criterion for the fatigue limit is correct—viz., that we must have no slipping even in the weakest unit.

But if the model represents the metal so accurately, why does it cease to do so at the yield point? The ultimate strength of a metal is much higher, but the ultimate strength of the model is the same as the yield point. It would not be difficult to alter the model to make it imitate the real metal, but the additions necessary for this purpose would not correspond with any reality in the metal. The rise of strength in the metal above the yield point is, I believe, due to the mutual interferences between the crystals. These must have a great effect as soon as there is much distortion—that is, after the yield point. The model and my theory are therefore limited to stresses not exceeding the yield point.

[3]*Phil. Trans. Roy. Soc.*, vol. 193A.
[4]*Phil. Trans. Roy. Soc.*, vol. 200, p. 248.

But fatigue is not quite so simple as this. Think of a crystal shearing and then of the two parts slipping backward and forward on each other. We should expect to find that it required a larger force to shear the crystal than to keep it slipping when once it had been sheared. In other words, that the adhesion between the surfaces would be greater than the friction. Experiments show that this is the case. The model can be altered so as to show this difference by making the sliding blocks grip a collar on the rod, off which they slip when the force is greater than the adhesion. How will this modification of the model affect the results we have already got? I have not time to prove it tonight, but you will find that nothing we have so far found is essentially altered till we come to the graph of the complete series of fatigue ranges. Fig. 10 shows the range graph for a five-unit model arranged to represent Bairstow's axle steel allowing for the effect of adhesion. Instead of being horizontal at the top it rises by steps, but these steps may be smoothed out by using more units in the model. Compare this with Bairstow's graph for axle steel—Fig. 8. You will see how closely they agree.

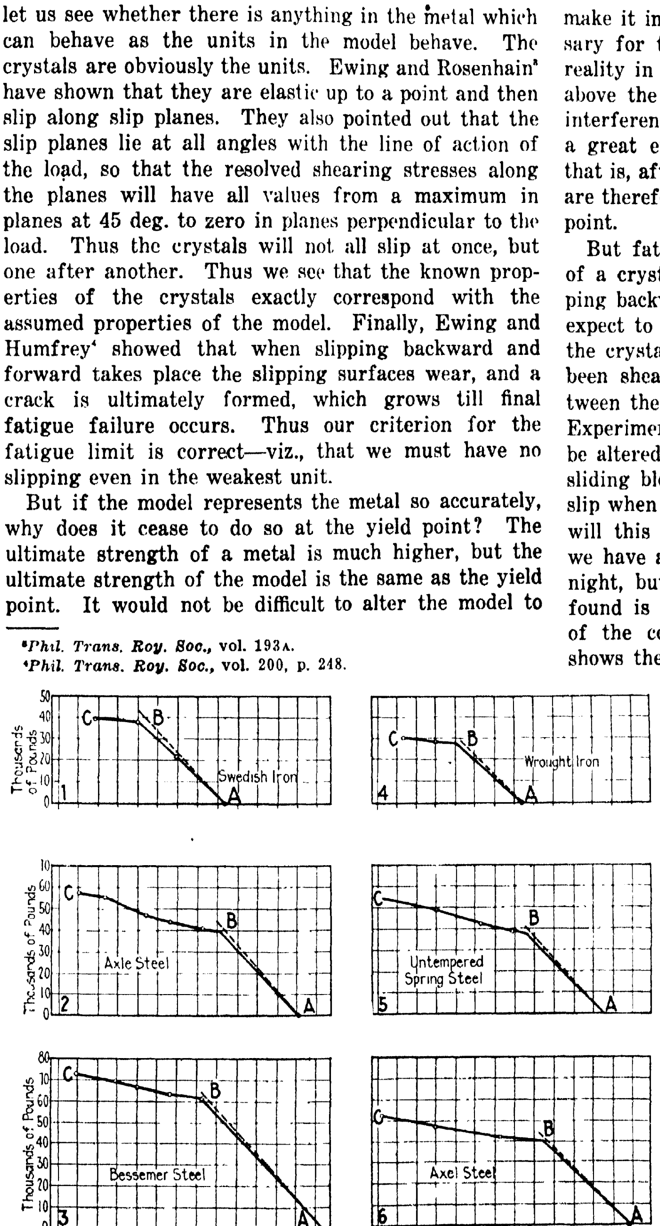
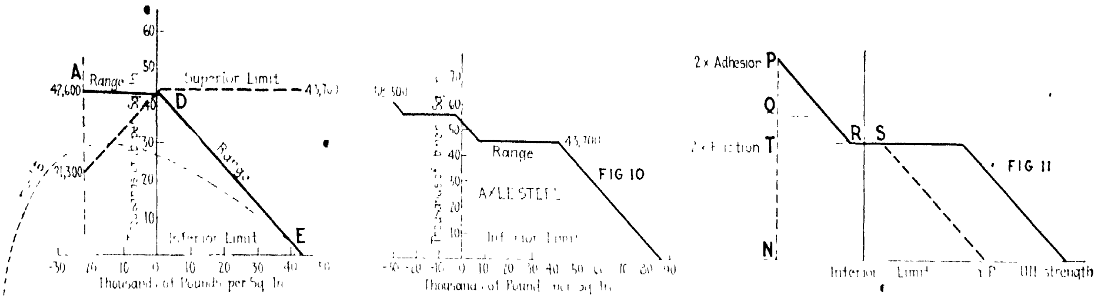


FIG. 8—ELASTIC RANGES BY BAIRSTOW AND SAFE FATIGUE RANGES BY WOHLER IN VARIOUS STEELS

This graph suggested two remarkable experiments. If all the adhesions could be broken down, then the fatigue limit should fall to the value 19.5 tons (44,000 lb. per sq.in.). This can be done by bringing the metal into the "cyclic condition" by overloading it under alternating stress and then gradually reducing the load. All the adhesions are broken down by this treatment, and the crystals are left in the stress-free condition, as we have seen. Tested in this condition, axle steel should have a fatigue limit 25 per cent lower than in the normal condition. I tried this experiment on some 0.33 carbon steel. The fatigue limit was lowered 29 per cent.

The second experiment was even more remarkable. If the steel could be made stress-free, and then have its adhesion



FIGS. 9, 10 AND 11—FATIGUE RANGES DERIVED FROM MODELS

Fig. 9—Swedish Iron. Fig. 10—Axle steel. Fig. 11—Abused steel (dotted) and "fatigue hardened" (full line).

restored, the fatigue limit should be raised to the full adhesion value—20 or 30 per cent above the ordinary value. I took the sample which I have just described, which was in the stress-free condition, and boiled it in water for 2 hours. This caused the crystals to heal, and so restored their adhesion. I then tested it, and the fatigue limit was 21 per cent above the original value. These remarkable experiments show that the fatigue limit of steel can have any value between two limits. They are shown in Fig. 11. Finally, these experiments give a direct measure of the ratio of adhesion to friction along crystalline slips, which for the steel tested was 1.7.

Other methods may be employed for raising the fatigue limit. If the metal is very slightly overloaded in the Wohler test for a few seconds and the load then reduced again, the adhesion of some of the crystals is broken down, but so little damage is done that the sheared faces heal at once and the process can be repeated again and again, each time raising the maximum load a little. Gough, at the National Physical Laboratory, raised the fatigue limit in this way 20 per cent for the steel already referred to, and Professor Lea in Birmingham raised another specimen by rather more.

These experiments show that healing of sheared crystals occurs and that this action may be hastened by very moderate temperatures. Also that the time required for healing depends on the extent to which the slipping faces have been damaged by rubbing. We are thus introduced to a new idea—healing may be taking place during a fatigue test, and the ultimate result (fracture or safety) may depend on a sort of race between slipping and healing. Healing may be thought of as the recrystallization of the minute quantity of metal disarranged by slipping, and it is not difficult to see why this takes place easily and quickly when we remember that the surfaces between which it occurs are parallel arrangements of crystallized material.

If healing produces an appreciable effect, it will raise the fatigue range above the elastic range and the amount it raises the fatigue range will be greater the more time there is for the action to take place—i.e., the slower the alternations of stress. A second modification of the fatigue range may occur, due to the fact, first demonstrated by Hopkinson, that it takes time for the crystals to slip. Hopkinson showed that for a very short duration of stress, say one-thousandth of a second, metals were elastic far above their ordinary limit. This phenomenon should also raise the fatigue range above the elastic range, but will be most effective at high speeds. These two actions make it necessary to qualify Bauschinger's general statement on the equality of the elastic range and the fatigue range. The magnitude of the two effects is being investigated. It seems probable that healing may be very effective at the temperatures at which some parts of engines—for example, valve springs—work.

The events occurring in the metal undergoing a fatigue test may be examined in other ways. If there is friction between the parts of crystals there must be heat generated, and we can measure this heat by observing the rise of temperature of the metal. This was first done by Hopkinson, and many observers have used the method since. The temperature rise follows closely on the departure from elasticity—i.e., it becomes large when the crystals start slipping. But there is found to be a very small evolution of heat at stresses far below the fatigue limit, and that the heat gradually increases as the load is increased. In other words, there is a small elastic hysteresis. The model does not indicate this elastic hysteresis, and what it is due to is not yet known.

Temperature observations have brought to light some very striking phenomena. When nickel is tested, there occur sudden heat bursts which rapidly disappear again. They recur every time the load is raised. How can these temporary evolutions of heat be explained? Consider the model. If it were stretched and compressed 2,000 times a minute without lubrication, what would happen? The sliding block would "run hot and seize." While it slipped heat would be generated, but the moment it seized the generation of heat would cease. That this may be a true explanation of what happens in nickel is confirmed by two striking facts. If the heat is due to slipping, heat bursts cannot begin below the elastic limit, for this is the point at which the first crystal slips. Experiment shows that they do not. Again, if a sample is tested up to fairly high stresses and all the crystals which slipped have seized, then if the test is repeated on the same sample no heat bursts can occur. This remarkable result is also confirmed by experiment. The trouble is like an infantile illness—a rapid rise of temperature, which a day or two later subsides, and immunity from the illness follows for the rest of one's life. Similar heat bursts occur in hard steel, but they last very much longer and are less pronounced.

In 1915 Prof. F. H. Smith and Mr. Wedgwood published a paper[5] on what they call yield ranges, illustrated with a very large number of figures showing the results of their tests. I have gone through those figures and find that a model consisting of only three units will reproduce them all. Of course, the figures given by the model are very angular, since it has so few units, but that defect could be remedied to any extent by multiplying the number of units.

I am not sure if I have made it clear that the model

[5]*Journal Iron and Steel Institute*, vol. 91.

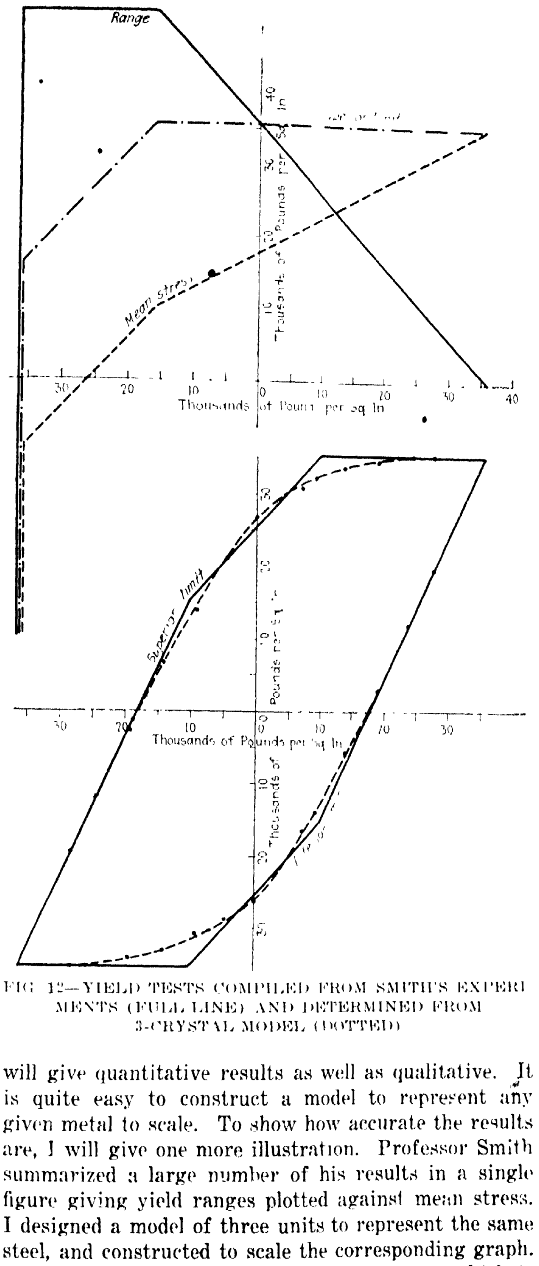


FIG. 12—YIELD TESTS COMPILED FROM SMITH'S EXPERIMENTS (FULL LINE) AND DETERMINED FROM 3-CRYSTAL MODEL (DOTTED)

will give quantitative results as well as qualitative. It is quite easy to construct a model to represent any given metal to scale. To show how accurate the results are, I will give one more illustration. Professor Smith summarized a large number of his results in a single figure giving yield ranges plotted against mean stress. I designed a model of three units to represent the same steel, and constructed to scale the corresponding graph. Fig. 12 shows the graph of the yield ranges, which is very similar to that for the fatigue ranges. On it is plotted the superior stress and the mean stress. Below it, the superior and inferior stresses are plotted on a mean stress base; the figure is a skew polygon. On this, to the same scale, I have drawn Smith's figure representing his test results. The agreement is, I think, striking. If the model could speak it would say: "I could have foretold the whole of the results of the tests which have taken you years to make."

The theory I have outlined. applies to iron, steel, nickel and copper. Whether it is true for all metals is not yet known. It is not unlikely that brittle materials like cast iron may behave differently. It ought to apply to fatigue in shear as well as in tension, but whether it does has not yet been ascertained.

Perhaps you wish to know the practical end of all these researches, and may feel inclined to say: "What is the use of your pretty models and fine theories?"

We hope before long to be able to put figures into designers' hands which will be a sure basis for all their strength calculations, figures which will not need factors of safety to allow for our ignorance of the strength of the materials. We hope to introduce fatigue limits into steel specifications, so that you will buy your materials on the basis of their useful strengths. We hope to have methods of fatigue testing as simple as tensile tests. We hope to be able to issue instructions which will save endless failures of engines. All these things are already possible. We have now only to verify and confirm before issuing our reports.

I will venture to make one suggestion today to all engine builders. Never run a new engine on a full-power test till you have raised the fatigue limits of all the highly stressed parts. This can be done, as Gough and Lea have shown, for test pieces by making a series of short runs at gradually increasing loads, finishing up at the highest overload which the engine will ever be called on to exert and slowing down between each. No marine engineer ever starts up a ship's engine at full load. He coaxes it up gradually. This may be partly to give the bearings time to run in; but the experiments I have described suggest that it may also be most valuable in giving time for the steel to "slip into the central position" and to heal. A proper start may add 20 per cent to the engine's strength.

Radio Principles in Induction Heating

It is quite recently (since about 1916) that electromagnetic energy intercepted in a secondary circuit has been absorbed before it escapes and used for producing heat free from the contaminating carbon of the arc furnace.

In a recent publication of the Engineering Foundation the development of the high-frequency induction furnace is described by its inventor, E. F. Northrup, who developed it with the assistance of G. H. Clamer. It is an ironless induction furnace which in its smaller sizes is used to melt the precious metals, gold, platinum, iridium and their alloys; also samples of carbonless iron and its alloys with various metals of the tungsten group. In its larger sizes, silver and the base non-ferrous metals and their alloys are melted; also nickel and iron alloys which must be maintained extremely pure.

The heating and melting of these materials result from the direct transformation of electromagnetic energy into heat energy within the substance itself or within the walls of a conducting crucible used to hold the product heated. If the substance to be heated does not conduct electrically, Pyrex glass for example, it is nevertheless heated and melted by the same process by placing it in a crucible which is made of conducting material.

These ironless induction furnaces, depending as they do upon the passing of a high-frequency current through an inductor coil, require for their operation a source of current of much higher frequency than the current supplied by commercial circuits. So-called "high-frequency" converters (up to from 3,000 to 30,000 cycles per second) of new design have been developed especially to meet this requirement. It is but a short step, however, to adapt the high-frequency, high-power converters which have been developed for transoceanic radio transmission to the service of inductive heating. Thus, again, the electron vacuum tube arises as the genie to do useful things.

Legal Notes

By Wellington Gustin
Of the Chicago Bar

Trade Custom and Written Contract

Unambiguous Agreement Cannot Be Altered by Oral Evidence of Trade Practices

A sales contract was the basis of an action brought by the Youngstown Sheet & Tube Co. against the Etna Forge & Bolt Co. The question of custom or usage in the trade became one of the main considerations determining the final disposition of the case in the United States Circuit Court of Appeals, 282 Federal 786.

Suit was brought on the contract to recover the balance of the purchase price of 400 tons of steel bars at "$3.50 per cwt., delivered." Judgment was entered in the District Court for the full amount claimed to be due for want of sufficient affidavit of defence.

Misleading Representations Claimed

The contract provided that the seller was to ship the 400 tons of steel "at mills' convenience," which refers to convenience of the plaintiff. Defendant purchaser alleged in its affidavit of defence that in the negotiations for the sale it "made known to the plaintiff that it did not require more than 100 tons of steel for immediate delivery, but that it would require the full amount of 400 tons during the remainder of the year 1920"; that plaintiff "represented to the defendant that there was very little likelihood that any steel on the said order could be shipped before the last quarter of the year"; that delivery could not possibly be made, except from time to time during the fourth quarter of 1920; that the price of steel fell shortly after the contract was made, and that by a custom of the steel trade it was entitled to receive the steel not already shipped at the reduced price, and that defendant was induced to enter into the contract by these fraudulent and misleading representations of the plaintiff, which shipped the entire 400 tons within 6 days after the contract was made.

The trial court gave two important reasons why it entered judgment against the purchaser of the steel. It pointed out, first, that the defendant received and unloaded all the steel, notwithstanding the alleged representations, when it was not compelled to do so under its theory of the case; second, the court said damages (as claimed by the defendant) to be recovered must always be the natural and proximate consequence of the act complained of, and those results must be considered proximate which the wrongdoer from his position must have contemplated as a probable consequence of his fraud or breach of contract. Now the defence did not charge that the plaintiff contemplated a drop in the price of steel, and so the damage demanded from the plaintiff was not such natural and probable consequences of the breach as to have been in the contemplation of the parties at the time of entering into the contract.

The defence contended that the apparent inconsistency of receiving and unloading the steel when it was not compelled to do so was within its legal rights, for after discovering the fraud, he had the right to affirm the contract and recover damages on account of the fraud, or the right to disaffirm it, and he chose the former. The court was not disposed to read into the contract the allegations as to delivery being made only in the last quarter of 1920. If these claims as to shipment being agreed upon to be in the last quarter were true the court points out that a wise business precaution would have seen to it that the precise understanding between the parties was incorporated into the written contract.

Rule Cited by the Court

The contract was written, short and its terms clear. The rule of law applicable as approved by the U. S. Supreme Court in many cases is:

"When parties have deliberately put their engagements into writing, in such terms as impart a legal obligation, without any uncertainty as to the object or extent of such engagement, it is conclusively presumed that the whole engagement of the parties, and the extent and manner of their undertaking, was reduced to writing; and all oral testimony of a previous colloquium between the parties, or of conversation or declarations at the time when it was completed, or afterward, as it would tend in many instances to substitute a new and different contract for the one which was really agreed upon, to the prejudice, possibly, of one of the parties, is rejected." Greenleaf's Evidence, Section 275.

This is the rule in Pennsylvania, where this case originated. In another case the Court of Appeals said:

"It is almost always true that a written contract has been preceded by parol negotiations, and that the terms of the contract are thus agreed upon before they are reduced to writing. Of course, the parties may leave the transaction parol, and if they adopt this course the contract must be proved by oral testimony in the usual manner, but if they put the complete contract into writing afterward, they may not contradict or vary the writing, unless fraud, accident or mistake has supervened." (222 Federal 8731.)

In the present case the court said on the question of fraud that it was so indefinitely and inconsistently alleged that it doubted its sufficiency to sustain the defence offered or to serve as a basis for damages. In any event, the court said, the defendant was liable, at the latest on Dec. 31, 1920, for the purchase price of the steel, unless the custom as claimed was a valid defence.

The defendants charged that if the plaintiff had fulfilled its contract as regards the time for shipment, by a custom of the steel trade defendant would have received the advantage of the reduced price of steel on so much of its order as was undelivered at the time of said price reduction, and would have been entitled to a credit of $3,000 upon 300 tons of steel. But the court says that if the custom did exist it would not relieve the defendant from paying the contract price. Some time after the steel had been delivered and accepted by defendant the price fell.

The rule as to custom to give it the force of law is that it must be notorious, and have existed long enough to justify the inference that the parties had it in view in making their contract. Such custom must be certain and uniform and not loose and variable.

The court said the custom, if it did exist, could not aid the defendant, for the terms of the written contract

were clear and unambiguous, that the steel was to be shipped "at mills' convenience," and when so shipped defendant was to pay "$3.50 cwt. delivered."

Custom or usage in a trade may be resorted to in order to make definite what is uncertain, clear up what is doubtful, or annex incidents, but not to vary or contradict the terms of a contract. (25 Sup. Ct. 202.)

Revelation of Trade Secrets

Defendant Must Disclose Processes, So That the Truth May Be Known

In an earlier decision, but recently reported, the federal District Court through Judge Learned Hand held that a plaintiff in a suit for infringement of a patent may require the revelation of trade secrets of defendant in order to ascertain whether there has been infringement. It appears the decision has not been appealed.

The suit was for infringement of a patented process brought by the Grasselli Chemical Co. against the National Aniline & Chemical Co., 282 Federal 381, and the defendant sought to avoid answering certain interrogatories propounded to it by the plaintiff. Since the suit was for treble damages, the defendant claimed the privilege to refuse to answer the interrogatories, but as the defendant was a corporation, it could not claim such privilege. Again it denied infringement in its answer in the case and the court held that this denial, making up the issue in the case, must be a full and complete answer. Interrogatories as here under consideration are a substitute for a bill of discovery in favor of the plaintiff whereunder the latter would have been entitled to discovery as to whether the defendant practiced the invention. That being a part of plaintiff's case, the court said it was entitled to have an answer to the interrogatories which were equivalent to the discovery.

Now to establish its case of infringement the plaintiff must prove that the defendant was practicing a process made up of several elements. It would be no evidence of that fact, says the court, to procure an admission that it has practiced a process made up of some of these elements, because that would not be the same process. But it would be material evidence to procure an admission that in its process the defendant used certain of those elements. The evidence might turn out to be insufficient, but that does not make it immaterial because it may fail completely to establish the plaintiff's case, says the court.

Truth Must Prevail, Says Court

In addition the defendant urged that it should not be required to disclose its secret processes. On this question the court points that the "situation is difficult, on the one hand to secure the plaintiff's right to get relevant evidence, and on the other, to protect the defendant from disclosing secrets which are not material. In the end the right of the plaintiff to bring out the truth must prevail, in so far as the inquiry is honestly limited to the actual issue of infringement."

In this case the court says that at the hearing the questions could be asked and the defendant would be obliged to answer them, and hence they could be asked by interrogatories in advance. The result may be to compel the defendant to disclose how far it goes in the process, though it does not use the process as a whole, and that might damage the plaintiff, says the court. This, however, is an inevitable incident to any inquiry in such a case; for if the defendant may not be made to answer, the plaintiff is deprived of its right to learn whether the defendant has done it a wrong.

An earlier case was cited as holding that a defendant may refuse to answer a revelant interrogatory because it would disclose a trade secret, but Judge Hand would not so interpret the ruling.

Infringement of Patented Article

Where Such Merchandise Is Not Marked, Notice of Infringement Is Prerequisite to Recovery of Damages

What notice the records of the Patent Office gives to the world is involved in an infringement suit brought by the Flat Slab Patents Co. against the Northwestern Glass Co. to recover damages for the infringement of patent 698,542, issued, April 29, 1902, to Orlando W. Norcross for improvements in "flooring for buildings." 281 Federal 53.

Section 4,900 of the Revised Statutes of the United States provides that a patentee must mark articles manufactured and sold as patented and that no damages shall be recovered for infringement except on proof that the defendant was duly notified of the infringement. Therefore where articles sold were not so marked or labeled, the court held that a notice of infringement was a prerequisite to recovery of damages, even though the patentee did not manufacture or sell the patented article and only granted licenses to others to engage in such manufacture.

Plaintiff contended that as it had never been engaged in manufacturing or selling the patented article it was not barred from recovery of damages under the statute. The court answers this by saying that it is true that under the law a patentee is not obliged to manufacture and sell the patented device. But the reason for giving some kind of notice to the alleged infringer would be as great or greater where the patented product was not manufactured or sold by the patentee as where it is. And the court held the requirement of notice was not limited here.

Patent Office Record Not Sufficient Notice

Counsel for plaintiff contended that the record of the Patent Office was sufficient notice of plaintiff's patent. The court said, however, that if the patentee was within the statute for giving notice he must give the notice the statute requires, and may not excuse himself by claiming that the record in the Patent Office was sufficient notice.

The case of the U. S. Mitis Co. vs. Carnegie Steel Co., 89 Fed. 206, and a number of other cases were cited in support of the proposition that when none of the patented devices have been made and sold, or where the patent is exclusively for a process, the section of the statute requiring notice does not apply. In the Carnegie Steel case the court there decided the section of law as to notice was not applicable where the patent in suit was exclusively for a process. But it was here pointed out that it was charged and not denied that the infringement was "after full notice" of the plaintiff's rights under his patent. This case is no authority that the statute does not apply where the patentee does not vend or sell. The court was not satisfied that any of the cases was an authority, and controlling, and therefore it thought that, after examining the statute, sound reason required applying the statute in this case.

Machinery and Appliances for Production and Control

Equipment News

From Maker and User

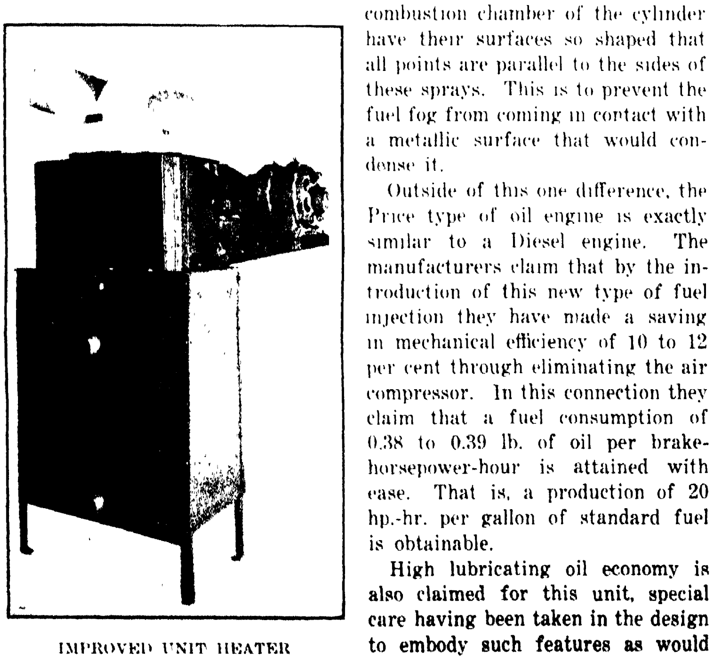
Materials and Accessories for Chemical Industries

Unit Heater for Industrial Plants

The York Heating & Ventilating Corporation, of Bridgeport, Pa., has recently placed on the market a unit heater which it recommends for industrial heating and ventilating purposes.

The makers of this equipment claim for it several advantages that have not been embodied in previous units of this type. In the first place the heating coil is made of the best grade of pipe with all joints at both headers welded and the whole is tested to a pressure of over 200 lb. per sq.in. This permits the unit to be used with either high- or low-pressure steam as desired. Another distinctive feature is claimed in the air-circulating fan. This fan has been provided with ball bearings so as to insure quiet and vibration free operation. In the accompanying photograph is shown this unit provided with a bracket on one side upon which the motor is mounted and direct connected to the circulating fan.

This heater is provided with a discharge outlet at the top which will direct the air in one, two, three or four directions as desired. The air inlet at the bottom takes the air from all four sides, thus having a low velocity of entrance and insuring the removal of the cold air from the floor, where it naturally settles. These units are supplied from a capacity of 346,000 B.t.u. per hour and a circulation of 3,870 cu.ft. of air per minute up to a maximum capacity of 1,850,000 B.t.u. per hour, and 9,820 cu.ft. of air per minute.



IMPROVED UNIT HEATER

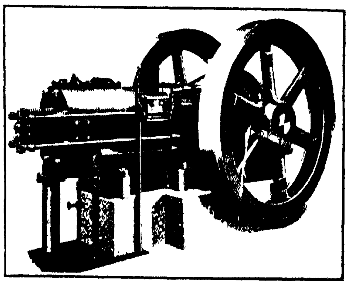
Horizontal Oil Engine

The Ingersoll-Rand Co., 11 Broadway, New York City, has placed on the market a horizontal oil engine for which are claimed numerous advantages.

This engine has as its distinguishing feature the employment of the Price system of fuel injection. In this system the oil is pumped by an ordinary pump into the cylinder through two spray nozzles, the sprays of which impinge one upon the other. The manufacturer lays stress on the fact that the head and combustion chamber of the cylinder have their surfaces so shaped that all points are parallel to the sides of these sprays. This is to prevent the fuel fog from coming in contact with a metallic surface that would condense it.

Outside of this one difference, the Price type of oil engine is exactly similar to a Diesel engine. The manufacturers claim that by the introduction of this new type of fuel injection they have made a saving in mechanical efficiency of 10 to 12 per cent through eliminating the air compressor. In this connection they claim that a fuel consumption of 0.38 to 0.39 lb. of oil per brake-horsepower-hour is attained with ease. That is, a production of 20 hp.-hr. per gallon of standard fuel is obtainable.

High lubricating oil economy is also claimed for this unit, special care having been taken in the design to embody such features as would count for a saving in lubricating oil. In connection with this effort, a cast-iron case has been used for covering the moving parts, such as the crank, rather than a sheet-iron case, because it is found that this



HORIZONTAL OIL ENGINE

effects a saving in lubricating oil, as it has no vibration to cause splashing. The manufacturers claim a delivery of 4,000 hp.-hr. for each gallon of lubricating oil used. The accompanying photograph shows this new horizontal oil engine.

Rubber-Lined Acid Tank

For the definite purpose of storing hydrochloric acid, the Hauser-Stander Tank Co., of Cincinnati, Ohio, has had on the market for some time a rubber-lined storage tank.

These tanks are especially made for lining with rubber, having fillets and wearing pieces so placed that the rubber lining is subjected to the least possible wear. The lining itself is made of pure rubber from $\frac{3}{32}$ to $\frac{3}{16}$ in. thick and is cemented to the wooden tank by a special process. The cover is either lined with rubber or coated with special pitch paint.

The tank is provided with a Duriron or hard rubber pipe and plugcock outlet. Other equipment of hard rubber or Duriron, such as pumps, piping, etc., can be used in connection with this equipment as desired. The manufacturer states that the system of storing hydrochloric acid in rubber-lined tanks shows an appreciable saving over any other method such as storage in carboys.

The Arca Regulator

The Arca Regulator is manufactured by the Aktiebolaget Arca Regulatorer of Stockholm, Sweden, and by British Arca Regulators, Ltd., of London, England. This device, which is the invention of Mr. Ragnar Carlstedt, is for the purpose of regulating apparatus in which variations of temperature, pressure, voltage, humidity, steam, density or other physical quantity occurs. It is in use for the purpose of regulating numerous types of equipment where sensitive and accurate regulation is required.

The principle of operation is as follows: The main features of the device are a pilot valve and a relay operated by a low hydraulic pressure. The variation in the physical quantity which is to be regulated acts on the relay. This relay controls the pilot valve, which in turn, through the amount of water which it allows to flow past, operates the mechanism which actually controls the equipment which it is desired to regulate.

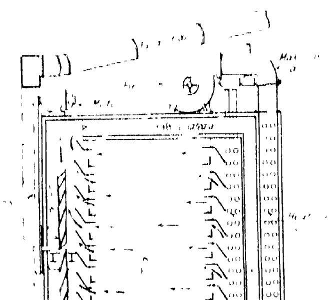
The relay consists essentially of a lever pivoted on one end and having the other end so located that it governs the opening of a jet of water which reaches the relay from the pilot valve. The position of this lever, and hence the amount of water flowing through the jet, is controlled by some such element as a copper bellows for pressure regulation, an ebonite strip for temperature regulation and other appropriate devices depending on the type of physical quantity to be controlled.

The amount of water which flows in the jet controls—through a diaphragm and spring—the position of the pilot valve. This pilot valve will in turn govern the amount of water which flows to the regulating device as against that which is allowed to flow to waste and hence governs the action of this regulating device. The regulating device is generally a hydraulic cylinder. The amount of water used is small and in most cases city pressure will suffice to actuate the regulator.

Up to the present time the installations of this apparatus have all been in Europe. The majority of these have been for the purpose of controlling steam or gas pressure. Others have been used for the control of the temperature of heat-treating furnaces. Among the most interesting applications have been one for controlling the position of the electrodes for an electric furnace, and one for controlling the flow of pulp in a paper machine.

Judelson Drier

Within the past decade great advances have been made in constructing shelf driers. In the old type of drier a material was frequently "casehardened," or in other words, the outside surface was dried rapidly and formed a crust, leaving the inside still wet. To overcome this a number of different designs were placed on the market using slightly moist air rather than absolutely dry air. The drying was thus effected more evenly and no casehardening resulted. One rather serious difficulty with many of the designs was the uneven drying of the various trays in the drier. In other words, the air would pass more effectively over one tray than another.



THE JUDELSON DRIER

To avoid this the Judelson drier, manufactured by the Domestic Laundry Equipment Corporation, places the trays in such a manner as to obtain an even distribution of the drying air. This will be seen by referring to the sketch, which shows the trays fairly wide apart at the top of the drier and increasingly close together toward the bottom.

The air comes into the system through the fan at the top and is forced down over steam coils at the right-hand side of the apparatus. At the bottom of the chamber it blows underneath a baffle plate and meets the return air, which has been recirculated. This mixture is the drying medium and is distributed through the drying trays by means of angle-iron deflectors. At the other side of the apparatus a large fan sucks the air through the trays and forces it partly through the return pipes, which pass just under the top of the drier and partly out through the exhaust pipe, shown in the photograph. A damper in the effluent pipe regulates the amount of air which is returned to the system and thus it is easy to obtain air of any degree of humidity or saturation for drying. Substantial proof that the distribution of drying air is fairly even is obtained by reading the two thermometers in the door of the drying chamber. Both the one at the top and the one at the bottom check during the drying of a given material. The equipment in addition embodies all the usual features of a drier, being insulated, substantially built, easy to control and cheap in operation.

Catalogs Received

KANSAS CITY OXYGEN GAS CO., Kansas City Mo. Catalogs 10 and 11. Catalog 10 describes equipment for doctors hospitals and laboratories for the use of nitrous oxide, oxygen, hydrogen and carbon dioxide. Catalog 11 describes apparatus and other specialties used in connection with oxy-welding and cutting.

GENERAL ELECTRIC CO. Schenectady, N. Y. Bulletin 41,316 describing synchronous motor drive for ammonia compressors, and Bulletin 46,053, describing a portable timing device which is used to supplant the stop watch in connection with timing instruments and other appliances.

DE LAVAL STEAM TURBINE CO., Trenton, N. J. Publications E1051, E1052 and E1053. E1051 describes the use of De Laval equipment in the textile dyeing and finishing plant of the United States Finishing Co at Norwich Conn. Bulletin E1052 describes an installation of De Laval steam turbine equipment in a byproduct coke plant of the New England Fuel & Transportation Co. at Everett, Mass. Bulletin E1053 describes the use of De Laval centrifugal pumps in an irrigation project in California.

AJAX ELECTROTHERMIC CORP. Trenton, N. J.—Bulletin 2—Describes the Ajax-Northrup 15-kva converter and small furnace for temperatures up to 2,000 C., which is used for electric furnace work in the laboratory.

GRAVER CORP., East Chicago, Ind. Bulletin 509, Feb. 1, 1923. A new issue of the Graver Corporation's bulletin on Zeolite Water Softening.

SULLIVAN MACHINERY CO., Chicago, Ill.—Circular 72-G. A handbook on rock drill steel, treating of its selection, heating, forging and tempering. This catalog also contains instructions for the care and use of drill sharpeners and drill steel furnaces.

SPEERE ENGINEERING CO., Detroit, Mich. -Pamphlet 211. A leaflet covering the Speere design of the Doherty direct condensation apparatus for water gas, known as the Doherty washer-cooler.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa.—Several new leaflets as follows: No. 1611, describing Type AF automatic auto-starters for polyphase squirrel cage induction motors. No. 1161-A, describing large squirrel cage induction motors of Type CF. No. 1765, describing motors for Westinghouse-Baldwin mine locomotives, series 900. No. 2390-A, describing Type E engine-driven alternating current generators. No. 3400, describing Type F-10 oil circuit breakers. No. 3499-A, describing Type CF control switches.

SCHUTTE-KOERTING CO., Philadelphia, Pa.—Bulletin 4-C, describing the Koerting venturi stack draft system. Bulletin 7-C, describing the Koerting centrifugal acid pump. Bulletin 17-A, describing the Koerting gear pump for viscous liquids.

SWENSON EVAPORATOR CO., Harvey, Ill.—Bulletin P-123. A new bulletin describing the Swenson reclaiming machinery for soda or sulphate processes, for use in pulp and paper mills.

Synopsis of Recent Literature

Elastic Limits of Fatigued Steel

Leonard Bairstow read a paper before the Royal Society of England (*Philosophical Transactions*, vol. 210A, p. 35) on "Elastic Limits of Iron and Steel Under Cyclical Variations of Stress," in which he described a series of experiments on an "axle steel" containing C 0.35 per cent, Mn 0.75, and with yield point 56,000 lb. per sq.in., maximum strength 85,500 and elongation in 2 in. 33.5 per cent. Similar experiments gave consistent results on a harder bessemer steel and Swedish iron. His tests were made on small tensile specimens mounted in a single-lever tension machine, so arranged that stresses could be alternated leisurely and automatically. A delicate optical extensometer measured the changes in length during the operation of the machine, studies being taken at intervals after the specimen had adjusted itself to conditions.

First tests on the axle steel were made with the stresses alternating between a stress of 31,600 lb. per sq.in. in tension and the same amount in compression. For several thousand repetitions of stress the steel was truly elastic—i.e., a stress-strain curve was a straight line going through the origin. As the test progressed, however, a slight hysteresis loop showed up in the stress-strain curve even when working between the same limits—that is, the line representing conditions during loading bent slightly, then as the load was released the specimen recovered in an elastic manner and drew a straight line. Conditions were exactly opposite during the compression cycle. The total stress-strain curve therefore appeared as a loop, the width of which represented the permanent set caused by one repetition of the load. After 19,000 repetitions of ±31,600 this "cyclical permanent set" measured by the width of the hysteresis loop equaled 11 per cent of the original elastic change. This loop, however, is fairly narrow compared with others obtained on heavier loading, and the author thinks that if the load alternated between 29,000 lb. per sq.in. in tension and 29,000 lb. per sq.in. in compression, the specimen would act in a truly elastic manner. In other words, the "superior" elastic limit of the original bar as determined by alternating load is 29,000 lb. per sq.in. in tension; the "inferior" elastic limit is 29,000 lb. per sq.in. in compression and the elastic range for symmetrical load is 58,000 lb. per sq.in.

After 19,000 repetitions the load was changed to 33,500 lb. per sq.in. in tension and compression. The narrow hysteresis loop immediately widened and gradually attained a certain width. Increasing the number of repetitions does not seem to change this, except that for very heavy loads it actually seems to decrease somewhat from the width assumed just after readjustment to the increased load. In other words, the specimen has apparently a "self-healing" property.

Loads were increased by steps, after the previous set of conditions seemed to be stationary. As the hysteresis loops widened, they continually showed the same nature; the curve on loading, either in tension or compression, is inelastic, but the specimen recovers in a truly elastic manner. Just before the specimen broke the extensometer was working perfectly and measuring distances equal to 1/100,000 of the length of the specimen. Therefore, the damage which is done by fatigue stresses is extremely localized. "It would appear that individual slips in the crystalline grains cannot have increased their extent prior to failure due to repetition."

To study the effect of unequal stresses, a first series fixed the maximum at 41,000 lb. in tension. The range of stress was increased by reducing the minimum stress, starting first at 18,500 lb. per sq.in. in compression. As this loading was repeated the stress-strain curve (which originally was truly elastic) gradually developed a hysteresis loop, and after 27,000 cycles, the width of this loop remained constant. On relieving the load, the specimen was found to have acquired a permanent extension, even though the maximum stress, 41,000 lb. per sq.in., is considerably below the yield point (56,000). As the loading continued this permanent extension increased at a very small but steady rate. Increasing the stress range by changing the compression stress to 21,800 lb. per sq.in. immediately increased the width of the hysteresis loop. No sudden increase in the permanent extension occurred, but it increased at a more rapid rate. In other words, if the permanent extension were plotted against the number of repetitions, it drew a straight line sloping upward at a slight angle. Every increase in the range of load was characterized by an angle in this line—the slope became steeper. The shape of the hysteresis loop remained exactly similar to that observed during symmetrical loading—i.e., the metal was plastic during half its loaded cycle, and perfectly elastic during the first half of the unloading cycle. The stress-strain curve is symmetrical about the average stress rather than about the zero load.

A second series of experiments with unequal stresses was then made with the superior stress at 52,000 lb. per sq.in. (still below the yield point) and the inferior stress at zero. The steel acted in a perfectly elastic manner until 2,000 repetitions had passed, then a rapid permanent extension occurred; simultaneously a hysteresis loop developed to measurable quantity, but remained stationary in width from 8,000 to 15,000 cycles. During this time the permanent extension remained nearly constant. The author thinks that a slightly lower range would have stabilized both these conditions and the steel would have been stable, even though a slight hysteresis loop would have been observed. This might have remained temporarily, but "there is every reason to believe that it would have disappeared by recovery if sufficient time were allowed. An extension of 0.2 mm. would have been produced in the process of raising the superior elastic limit from 29,000 to 51,500."

Other tests were made, one series starting with a maximum of 63,700 lb. per sq.in. in tension and an inferior stress of 17,000 in tension. Since the superior stress is above the yield point, a permanent extension occurred at the first load, but did not progress. A very narrow hysteresis loop was observed, gradually growing narrower.

Important Articles In Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem & Met.* The articles listed below have been selected from those publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. Those that are of unusual interest will be published later in abstract in this department, but since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage. The magazines reviewed have all been received within a fortnight of our publication date.

THE USE OF BREATHING APPLIANCES IN CHEMICAL WORKS. Leonard Levy. *Chemical Age* (London), April 7, 1923, pp. 362-3.

THE CENTENARY OF THE ALKALI INDUSTRY IN ENGLAND. (To be cont'd.) Anon. *Chemistry & Industry*, April 20, 1923, pp 383-6

THE PRINCIPLES OF TRANSFERENCE OF HEAT. (To be cont'd.) Geoffrey J. Greenfield. *Chemistry & Industry*, April 20, 1923, pp 390-2.

MANUFACTURE OF SODIUM THIOSULPHATE. L. Hargreaves and A. C. Dunningham. *J. Soc. Chem. Ind.*, April 13, 1923, pp 147-154T

JOINT CONFERENCE ON CORROSION PROBLEMS. *Chemical Age* (London), April 14, 1923, pp. 394-6.

SEABOARD LIQUID PURIFICATION PROCESS. H. R. Broker. *Gas Age-Record,* April 21, 1923, pp. 499-500

KEEPING LOST TIME WITHIN BOUNDS. James J. Martindale. *Factory*, May, 1923, pp 518-520.

LIGHTING THE FACTORY. S. G. Hibben. *Factory*, May, 1923, pp. 523-526.

TRENDS IN MANAGEMENT. William Leavitt Stoddard. *Factory*, May, 1923, pp 528-529

LIGNITE CHAR: ITS PRODUCTION AND POSSIBILITIES. O. P. Hood. *Mechanical Engineering*, May, 1923, p. 282

ALUMINUM BRONZE AS AN ENGINEERING MATERIAL. W. M. Corse. *Mechanical Engineering*, May, 1923, pp. 283-4.

MANAGEMENT ENGINEERING IN THE PAPER INDUSTRY. R. B. Wolf. *Mechanical Engineering*, May, 1923, pp. 295-6.

THE OIL VENTURI METER. Ed S. Smith, Jr. *Mechanical Engineering*, May, 1923, pp. 297-298

LES ACCUMULATEURS DE VAPEUR. M. Emmanaud. *La Technique Moderne*, April, 1923, pp 193-197.

Other tests starting with a superior load of 77,000 lb. per sq.in. in tension and an inferior load of 42,500 lb. in tension acted in the same way. In this series the hysteresis loop gradually decreased in width and finally traced a straight line. Increasing the range by decreasing the lower limit to 34,000 lb. per sq.in. in tension did not change these conditions. Further decrease, however, immediately increased the hysteresis loop and caused the permanent extension to increase. However, the loop was very narrow even later when the extension was increasing rapidly to failure.

In general, it was found that the hysteresis loops were similar for all fatigue stresses: they contain evidence of elastic recovery for one-half the cycle. The width is greatest at equal and opposite stresses, decreasing in width as the load is unbalanced. It is probably zero at the limit. Permanent extension due to a superior load above the elastic limit rapidly grows when the piece nears failure. At the beginning of a test a large permanent extension may occur on the first overload, but if the stresses are not excessive remain stationary as the hysteresis loop approaches zero. In these circumstances the author thinks that the specimen may be safe—that is, acting in a truly elastic manner—even though at first it appears to have a cyclic permanent set. An experiment illustrative of this point is on a bar of Swedish iron which was strained between 20,000 lb. per sq.in. in tension to 18,500 lb. per sq.in. in compression. It acted in an elastic manner to 100,000 repetitions, and suddenly developed a hysteresis loop, which remained constant, even up to 1,000,000 repetitions. The specimen was unbroken, and was laid aside for months, after which it was tested again in a similar manner. Its elasticity was completely restored. Therefore the author is of the opinion that the appearance of a narrow hysteresis loop is not necessarily a sign that failure impends.

The accompanying table contains approximate data on the elastic ranges under these cyclic tests. If the range of stress is plotted against the minimum (inferior) stress the curve shown in Fig. 8 of Prof. Jenkin's article on p. 813 of this issue may be had.

ELASTIC RANGE OF AXLE STEEL UNDER STRESS

Superior Stress	Inferior Stress	Range Lb./Sq. In.
+29,000	—29,000	58,000
+39,000	—17,000	56,000
+52,000	0 0	52,000
+63,000	+18,000	45,000
+76,000	+34,000	42,000

If this steel is tested in a tension machine in the ordinary way, it acts in an elastic manner and acquires no permanent set up to 56,000 lb., whereupon the yield point occurs and a rapid permanent stretch occurs. However, **the above-described experiments show that an unbalanced cyclic load with a maximum *less* than the yield point will develop a gradual permanent extension. This occurs at any load below the yield point and above 29,000 lb. per sq.in. The latter figure might be called the "natural" elastic limit.** "Below the static yield point, iron and steel appear to be capable of maintaining an unstable condition for a considerable time against cyclical variations of stress which ultimately produce a considerable change of length. Bauschinger's 'primitive' and 'natural' elastic limits really state that ordinary extensometers are not sufficiently sensitive to detect the first signs of want of elasticity, and that fatigue increases these signs to recognizable magnitude."

Bairstow then goes on to compare the elastic ranges which he determined by the same methods described above for Swedish iron, axle steel and hard bessemer steel with similar materials actually tested in fatigue under unbalanced stresses by Wöhler. These curves are reproduced as Fig. 8 of Prof. Jenkin's paper, p. 813 of this issue. The agreement is so very good that the author believes it establishes the identity between elastic range and safe fatigue range. He, therefore, restates Bauschinger's theorem as follows: "The superior limit of elasticity can be raised or lowered by cyclical variations of stress and at the same time, the inferior limit of elasticity will be raised or lowered by a definite, but not necessarily the same, amount. The range of stress between the two elastic limits has, therefore, a value which depends only on the material and the stress at the inferior limit of elasticity. This elastic range of stress is the same in magnitude as the maximum range of stress which can be repeatedly applied to a bar without causing fracture, no matter how great the number of repetitions."

Can Gasoline Be Made From Animal and Vegetable Oils?*

The motor fuel problem in France is a peculiar one and its solution would justify unusual methods. The fact that France is dependent upon foreign sources of supply for petroleum has led to an intensive investigation of various substitutes for mineral oils. Most of the attempts to solve the motor fuel problem have turned around alcohol, naphthalene and various other substitutes that have been tried in other countries with varying degrees of success. There is one raw material, however, which France seems to possess in an almost inexhaustible supply, that has only recently been considered in connection with the possibilities of developing a gasoline substitute. The crude vegetable oils that the French colonies are able to produce in almost **unlimited quantities have previously** been used solely as food products or in the manufacture of soap, paint, etc. They have never been used for combustion, except in certain special Diesel engines and then only on a small or experimental scale.

*An abstract of a paper by Prof. A. Mailhe of Toulouse, France presented at the International Congress of Liquid Fuels in Paris, France, October, 1922, and appearing in *Chimie et Industrie*, February, 1923. Translated by Joseph F. Shadgen, Consulting Engineer, New York City.

The work of Professor Mailhe, **an associate** of Sabatier at Toulouse, **has** demonstrated **that by a catalytic dehydration** these oils **may be disintegrated** to yield water, **acrolein, combustible** gases and **low-boiling liquids.** The catalyzers used were **magnesium** oxide, kaolin and alumina. **This process** is then followed by **hydrogenation,** using metallic copper, preferably **electrolytic,** as a catalyst. **Its action is** less pronounced than that of **nickel and** iron, and therefore it causes **less carbon** to be deposited. **To prepare the** catalyst equal parts of powdered **copper** and magnesium oxide are **mixed, using** glue or starch as a binder. **Small balls** made from this mixture **are air-dried** and introduced into a copper **tube 1⅛ in.** in diameter, 40 in. long **and heated to** 500 deg. C. by a row of **bunsen burners.** The temperature should never **exceed** 650 deg. C. The oil is **introduced at** one end of the tube, where **its input is** regulated by a needle valve. **The incoming** oil vaporizes **immediately and** after the vapors pass over **the catalyzer** they leave the tube to enter **refrigerating** coils and absorption **apparatus.**

DECOMPOSING LINSEED OIL

With this simple equipment **Professor** Mailhe studied the **decomposition** of linseed, palm, whale, fish, **coconut** and cottonseed oils. Linseed oil **produced** an abundant supply **of gas and** considerable quantities **of low-boiling** liquids. The composition **of the gases** so obtained was CO_2 6 **per cent, CO** 9 per cent, C_nH_{2n} 54 **per cent,** C_nH_{2n} + H 31 per cent. **The liquid** products were **of mahogany color with** a strong odor and **acid reaction. On** redistillation they were **split up into** three fractions distilling **below 40 deg.** C., between 50 and 150 deg. C. **(density** 0.76) and between 150 and 230 **deg. C.** (density 0.86). **The residue was re**treated in the catalyzer. **Washing the** direct acid condensate **with diluted soda** solution changed the **color to a light** yellow. **Analysis showed the presence** of hydrocarbons almost **exclusively and** the liquid resembled **cracked gasoline** in appearance **and in properties when** used in internal combustion **motors.**

When submitted to **further hydrogenation** in the presence **of metallic** nickel at about 180 deg. C., **a water-white** liquid was produced **which had** no disagreeable odor **and made up** almost entirely **saturated compounds.**

A study of the composition **of the** original condensates **showed that they** consisted of complex **mixtures of paraffine,** aromatic and **cyclo-paraffine** hydrocarbon.

Numerous tests were **made by Professor** Mailhe on samples **of other oils** of animal or **vegetable origin and of** various **fatty acids and their glycerides.** All **were found to yield the same or** similar results as **those previously described** for linseed oil.

In general it may be said that the process consists of two steps as follows: (1) Rupture of the complex glyceride and the elimination of the oxygen in the form of water, acrolein, CO and CO_2. Excess acids are neutral-

ized with soda to give a product resembling unrefined cracked gasoline. (2) Transformation of that liquid into a water-white saturated gasoline or kerosene by the catalytic hydrogenation in the presence of metallic nickel. Either water gas or pure hydrogen can be used in the hydrogenation.

If desired, the oils may first be saponified to yield glycerine. The remaining fatty acid may then be put through this process to yield first a rich gas of exceptionally high heat value, and second a mixture of liquid hydrocarbons which boil somewhat below 250 deg. C.

Laboratory tests indicate that on the average a ton of crude oil will yield 10,500 to 11,500 cu.ft. of gas and 650 to 750 lb. of motor fuel. It is evident, of course, that at the present value of vegetable or animal raw materials it is extremely impractical. Its only value lies in the possibility of developing the almost inexhaustible resources of the tropics on a scale such as has been approached by systematic plantation of rubber and other colonial products. If the deposits of mineral oil are ever exhausted it may be that such a process as this will provide our future motor fuel.

Review of Recent Patents

Dehydrating Chlorhydrin Solutions—Ethylene and propylene chlorhydrins, when in very concentrated or anhydrous form, are excellent solvents for natural and synthetic resins, particularly copals, for fatty oils, and for use in varnishes, cellulose ester solutions and lacquers. Small amounts of water seriously interfere with these applications. For example, ethylene and propylene chlorhydrins containing 8 per cent of water will only partly dissolve copals. Concentration of dilute chlorhydrin solutions by fractional distillation is difficult, since constant boiling mixtures are formed. Benjamin T. Brooks, of Bayside, N. Y., has found, however, that saturation of the fractions with an inert salt improves the separation, the method being as follows:

A 5 per cent aqueous solution containing ethylene and propylene chlorhydrins is distilled through an efficient fractionating column until about 40 per cent of the solution has been distilled. The distillate is saturated with common salt and distilled again and the second distillate thus obtained is saturated with common salt. The aqueous saline solution is separated from the oily chlorhydrin layer and returned to the still for reconcentration. The oily chlorhydrin layer is treated with an equal volume of benzene and the aqueous layer thus formed is separated and also returned to the still. The benzene solution is distilled, thus recovering the benzene, and the fraction boiling from 126 to 134 deg. C. is collected as anhydrous chlorhydrins. As thus prepared the chlorhydrins are excellent solvents for copals and cellulose esters and may be incorporated in other solvent mixtures in which aqueous chlorhydrin mixtures could not be used. (1,446,874. Assigned to Chadeloid Chemical Co. Feb. 27, 1923.)

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Standard cells are used, such as that covered by United States patent 1,269,-566 to MacDougall and Middleton. The improved method of manufacture depends upon the fact that relationship of space between electrodes to temperature has been found to exist. If the **electrodes are spaced under ¼ and over ⅛ in. and if diaphragms of asbestos cloth are used, the current density and consequently the temperature may be increased. The current density may be raised from 0.25 ampere per square inch, which has been the maximum density obtainable in the past, to from 1.5 to 3 amperes per square inch. A temperature of 90 to 95 deg. is employed and an aqueous electrolyte consisting of 17 per cent caustic soda is used. The voltage required when operating at a density of 3 amperes per square inch and a temperature of 95 deg. is approximately 2.5.** To facilitate the removal of the gases evolved at the electrodes, porous material, the composition of which is not specified, is used in making these. (1,446,736. Feb. 27, 1923.)

Preparation of Solid Preservative Substance for Rubber Latex—The preservative used in transporting rubber latex, which is alkalized phenol, may be obtained by a method patented by S. C. Davidson, deceased, of Belfast, Ireland. Since the transportation of this alkalized phenol in fluid-tight metal

American Patents Issued April 24, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,452,520—Process for Carrying Out Continuous Fusions. W. O. Mitscherling, Wilmington, Del., assignor to Atlas Powder Co., Wilmington, Del.

1,452,553—Dechlorinated Chlorinated Glycerides and Derivatives Therefrom. H. A. Gardner, Washington, D. C.

1,452,573—Electrodeposition of Tin. L. D. Simpkins, Brooklyn, N. Y., assignor to National Lead Co., New York City.

1,452,589—Electrolytic Cell—D. A. Brading, Chicago, Ill.

1,452,594—Thermally Insulated Apparatus and Method of Insulating the Same. G. Claude, Paris, France, assignor to Société l'Air Liquide Société Anonyme pour l'Étude des Procédés Georges Claude, Paris, France.

1,452,605—Arsenical Compound. L. M. Hussey, Philadelphia, Pa., assignor to J. F. Hamner, Philadelphia.

1,452,617—Process of and Apparatus for Distilling Liquids. W. E. Sanger, New York City, assignor to William Gartigue & Co., New York City.

1,452,662—Method of Recovering Zinc From Lead Zinc Ore. R. V. Smith, Eureka, Utah.

1,452,739—Decolorizing and Purification of Saccharine Materials. J. J. Hood, P. G. Clark of London and John Clark of Hutton, England.

1,452,750—Readily Fusible Alloy. A. D. Mulligan, London, England.

1,452,774—Intermediates and Dyestuffs of the Anthraquinone Series. F. W. Atack, Manchester, England, and C. W. Soutar, St. Andrews, Scotland.

1,452,778—Process and Apparatus for the Recovery of the Vapors of Volatile Liquids From Aeriform Mixtures. E. A. Barbet, Paris, France.

1,452,805—Dyestuffs Containing Sul- and Dyeing Vegetable Fibers With- a Mordant and Process of Making ort, and H. Balhorn, Hochst, Germany, assignors to Leopold Cassella & Co., a corporation of Germany.

1,452,813—Method of Decomposing Mixed Metal Salt Solutions. H. Pauling, Berlin, Germany.

1,452,815—Process of and Apparatus for Grading Solid Materials. C. I. Reed, Glenside, Pa.

1,452,898—Process of Treating Rock Asphalt. J. B. Smyth, Beaumont, Tex.

1,452,928—Drying Kiln. E. F. Perkins, Chicago, Ill.

1,452,931—Zinc Smelting Furnace. B. Raeder, Kykkelsrud, Norway, assignor to himself and to A. Zink, both of Kykkelsrud.

1,452,966—Agitator. C. Field, Yonkers, N. Y., assignor to Chemical Machinery Corp., New York City.

1,452,971—Carboy. F. E. Hodes, Denver, Colo.

1,453,021—Preparation for Dyeing Furs, Hairs and the Like. P. Onnertz, Berlin, Germany, assignor to Actien Gesellschaft für Anilin Fabrikation, Berlin, Germany.

1,453,037—Apparatus for the Treatment of Naturally Occurring Hydrocarbon-Containing Materials. C. P. Bowie, Berkeley, Calif., and M. J. Gavin, Boulder, Colo.

1,453,060—Conversion of Ammonia Into Ammonium Chloride. C. Bosch and C. Kircher, Ludwigshafen, and E. Dehnal, Rossen, assignors to Badische Anilin & Soda Fabrik, Ludwigshafen, Germany.

1,453,113—Drying Cylinder. E. Hutchins, New York City, assignor to International Paper Co., Inc., of New York.

1,453,132—Process for the Recovery of Pure Alkalis From Impure Lyes. K. Heinemann, Heidenau, Germany.

1,453,210—Process for Purifying the Residue Obtained in Producing Ammonia From Cyanide. C. T. Thorssell, and L. R. Lunden, Gottenberg, Sweden, assignors to Aktiebolaget Kvafveindustri, Gottenberg.

1,453,215—Method of Volatilizing, Distilling, or Separating Absorbed Vapors. C. L. Voress, New City and V. C. Cantor, Bradford, Pa., assignors to Gasoline Recovery Corp., of Delaware.

1,453,254—Alloy and Process of Making Same. A. B. Norton, Cleveland, Ohio, assignor to Aluminum Manufacturers, Inc., Cleveland, Ohio.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

drums is very expensive, the solid form is desirable. In carrying out the proposed method of preparation, 2 parts by weight of phenol crystals are mixed with 1 part by weight of caustic soda in solid form. These ingredients are mixed or ground together in a warmed receptacle for a few minutes, during which time the mixture becomes semi-fluid. Gradually it assumes the condition of a fine white powder. Under pressure, this powder may be pressed into solid blocks. These blocks may be readily transported in lead-lined wooden boxes out of contact with the air. (1,447,930. March 6, 1923.)

Smokeless-Powder Dynamite—L. H. Jones of Kenvil, N. J., has assigned to the Hercules Powder Co., of Wilmington, Del., the following patent covering the production of smokeless powder dynamite. Ordinary smokeless gunpowder is utilized in admixture with either sodium nitrate or ammonium nitrate, chalk, nitro-glycerine and water. Wood pulp and corn meal may also be used to give bulk, while at the same time a certain amount of the smokeless powder may be replaced by trinitrotoluol. The moisture content of the materials going into the explosive must be less than 2½ per cent and, better, not over 1 per cent. The nitroglycerine is primarily included for the purpose of agglutinating any smokeless powder and nitrate dust that may be present and thus insure against premature explosion, and at the same time assure regulatable detonation. The sensitiveness of the mixture is controlled by varying the relative amount of the nitrates employed and also by decreasing or increasing the amount of ammonium nitrate in comparison with the amount of smokeless powder. The resulting explosive is safe to use and to transport. It is dry, non-balling, non-freezable and may be readily loaded into cartridges or boreholes. (1,447,248. March 6, 1923.)

Composition of Matter for Use as a Roof Paint—To J. Gower and H. Wolfe, of Sparta, Ill., a patent has been granted for a roof paint the composition of which involves inexpensive materials and for which claims are made of great resistance to deterioration and the action of the elements. This material is impervious to the action of the sun's rays and also to moisture.

The recommended proportions are 1½ qt coal tar; 1½ qt. of melted rubber compound, and 1 qt. of varnish. These are mixed together thoroughly, the tar and rubber compound forming the body of the paint, while the varnish acts as a drier and renders the paint more elastic than would otherwise be the case. (1,447,208. March 6, 1923.)

Viscose Threads and Filaments—Unevenness in size of cellulose threads, filaments, etc., made from viscose, due to globule formation, can be overcome by a method patented by H. J. Hegan, of Coventry, England. In the usual process of fabrication the viscose is forced through an orifice into an acid bath containing only sulphuric acid, some sulphate and such compounds as glucose and zinc salt. During this process tendency for globules to form and pass on to the winding apparatus is common. By the addition of sodium oleate in the proportion of 2 parts to 10,000 of viscose this tendency may be overcome. The addition of the sodium oleate may be made during the manufacture of the viscose, but it is made preferably afterwards, or just previous to the time of thread and filament formation. (1,446,301. Feb. 20, 1923.)

Reduction of Nitro-Compounds—An improved method for the reduction of nitro-compounds to amino-compounds has been patented by D. A. Legg, of London, England. This is based mainly upon the use of an improved catalyst which consists of fused copper oxide prepared as indicated in British patent application 21,667. This is claimed to work with complete satisfaction under the conditions which must be met. Nitro-compounds in the vapor state in conjunction with such a reducing agent as hydrogen are passed over this catalyst at a temperature which may range from 180 to 300 deg. C. The nitro-compound reduced may also be mixed with water gas, other reducing gases, or with an alcohol that is capable of being dehydrogenated under the conditions as indicated suitable for the reduction of the nitro-compound.

The reduction of nitro-benzene to aniline is specifically covered in the patent. Nitro-toluenes can be reduced to toluidines in a similar manner. The catalyst used does not readily become inactivated and when it does it can be restored by superficial reoxidation by heating in air to a high temperature (1,447,557. March 6, 1923.)

Flattening Sheet Glass—Patents to I. W. Colburn, 1,248,809, dated Dec. 4, 1917, and 1,274,385, dated Aug. 6, 1918, cover an apparatus in which a sheet of glass is drawn upward from a bath of molten glass, bent into a horizontal plane, reheated, and then passed through a drawing mechanism which gives the required longitudinal pull to produce the continuous sheet of glass and at the same time flattens the reheated and softened sheet into its final form. This mechanism has been improved by Seth B. Henshaw, of Charleston, W. Va., through the addition to the draw bars of a series of worms which operate by means of rack and pinion drive to stretch the sheet laterally. The threads of the worms engage the softened thick edges of the sheet, with the result that there is a tendency to stretch the sheet laterally over the whole area engaged by the draw-bars and draw-table. This aids in obtaining a flatter sheet and also tends to draw out wrinkles and waves which may be present. (1,447,661; assigned to Libbey-Owens Sheet Glass Co. March 6, 1923.)

Drawing Sheets of Glass Simultaneously—In the application of Joseph P. Crowley, Serial No. 386,440, filed June 4, 1920, is disclosed a system of drawing sheet glass wherein a pair of sheets are drawn vertically from a bath of molten glass and, after becoming partially set so that they will not adhere to one another, are brought into contact and bent collectively about a single bending roller and then passed through a single drawing mechanism and into the leer. Such a system doubles the output of the sheet drawing apparatus and also has the advantage that a traveling surface of glass (the lower sheet) is interposed between the upper sheet of the pair and the operating portions of the drawing and bending devices so that nothing encounters this upper sheet to mar its surface.

The present invention is an addition to and improvement upon the sheet glass drawing system set forth in this Crowley application. In the present system the sheets are drawn as before in separable contact with one another, but as they enter the leer, mechanism is provided whereby the sheets are separated and conveyed individually through the leer, from which they emerge onto individual cutting tables. In this way both surfaces of each sheet are exposed throughout the travel of the sheet through the leer, thus obtaining more uniform and satisfactory annealing. Also since each sheet emerges separately onto its own cutting table the process of severing the respective sheets into suitable lights or sections is greatly facilitated. (1,447,654. Arthur E. Fowle, of Toledo, Ohio, assignor to the Libbey-Owens Sheet Glass Co. March 6, 1923.)

Sagger Construction—In the burning of ceramic wares, such as sanitary ware, the molded ware is often of large size and the strain put upon the saggers when several of these are superimposed in the kiln is very great. Consequently the life of these saggers is short, due to cracking, warping or settling in such a way as to cause the ware to deform and become ruined. Sometimes these saggers, which are usually made of burnt clay, last for only one run. Silicon carbide when made into refractory forms (see for example U. S. Pat. 1,042,844) has remarkable mechanical strength even at high temperature. At 1,350 deg. C. the modulus of rupture is approximately 2,200 lb. per sq.in., whereas the corresponding value for fireclay is only about 115 lb. per sq.in. Hence at kiln temperatures a silicon carbide refractory structural member has about nineteen times the resistance to cross breaking that is possessed by a fireclay refractory. For this reason, Frank J. Tone, of Niagara Falls, N. Y., proposes to use silicon carbide plates for reinforcing fireclay saggers. The plates may be of such size and shape as nearly to cover the inside bottom of the sagger, or they may be large enough to form a cover, thus supporting the entire bottom of the sagger above. In this way life of saggers has been prolonged to several hundred runs. (1,448,011. Assigned to the Carborundum Co. March 13, 1923.)

Men in the Profession

Dr. E. F. ARMSTRONG has been nominated to the presidency of the Society of Chemical Industry (London) for a second year of office.

ALBERT V. BLEININGER, ceramic engineer and chemist for the Homer Laughlin China Co., Newell, W. Va., gave an interesting address before the members of the Rotary Club, East Liverpool, Ohio, April 24, on "Manufacture of Optical Glass."

B. E. BROWN, of the Bureau of Plant Industry, Washington, recently visited Freehold and Hightstown, N. J., where he supervised the application of fertilizers in the co-operative experiments being conducted in that state.

R. R. CAMPBELL, vice-president of the American Writing Paper Co., Holyoke, Mass., in charge of production, has resigned.

Dr. G. H. A. CLOWES, chemical director, Eli Lilly & Co., Indianapolis, Ind., was the principal speaker at the meeting of the Indiana Section of the American Chemical Society, April 13, at Indianapolis.

C. R. DELONG, M. G. DONK and E. M. WHITCOMB sailed for Europe from New York on May 3 on the steamer "Mongolia." The party intends to conduct investigations of the cost of producing certain chemicals in Germany, Norway, Holland and Switzerland.

JOHN J. EVANS, general manager of the Lancaster, Pa., plant of the Armstrong Cork Co., has been elected president of the Lancaster Chamber of Commerce.

ALEX. L. FEILD, of the Union Carbide & Carbon Research Laboratories, delivered an instructive and interesting lecture on metallography before the senior class of the Cooper Union Night School on April 23.

Dr. KUNO B. HEBERLEIN returned the latter part of April from a business trip in Europe.

Dr. L. O. HOWARD, chief of the Bureau of Entomology, according to word from Holland, has been made honorary president of the International Conference of Phytopathologists and Economic Entomologists, which is to be held June 24 at Wageningen, Holland. Dr. Howard sailed for Europe May 5. While abroad he will attend the International Congress of Agriculture at Paris, May 22 to 26, and the International conference concerning *Dacus olea* to be held at Madrid June 18. He will visit entomological institutions in England, France, Italy, Spain, Belgium and Holland, and will consult with many experts concerning the entomological exchange of living beneficial parasites of injurious insects.

Dr. ALBERT W. HULL, scientist in the research laboratory of the General Electric Co., Schenectady, N. Y., has been awarded the Howard N. Potts gold medal for scientific research by the Franklin Institute, Philadelphia. The award was made for his studies in the crystalline structure of matter by means of X-rays and was based on a paper entitled "Crystal Structures of Common Elements" read before the Franklin Institute last year. The Potts medal was established in 1906 from a trust fund left by the will of H. N. Potts of Philadelphia. It is awarded for "distinguished work in science or the mechanic arts."

FORREST K. PENCE, ceramic engineer, has resigned as head of the research department of the Knowles, Taylor & Knowles Co., East Liverpool, Ohio, manufacturer of pottery, to become president and general manager of the Paducah Pottery Co., Paducah, Ky. R. V. MILLER, formerly of the ceramic department, Ohio State University, Columbus, Ohio, will succeed Mr. Pence at the Knowles plant.

G. W. ROBINSON, head of the department of agricultural chemistry, University College, Bangor, North Wales, recently visited the Department of Agriculture, Washington, to learn something of the research work being done in soil physics in the United States. Professor Robinson, who holds a traveling fellowship from the Wales university, plans to spend 2 months studying the experimental work in soil physics at state experiment stations in Georgia, Texas, Arizona, California, Utah, Kansas, Illinois, Michigan, New York, Massachusetts and New Jersey.

Dr. J. J. SKINNER, of the Bureau of Plant Industry, has returned to Washington from Fayetteville and New Bern, N. C., where he supervised the application of fertilizers in the co-operative experiments and inaugurated fertilizer experiments with cotton.

E. W. TREND, representing the mines and chemical works of the Mount Lyell Mining & Railway Co., Ltd., Melbourne, Australia, is a visitor in the United States on business and is making his headquarters at the Chemists' Club, New York City, for several weeks.

Obituary

WILLIAM BRADY, chief chemist and chemical engineer, South Chicago plant, Illinois Steel Co., died on April 22. He was active in chemical circles in the Chicago district, having served as chairman of the Chicago Section of the A.C.S. in 1905, as councilor from 1909 to 1917 and as director from 1913 to 1916. He was also a member of the Chicago Chemists Club, American Electrochemical Society, A.S.T.M. and A.A.A.S.

Calendar of Coming Society Meetings

AMERICAN ASSOCIATION OF CEREAL CHEMISTS will hold its ninth annual convention at Hotel Sherman, Chicago, June 4 to 9.

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual convention in Norfolk, Va., May 7 to 9.

AMERICAN ELECTROPLATERS SOCIETY will hold its eleventh annual meeting at Providence, R. I., July 2 to 5.

AMERICAN GAS ASSOCIATION will hold its annual convention the week of Oct. 15 at Atlantic City. An elaborate exhibition of gas making and gas-utilization equipment is planned.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its summer meeting June 20-23 at Wilmington, Del.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W. Va., June 7, 8 and 9.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold its spring meeting May 28 to 31 in Montreal, Canada.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

AMERICAN ZINC INSTITUTE, INC., will hold its fifth annual meeting at the Hotel Chase, St. Louis, May 7 and 8.

ASSOCIATED COOPERAGE INDUSTRIES OF AMERICA will hold its eighth annual meeting May 8 and 9 in St. Louis, Mo. Headquarters will be the Jefferson Hotel.

CANADIAN INSTITUTE OF CHEMISTRY will hold its annual meeting in Toronto, May 29 to 31.

CHAMBER OF COMMERCE OF THE UNITED STATES will hold its eleventh annual meeting in New York May 7 to 11.

NATIONAL ASSOCIATION OF MANUFACTURERS OF THE UNITED STATES OF AMERICA will meet in annual conference May 14 to 16, inclusive, at the Waldorf-Astoria, New York City.

IRON AND STEEL INSTITUTE (London) will hold its annual meeting May 10 and 11 at the House of the Institution of Civil Engineers, London, S. W. 1.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (NINTH) will be held in New York Sept. 17-22.

NATIONAL FERTILIZER ASSOCIATION will hold its thirtieth annual convention at White Sulphur Springs, W. Va., the week of June 11.

NATIONAL LIME ASSOCIATION will hold its fifth annual convention at the Hotel Commodore, New York City, June 13 to 15.

NATIONAL SYMPOSIUM ON COLLOID CHEMISTRY will be held at the University of Wisconsin, June 12 to 15.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

PACIFIC DIVISION, American Association for the advancement of Science, will hold its seventh annual meeting at the University of Southern California, Los Angeles, Sept. 17 to 20, in conjunction with the summer session of the national association and a meeting of the Southwestern Division of the National Association.

SOCIETY OF CHEMICAL INDUSTRY, Canadian Section, will meet in Toronto, May 29 to 31.

SOCIETY FOR STEEL TREATING — Eastern sectional meeting will be held June 14 and 15, in Bethlehem, Pa.

The following meetings are scheduled to be held in Rumford Hall Chemists' Club, East 41st St., New York City: May 11 —Société de Chimie Industrielle (in charge) American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8 — American Chemical Society, regular meeting.

Industry and Trade

Current News and Market Developments

May 7, 1923

CHEMICAL & METALLURGICAL ENGINEERING

Tenth Avenue at 36th Street, New York

H. C. PARMELEE, *Editor*

The Summary of the Week

F. E. Breithut appointed chemical trade commissioner for the Department of Commerce, to be stationed in Berlin.

Report from Rome states that, according to American-Sicilian sulphur agreement, world's consuming requirements will be apportioned among producers.

Standards of strength for coal-tar dyes are specifically defined in list emanating from Washington. The standards, when adopted, will be used as a basis for levying import duties.

Acetic acid has been marked up in price, following the recent advance in acetate of lime.

There were offerings of Indian linseed, c.i.f. New York, at a price only 15c. per bushel higher than the prevailing quotation for Argentine linseed. This indicates that the United States may import from India.

Another advance in price was registered in the market for tartaric acid. Frequent price advances have failed to check buying interest.

Tin bichloride and tin crystals are offered at lower prices for May delivery. The decline resulted from lower producing costs as represented by declines in the metal.

Prices for pure spirits of turpentine show a decline of 12c. per gal. for the week. New production is coming in, and demand both at home and for export has been quiet.

Red prussiate of potash sold off sharply during the week. This was due to eagerness of holders to unload.

Arrivals of nitrite of soda from foreign markets were pressed for sale and market prices were forced downward.

Why Produce Synthetic Phenol?

AT THE moment phenol is probably the most interesting commodity on the chemical market. A shortage not entirely anticipated by the consuming industries has recently sent prices skyward. Spot market quotations have risen 65 per cent in 2 months and over 400 per cent during the past year. Naturally contracts have been made at somewhat lower prices, but the figure of 28c. per lb., reported for some recent business, is more than double the manufacturers' prices of a year ago. As one of the results of this situation synthetic phenol works that have been closed down since 1919 are planning to resume production, while the construction on at least one new synthetic plant is already nearing completion.

The question is asked: Why is it necessary to make phenol synthetically? Is not the present record-breaking production of byproduct coke making available greater supplies of coke-oven tar than ever before in history? It is true, to be sure, that the output of byproduct coke in March was three and a quarter million tons, or nearly 50 per cent more than the average monthly output during any previous year and that 1923 will undoubtedly set a new record for the industry. But this does not necessarily mean that the output of phenol will increase in that proportion. Our supply of phenol is determined by the amount of tar that is distilled—not by the amount that is made. During the past year the shortage of both transportation and coal caused an increased quantity of tar to be burned as fuel in steel plants and gas works. Thus the quantity of tar which could be handled profitably by the tar distiller was considerably restricted.

The 1922 output of natural phenol - estimated between a million and a million and a half pounds—was practically all that could be produced under the circumstances. Furthermore, the consumers got little relief from imports, for the high duties of the tariff act of 1922 have proved practically prohibitive.

In 1918, it will be recalled, because of war demands we had an enormous output of phenol (106,794,277 lb.), which was made almost entirely in synthetic phenol plants. At the time of the armistice the government's surplus stocks amounted to 35,000,000 lb., or nearly three times the normal annual consumption. As this surplus found its way to the market, prices declined sharply—falling from 40c. per lb. to less than 10c. per lb.—although early in 1920 the market recovered to about 15c. Production during 1920 and 1921 was practically nil, and in the latter year the reported sales amounted to only 292,645 lb. The market was considerably depressed during these 2 years and it was not until the last quarter of 1922 and the enactment of the new tariff that the present movement had its beginning.

In the U. S. Tariff Commission's "Census of Dyes and Coal-Tar Chemicals" for 1919 the following was said of the phenol situation:

> It is probable that the present and future consumption of phenol will be in excess of the amount of natural phenol obtained from coal-tar distillates, and that when the surplus stocks have been consumed some of the synthetic plants will necessarily resume production.

Present developments, it would seem, form a striking confirmation of this prediction.

Tentative Standards Evolved for Coal-Tar Dyes in Import Trade

Duties Will Be Levied According to These Standards of Strength—Producers and Importers Invited to Criticise List

A TENTATIVE list of standards of strengths of coal-tar dyes in ordinary use in the United States prior to July 1, 1914, has been issued by the Customs Division of the Treasury Department. Copies have been sent to prominent producers and importers for criticism. Suggestions received by May 7 will be given consideration in the final draft of the list, according to the announcement of Director Ernest W. Camp.

About 100 dyes are named in the list. Others are to be classified according to their characteristics corresponding to some one dye in the list. The new tariff act provides that coal-tar products when imported be assessed for duty on the basis of the strength in ordinary use prior to July 1, 1914. Many dyes and chemicals now are imported in more concentrated forms. In such cases, the specific duty of 7 cents per pound will be multiplied in proportion to the increase in strength. The lowest commercial strength in ordinary use prior to the outbreak of the war in Europe is taken as the basis.

The announcement of the Customs Division accompanying its tentative list makes it plain that because a certain dye is chosen as a standard of strength it is not necessarily meant that this particular dye is the best or purest of the class, although its dyeing properties have been taken into consideration. This announcement is to forestall possible efforts to capitalize inclusion in the standard strength list for advertising purposes.

Supplemental lists of such dyes as have been determined to fall within the class corresponding to each standard will be issued in the future.

Following is the announcement of the Customs Division, together with the tentative list:

TREASURY DEPARTMENT,
May , 1923.

To Officers of the Customs and Others Concerned:

Attention is invited to the following proviso of paragraph 28, tariff act of 1922: "That in the enforcement of the foregoing provisos in this paragraph the Secretary of the Treasury shall adopt a standard of strength for each dye or other article which shall conform as nearly as practicable to the commercial strength in ordinary use in the United States prior to July 1, 1914; that if a dye or other article has been introduced into commercial use since said date, then the standard of strength for such dye or other article shall conform as nearly as practicable to the commercial strength in ordinary use, that if a dye or other article was or is ordinarily used in more than one commercial strength, then the lowest commercial strength shall be adopted as the standard of strength for such dye or other article."

Pursuant to the foregoing provisions of law standards of strength are hereby adopted as follows:

TENTATIVE STANDARDS FOR COAL-TAR DYES IN IMPORT TRADE

Class Similar in Character and Shade to	Mfr.	Standard	Mfr.
Acid Anthracene Red 3 B	(By)	Acid Anthracene Red 3 B M	(Gar)
Acid Green 2 B	(By)	Acid Green G	(Ch)
Acid Milling Yellow G	(S)	Acid Milling Yellow G	(S)
Acid Violet 4 B N	(B)	Acid Violet 4 B N	(B)
Acid Violet 6 B N	(B)	Acid Violet 6 B N	(B)
Algol Yellow 3 G	(By)	Algol Yellow 3 G single (12%) paste	(By)
Alizarine Blue Black B	(By)	Alizarine Blue Black B	(By)
Alizarine Blue Black 3 B	(By)	Alizarine Blue Black 3 B	(By)
Alizarine Cyanine N S	(By)	Alizarine Cyanine N S	(By)
Alizarine Cyanine Green G Extra	(By)	Alizarine Cyanine Green C G	(Ch)
Alizarine Cyanine Green 3 G	(By)	Alizarine Cyanine Green 3 G	(By)
Alizarine V I Extra Pure 20%, Paste	(B)	Alizarine V I Extra Pure 20%, Paste	(B)
Aniline Yellow. ..	(B)	Martius Yellow	(A)
Anthracene Acid Brown G	(C)	Pontachrome Brown G	(Dup)
Anthracyanine Brown G L	(By)	Anthracyanine Brown G L A	(Gras)
Auramine O	(B)	Auramine II	(B)
Benzo Fast Black L	(By)	Pontamine Fast Black L N	(Dup)
Benzo Fast Blue 4 G L	(By)	Benzo Fast Blue 4 G L	(By)
Benzo Fast Orange S	(By)	Pontamine Fast Orange S	(Dup)
Benzo Fast Pink 2 B L	(By)	Pontamine Fast Pink B L	(Dup)
Benzo Fast Red 8 B L	(By)	Benzo Fast Red 8 B L	(By)
Benzo Fast Scarlet 2 B L	(By)	Benzo Fast Scarlet 2 B L	(By)
Benzo Fast Scarlet 5 B L	(By)	Benzo Fast Scarlet 5 B L	(By).
Benzo Rhoduline Red B	(By)	Benzo Rhoduline Red B	(By)
Brilliant Acridine Orange A	(DH)	Brilliant Acridine Orange	(DH)
Brilliant Benzo Fast Yellow G I	(By)	Brilliant Benzo Fast Yellow G I	(By)
Brilliant Crocein M	(C)	Brilliant Crocein M	(C)
Brilliant Fast Blue B	(By)	Brilliant Fast Blue B	(By)
Brilliant Milling Blue B	(C)	Brilliant Milling Blue B	(C)
Brilliant Pure Yellow 6 G Extra	(By)	Brilliant Pure Yellow 6 G Extra	(By)
Brilliant Wool Blue F F R Extra	(By)	Brilliant Wool Blue FF R Extra	(By)
Chinoline Yellow (various marks)	(Var)	Quinoline Yellow 100%	(NA)
Chloramine Yellow 2 G	(By)	Thiazol Yellow 2 G M	(Gar)
Chrome Acetin Blue	(DH)	Chrome Acetin Blue	(DH)
Chrome Brown R V V	(G)	Chrome Brown R V V	(G)
Chrome Printing Red B	(DH)	Chrome Printing Red B	(DH)
Chrome Violet CG	(DH)	Chrome Violet C G	(DH)
Chromoxane Brilliant Blue G	(By)	Chromoxand Brilliant Blue G	(By)
Chrysamine G	(By)	Chrysamine G	(By)
Chrysamine R	(By)	Chrysamine R	(By)
Ciba Blue 2 B	(J)	Ciba Blue 2 B D (16%) Paste	(Dow)
Coriphosphine O	(By)	Coriphosphine O	(By)
Cyanol F F	(C)	Cyanol F F	(C)
Deltapurpurine 5 B	(By)	Deltapurpurine 5 B	(By)
Diamine Catechin G	(C)	Pontamine Catechu G	(Dup)
Diamine Fast Blue F F B	(C)	Diamine Fast Blue F F B	(C)
Diamine Fast Red 8 B L	(C)	Benzo Fast Red 8 B L	(By)
Diamine Rose G D	(C)	Diamine Rose G D	(C)
Diamine Sky Blue F F	(C)	Direct Sky Blue F F	(Newp)
Dianil Fast Scarlet 8 B S	(M)	Pontamine Fast Pink G	(Dup)
Diazo Sky Blue 3 G	(By)	Diazo Sky Blue 3 G	(By)
Diazo Geranine B Extra	(By)	Diazo Geranine B Extra	(By)
Diphenyl Brown G S	(G)	Direct Brown R C	(Newp)
Diphenyl Fast Brown G N C	(G)	Diphenyl Fast Brown G N C	(G)
Eclipse Brown 3 G K	(G)	Sulphogene Yellow D.	(Dup)
Erika B.	(A)	Erika B.	(A)
Eriochrome Black E	(G)	Alizarole Black 3 G	(NA)
Erythrosin B	(C)	Erythrosin N blue shade	(H. & M.)

Calendar

The following important technical meetings are scheduled for the immediate future:

AMERICAN ZINC INSTITUTE
St. Louis, May 7-8

AMERICAN ASSN OF ENGINEERS
Norfolk, May 7-9

AMER SOCIETY MECHANICAL ENGRS
Montreal, May 28-31

CANADIAN INSTITUTE OF CHEMISTRY
Toronto, May 29-31

SOCIETY OF CHEMICAL INDUSTRY
Canadian Section
Toronto, May 29-31

AMER. ASSN CEREAL CHEMISTS
Chicago, June 4-9

AMER LEATHER CHEMISTS ASSN
White Sulphur Springs, W. Va., June 7-9

NAT'L FERTILIZER ASSOCIATION
White Sulphur Springs, W. Va., June 11-16

NATIONAL LIME ASSOCIATION
New York City, June 13-15

SOCIETY FOR STEEL TREATING
Eastern Sectional Meeting
Bethlehem, Pa., June 14-15

AMER INST CHEMICAL ENGRS.
Wilmington, Del., June 20-23

AMER SOC FOR TESTING MATERIALS
Atlantic City, June 25-29

Argentina Imports American Printing Ink

Argentine requirements for printing and lithographic inks reaches 1,000,000 lb. annually, of which 80 per cent is imported from the United States. The business is largely in the hands of a few houses that import the ink in barrels and rework it in local shops. Some ink is imported prepared in cans, but this is not considered as successful nor as economical a method as to import in bulk, since the saving of about 5 cents a pound in import duties on ink imported in bulk more than pays for the cost of reworking and packing. The journey through the tropics also affects the prepared ink, and it is therefore possible to supply the consumer with a superior and more uniform product when it is prepared for the market in Buenos Aires. One American manufacturer, with a factory in Buenos Aires, has the bulk of the trade, and by personal work has captured a market which was formerly in the hands of German and French firms.

Linseed Exports From India

Shipments of linseed from India for the crop year ended March 31 reached the total of 10,596,000 bu. The United Kingdom was the principal buyer, taking 5,944,000 bu. The Continent absorbed 4,652,000 bu. The new crop situation is favorable and the exportable surplus for the 1923-24 season is estimated by shippers at 12,000,000 bu.

TENTATIVE STANDARDS FOR COAL-TAR DYES IN IMPORT TRADE (Continued)

Fast Acid Violet A 2 R	(M)	Fast Acid Violet A 2 R	(M)
Fast Light Yellow 3 G	(By)	Fast Light Yellow G 3 X.	(Phar)
Fast Mordant Yellow G	(B)	Alizarine Yellow 2 G	(Gras)
Guinea Fast Red B L	(A)	Guinea Fast Red B L	(A)
Helindone Pink A N	(M)	Helindone Pink A N single (10%) Paste	(M)
Helindone Pink B N	(M)	Helindone Pink Single (10%) Paste	(M)
Hydren Blue G	(C)	Hydren Blue G Single (20%) Paste	(C)
Hydren Blue R	(C)	Hydren Blue R Single (20%) Paste	(C)
Indanthrene Black BB	(B)	Anthrene Black B Single (12½%) Paste	(Newp)
Indanthrene Blue B C S	(B)	Anthrene Blue B C S Single (20%) Paste	(Newp)
Indanthrene Blue G C	(B)	Anthrene Blue G C Single (10%) Paste	(Newp)
Indanthrene Blue G C D	(B)	Anthrene Blue G C D Single (8½%) Paste	(Newp)
Indanthrene Blue 3 G	(B)	Ponsol Blue 3 G Single (10%) Paste	(Dup)
Indanthrene Blue 5 G (new)	(By)	Algol Blue 3 G (old) Single (12½%) Paste	(By)
Indanthrene Blue R E Z	(B)	Indanthrene Blue R E Z	(B)
Indanthrene Blue R S	(B)	Anthrene Blue R S Single (10%) Paste	(Newp)
Indanthrene Blue R S P	(B)	Ponsol Blue R P Single Paste	(Dup)
Indanthrene Brilliant Violet 2 BK (new)	(By)	Algol Bril Violet 2 B (old) Single (12½%) Paste .	(By)
Indanthrene Brilliant Violet 2R (new)	(B)	Indanthrene Violet 2 R Extra Single (12½%) Paste . .	(B)
Indanthrene Brown B	(B)	Anthrene Brown 2 B Double (22%) Paste .	(Newp)
Indanthrene Brown R (new)	(By)	Algol Brown R (old) Single (12½%) Paste	(By)
Indanthrene Golden Orange G	(B)	Indanthrene Golden Orange G (Single (12½%) Paste	(B)
Indanthrene Golden Orange R	(B)	Indanthrene Golden Orange R Single (12½%) PST . .	(B)
Indanthrene Orange RRT (new)	(B)	Indanthrene Golden Orange RRT (old) single (20%) Paste	(B)
Indanthrene Yellow G	(B)	Anthrene Yellow G Single (12½%) Paste	(Newp)
Indanthrene Yellow G K (new)	(By)	Algol Yellow R Single (12½%) Paste	(By)
Indigo MLB 2B	(M)	Midland Vat Blue R Single (20%) Paste	(Dow)
Katigen Green 2 G	(By)	Katigen Green 2 G	(By)
Light Green S F Yellowish	(M)	Pentacyl Light Green S F Yellowish	(Dup)
Methylene Blue 2 B	(By)	Methylene Blue 2 B	(By)
Neptune Blue B	(B)	Neptune Blue B	(B)
Neptune Blue B G	(B)	Neptune Blue B G	(B)
Oxamine Black B H N	(B)	Oxamine Black B H N	(B)
Para Sulphon Brown V	(S)	Para Sulphon Brown V	(S)
Patent Marine Blue	(M)	Patent Marine Blue	(M)
Polar Yellow 2 G Conc	(G)	Polar Yellow 2 G Conc	(G)
Pyrazol Orange 2 R	(S)	Pyrazol Orange 2 R	(S)
Pyrazol Orange R	(S)	Pyrazol Orange R	(S)
Resorcin Brown F	(K)	Resorcin Brown F	(K)
Rhodamine B	(B)	Rhodamine B	(B)
Rhoduline Blue 3 G O	(By)	Rhoduline Blue 3 G O	(By)
Rhoduline Sky Blue 3 G	(By)	Rhoduline Sky Blue 3 G	(By)
Silver Grey P	(A)	Silver Grey P	(A)
Sulphon Yellow B G	(By)	Sulphon Yellow B G	(By)
Supramine Red B	(By)	Supramine Red B	(By)
Supramine Red 2 G	(By)	Supramine Red 2 G	(By)
Thio Chromorhodine B R	(DH)	Thio Chromorhodine B R	(DH)
Thional Brown G	(S)	Thional Brown G	(S)
Thio Violet 5 R	(DH)	Thio Violet 5 R	(DH)
Trisulphon Brown B	(S)	Trisulphon Brown B	(S)
Xylene Light Yellow R	(S)	Xylene Light Yellow R	(S)
Zambesi Black D	(A)	Diazine Black D R	(NA)

KEY TO ABBREVIATIONS

(A)	Actien Gesellschaft, Berlin, Germany	(Gras)	Grasselli Chemical Works, U S A
(B)	Badische Co. Germany	(H & M)	Heller & Merz, U S A
(By)	Bayer & Co , Germany	(J)	Gesellschaft für Chemische Industrie, Switzerland
(C)	Casella & Co , Germany	(K)	Kalle & Co , Germany
(Ch)	Chemical Co. of America, U S A	(M)	Meister Lucius & Brüning, Germany
(DH)	Durand & Huguenin, Switzerland	(NA)	National Aniline & Chemical Co , U S A
(Dow)	Dow Chemical Co., U S A	(Newp)	Newport Chemical Works, U.S A
(Dup)	Dupont Chemical Works, U.S.A	(Phar)	Pharma Chemical Corporation, U S A
(G)	Geigy & Co , Switzerland	(S)	Sandoz Chemical Works, Switzerland
(Gar)	Garfield Aniline & Chemical Works, U. S. A		
(Var)	Various		

In selecting the standards set forth in the foregoing list the main consideration has been the choosing of that dye which corresponds in strength as nearly as practicable to the lowest commercial strength of the given class, in conformity with paragraph 28 of the tariff act of 1922 The fact that a certain dye is chosen as a standard does not necessarily mean that that particular dye is the best or purest of the class although its dyeing properties have of necessity been taken into consideration

It is the intention of the department to issue from time to time supplementary lists of such dyes as have been determined to fall within the class corresponding to each standard adopted

Would Make Goldsmith Chief Tariff Investigator

The long-vacant post of chief foreign investigator for the United States Tariff Commission is to be filled soon. It has recently been learned that the commission is agreed upon Alan Goldsmith, now chief of the Western European Division of the Bureau of Foreign and Domestic Commerce of the Department of Commerce as the man for the work. Mr. Goldsmith is expected to return soon from Rome, where he represented the Department of Commerce at the recent meeting of the International Chamber of Commerce.

At the present time the commission has two representatives in Europe. Chairman Marvin, it is known, has been advised by them that great difficulty may be expected by the investigators who are seeking data upon which to base recommendations for changes in the tariff rates. In France, especially, it is said that manufacturers are openly hostile to these inquiries, being unwilling to open up their books and let the investigators learn what it costs them to produce the commodities which are exported to the United States. Some offers of co-operation have been made in Germany.

The foreign investigations naturally are not expected to get well under way until a directing head is chosen. For more than a year the office has been unfilled and the commissioners have been apparently unable to unite upon one man. However, it is understood that Mr. Goldsmith was quite acceptable to all the commissioners.

War Gases Cure Disease

Recent Experiments Show That Influenza, Tuberculosis and Paresis Are Benefited by Treatment

To cure rather than to kill is the most modern use of the so-called poison gases. Experts of the Chemical Warfare Service believe that the possibility of successfully treating influenza, tuberculosis, paresis and other afflictions by the use of poison gases has been demonstrated by experiments now being conducted at Edgewood Arsenal.

It is asserted that through experiments with chlorine gas, the chemists have established the fact that epidemics of grip and colds may be checked almost instantly by the introduction of weak concentrations of the gas into the rooms occupied by those exposed.

Mustard Gas for Tuberculosis

That mustard gas is a specific for tuberculosis apparently seems to be demonstrated by the experiments conducted under the direction of Lieutenant-Colonel E. B. Vedder of the Army Medical Corps. Guinea pigs inoculated with tuberculosis germs and a concentration of mustard gas were apparently rendered immune by the gas and failed to contract the disease. An equal number of guinea pigs inoculated with tuberculosis germs and not subjected to the mustard gas treatment contracted the disease.

Experiments With Lewisite

As a result of experiments with lewisite, the chemists have evolved what appears to be a remedy, if not a cure, for paresis and locomotor ataxia.

Dr. A. S. Loevenhart of the University of Wisconsin has been studying the effects of lewisite upon the human system in conjunction with the chemists at Edgewood Arsenal. He has the records of forty-two persons committed to insane hospitals with paresis, who have come under this treatment. Of that number twenty-one have been cured.

Chlorine as Cold Cure

The fact that chlorine might be used to prevent or cure colds, influenza and pneumonia was demonstrated during the war at Edgewood Arsenal by accident. It was remarked that cases of influenza or pneumonia did not occur among the workers in the laboratory where chlorine was being made, although 10 to 20 per cent of others on duty at the arsenal were victims. Investigation showed that in the rooms where chlorine gas was being made there was a slight leakage of chlorine, just enough to act as a germicidal agent.

Following out this idea, the Chemical Warfare Service and the Medical Department have made great advances on this line and it is now believed practicable to introduce small quantities of chlorine into school rooms, factories, churches and other places where persons gather.

Testing Materials Meeting Plans Announced

Society's Twenty-sixth Annual Session to Have a Program Replete With Committee Reports and Papers

The twenty-sixth annual meeting of the American Society for Testing Materials is to be held at Chalfonte-Haddon Hall, Atlantic City, N. J., June 25 to 29. The program promises to be very complete. Besides the reports of about thirty-five committees several special papers are to be read. Some of the features of the meeting are as follows

Metals—The Endurance of Metals Under Repeated Stresses is discussed in two papers, one devoted primarily to steel and the other to duralumin and manganese bronze. The work of the Bureau of Standards in the study of Gases in Steel is described. There will be a discussion on the desirability of including Chemical Requirements in Cast-Iron Specifications. A further report on Effect of Sulphur in Steel will be presented by the joint committee on that subject.

Concrete and Reinforced Concrete.—The outstanding feature is a discussion (to which an entire session will be devoted) on the topic "What Properties of and Methods of Making Concrete Require Further Investigation?" Slag as an Aggregate in Concrete is discussed in one paper; Fatigue of Concrete in another; and there are two papers on the use of Calcium Chloride in Concrete.

Consistency—This subject has long been a troublesome one. A paper by the sub-committee on consistency will record the various conceptions of consistency and methods of test developed by the several committees, and the whole discussion will be introduced by a paper treating with fundamental considerations involved in this property of materials.

Slate—The program contains two papers on this subject, which will be discussed at an A.S.T.M. meeting for the first time.

Glue—A comprehensive discussion on "The Testing of Glue" has been arranged at the request of a number of glue chemists and large users of glue. This is an important matter in many industries.

Testing—The entire meeting is replete with valuable papers and reports on methods of testing, covering such topics as babbitt metal, magnetic properties, tool steels, insulating varnishes, paints, concrete, etc. There are also included descriptions of new devices in extensometers, an accelerometer for measuring impact, and a new machine for testing textiles.

Chicago Lard Stocks Gain

Stocks of lard in Chicago increased 20,717,000 lb. in the past month. The stocks on May 1 were estimated at 34,212,000 lb., which compares with 13,495,000 lb. on April 1 and 45,147,000 lb. on May 1 a year ago.

Agreement Between American and Italian Producers of Sulphur

Prices Will Be Fixed From Time to Time—American Production to Supply Demands of North America—World Consumption Apportioned

IN A REPORT dated March 27, Consul H. Earle Russell of Rome, Italy, gives interesting details of the agreement recently made by American and Sicilian producers of sulphur. Mr. Russell states that the essential points of the accord concern the determination of the sales prices and the designation of the quantities to be placed by each of the contracting parties.

Prices will be fixed from time to time with reference to the conditions in the individual consuming countries, and in such a manner as to reach gradually the pre-war level.

By agreement made at the time of signing the accord, prices have on the average been increased by more than one dollar per ton over those provisionally determined in October, 1922.

Division of Markets

With regard to the division of markets, it has been decided that the American production shall supply the demands of North America, while the Italian product will be reserved for the national needs The remaining world consumption will be met in determined proportions by America and Sicily, to the latter being given the exclusive right of sale up to 65,000 tons for the manufacture of sulphuric acid in any country On the basis of the approximate figures of the present world consumption, it is calculated that Sicily will be able to export annually about 145,000 tons of raw and worked sulphur, in addition to the 65,000 tons destined for the manufacture of sulphuric acid. These quantities are considerably greater than those exported by Italy in the last few years.

The exportation of raw sulphur to individual markets will then be regulated, taking into account as far as possible the advantages accruing to each of the contracting parties from their geographical position in relation to the various consuming countries. The exportation of worked sulphur remains entirely unfettered. The contracting parties are pledged to maintain the present situation in the industry of refining and grinding of sulphur, which represents a guarantee for the Italian production of worked sulphur.

Agreement Holds Until 1926

The duration of the agreement is fixed until Sept. 30, 1926, and may be prolonged. It is, however, proper for the parties to denounce the convention even before the above date by a notice from one to the other of not less than 6 months. However, it is arranged that the rupture of the agreement will not take place during the sulphur selling season.

There is also created a central office in London with representatives of both parties for the exchange of data, information and statistics, and for the maintenance of a closer contact between the parties themselves in regard to the execution of the agreement.

Settlement of Disputes

Each dispute that may arise over the same will be submitted to the judgment of a board of arbitration with headquarters in London, composed of a representative of each of the parties and of a third named by the first two, or, in default thereof, by the president of the Chamber of Commerce.

The agreement is viewed with much jubilation by the Sicilian producers, who consider it of great importance to the sulphur industry as giving to it a period of recuperation and relative tranquillity necessary to cure the evils of the recent past and to provide for a better system and organization.

General Reduction in German Export Duties

A general abolition or reduction in the German export duties became effective April 29, according to a cablegram of that date, received at the Department of Commerce from Commercial Attaché Charles E. Herring at Berlin. It is stated that owing to the heavy decrease in export orders since February and to high prices this measure has been deemed necessary.

It is also reported that German manufacturers and wholesalers, with the exception of the clothing industry, are generally in favor of abolishing the export control boards, which are known in German as the "Aussenhandelsstelle."

Personals

Jerome Rockhill, son of the late Clayton Rockhill, has joined the staff of Julian W. Lyon & Co., importers and dealers in essential oils in New York.

M. F. Austin, manager of the vegetable oil department of J. C. Francesconi & Co., has returned from a business trip to points in New England.

William L. Greenbaum has been appointed receiver for the Kemiko Co., disinfectants, 426 Broome St., New York. Liabilities are placed at $4,295; assets about $2,000. The company is incorporated under the laws of New Jersey with authorized capital of $25,000.

Major Breithut Appointed Chemical Trade Commissioner at Berlin

Has Had Broad Experience in Chemical Industries and Unusual Background in Chemical Economics—Widely Known for Work in Chemical Warfare Service and War Industries Board

THE significance of the German chemical industry in its relation to our own developments has led the U. S. Department of Commerce to appoint Dr. F. E. Breithut to the staff of Commercial Attaché Herring at Berlin as Chemical Trade Commissioner. In this capacity, Dr. Breithut will be of considerable service to the American industry.

In selecting Dr. Breithut for this post, the Department of Commerce secures the services of a trained chemical economist. During the war he served as an assistant to Herbert Hoover in various food conservation campaigns and was later commissioned as a major in the Chemical Warfare Service. In the latter capacity he was attached to the headquarters staff of Major-General W. L. Siebert, acting first as chief of personnel, then as chairman of the chemicals group, price section, of the War Trade Board, and subsequently as chief of procurement, salvage and sales.

After the armistice, Dr. Breithut spent 4 years in dyestuff and other industrial chemical work, returning to the College of the City of New York last year.

While teaching there Dr. Breithut instituted a course in the economics of the chemical industry. This attracted widespread interest in educational circles and it so impressed the chemical trade that the Salesman's Association of the American Chemical Industry induced Dr. Breithut to give a special evening course particularly adapted to the requirements of its members.

F. E. BREITHUT

The new trade commissioner has contributed several articles to the literature of chemistry, both popular and technical. His technical publications include "Is There an American Dye Monopoly?" "The Economic Status of the American Chemical Industry," and "Prices of Chemicals During the War." More recently he has published "The Inspection of Establishments Producing, Using or Refining Wood Alcohol," and "A New Method of Measuring the Partial Vapor Pressures of Binary Mixtures."

New York Chapter Formed by Institute of Chemistry

The New York Chapter of the American Institute of Chemistry came into being on April 30. On that date about thirty members of the National Institute gathered for dinner and preliminary election of officers for a New York chapter. Dr. R. V. Bacon was made chairman. Dr. A. Naglevoort was elected vice-chairman, Thomas Wright treasurer and C. L. Bryden secretary. At the same time publicity and membership committees were appointed.

The first work to be done in the state of New York is that of classification of chemists according to economic status. To this end it is proposed to make a fact-finding survey concerning the chemists of the entire district. Following this classification a more definite plan of activity will be adopted.

In the meantime the enrollment of properly qualified members is sought. The next meeting of the chapter is to be held on May 28. The hour and place will be announced later.

Dye Importers Contemplate New Association

Several importers of dyes are considering the formation of a separate and distinct organization. What form the new body will take is as yet unannounced. Question exists as to the advisability of affiliating with a national association of importers as a dyestuff group.

Among those mentioned as interested in such a project are William Baur, of Bachmeir & Co.; Mr. Loeffler, of the American Aniline Products Co.; Mr. Rosenthal, of the Ackerman Color Co., and Dr. Pickerall, of Herman A. Metz & Co.

G. C. Davis, former government tariff expert, has been called into consultation by those interested in the plan. Mr. Davis has acted in an advisory capacity in tariff matters for a number of the larger dye houses in New York, and his views are being sought with respect to the problems with which an organization such as is contemplated must cope.

News Notes

Eighty per cent of the dyes consumed in Great Britain are now being produced by the British dye-making industry, according to an analysis of the dyestuffs business in the United Kingdom received recently by the Commerce Department from Consul General Robert P. Skinner, at London.

Another war-time project of Uncle Sam is being offered for sale. Bids on the Norfolk army supply base, covering an area of 900 acres, with terminal improvements, are to be opened on May 22. As a shipping, export and storage base, this area is one of the best located on the Atlantic seaboard.

The quantity of hydrocyanic acid absorbed by a large number of fumigated fruits, vegetables, seeds, flour and other foodstuffs has recently been determined in the Bureau of Chemistry. The results of this work, as well as a brief review of the literature, are to be given in a bulletin, immediately obtainable from the Division of Publications at Washington.

Synthetic apple oil prepared by Dr. F. B. Power and his associate, V. K. Chesnut, of the Bureau of Chemistry, for which a public service patent was granted in 1922, is now being manufactured by a commercial concern in New York. This apple oil possesses the aroma of ripe apples and is the result of a prolonged chemical investigation of their odorous constituents.

Barely 1,000 ounces of platinum constitutes the total production of the United States for 1922. J. M. Hill, of the Geological Survey, points out that the larger part of this was produced in California.

War mineral claims to the number of about 800 have now been settled. This leaves about 400 of the less important ones open to adjustment. Of the $8,500,000 appropriated by Congress 2 years ago, $2,250,000 remains for the remaining settlements, which it is planned may all be made by January, 1924.

Recent specifications that have been submitted to the American Engineering Standards Committee for comment and criticism, prior to their formal adoption by the Federal Specifications Board, include: Steel castings, foundry pig, semi-steel castings, ingot copper, ingot tin, slab zinc and phosphor copper.

Swiss iron foundries are operating in many cases at a loss. The outlook is regarded as extremely dubious due to the cutting off of iron and coal supplies. A rise in prices is considered urgently necessary if activity at these works is to be continued.

The British America Nickel Co. is shortly to resume operations, discontinued two years ago. C. A. Rose of New York is to be general manager of technical operations. The capacity of the plant will eventually be 10,000 tons of nickel a year. Production of other metals, especially copper, will also be carried on.

Coal-Tar Dyes Imported Through Port of New York During April

Detailed Information Compiled by Chemical Section of Commerce Bureau and Tariff Commission

IMPORTS of coal-tar dyes for April totaled 242,022 lb., with an invoice value of $256,751.

The four dyes leading in quantity imported were xylene light yellow, diaminogene blue, patent blue (No. 543) and diazamine blue BR. Of the total quantity imported in April, 1923, 42 per cent came from Switzerland, 37 per cent from Germany, 18 per cent from Italy, 2 per cent from Canada and 1 per cent from England. Switzerland led for the first time in 1923, indicating that the Ruhr occupation has not seriously affected the supply of raw material for dye making in that country. Prior to the war Switzerland depended almost exclusively on Germany for these materials. Official statistics for 1922, however, show that she imported crude and intermediates from France, Great Britain, Poland, Italy, Czechoslovakia, United States and Germany

The dyes in this report are grouped by Schultz numbers and in the case of those which could not be identified by Schultz number, the classification according to ordinary method of application was adopted. As the pastes and powders of the vat dyes vary widely in strength and quantity, each vat dye has been reduced—in nearly every case—to a single strength basis.

The designation "c" for competitive, and "n.c.' for non-competitive, in column 1 of the report, indicates the appraisement basis for the assessment of the ad valorem duty in paragraph 28 of the tariff act of 1922. Those dyes without designation are doubtful, pending further investigation.

The ad valorem rate for competitive dyes is based on the American selling price, as defined in subdivision (*f*) of section 402 of title IV; the ad valorem rate for non-competitive dyes is based on the United States value, as defined in subdivision (*d*) of section 402 of title IV of the tariff act of 1922. All dyes are listed where imports for the month were 500 lb. or more.

Schultz No.	Name of Dye	Mfr	Quantity, Lb	Invoice Value, Dollars	Per Cent By Countries	
9	Direct yellow G		2,002		Switzerland	100
c	Sun yellow G	S				
22	Xylene light yellow		12,149		Switzerland	100
	Xylene light yellow R conc	S				
	Xylene light yellow 2G conc 75%	S				
28	Hansa Yellow G		500		Germany	100
n c	Hansa yellow G powder 100%	M				
88	Acid anthracene brown		2,757	1,604	Germany	100
n c	Acid anthracene brown PG	By				
c	Acid anthracene brown RH extra	By			Germany	100
222	Janus yellow		500		Germany	100
n c	Yellow IG (Janus yellow G)	M				
265	Acid milling black	G	3,969		Switzerland	100
	Acid milling black B652					
273	Diaminogene blue		10,588	7,766	Germany	85
n c	Diaminogene blue NA	C			Italy	15
n c	Blue NA (100%, standard)	C				
274	Diaminogene					
n c	Black extra (100%, standard)		7,000		Germany	100
	(Diaminogene extra)	C				
319	Diamine scarlet	S	3,002		Switzerland	100
	Chloramine red 3B (standard)					
392	Toluylene orange		1,334	1,133	Switzerland	99
n c	Direct fast orange K	I			Germany	1
c	Toluylene fast orange GL	By				
456	Benzo fast blue		1,551	2,401	Germany	50
n c	Benzo fast blue 2GL	By			Italy	50
n c	Benzo fast blue 4GL	By				
494	Auramine G		1,212		Switzerland	100
n c	Auramine G	I				
506	Erioglaucine		1,279		Switzerland	100
n c	Erioglaucine AP 545	G				
527	Acid violet 4BN		4 004		Switzerland	100
c	Acid violet 4BNS conc 6 10	S				
537	Methyl blue for silk		882		Switzerland	100
c	Methyl Lyons blue 410	G				
543	Patent blue		14,035	9,458	Germany	100
	Brilliant acid blue V	By				
c	Neptune blue BGX conc	B				
n c	Patent blue V (56%)	M				
n c	Patent marine blue LE	M				
545	Patent blue A		3,449	3,154	Germany	99
	Brilliant acid blue FF	By			Canada	1
c	Patent blue A (56%)	M				
c	Patent blue A	Q				
553	Eriochrome cyanine		999		Switzerland	100
n c	Eriochrome cyanine R C 935	G				
564	Naphthalene green		993		Switzerland	100
	Naphthalene green V	Q				
571*	Rhodamine 6G		3,272	9,364	Switzerland	41
n c	Rosazeine 6G extra (100%)	M			Italy	31
n c	Rhodamine 6G extra (100%)	M			Germany	24
n c	Rhodamine 6G extra (500%)	M			Canada	4
n c	Rhodamine 6GD extra (100%)	M				
n c.	Rhodamine 6GD extra (500%)	M				
n c	Rhodamine 6GDN extra	M				
n c	Rhodamine 6GDN extra (500%)	M				
	(52% of the total quantity is 500% strength)					
573	Rhodamine B		3,883	9,195	Switzerland	57
c	Rhodamine B extra	I			Italy	30
c	Rosazeine B extra (100%) (Rhodamine B extra)	M			Germany	13
c	Rhodamine B extra (500%)	I				
	Notes—54% of the total quantity is 500% strength					
609	Homophosphine		2,033	3,548	Germany	100
n c	Auracine G	By				
n c	Coriofiavine GOOO (150%)	GrE				
663	New methylene blue		1,100	1,853	Germany	91
n.c.	New methylene blue NX (100%)	C			Canada	9
n c.	Methylene blue N NX (70%)	B				
759	Anthraflavone (single strength)		2,528	2,025	Italy	100
n c	Anthraflavone GC paste fine	B				
n c.	Anthraflavone GC paste	B				
n c.	Anthraflavone GC powder	B				
760	Indanthrene golden orange G (single strength)		4,202	3,551	Italy	85
					France	15
	Indanthrene golden orange G paste	B				
n c.	Indanthrene golden orange G double paste	B				
n c.	Indanthrene golden orange G double paste fine	B				
n c	Indanthrene golden orange G powder	B				
761	Indanthrene golden orange (single strength)		6,177	7,251	Italy	62
n c.	Indanthrene golden orange 2RT paste	B			Germany	17
n c	Indanthrene golden orange 2RT powder	B			Canada	13
n c	Indanthrene golden orange RRTS powder	B			France	8
n c	Helindone golden orange IRRT paste fine (10%)	M				
767	Indanthrene violet RR (single strength)		2,699	2,587	Germany	52
c	Helindone violet IRR extra paste (10%)	M			Italy	48
c	Indanthrene violet RR extra double paste	B				
794	Cibanone black (single strength)		1,760[b]		Switzerland	100
n c	Cibanone black 2G powder (100%)	S				
795	Cibanone yellow R		6,393		Switzerland	100
n.c.	Cibanone yellow R paste 10%	S				
799	Alizarin cyanine G		882		Germany	100
n.c.	Alizarin cyanine 2G powder	By				
820	Algol brilliant violet R (single strength)		3,115	1,716	Italy	100
n.c.	Algol brilliant violet R paste	By				
n.c.	Algol brilliant violet R powder	By				

Head of Nitrate Survey Named

The nitrate investigation of the government is to be in charge of H. A. Curtis, formerly general manager of the Clinchfield Carbocoal Corporation and during the war connected with the Ordnance Department.

William H. Walker, of Glenn Willows, Calif., was named as assistant head of the nitrate survey. He is a vice-president of the American Farm Bureau Federation and is to take charge of the study of the probable demand for nitrates, chiefly from the agricultural point of view.

The work of the investigation will be carried on in close collaboration with trade and governmental organizations already active in the field.

Potash, according to a statement by Secretary Hoover, probably will be the next chemical commodity to be taken up by the foreign monopoly survey. Thus far Mr. Hoover sees no necessity for an investigation into the Japanese control of camphor production, on the theory that a large part of the product is manufactured synthetically. It is the department's intention, however, to make a study of all raw materials of import upon which this country is dependent and which are produced under foreign monopolies.

	Name of Dye	Mfr	Quantity, Lb.	Invoice Value, Dollars	Per Cent By Countries	
	Indanthrene claret B..		825		Italy	100
	Indanthrene Bordeaux B extra paste	B				
	Indanthrene blue Rs (single strength)		8,097		France	100
	Indanthrene blue RS triple powder for paper	B				
	Indanthrene blue GCB (single strength)		4,863	2,491	Canada	59
	Indanthrene blue GCD paste	B			Italy	41
	Indanthrene blue GCD double paste	B				
	Indanthrene blue GCD powder	By				
	Alizarin astrol.		5,101	11 052	England	51
	Alizarin astrol B powder	By			Italy	43
	Alizarin rubinol GW	By			France	6
	Alizarin rubinol GW powder	By				
	Alizarin rubinol R	By				
	Alizarin rubinol R powder	By				
	Alizarin rubinol 3G	By				
	Alizarin saphirol B		1,336	2,254	Germany	41
	Alizarin blue SAWSA powder	By			Italy	41
	Alizarin saphirol	By			France	18
	Alizarin saphirol B	By				
	Alizarin saphirol WSA	By				
	Helio fast blue BL (100%)	By				
	Alizarin blue black B		4,729	4,023	Germany	62
	Alizarin blue black B	By			France	14
	Alizarin blue black B (100%)	By			Italy	14
	Alizarin blue black B powder (80%)	By				
	Algol brown B (single strength)		4,492	4,171	Germany	78
	Algol brown G paste	By			Italy	22
	Algol brown R paste	By				
	Algol brown R powder	By				
	Vat brown R paste	By				
	Ciba violet B (single strength)		4,845		Switzerland	100
	Ciba violet B paste 10%	I				
	Ciba violet B powder	I				
	Helindone brown G (single strength)		980		Italy	100
	Thio indigo brown G powder	K				
	Ciba scarlet		3,981	3,874	Switzerland	75
	Ciba scarlet G extra paste (20%)	I			Germany	25
	Helindone fast scarlet C paste (17%)	M				
	Helindone pink		5,043		Italy	59
	Helindone pink AN (10%) paste	M			Germany	41
	Helindone orange R (single strength)		3,400	2,222	Germany	67
	Helindone orange R powder	M			Italy	33
	Helindone orange R powder (100%)	M				
	Helindone red 3 B		2,000		Germany	100
	Helindone red 3 B paste (20%)	M				
	Ciba Bordeaux B		551		Switzerland	100
	Ciba Bordeaux B paste (10%)	I				
	Acid alizarin gray G		1,785	3,012	Germany	56
	Acid alizarin gray G	M			Italy	24
	Acid alizarin gray G (80%)	M			France	12
	Acid alizarin gray G (100%)	M			Canada	8
	Alizarin light blue B conc	S	2,286		Switzerland	100
	Azo wool violet 7R (Standard 100%)	C	500		Germany	100
	Polar orange R conc 599	G	999		Switzerland	100
	Scarlet 2 R (Standard not conc.)	S	500		Switzerland	100
	Wool fast yellow 3G (80%)	B	560		Germany	100
	Unidentified Vat Dyes					
	Helindone pink		7,366	6 907	Germany	68
	Helindone pink B extra paste	M			Italy	32
	Helindone pink B extra paste (10%)	M				
	Helindone pink R extra paste	M				
	Helindone pink R extra paste (10%)	M				
	Hydron pink		2,747	2,993	Germany	72
	Hydron pink FB paste	C			Italy	28
	Hydron pink FF paste	C				
	Hydron scarlet		1,213		Switzerland	82
	Hydron scarlet 2B paste	C			Italy	18
	Thio indigo pink RN paste	K	891		Italy	100
	Thio indigo violet 2R paste	K	914		Italy	100
	Unidentified Mordant and Acid Chrome Dyes					
c.	Anthracene chromate brown EB	C	1,500		Germany	100
	Chromorhodine		991	3,335	Switzerland	100
	Chromorhodine BN powder	DH				
	Chromorhodine BR powder	DH				
	Eriochrome flavine A conc	G	1,764		Switzerland	100
n.c.	Eriochrome red G	G	1,100		Switzerland	100
n.c.	Metachrome blue black 2 BX	A	4,000		Germany	100
	Modern royal blue powder	DH	661		Switzerland	100
	Omega chrome brown		1,190	1,145	Switzerland	100
	Omega chrome brown G conc	S				
	Omega chrome brown PB conc	S				
	Unidentified Direct Dyes					
	Chlorantine brown Y	I	2,205		Switzerland	100
c.	Chlorantine fast yellow 4 GL	I	1,102		Switzerland	100
	Diamine catechine		3,186	3,194	Switzerland	97
c.	Diamine catechine B (100%)	C			Germany	3
c.	Diamine catechine GR (200%)	I				
	Diamine fast orange		1,781	1,615	Italy	68
n.c.	Diamine fast orange	C			Germany	32
n.c.	Diamine fast orange EG	C				
n.c.	Diamine fast orange ER	C				
n.c.	Diazamine blue BR conc. 6-10	S	10,009		Switzerland	100
n.c.	Diazo blue NA	L	2,205		Germany	100
n.c.	Diazo sky blue B	By	1,008		Germany	100
	Oxamine fast blue		2,692	2,641	Germany	93
n.c.	Oxamine fast blue RR	B			Canada	7
n.c.	Oxamine fast blue 6B	B				
n.c.	Minaso fast blue RRX (50%) (Oxamine fast blue RRX)	B				
	Parasulphon brown		1,000	636	Switzerland	100
n.c.	Parasulphon brown G	S				
n.c.	Parasulphon brown V	S				
	Unidentified Sulphur Dyes					
	Thional yellow 2G	S	2,002		Switzerland	100
	Unidentified Basic Dyes					
	Rhodamine		1,652	7,043	Switzerland	100
n.c.	Rhodamine 4GD	I				
n.c.	Rhodamine 6GH conc. (425%)	I				
n.c.	Rhodamine 6GH (400%)	I				

Ernest C. Klipstein Dies

Ernest Christian Klipstein, head of E. C. Klipstein & Co., the Warner-Klipstein Co. and the Bulls Ferry Chemical Co., died Sunday morning, April 29. Mr. Klipstein had been stricken with an attack of kidney trouble only 4 days prior to his death and was taken to St. Vincent's Hospital, New York City, but failed to respond to treatment. He was born in Virginia in 1851 and for many years had occupied a prominent position in the dye and chemical industries of this country. He is survived by his wife and three sons, Ernest H., Gerald P. and Kenneth H. Mr. Klipstein had lived in East Orange, N. J., since 1889, and funeral services were held at his late home there on Tuesday afternoon, May 1.

Financial Notes

A large percentage of the securities of the St. Louis Coke & Chemical Co. has been pledged to the readjustment plan of the company's financial structure, which would reduce fixed charges from $1,230,248 to $454,160. The readjustment of the finances will undoubtedly be through the medium of a new company, says a report from St. Louis.

Mathieson Alkali Works, Inc., reports for the quarter ended March 31 last net earnings of $386,303 after depreciation, compared with $151,667 a year ago. Gross earnings totaled $521,227, against $286,750.

Stockholders of the Commercial Solvents Corporation at a special meeting authorized an issue of $1,000,000 8 per cent first preferred stock for the purpose of building a new plant.

Tennessee Copper & Chemical Corporation shows a net income of $337,421 for 1922, equivalent to 42c. a share earned on the 794,426 shares of capital stock of no par value. This compares with a net income of $147,175, or 18c. a share, in the previous year.

The New Jersey Zinc Co. reports income of $1,905,456 for the first 3 months of 1923. This includes dividends from subsidiary companies and is after deduction of expenses, taxes, maintenance, depreciation and other charges. The total compares with $1,126,080 in the same period in 1922.

The American Hide & Leather Co. reports a deficit of $118,175 for the first 3 months of 1923, after payment of all operating expenses, interest on loans, reserves for depreciation and other charges. This compares with a deficit of $23,221 in the same period last year.

The Columbia Textile Co. for the quarter ended March 31 reports net sales of $1,513,177 and net income available for bond interest, after depreciation and other charges, of $111,631.

Facts and Figures That Influence Trade in Chemical Products

Market Conditions

Current Prices Imports and Exports The Trend of Business

Irregular Price Movement Features Trading in Chemicals

Acetic Acid Advanced in Price—Bichromates Stronger—Formaldehyde Steadies—Tin Crystals Lower—Nitrite of Soda Weakens Under Increased Offerings—Red Prussiate of Potash Sells Off Sharply—Glaubers Salts Weak

THE movement of prices for chemicals in the past week has been very irregular. In some cases imported makes have come on our market in sufficient volume either to beat down the prices asked for domestic goods or to cause their own offering at buyers' prices. Nitrite of soda is one of the materials which came in from abroad only to find an unreceptive market and many holders preferred to cut prices rather than hold for a higher market later on. Glaubers salt was in a similar position, with little chance of a stronger market until supplies get into stronger hands. In a few cases such as bichloride of tin and tin crystals lower prices were the result of reduced production costs. On the other hand the advance in acetate of lime as announced a week ago had the effect of bringing out new price schedules for acetic acid, but as some producers were affected more than others by the change in the raw material it was natural to look for a difference in quotations for the acid and there is a range according to seller, especially on the higher grades.

Export buying, which has been a feature in the market for caustic soda so far this year, was less pronounced and values were a little less firm, as some sellers were willing to sacrifice a little in order to book business. On the other hand heavy arrivals of arsenic from foreign markets were readily absorbed on arrival here. The arsenic situation shows little if any change. Buyers have their ideas as to what they want to pay and when their limit has been reached they retire from the market. In spite of reports that an extensive short interest exists, this is not borne out in the market, which would be highly sensitive to heavy buying. Formaldehyde still feels the effects of second-hand offerings, but the latter have been much reduced in volume and the market is coming under the control of producers who say that resale lots recently have sold under the cost of production. Red prussiate of potash was practically a drug on the market a short time ago. Some holders of stocks began to sell at private terms and far enough under the quoted levels to interest buyers. In this way considerable of this material has changed hands, but there is no such thing as firmness in price.

Acids

Acetic Acid—The market has been in a rather unsettled position, following the recent advance in acetate of lime. Producers of acid who require acetate of lime have put up prices, but some difference is found according to seller. Several of the largest consumers are covered on old contracts, but business was reported to have been good during the past week. Prices for 28 per cent are given at 3.38c. per lb. and for 56 per cent 6.75c. per lb. These quotations are for carlots with the usual premiums for smaller lots. Glacial acetic acid is still available at 12c. per lb., carlots, although most sellers are asking higher prices.

Boric Acid—Some producers lowered asking prices during the period. Demand was moderate, but competition is rather keen. Present prices show a range from 11c. to 11½c. per lb., in barrels, for round lots, the difference being according to seller.

Hydrofluoric Acid—According to a report just issued by the Department of the Interior there were 4,800 short tons of fluorspar shipped to makers of hydrofluoric acid in 1922, as compared with 1,833 short tons in 1921. This would indicate a material increase in the output of the acid last year. The present market is a quiet affair. Asking prices are unchanged at 7@8c. per lb. for 30 per cent and 11@12c. per lb. for 48 per cent.

Sulphuric Acid—Inquiry for prompt delivery has eased off a little, but contract holders are calling for stocks and the position of producers has hardly improved. With some sellers prices are little better than nominal, but former prices are still holding, with 60 deg. acid quoted at $9.50@$11 in tanks and 66 deg. acid at $16@$16.50.

Tartaric Acid—With the buying movement holding up, the strength of the market was demonstrated by another advance of 1½c. per lb. last week. The revised asking price is 37½c. per lb. and the market was reported to be strong even at the advance. Imported tartaric sold earlier in the period at 36c. per lb. and an offering for shipment was made on the basis of 29c. per lb. in bond.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	179.28
Last week	179.23
May, 1918	270.00
May, 1919	248.00
May, 1920 (high)	280.00
May, 1921 (low)	143.00
May, 1922	159.00

The index number for the week shows a moderate gain. The advances in acetic acid, formaldehyde in outside selling channels, and caustic potash, brought about the 5 point rise

Potashes

Bichromate of Potash—Some delays in deliveries are reported and the market has taken on a stronger tone as far as prices for prompt shipment are concerned. The general asking price is given at 11c. per lb., f.o.b. works.

Caustic Potash—Sales of small lots of imported were made at 8¼c. per lb. on spot and some goods afloat sold at 8c. per lb. The general asking price for imported on spot was 8½c. per lb. Some producers of domestic caustic put prices up to 9c. per lb. at works, but there were offerings of domestic make at 8½c. per lb. and prices showed a range according to seller. Opinions differed regarding the strength of prices and regarding the outlook for the present.

Muriate of Potash—New prices on German muriate have been expected but so far have not been made. The market is unsettled, as offerings are widely scattered and selling pressure has weakened values. The current quotation of $35 per ton is still subject to shading.

Permanganate of Potash—While prices of 22c. to 24c. per lb. were asked for spot material there was not much trouble in finding sellers at the inside figure. Offerings afloat were available at 21½c. per lb. and prompt shipment was quoted at 21c. per lb. Demand was not large and this no doubt influenced some holders to offer inducements in order to dispose of stocks that they have on hand.

Prussiate of Potash—Red prussiate has been quietly selling at private terms for the past 2 weeks or more. Last week prices were lower than ever, and sales went through as low as 70c.

per lb. The market closed unsettled, with intimations that 70c. could still be done by buyers. Yellow prussiate was in quiet demand and while 37c. per lb. is asked, this price likewise can be shaded.

Sodas

Bichromate of Soda—The market is stronger with reports that the output of some producers has been curtailed. Sellers have been less eager for round lot orders, especially for prompt shipment. The asking price is generally held at 8c. per lb., with spot offerings having changed hands in a small way at 7⅞c. per lb.

Caustic Soda—While export orders still are heard and some of good volume, it is evident that the demand from overseas has fallen off as standard makes have been offered at 3.40c. and other brands were free at 3.30c. for New York. Domestic buyers are taking deliveries with regularity, but total business for the week appeared to be on the decline. Prices for standard makes continue at 2½c. per lb., carlots, at the works, basis 60 per cent, and upward for smaller lots.

Fluoride of Soda—Increased production costs have been a factor in the market for domestic made fluoride and asking prices have responded. The quotation for round lots is now 11c. per lb. works. Offerings of imported also are firmer and 9½@9¾c. per lb. is asked.

Nitrate of Soda—Demand from the fertilizer trade has been of small proportions and prices for 95 per cent are easy as a result. There were offerings at $2.50 per 100 lb. f.o.b. Charleston, during the week, but spot material at New York was limited and was pretty well held at $2.60 per 100 lb. There were no new developments as far as shipments were concerned and new contract prices have not yet been named.

Nitrite of Soda—Imported material has been reaching the market in a rather large way. In fact the pressure of such offerings has had a depressing effect on prices and offerings were freely available on spot at 8c. per lb. For shipment 7¾c. per lb. could be done and with lower cables from primary points abroad the situation showed a decided change in buyers' favor.

Prussiate of Soda—The market for yellow prussiate of soda has settled at the 17½c. per lb. level. This price is quoted by first hands and any material held by others must meet this competition. Imported was largely neglected, with shipment prices reported fractionally higher than the price asked for domestic.

Miscellaneous

Acetate of Lime—The new price list was in effect throughout the week and sellers agree that price shading will not be a factor unless there is a change in fundamental conditions which will admit of manufacture at a larger margin of profit. Current prices are 4@4.05c. per lb.

Acetone—For spot goods the price is 25c. per lb. and upward on a quantity basis. On round lot shipments from works the quotation is 24½c. per lb. The recent marking up in price brought about increased inquiry, but actual orders placed are said to be moderate.

Arsenic—There were reports of sales of white arsenic in the spot market at 15¼@15⅜c. per lb. Interest is keen but reports differ on the volume of business placed. Rather heavy arrivals from abroad were reported but most of these seemed to be destined to fill old orders. From the various reports heard it is clear that no decided price movement threatens. This is shown by offerings of immediate from Canada at 15c. per lb., with the same price quoted for May-June shipment. Until buying becomes more active it would seem that offerings are large enough to prevent any sharp advances in price.

Bleaching Powder—Recent slowing up in consuming demand has brought out some selling pressure. Producers who found goods accumulating began to cut values in order to attract new accounts and this has been done by so many factors that it is almost equivalent to a general lowering of prices on prompt shipment from 2c. to 1.90c. per lb. for large drums, f.o.b. producing point. The contract price is unchanged at 1.90c. per lb. works

Copperas—Producers report fairly active trading and a firm situation, business passing at $29@$29.75 per ton, f.o.b. works.

Copper Sulphate—There was no change in the position of imported sulphate and prices continue to be easy. On spot goods said to be of good quality are offered at 5½c. per lb., with the possibility of buying under that level on a firm bid. The same price applies to shipments. Domestic sulphate is affected somewhat by the competition from foreign, but some producers have a good part of their output sold ahead and are relying on quality to uphold demand for their goods even at a price differential. Prices for domestic are quoted at 6c. to 6.50c. per lb. according to seller and quantity.

Formaldehyde—Odd lots still appear on the market. Sales at 14¾c. per lb. were noted and it is believed that more lots at that figure can be located. In general, however, the market is working into a firmer position as 15c. per lb. is the lowest price of prominent factors and 15½c. per lb. is quoted by many. It is a question of cleaning up the second-hand lots before the market will settle at the higher level.

Methyl-Acetone—Makers announced an advance of 5c. per gallon, following closely upon the uplift in the market for acetate of lime. The revised schedule of prices quotes 80c. per gal. in tank cars and 85c. per gal. in drums, round-lot basis.

Tin Crystals—Lower price levels have been announced for May deliveries. The easier position of the metal market is responsible for the reduction in crystals. Current prices are 35½@36c. per lb., or a decline of 1½c. per lb. from the April figures. Bichloride of tin also was marked down and is offered at 12½@13c. per lb.

Denatured Alcohol Steadies

Some traders reported a better feeling in the market for denatured alcohol as outside offerings were not so much in evidence. The demand was fair and holdings were not considered large. On the No. 1 special the market held at 33c per gal. in drums, and 39c. per gal. in barrels, round-lot basis. The No. 1, 188 proof, completely denatured, was maintained at 41c. per gal., in drums. Ethyl spirits, U.S.P., 190 proof, closed unchanged at $4.70 per gal., in barrels. Producers of methanol reported the market as firm, but quotably unchanged at $1.18 per gal. for the 95 per cent, and $1.20 per gal. for the 97 per cent. The fact that other wood distillates were advanced about a week ago apparently had no influence on methanol.

Philip Weisenthal Arrested On Charges of Fraud

Philip Weisenthal, president of a chemical firm in Hamburg, Germany, and with New York offices at 565 Broadway, was arrested on Monday as he reached New York on the steamer "American Legion." Mr. Weisenthal is charged with defrauding the American Express Co of $300,000, secured as loans against fraudulent invoices. Sidney Hass, manager of the New York branch of the Weisenthal interests, also was taken into custody. Both men are charged with grand larceny and forgery.

It is stated that Weisenthal, after getting export invoices passed by the American consular agent at Hamburg, made out new invoices in which the value of the goods was increased materially over the amounts shown on the original invoices. The false invoices were then presented to the Hamburg agent of the American Express Co. and loans negotiated on the basis of the raised figures. Weisenthal led his pursuers a lengthy chase before being taken into custody. He left Germany for London and from the latter city sailed to Las Palmas, thence to Rio de Janeiro, to Buenos Aires, and from the latter port to New York.

Cobalt and Cellulose Imports Included in Return

Beginning on May 1, the Chemical Division of the Department of Commerce expanded its service of recording chemical imports through the port of New York by adding those chemicals covered by paragraphs 27 and 28 of the tariff law. Paragraph 27 refers to cobalt oxide and other cobalt salts and compounds. Paragraph 28 refers to compounds of pyroxylin and other cellulose esters.

Coal-Tar Products

Spot Phenol Steady—Consumers Not So Anxious Over Future Supply —Benzyl Chloride Higher—Creosote Oil Arrives From Hull

THE output of the byproduct coke ovens has increased steadily since the first of the year, yet the supply of coal-tar bases has not shown a corresponding gain. This is explained by the fact that producers and distillers have found it more profitable to utilize this material in crude form for heating purposes, manufacturing roofing materials, road-binders, etc. As a result the output of natural phenol is not likely to increase appreciably, and with sufficient tariff protection the trade is now looking forward to a larger output of the synthetic product. Phenol on spot sold in a small way during the past week at prices ranging from 55@57c. per lb., but on contract there was a possibility of doing business at close to 28c.

The drop in gasoline naturally led traders to look for an easier situation in benzol, but producers announced no change in their policy of marketing this commodity. The production is moving in a satisfactory way in motor fuel channels and so far as the pure grade is concerned prices are firmly maintained. The arrival of a cargo of creosote oil from Hull attracted much attention. The demand for creosote oils has been good and firm prices were the rule. Producers of benzyl chloride advanced contract prices. Benzaldehyde, technical, was in good demand. Naphthalene on spot was nominally unchanged. Cresylic acid was offered more freely by producers, and this was reflected in easier prices for the imported material for either immediate or nearby delivery. There were no new developments in connection with the tariff on cresylic acid. Xylenes were in scanty supply and so far as spot material was concerned the market was in a wholly nominal position.

Benzene—The production appears to be well taken care of despite numerous reports of a quiet state of trade. The decline in prices for gasoline did not change the attitude of producers, who seem to feel that consumption of motor benzol will not meet with any serious setback. Production of the pure benzol is moderate and prices ruled steady in nearly all directions. The 90 per cent benzol held at 27c., contract basis. The pure was unchanged at 30@32c. per gal., in drums, carload lots or more.

Creosote Oils—A round lot of creosote oil arrived at New York last week from Hull. The market was fairly active and with domestic production well taken care of prices were firmly maintained. On the 25 per cent grade the market settled at 34@36c. per gal.

Cresylic Acid — New production is coming in, and this influenced holders of foreign material to offer supplies a little more freely. Nominal quotations on the 97 per cent grade, in drums, ranged from $1.25@$1.30 per gal.

Naphthalene — New contract prices were not announced, but a feeling prevails that the range will be higher than last year, when the bulk of the output of domestic producers sold at 6½@7c. per lb. The spot market for ball and flake was nominal at 9½@10c. per lb. Demand was not up to expectations.

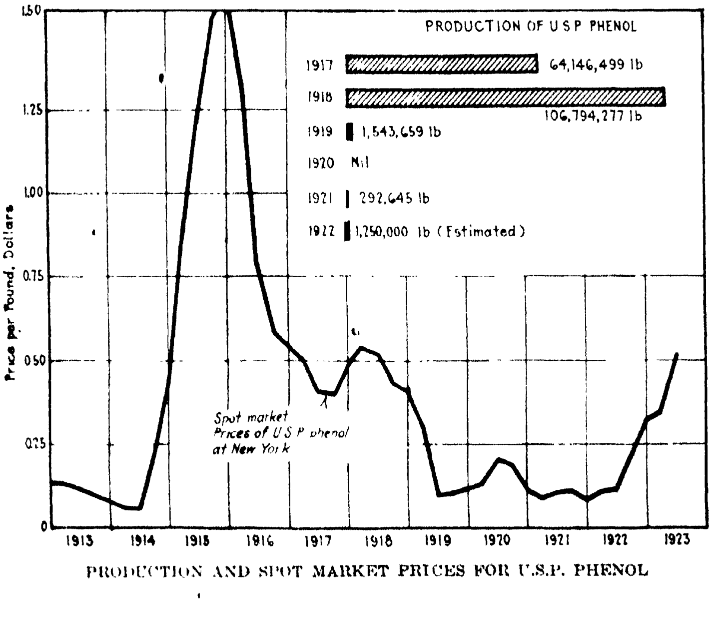
Phenol—Scattered lots of spot material sold through second-hands at 55@57c. per lb. The traders were not so bullish on forward material, feeling that enough new production of the synthetic phenol would come on the market in the near future to take care of the expansion in business. On contract material producers were not openly quoting, but it was reported that last sales went through around 28c. Producers were not at all pleased with the efforts of speculative traders to "bull" the market.

Benzyl Chloride — Production will soon be increased so as to meet the requirements of the trade, but prices will be raised because of the higher cost of manufacture. The leading producer will revise his schedule on the 95@97 per cent refined to 45c. per lb. and on the technical to 30c. per lb., deliveries to commence in July.

Benzaldehyde—There was a good call for the technical grade at 75c. per lb. in drums and 80c. in cans. The market closed firmer.

Salicylic Acid—Demand was quiet all last week, but with stocks moderate prices were steady at 47@48c. for the technical.

Xylene—The pure in drums, on spot, sold through outside channels at 95c.@$1 per lb. The contract price was unchanged at 75c. per lb.



PRODUCTION AND SPOT MARKET PRICES FOR U.S.P. PHENOL

Trade Notes

The Naphthalene Products Co. is a new concern at Birmingham, Ala., which has begun to manufacture refined naphthalene products.

The purchase by Certainteed Products Corporation of the properties of Cook's Linoleum Co. and the Standard Inlay Co. has been ratified by the stockholders of all of the corporations and titles have been passed.

John D. Ryan, chairman of board of directors of the Anaconda Copper Mining Co., in commenting on the income statement of the company, stated that the zinc oxide plant at East Chicago operated throughout the year and produced 2,008,535 lb. Construction of an operating unit of a French process plant with capacity of approximately 16,000 lb. of zinc oxide daily was about completed, while a similar plant was in process of construction at Akron, Ohio.

The Air Reduction Co. has leased offices in the Canadian Pacific Building, Madison Ave. and 44th St.

The United Smelting & Aluminum Co., Inc., of New Haven, Conn., has opened a new warehouse at 216-218 Water St., New York City, to which it is also removing its offices.

The annual meeting and election of officers of the Paint, Oil and Varnish Club of New York will be held on Thursday, May 10, at Delmonico's. Senator Royal S. Copeland will be the guest of honor.

The plant of the Cornwall Chemical Corporation, at Cornwall, below Newburgh, was destroyed by fire May 1, with an estimated loss of $100,000. The fire started when chemicals, leaking from a storage tank, came in contact with boilers and exploded.

Vegetable Oils and Fats

Linseed Oil Futures Lower—Nearby Cottonseed Oil Steady—China Wood Easier—Coconut Unsettled—Tallow Declines

TRADING in vegetable oils and animal fats was quiet all week and the tendency of prices, taken as a whole, was toward lower levels. Liquidation in imported linseed oil resulted in a very unsettled market for the foreign material. Domestic linseed oil for summer delivery went off fully 5c. per gal. Shorts were buyers of May cottonseed oil in the option ring and this served to steady prices for the old crop months. Crude was nominally unchanged. China wood oil was offered more freely for shipments. Easier prices obtained for coconut, soya, palm and sesame oils. Tallow again went off, outside goods equal to extra bringing 8¼c. per lb. delivered. There was little or no buying interest in fish oils for future delivery.

Linseed Oil—Crushers continued to offer spot oil in a rather limited way and prices held on the $1.17 per gal. basis for carload lots, cooperage included. On futures, however, the situation eased off until several crushers appeared anxious for July forward business at $1.05 per gal., carload lots, cooperage basis. Demand was quiet all week and the larger consumers could not be interested in forward material. The fact that close to 5,000,000 bushels of seed are now afloat consigned to United States ports led many to take the stand that the oil situation will soon right itself. Argentine shipments continue at a liberal rate and last week saw several offerings of Indian seed at a premium of only 15c. per bushel over the prevailing c.i.f. quotation on the Argentine product. A small parcel of Moroccan seed also was available. With indications of a larger acreage in the northwest the seed supply in sight for the remainder of the year looms up rather large, notwithstanding the healthy increase in the volume of oil sales. Domestic cake prices were steady so far as crushers were concerned, the market settling around $36.50 per ton, f.a.s. New York. Imported oil was unsettled all week. Receipts were larger and this prompted some "profit taking" by the speculative element. Spot foreign oil sold down to $1.05 per gallon, in barrels, Private advices from London reported sales of bulk oil for June-July shipment to America. May shipment from the other side closed nominally at $1.05 per gal., in barrels, duty paid.

Cottonseed Oil—May oil in the option market on the Produce Exchange was steady to firm on covering by shorts. Futures were unsettled on the general weakness in other commodities. The sugar investigation put a damper on speculative activity. New crop developments attracted attention and several private preliminary estimates on acreage indicated an increase in the plantings of approximately 10 per cent. May oil, prime summer yellow, sold up to 11.83c. during the week. December sold under 9c. per lb. Crude held at 10c. mills on actual sales. Rumors that this figure could be shaded lacked confirmation. Bleachable oil was offered at 11¼c., buyers' tanks, f.o.b. New York, with no buyers. Cash trade in cooking oil and lard compound was slow, yet no weakness developed in the local market. Operators now believe that the April consumption figures when available may show that not more than 150,000 barrels were disposed of. Lard stocks in Chicago increased 21,000,000 pounds during the month of April. Lard compound was nominally unchanged at 13½c. asked, carload lots, f.o.b. New York. Oleo stearine was easy at 10½c., with no sales.

China Wood Oil—The undertone was easier on free offerings from the coast. Spot oil settled at 35@38c. per lb., while on futures there were sellers at 26@27c. per lb., f.o.b. New York, according to position. Trading was dull.

Coconut Oil—The coast market for Ceylon type oil was unsettled with sales of several tank cars of May at 8⅞c. Most traders, however, continued to ask 9c. on coast business. Ceylon type oil was offered in the New York trade at 9¼c. per lb., sellers' tank cars, immediate shipment. Copra was quiet but unchanged at 5⅜@5⅝c. per lb., c.i.f. coast, standard brands. Copra cake was offered at $31@$32 per ton, f.a.s. New York.

Corn Oil—The market held at 10⅜c. per lb. tank cars, f.o.b. point of production, or 10½c. Chicago.

Olive Oil Foots—There were offerings of Greek prime green foots for immediate shipment from the other side at 9½c. per lb. landed weights, ex-dock New York.

Palm Oils—Lagos oil sold to tin-plate mills at 8⅜c. per lb. nearby delivery. Niger oil sold on spot at 7¼c. per lb., while on futures there were offerings at 7¾c. per lb.

Soya Bean Oil—Bulk oil for shipment from the Orient was worked at 7.75c. per lb. in bond, c.i.f. New York. The coast market on nearby crude settled at 10⅜@10½c. per lb. sellers' tanks, duty paid, a decline of ⅛c. for the week. Demand was less active because of the unsettled market for linseed oil for future delivery.

Fish Oils—There were offerings of crude menhaden oil for future delivery, "if made," at 50c. per gal. in tanks, f.o.b. fish factory. No sales were reported. Newfoundland tanked cod oil closed at 70c. per gal., in barrels, f.o.b. New York.

Tallow and Greases—The last sale of extra special tallow went through at 8½c. per lb., f.o.b. plant, a decline of ¼c. Outside goods, equal to extra in quality sold at 8¼c. per lb. delivered. The market was easy at the close. At the London auction, held May 2, 1,716 casks were offered and 424 were disposed of. Prices realized were unchanged to 1 shilling lower. Yellow grease in the New York trade closed at 8c. nominal

Miscellaneous Materials

Glycerine—The feature in the market was the firmer position of crude glycerine, several cars selling at 10¾@11c. per lb., on the soap-lye, basis 80 per cent, the top figure prevailing towards the close. There were bids at 11c. on Friday. Saponification was more or less nominal at 12½@12¾c., loose, basis 88 per cent. There were no transactions in saponification. Dynamite was offered at 16¾c., in drums, carload lots, f.o.b. New York territory, with last sales at 16½c Chemically pure was unsettled in some directions and a little business was placed at 17¾c. per lb., in drums. Refiners generally held out for 18c. per lb.

Shellac—The market was quiet and irregular, closing prices being slightly lower than a week ago. T. N. was offered at 69c. on spot. Bleached, bone-dry, held at 82@84c. per lb., nearby delivery. Superfine orange was available at 74@76c. per lb. Cables from Calcutta were easier and speculators were disposed to favor the bear side for the time being. Demand was routine only so far as the consuming trades were concerned.

Naval Stores—A sharp drop in spirits of turpentine occurred last week, amounting to 12c. per gal. The demand fell away because of the recent showing of weakness and with new crop offerings on the increase the market favored buyers. At the close the nominal quotation stood at $1.30 per gal. Rosins also were easier, but no important price movement took place. Rosin oils closed unchanged.

Lithopone—Demand was seasonally active and with no change in basic materials, prices held at 7@7¼c. per lb. carlots, the inside obtaining for bags.

White Lead—Another drop in the price of the metal failed to bring out a change in the market for lead pigments. Pig lead closed at 7¾c. per lb., which compares with 8c. a week ago Demand for white lead was fairly active. Corroders have sent a notice to the trade offering lead pigments for shipment through to August on a guarantee against decline basis. Standard dry white lead, basic carbonate, held at 9¾c. per lb. in casks, carload lots or more.

Zinc Oxide—Spelter was easier, but not so as to influence the market for oxide. Prices held on the basis of 8c per lb. for the American process, lead free, carload lots. The French process, red seal, was unchanged at 9¾c. per lb. Several plants are under construction to produce Franch process oxide, according to reports.

Imports at the Port of New York

April 27 to May 8

ACIDS—12 dr cresylic, Manchester, Order, 85 dr cresylic, London, Celluloid Co., 100 bg stearic, Hamburg, Innis, Speiden & Co., 60 dr cresylic, Glasgow, Order.

ALCOHOL—51 csk. butyl, Bordeaux, Order

ALIZARINE—12 csk., Liverpool, A Klipstein & Co.

AMMONIUM—22 cs. phosphate, Hamburg, Bengol Trading Co., 42 csk muriate, Liverpool, Brown Bros. & Co., 10 cs carbonate, Liverpool, Brown Bros. & Co

ANTIMONY SULPHIDE—14 csk, F B Vandegrift & Co

ARSENIC—28 csk., Bordeaux, N Y Trust Co, 144 dr, Durban, C Tennant Sons & Co., 100 bbl., Tampico, American Metal Co, 100 cs., Rotterdam, Lunham & Moore, 215 csk., Marseilles, Order.

ASBESTOS—1,300 bg, Cape Town Irving Bank-Col Trust Co., 626 bg, Durban D. D Crumpton.

BARIUM CHLORIDE—212 pkg, Hamburg, Roessler & Hasslacher Chem Co, 24 bbl., Hamburg, Innis, Speiden & Co, 28 bbl, Hamburg, Order, 11 csk, Hamburg, Order, 12 csk, Hamburg, Innis, Speiden & Co., 26 csk, Hamburg, E Suter & Co.

BARYTES—399 bg, Bremen, N Y Trust Co

BLANC FIXE—68 bbl., Hamburg, A Murphy & Co, 4 csk, Hull, Meteor Products Co.

BRONZE COLOR—41 cs, Bremen, Baer Bros.

CASEIN—10 bg, Hamburg, Hensel, Bruckman & Lorbacher 266 sk., Bordeaux, J A W Bird, 50 sk Bordeau, Monito Waterproof Glue Co. 584 bg, Buenos Aires, T. M. Duche & Sons, 1393 bg, Buenos Aires, Brown Bros & Co, 1,812 bg., Buenos Aires Kalbfleisch Corp, 274 bg., Buenos Aires, Brown Bros & Co, 700 bg., London, Brown Bros & Co.

CALCIUM CHLORIDE—317 dr, Hamburg, Blackburn Trading Co., 323 dr, Hamburg, H J Baker & Bro

CAMPHOR—280 cs, Hamburg, A. Oehse & Co

COAL-TAR DISTILLATE—38 dr., Liverpool, Order.

CHEMICALS—80 bbl, Hamburg, Roessler & Hasslacher Chem. Co, 25 pkg, Hamburg, Jungmann & Co, 112 pkg, Hamburg, Order, 74 cs, Bremen, Pfaltz & Bauer, 126 csk, Rotterdam, Hummel & Robinson, 20 bbl, Hamburg, Hummel & Robinson, 27 csk., Hamburg, Jungmann & Co, 100 pkg, Gothenburg, Powers, Weightman & Rosengarten

CHALK—1,150 bg Antwerp, Bankers Trust Co, 508,000 kilos, Dunkirk, J W. Higman & Co.; 1,666,317 kilos, Dunkirk, Tainter Trading Co, 500 tons, London, Baring Bros. & Co., 1,000 tons, London, Tainter Trading Co.

COLORS—55 cs bronze, Hamburg, Bank of the Manhattan Co, 2 bbl. aniline, Hamburg, Fezandie & Sperrle, 21 csk do., Hamburg, H. A. Metz & Co, 21 csk. do., Hamburg, Bank of the Manhattan Co, 21 csk. do, Hamburg, G. A Kuhl; 37 csk do., Hamburg, Guaranty Trust Co; 4 csk do., Hamburg, N Y Color & Chemical Co., 7 csk do., Hamburg, Carbic Color & Chemical Co, 45 csk do., Hamburg, Grasselli Chemical Co; 50 csk do Hamburg, Kuttroff, Pickardt & Co, 7 csk do., Hamburg, Guaranty Trust Co 4 cs, do, Hamburg, J. C. Robold & Co, 12 csk aniline, Hamburg, H. R Jahn, 10 csk do., Hamburg, Franklin Imp & Export Co.; 4 dr. aniline, Southampton, Order, 20 csk dry, Southampton, Order; 11 csk aniline, Hamburg, Kuttroff, Pickardt & Co, 56 csk aniline, Hamburg, E. C Foster, 42 pkg do., Antwerp, Geigy Co., 100 csk venetian red, Liverpool, J L. Smith & Co.; 190 pkg. dry colors, Hull, J. L Smith & Co.; 4 csk. vermilion, London, C H. Powell & Co; 17 cs aniline, Havre, Sandoz Chem. Works, 8 csk. do., Havre, Irving Bank, 10 bbl. aniline, Genoa, Nat'l Aniline & Chem Co, 24 bbl. do., Genoa, Order.

COPPER SULPHATE—107 bbl., Hamburg, Order; 94 csk., London, Ore & Chem. Corp.; 100 csk., Liverpool, Westminster Bank; 129 bbl., Hamburg, Order.

COPRA—75 bg, Port Antonio, Order.

CREOSOTE—100 csk., Manchester, T. D. Downing & Co, Round lot of oil in bulk, Hull Order

DEGRAS—162 bbl., Hull, Order.

DIVI-DIVI—983 bg, Maracaibo, Am Trading Co, 1,781 bg., Maracaibo, Paris & Co 1,652 bg, Monte Cristi, N Y & Hanseatic Co.

EPSOM SALT—48 bg, Bremen, A Blank, 500 bg, Bremen, Globe Shipping Co.; 835 bg Hamburg, Innis, Speiden & Co.; 218 csk Hamburg, Roessler & Hasslacher Chem Co

FUSEL OIL—8 dr., Dunkirk, Guaranty Trust Co, 11 dr., Dunkirk, Order

GLYCERINE—20 csk, Bordeaux, Order, 25 csk., Marseilles, Brown Bros & Co, 60 cs Marseilles, Order.

FUSTIC—460 pc, San Juan de Sur, W. R Grace & Co

GUMS—60 bg damar, London, S Winterbourne & Co., 305 bg. copal, Antwerp, Central Union Trust Co.; 345 bg do., Antwerp, Chemical Nat'l Bank; 102 bg copal, Antwerp, Order, 35 bg copal and 70 cs. damar, Singapore, France, Campbell & Darling, 385 bg copal, Singapore, Order, 200 cs damar, Batavia, Chem. Nat'l Bank, 100 cs. damar, Batavia, Nat'l City Bank, 181 sk copal, Matadi, L. C Gillespie & Sons, 230 cs. damar, London, France, Campbell & Darling, 1,604 bg. copal, Matadi, L. C. Gillespie & Sons; 579 bg copal, Matadi, Niger Co; 100 cs damar, Singapore, Baring Bros. & Co., 420 pkg arabic, Sudan, Thurston & Braidich, 1,210 pkg arabic, Sudan, Order, 114 bg copal, London, Order

GAMBIER—501 cs, Singapore, N. Y. Trust Co, 504 cs., Singapore, Order; 85 cs, London, Order.

IRON OXIDE—28 bbl, Malaga, C. F. Olson & Co, 100 bbl, Malaga, E. M & F Waldo, 38 bbl, Malaga, L H Butcher & Co, 125 bbl, Malaga, Reichard-Coulston, Inc, 10 csk, Liverpool, C B Crystal & Co, 72 csk., Liverpool, Reichard-Coulston, Inc, 34 csk, Liverpool, J Lee Smith & Co.

LYCOPODIUM—179 pkg, London, Order.

MAGNESITE—88 csk., Rotterdam, Speiden-Whitefield Co.

MAGNESIUM—20 csk sulphate, Manchester, Order, 50 cs calcined, Newcastle, Order, 250 dr chloride, Hamburg, Innis, Speiden & Co.; 61 dr chloride, Hamburg, A. Kramer & Co.

MANGROVE—1,600 bg, Beira, Cooper & Cooper

MYRBANE—12 dr., Manchester, Rendrock Powder Co.

NAPHTHALENE—269 bg, Manchester, Order, 1 cs, London, J. C. Robold & Co

OILS—Castor—150 bbl., Hull, Order. **Cod**—300 bbl, Aberdeen, Order. **China Wood** 223 bbl., London, Order, 30 bbl., London, S. Winterbourne & Co, 584 csk. Hankow, Equitable Eastern Banking Co **Linseed**—177 bbl., Rotterdam, Welch, Holme & Clarke Co., 143 bbl, Rotterdam, Meteor Products Co; 141 bbl., Rotterdam, Bur Mac Chem. Corp; 128 dr, Rotterdam, W. Van Doorn; 665 bbl., Rotterdam, Order; 200 bbl, Hull, Order, 444 bbl., London, Irving Bank-Col Trust Co.; 438 bbl., London, Nat'l City Bank; 295 bbl., London, Order. **Olive Foots** (sulphur oil) —699,830 kilos in bulk, Bari, Order; 350 bbl., Naples, Banco Commercial Ital.; 200 bbl., Naples, Banca Comm Italo. **Palm** — 264 csk, Liverpool, Niger Co.; 1,017 csk., Matadi, Niger Co; 1,635 csk, Matadi, Niger Co, 33 csk, Grand Bassam, Oelrichs & Co., 171 csk., Liverpool, Fourth Nat'l Bank; 174 csk, Liverpool, D. Bacon; 70 csk, Liverpool, Niger Co.; 25 csk., Liverpool, Thornett & Fehr, 138 csk., Liverpool, Nat'l Bank of Commerce, 5 csk., Liverpool, Order. **Rapeseed**—500 bbl, Hull, Vacuum Oil Co.; 600 dr, Liverpool, Vacuum Oil Co.; 188 bbl., Liverpool, Busk & Daniels.

PHOSPHATE—200 bg. bone, Antwerp, Hollingshurst & Co.; 1,250 bg. bone, Antwerp, Order.

POTASSIUM SALTS—46 bbl. carbonate, Hamburg, Hans Hinrichs Chem. Corp.; 20 bbl prussiate, Hamburg, Broedermann & Litzrodt, 237 bbl nitrate, Brown Bros. & Co, 240 dr., permanganate, Hamburg Meteor Products Co.; 28 dr. permanganate, Hamburg, Bengol Trading Co.; 100 dr permanganate, London, Order; 135 csk salts, Hamburg, Roessler & Hasslacher Chem Co., 1,500 bbl chlorate, Hamburg, Columbia Trust Co., 75 dr. caustic, Hamburg, Peters, White & Co.; 1,000 csk chlorate, Hamburg, Columbia Trust Co.; 700 csk. do., Hamburg Mech. & Metals Nat'l Bank, 13 csk. chlorate, 79 dr. caustic, 68 csk alum, Hamburg, Order; 13 csk. carbonate, Bremen, P. H. Petry & Co.; 17 csk. permanganate, Rotterdam, Order, 1,000 bg. sulphate, Bremen, A. Vogel; 19 dr permanganate, Hamburg, Bengol Trading Co., 20 dr permanganate, Hamburg, S. Rosenblatt; 65 csk. salts, Hamburg, E Suter & Co, 208 dr. salts, Hamburg, Superfos Co, 125 dr. caustic, Hamburg, E. Suter & Co, 65 csk carbonate, Hamburg, Goldschmidt Corp., 4,000 bg. muriate, Hamburg, Order, 1 lot manure salts, Hamburg, Order

QUEBRACHO—21,211 bg., Buenos Aires, Order.

SEEDS—Linseed—47,834 bg and 1,165,212 kilos in bulk, Buenos Aires, Order; 69,672 bg, Rosario, Order; 34,190 bg., Buenos Aires, Order, 43,349 bg., Rosario, Spencer Kellogg & Sons, 24,330 bg., Buenos Aires, Spencer Kellogg & Sons

SAL AMMONIAC—75 bbl., Hamburg, Hans Hinrichs Chem Corp.; 29 bbl., Hamburg, Roessler & Hasslacher Chem Co.; 28 csk., Hamburg, Order.

SHELLAC—700 pkg, London, Order, 15 bg garnet, Hamburg, Kasebler-Chatfield Shellac Co, 30 cs. garnet, Hamburg, Order, 17 bg garnet, Hamburg, Irving Bank-Col. Trust Co, 4 cs, Hamburg, Broedermann & Litzrodt, 18 bg. garnet, Hamburg, Order

STARCH—1,000 bg. potato, Rotterdam, Stein-Hall & Co, 500 bg do., Rotterdam, Spier, Simmons & Co.; 250 bg. do, Rotterdam; Order

SODIUM SALTS—113 dr salts, Hamburg, C S Grant & Co., 360 pkg salts, Hamburg, Roessler & Hasslacher Chem. Co, 300 bbl. chlorate, Hamburg, Monmouth Chemical Co, 300 csk hyposulphite, Hamburg, Order, 50 bg. silicate, Hamburg, Order; 500 csk nitrite, Hamburg, Kuttroff, Pickhardt & Co; 1,580 cs. cyanide, Hamburg, Roessler & Hasslacher Chem. Co.; 200 csk. hyposulphite, Hamburg, Order; 50 csk. perborate, Hamburg, Order, 160 csk. nitrate, Brevik, Norwegian Nitrogen Products Co, 175 csk. nitrite, Hamburg, E Suter & Co.; 250 bg. sulphate, Hamburg, A. J Marcus, Inc.; 42 csk. bisulphite, Hamburg, Order, 48 csk. nitrite, Bergen, Order, 100 csk hyposulphite, Marseilles, E. Walters, 125 csk. do., Marseilles, Nat'l City Bank.

SUMAC—350 bg, Palermo, Order

TALC—200 bg., Bordeaux, E. M. & F. Waldo; 150 bg, Bordeaux, Reichard-Coulston, Inc., 400 bg., Bordeaux, L. A. Salomon & Co, 400 bg., Genoa, Order.

TARTAR—46 csk. crude, Naples, Tartar Chemical Works; 110 sk, Marseilles, C. Pfizer & Co, 83 sk., Marseilles, Tartar Chem Works, 140 sk., Lisbon, Tartar Chem Co; 100 sk., Bilboa, Tartar Chem. Co.

TALLOW—445 csk. beef, Buenos Aires, Order.

WAXES—387 bg ozokerite, Hamburg, J. Dick; 52 bg. carnauba, Cara, London & Braz. Bank; 111 bg. carnauba, Cara, Order, 47 bg. bees, Cardenas, D. Steengrafe; 12 bg bees, Santo Domingo, J. J. Julia; 8 bg. bees, Santo Domingo, F. Ricart & Co.; 63 bg. bees, Rio de Janeiro, Order; 50 cs. bees, Hamburg, Hummel & Robinson; 48 cs bees, Havana, Order

WHITING — 380 bg, Dunkirk, Taintor Trading Co.

ZINC CHLORIDE—37 csk., Hamburg, Order.

ZINC OXIDE — 25 bbl., Antwerp, Reichard-Coulston, Inc.; 22 bbl., Hamburg, A. Kramer & Co.; 400 bbl., Marseilles, Bankers Trust Co.

ZINC WHITE — 50 bbl., Marseilles, Reichard-Coulston, Inc.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb	$0 38 –	
Acetone, drums	lb.	25 –	25½
Acid, acetic, 28%, bbl	100 lb.	3 38 –	3 50
Acetic, 56%, bbl	100 lb.	6 75 –	7 00
Glacial, 99½%, bbl.	100 lb.	12 00 –	12 50
Boric, bbl	lb.	.11 –	11½
Citric, kegs	lb.	49 –	50
Formic, 85%	lb.	.14½ –	17
Gallic, tech.	lb	45 –	50
Hydrofluoric, 52%, carboys	lb.	.12 –	12½
Lactic, 44%, tech, light, bbl.	lb	.11½ –	12
22%, tech, light, bbl.	lb	05½ –	06
Muriatic, 18° tanks	100 lb	90 –	1 00
Muriatic, 20°, tanks	100 lb.	1 00 –	1 10
Nitric, 36°, carboys	lb	04½ –	05
Nitric, 42°, carboys	lb.	.06 –	06½
Oleum, 20%, tanks	ton	18 50 –	19 00
Oxalic, crystals, bbl	lb.	.13½ –	13¾
Phosphoric, 50% carboys	lb.	.07½ –	.08½
Pyrogallic, resublimed	lb.	1 50 –	1 60
Sulphuric, 60°, tanks	ton	9 50 –	11 00
Sulphuric, 60°, drums	ton	13 00 –	14 00
Sulphuric, 66°, tanks	ton	16 00 –	16 50
Sulphuric, 66° drums	ton	20 00 –	21 00
Tannic, U S P, bbl	lb.	65 –	70
Tannic, tech, bbl	lb.	.45 –	50
Tartaric, imp crys, bbl	lb.	.36½ –	
Tartaric, imp, powd, bbl	lb.	36½ –	
Tartaric, domestic, bbl.	lb.	37½ –	
Tungstic, per lb	lb.	1.10 –	1 20
Alcohol, butyl, drums, f o b works	lb	.26 –	28
Alcohol ethyl (Cologne spirit), bbl	gal	4 75 –	4 95
Ethyl, 190 p'f U S P, bbl	gal	4 70 –	
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 190 proof			
No 1, special bbl	gal	.39 –	41
No 1, special, dr	gal	33 –	35
No. 1, 188 proof, bbl	gal	.40 –	42
No 1, 188 proof, dr	gal	34 –	36
No 5, 188 proof, bbl	gal	38 –	40
No 5, 188 proof, dr	gal	.32 –	34
Alum, ammonia, lump, bbl	lb	.03½ –	03¾
Potash, lump, bbl	lb.	03 –	03½
Chrome, lump, potash, bbl	lb.	.05½ –	05¾
Aluminum sulphate, com., bags	100 lb.	1 50 –	1 65
Iron free bags	lb	02½ –	02¾
Aqua ammonia, 26°, drums	lb	.06½ –	07½
Ammonia, anhydrous, cyl	lb	.30 –	30½
Ammonium carbonate, powd casks, imported	lb	.09½ –	10
Ammonium carbonate, powd domestic, bbl	lb	.13 –	.14
Ammonium nitrate, tech, casks	lb	10 –	11
Amyl acetate tech, drums	gal.	3 50 –	3 75
Arsenic, white, powd, bbl.	lb	15 –	15½
Arsenic, red, powd, kegs	lb	14½ –	15
Barium carbonate, bbl.	ton	78 00 –	80 00
Barium chloride, bbl.	ton	90 00 –	95 00
Barium dioxide, drums	lb.	.18 –	18½
Barium nitrate, casks		.08 –	08½
Barium sulphate, bbl.	lb.	04 –	04¼
Blanc fixe, dry, bbl	lb.	.04½ –	.04¾
Bleaching powder, f o b wks., drums	100 lb.	1 90 –	
Spot N. Y. drums	100 lb.	2 40 –	
Borax, bbl.	lb.	05½ –	05¾
Bromine, cases	lb.	28 –	30
Calcium acetate, bags	100 lb	4 00 –	4 05
Calcium carbide, drums	lb.	04½ –	04¾
Calcium chloride, fused, drums	ton	22 00 –	23 00
Gran. drums	ton	28 00 –	30 00
Calcium phosphate, mono, bbl.	lb.	.06½ –	07
Camphor, cases	lb.	.86 –	.88
Carbon bisulphide, drums	lb.	.07 –	.07½
Carbon tetrachloride, drums	lb.	.10 –	.
Chalk, precip.—domestic, light, bbl	lb.	.04½ –	.04¾
Domestic, heavy, bbl.	lb.	.03½ –	.03¾
Imported, light, bbl	lb.	.04½ –	.05
Chlorine, liquid, cylinders	lb.	.06 –	.06½
Chloroform, tech., drums	lb.	.35 –	.38
Cobalt oxide, bbl.	lb	2 10 –	2 25
Copperas, bulk, f.o b wks.	ton	19 00 –	20.00
Copper carbonate, bbl.	lb	19 –	.20
Copper cyanide, drums	lb	47 –	.50
Coppersulphate, crys., bbl	100 lb.	6 00 –	6.25
Cream of tartar, bbl.	lb.	.25½ –	.26½
Epsom salt, dom., tech, bbl.	100 lb.	1 90 –	2.15
Epsom salt, imp., tech, bags	100 lb.	1.00 –	1 15
Epsom salt, U.S.P., dom, bbl.	100 lb.	2.50 –	2.60
Ether, U.S.P., drums	lb.	.13 –	.15
Ethyl acetate, com., 85%, drums	gal.	.80 –	.85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 –	1.00
Formaldehyde, 40%, bbl.	lb.	.14½ –	.15½

Fullers earth—imp, powd	net ton	$30 00 –	$32 00
Fusel oil, ref, drums	gal	3 55 –	4 05
Fusel oil, crude, drums	gal	2 30 –	2 40
Glaubers salt, wks, bags	100 lb	1 20 –	1 40
Glaubers salt, imp, bags	100 lb	85 –	.95
Glycerine, c p, drums extra	lb	.18 –	18½
Glycerine, dynamite, drums	lb	16½ –	16¾
Glycerine, crude 80%, loose	lb	11 –	11½
Iodine, resublimed	lb	4 55 –	4 65
Iron oxide, red, casks	lb	12 –	.18
Lead:			
White, basic carbonate, dry, casks	lb	09½ –	.10
White, basic sulphate, casks	lb	09½ –	
White, in oil, kegs	lb	.12½ –	14
Red, dry, casks	lb	11½ –	12
Red, in oil, kegs	lb.	13½ –	.15
Lead acetate, white crys, bbl	lb.	13½ –	14
Brown, broken, casks	lb	12½	
Lead arsenate, powd, bbl	lb	23 –	24
Lime-Hydrated, bbl	per ton	16 80 –	17 00
Lime, Lump, bbl	280 lb	3 63 –	3 65
Litharge, comm, casks	lb	.10½ –	.11
Lithophone, bags	lb	07 –	07½
in bbl	lb	07 –	07¾
Magnesium carb, tech, bags	lb	08 –	.08½
Methanol, 95%, bbl	gal.	1 18 –	1 20
Methanol, 97%, bbl	gal.	1 20 –	1 22
Nickel salt, double, bbl.	lb	10½ –	.
Nickel salts, single, bbl.	lb.	11½ –	.
Phosgene		.60 –	.75
Phosphorus, red, cases	lb.	35 –	40
Phosphorus, yellow, cases	lb.	30 –	35
Potassium bichromate, casks	lb	11 –	.11½
Potassium bromide, gran, bbl	lb	19 –	.20
Potassium carbonate, 80-85%, calcined, casks	lb	.06½ –	07
Potassium chlorate, powd	lb	07½ –	08
Potassium cyanide, drums	lb	.45 –	50
Potassium, first sorts, cask	lb.	.09	09½
Potassium hydroxide (caustic potash) drums	lb	08½ –	09
Potassium iodide, cases	lb	3 65 –	3 75
Potassium nitrate, bbl.	lb.	06¾ –	.07½
Potassium permanganate, drums	lb.	22 –	22½
Potassium prussiate, red, casks	lb.	.70 –	.75
Potassium prussiate, yellow, casks	lb.	.37 –	37½
Salammoniac, white, gran, casks, imported	lb.	.07 –	07½
Salammoniac, white, gran., bbl, domestic	lb.	.07¾ –	.08
Gray, gran, casks	lb.	08 –	09
Salsoda, bbl.	100 lb.	1 20	1 40
Salt cake (bulk).	ton	26 00 –	28.00
Soda ash, light, 58% flat, bags, contract	100 lb.	1 60 –	1.67
Soda ash, light, basis, 48%, bags, contract, f.o b. wks.	100 lb.	1.20 –	1 30
Soda ash, light, 58%, flat, bags, resale	100 lb.	1.75 –	1.80
Soda ash, dense, bags, contract, basis 48%	100 lb	1.17½ –	1 20
Soda ash, dense, in bags, resale	100 lb.	1 85 –	1 90
Soda, caustic, 76%, solid, drums, f.a.s.	100 lb	3 30 –	3.40
Soda, caustic, basis 60%, wks, contract	100 lb	2.50 –	2 60
Soda, caustic, ground and flake, contracts.	100 lb.	3 80 –	3.90
Soda, caustic, ground and flake, resale	100 lb.	3 72½ –	.
Sodium acetate, works, bags	lb.	05½ –	.06¼
Sodium bicarbonate, bbl	100 lb.	2.00 –	2.50
Sodium bichromate, casks	lb.	.08 –	
Sodium bisulphate (niter cake)	ton	6.00 –	7.00
Sodium bisulphite, powd., U.S.P., bbl.	lb.	.04½ –	.04¾
Sodium chlorate, kegs	lb.	.06½ –	.07
Sodium chloride	long ton	12.00 –	13.00
Sodium cyanide, cases	lb.	.20 –	.23
Sodium fluoride, bbl.	lb.	$0.09½ –	$0 10
Sodium hyposulphite, bbl.	lb.	.02½ –	.03
Sodium nitrite, casks	lb.	.08 –	.08½
Sodium peroxide, powd, cases	lb.	.28 –	.30
Sodium phosphate, dibasic, bbl.	lb	.03½ –	.04
Sodium prussiate, yel drums	lb.	.17½ –	.18
Sodium silicate (40°, drums)	100 lb.	80 –	1.25
Sodium silicate (60°, drums)	100 lb.	2.00 –	2.25
Sodium sulphide, fused, 60-62% drums	lb.	04½ –	.04¾
Sodium sulphite, crys, bbl.	lb.	.03½ –	.03¾
Strontium nitrate, powd, bbl.	lb	.09½ –	.10
Sulphur chloride, yel drums	lb.	.04½ –	.05
Sulphur, crude	ton	18.00 –	20.00
At mine, bulk	ton	16 00 –	18.00
Sulphur, flour, bag	100 lb.	2 25 –	2.35
Sulphur, roll, bag	100 lb.	2.00 –	2.10
Sulphur dioxide, liquid, cyl.	lb	.08 –	.08½
Talc—imported, bags	ton	30 00 –	40.00
Talc—domestic powd, bags	ton	18 00 –	25.00
Tin bichloride, bbl	lb.	.12½ –	.13¾
Tin oxide, bbl.	lb.	.50 –	
Tin crystals, bbl	lb.	.35½ –	.36
Zinc carbonate, bags	lb.	.14 –	.14½
Zinc chloride, gran, bbl.	lb.	.06 –	.07
Zinc cyanide, drums	lb.	.37 –	.38
Zinc oxide, lead free, bbl	lb.	.08 –	.08½
5% lead sulphate bags	lb.	.07½ –	......
10 to 35% lead sulphate, bags	lb.	.07 –	......
French, red seal, bags	lb.	09½ –	......
French, green seal, bags	lb.	.10½ –	......
French, white seal bbl	lb	12 –	......
Zinc sulphate, bbl	100 lb.	2.50 –	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb.	$0 65 –	$0.80
Alpha-naphthol, ref, bbl	lb	.75 –	.90
Alpha-naphthylamine, bbl	lb.	.36 –	38
Aniline oil, drums	lb.	.16 –	.16½
Aniline salts, bbl	lb	24 –	.25
Anthracene, 80%, drums	lb.	.75 –	1.00
Anthracene, 80%, imp, drums, duty paid.	lb.	.70 –	.75
Anthraquinone, 25%, paste, drums	lb	70 –	.75
Benzaldehyde U S P, carboys	lb.	1 40 –	1.45
tech, drums	lb	75	80
Benzene, pure, water-white, tanks and drums	gal.	.30 –	.32
Benzene, 90%, tanks & drums	gal	.27 –	.30
Benzene, 90%, drums, resale	gal.	.30 –	.33
Benzidine base, bbl	lb.	.85 –	.90
Benzidine sulphate, bbl.	lb.	.70 –	.75
Benzoic acid, U S P, kegs	lb.	.72 –	75
Benzoate of soda, U S P., bbl.	lb.	.57 –	.65
Benzyl chloride, 95-97%, ref, drums	lb.	.45 –	.
Benzyl chloride, tech, drums	lb.	.30 –	.35
Beta-naphthol, subl, bbl.	lb.	.55 –	.60
Beta-naphthol, tech, bbl	lb.	.23 –	.23½
Beta-naphthylamine, tech	lb.	.80 –	.90
Carbazol, bbl	lb.	.75 –	.90
Cresol, U.S P, drums	lb.	.25 –	.29
Ortho-cresol, drums	lb.	.28 –	.30
Cresylic acid, 97%, resale, drums	gal.	1 30 –	...
95-97%, drums, resale	gal.	1.25 –	.
Dichlorbenzene, drums	lb.	.07 –	.09
Diethylaniline, drums	lb.	.50 –	.60
Dimethylaniline, drums	lb.	.42 –	.43
Dinitrobenzene, bbl	lb.	.19 –	.20
Dinitroclorbenzene, bbl	lb.	.22 –	.23
Dinitronaphthalene, bbl	lb.	.30 –	.32
Dinitrophenol, bbl	lb.	.35 –	.40
Dinitrotoluene, bbl	lb.	.20 –	.22
Dip oil, 25%, drums	gal.	.25 –	.30
Diphenylamine, bbl	lb.	.50 –	.52
H-acid, bbl.	lb.	.85 –	....
Meta-phenylenediamine, bbl.	lb.	1.00 –	1 05
Michlers ketone, bbl	lb.	3.00 –	3.50
Monochlorbenzene, drums	lb.	.08 –	.10
Monoethylaniline, drums	lb.	.95 –	1.10
Naphthalene, flake, bbl.	lb.	.09½ –	10
Naphthalene, balls, bbl	lb.	.09¾ –	.10¼
Naphthionate of soda, bbl.	lb.	.58 –	.65
Naphthionic acid, crude, bbl.	lb.	.55 –	.60
Nitrobenzene, drums	lb.	.10 –	.12
Nitro-naphthalene, bbl.	lb.	.30 –	.35
Nitro-toluene, drums	lb.	.15 –	.17
N-W acid, bbl.	lb.	1.25 –	1.30
Ortho-amidophenol, kegs.	lb.	2.30 –	2.35
Ortho-dichlorbenzene, drums	lb.	.17 –	.20
Ortho-nitrophenol, bbl	lb.	.90 –	.92
Ortho-nitrotoluene, drums	lb.	.10 –	.12
Ortho-toluidine, bbl	lb.	.14 –	.15
Para-amidophenol, base, kegs	lb.	1.20 –	1.30
Para-amidophenol, HCl, kegs	lb.	1.25 –	1.35
Para-dichlorbenzene, bbl.	lb.	.17 –	.20
Paranitraniline, bbl.	lb.	.74 –	.75
Para-nitrotoluene, bbl.	lb.	.60 –	.65
Para-phenylenediamine, bbl.	lb.	1.45 –	1.50
Para-toluidine, bbl	lb.	.95 –	.98
Phthalic anhydride, bbl.	lb.	.35 –	.38
Phenol, U.S.P., drums	lb.	.55 –	.57
Picric acid, bbl.	lb.	.20 –	.22
Pyridine, dom., drums	gal.	nominal	
Pyridine, imp., drums	gal.	2.50 –	2.75

Resorcinol, tech., kegs......	lb.	$1.40 - $1.50
Resorcinol, pure, kegs...	lb.	2 00 - 2.10
R-salt, bbl.	lb.	.55 - .60
Salicylic acid, tech., bbl.	lb.	.47 - .48
Salicylic acid, U.S.P., bbl	lb.	.50 - .52
Solvent naphtha, water-white, drums	gal.	.37 - .40
Crude, drums	gal.	22 - 24
Sulphanilic acid, crude, bbl	lb	18 - .20
Thiocarbanilide, kegs	lb.	.35 - .38
Toluidine, kegs	lb.	1.20 - 1 30
Toluidine mixed, kegs...	lb.	30 - 35
Toluene, tank cars	gal.	.30 - 35
Toluene, drums	gal.	.35 - 40
Xylidines drums	lb	.45 - 47
Xylene, pure, drums......	gal.	.75 - 1 00
Xylene, com., drums	gal.	.37 -
Xylene, com., tanks...	gal.	.32 -

Naval Stores

Rosin B-D, bbl	280 lb	$6 30 - 6 35
Rosin E-I, bbl	280 lb	6 35 - 5 46
Rosin K-N, bbl	280 lb	6 40 - 6 50
Rosin W G-W W, bbl	280 lb	6 80 - 7 80
Wood rosin, bbl	280 lb	6 20
Turpentine, spirits of, bbl	gal	1 28 - 1 30
Wood, steam dist., bbl	gal	1 22 - 1 24
Wood, dest. dist., bbl	gal	1 05 - 1 10
Pine tar pitch, bbl	200 lb	6 00
Tar, kiln burned, bbl	500 lb	- 13 00
Retort tar, bbl.	500 lb	- 12 00
Rosin oil, first run, bbl	gal	45 -
Rosin oil, second run, bbl	gal	48 -
Rosin oil, third run, bbl	gal.	52 -
Pine oil, steam dist	gal	.80 -
Pine oil, pure, dest. dist	gal	.75
Pine tar oil, ref	gal.	.48 - ..
Pine tar oil, crude, tanks f o b Jacksonville, Fla	gal.	32 - 32½
Pine tar oil, double ref., bbl	gal.	- .75
Pine tar, ref., thin bbl	gal	25
Pinewood creosote, ref., bbl	gal	- .52

Animal Oils and Fats

Degras, bbl	lb	$0 03½ $0 04
Grease yellow, bbl	lb	08 - 08¼
Lard oil, Extra No 1, bbl	gal	92 - 94
Neatsfoot oil, 20 deg bbl	gal	1 30 -
No 1, bbl	gal	92 - 94
Oleo Stearine		.10½
Red oil, distilled, d p bbl	lb	11 - 11½
Saponified bbl	lb	11 - 11½
Tallow, extra, loose	lb	08½ -
Tallow oil, acidless, bbl	gal.	.95 - .97

Vegetable Oils

Castor oil, No 3, bbl	lb	$0 14 -
Castor oil, No 1, bbl	lb.	14½ -
Chinawood oil, bbl	lb.	38 - 40
Coconut oil, Ceylon, bbl	lb	10½ - 10¾
Ceylon, tanks, N Y	lb	.09¾
Coconut oil, Cochin, bbl	lb	10½ -
Corn oil, crude, bbl	lb	12½
Crude, tanks (f o b mill)	lb	10½ - 10¾
Cottonseed oil, crude (f o b mill), tanks	lb.	09½ - 10
Summer yellow, bbl	lb	12½ - .12¾
Winter yellow, bbl	lb	13½ - .13¾
Linseed oil, raw, car lots, bbl	gal	1 17 -
Raw, tank cars (dom.)	gal	1 12 -
Boiled, cars, bbl (dom.)	gal	1 19 -
Olive oil, denatured, bbl	gal.	1 15 -
Sulphur, (foots) bbl	lb	10 - 10½
Palm, Lagos, casks	lb	.08½ - 08¾
Niger, casks	lb	07½ - 08
Palm kernel, bbl	lb	.09½ - 10
Peanut oil, crude, tanks (mill)	lb.	.13½ -
Peanut oil, refined, bbl	lb.	.17 -
Perilla, bbl	lb.	.16½ - 16¾
Rapeseed oil, refined, bbl	gal	.84 - .85
Rapeseed oil, blown, bbl	gal	.90 - 91
Sesame, bbl	lb	12½ - 13
Soya bean (Manchurian), bbl	lb.	.13½ -
Tank, f o b Pacific coast	lb	.10½ -
Tank, (f o b N Y)	lb	.10½ - 10¾

Fish Oils

Cod, Newfoundland, bbl	gal	$0 70 - $0 72
Menhaden, light pressed, bbl.	gal	76 -
White bleached, bbl..	gal.	78 -
Blown, bbl	gal.	.82 -
Crude, tanks (f o b factory)	gal.	50 - 52
Whale No. 1 crude, tanks, coast	lb	.08 - ...
Winter, natural bbl	gal	.76 - 78
Winter, bleached bbl	gal	.79 - .80

Oil Cake and Meal

Coconut cake, bags	ton	$32.00 -
Copra, sun dried, bags, (c i f)	lb	.05¾
Sun dried Pacific coast	lb	05½ -
Cottonseed meal, f o b mills	ton	39 00 - 40 00
Linseed cake, bags	ton	36 50 -
Linseed meal, bags	ton	38 50 -

Dye & Tanning Materials

Albumen, blood, bbl	lb	$0 45 - $0 50
Albumen, egg, tech, kegs	lb.	.80 - 85
Cochineal, bags	lb	.35 - .36
Cutch, Borneo, bales	lb	.04½ - .05
Cutch, Rangoon, bales.....	lb.	.13 - .13½
Dextrine, corn, bags	100 lb.	3 64 - 3 69
Dextrine, gum, bags....	100 lb	3 99 - 4 09
Divi-divi, bags.......	ton	38 00 - 39.00
Fustic, sticks............	ton	30.00 - 35.00
Fustic, chips, bags..........	lb.	.04 - .05
Logwood, sticks	ton	28.00 - 30.00
Logwood, chips, bags........	lb.	.02½ - .03½
Sumac, leaves, Sicily, bags...	ton	$70 00 - $72 00
Sumac, ground, bags....	ton	65 00 - 67 00
Sumac, domestic, bags.. ...	ton	40 00 - 42 00
Starch, corn, bags	100 lb.	2.97 - 3 07
Tapioca flour, bags..	lb.	.05½ - .06½

Extracts

Archil, conc., bbl	lb.	$0.17 - $0 18
Chestnut, 25%, tannin, tanks	lb.	02 - .03
Divi-divi, 25%, tannin, bbl.	lb	.04 - .05
Fustic, crystals, bbl	lb	.20 - 22
Fustic, liquid, 42°, bbl.	lb.	08 - 09
Gambier, liq., 25%, tannin, bbl	lb	.08 - 09
Hematine crys., bbl	lb.	.14 - 18
Hemlock, 25%, tannin, bbl.	lb	.04 - 05
Hypernic, solid, drums	lb.	.24 - .26
Hypernic, liquid, 51°, bbl	lb	.14 - .17
Logwood, crys., bbl.	lb	19 - .20
Logwood, liq., 51°, bbl.	lb.	.09 - .10
Quebracho, solid, 65% tannin, bbl	lb	04½ - .05
Sumac, dom., 51°, bbl	lb	.06½ - .07

Dry Colors

Blacks-Carbongas, bags, f o b works	lb	$0 16 - $0 18
Lampblack, bbl	lb	12 - 40
Mineral bulk	ton	35 00 - 45 00
Blues-Bronze, bbl	lb	55 - 60
Prussian, bbl	lb	55 - 60
Ultramarine, bbl	lb	08 - 35
Browns, Sienna, Ital., bbl	lb	06 - 14
Sienna, Domestic, bbl	lb	03½ - 04
Umber, Turkey, bbl	lb	04 - 04½
Greens-Chrome, C P Light, bbl	lb	32 - 34
Chrome commercial, bbl	lb	.12 - 12½
Paris bulk	lb	30 - 35
Reds, Carmine No. 40, tins	lb	4 50 - 4 70
Oxide red, casks	lb	10 - 14
Para toner, kegs	lb	1 00 - 1 10
Vermilion, English, bbl	lb	1 30 - 1 32
Yellow, Chrome C P bbls	lb	20 - 21
Ocher, French, casks	lb	02½ - 03

Waxes

Bayberry, bbl	lb	$0 28 - $0 30
Beeswax, crude, bags	lb	20 - 23
Beeswax, refined, light, bags	lb.	.32 - .34
Beeswax, pure white, cases.	lb	.40 - .41
Candelilla, bags..	lb	24 - .25
Carnauba, No 1, bags ..	lb	.42 - 43
No. 2, North Country, bags	lb.	.23 - 23½
No 3, North Country, bags	lb	19½
Japan, cases	lb	14½ - 15
Montan, crude, bags	lb.	.04½ - .04¾
Paraffine, crude, match, 105-110 m p.	lb.	.04½ - .04¾
Crude, scale 124-126 m.p., bags	lb.	.03 - 03¼
Ref., 118-120 m.p., bags.	lb.	.03½ -
Ref., 125 m p., bags	lb.	.03¾ -
Ref., 128-130 m p., bags	lb.	.04½ - .04¾
Ref., 133-135 m p., bags.	lb	.05 - ...
Ref., 135-137 m p., bags	lb.	.05½ - .05¾
Stearic acid, sgle pressed, bags	lb.	.13½ -
Double pressed, bags	lb	.14½ -
Triple pressed, bags	lb.	.15½ - .16

Fertilizers

Ammonium sulphate, bulk, f o b works	100 lb.	$3 25 - $3 30
F a s double bags....	100 lb	3 85 - 3 90
Blood, dried, bulk	unit	4 25 -
Bone, raw, 3 and 50, ground	ton	27 00 - 30 00
Fish scrap, dom., dried, wks..	unit	nominal
Nitrate of soda, bags ..	100 lb.	2 60 - 2.65
Tankage, high grade, f.o.b. Chicago	unit	3 25 - 3 50
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%..	ton	$4 00 - $4 50
Tennessee, 78-80%	ton	8 00 - 8 25
Potassium muriate, 80%, bags	ton	35 00 - 36.00
Potassium sulphate, bags basis 90%	ton	45 67 - ...

Crude Rubber

Para—Upriver fine..	lb	$0 28 - ..
Upriver coarse	lb	.23 - ..
Upriver caucho ball.	lb	.25 -
Plantation—First latex crepe	lb.	.31 - ....
Ribbed smoked sheets	lb	.31 - ....
Brown crepe, thin, clean	lb.	.29 - ..
Amber crepe No 1.	lb.	.29½ -.

Gums

Copal, Congo, amber, bags	lb	$0 12 - $0 13
East Indian, bold, bags	lb	.23 - 23½
Manila, pale, bags	lb	.20 - 20½
Pontinak, No 1 bags	lb	.20 - 20½
Damar, Batavia, cases	lb	.30½ - 31
Singapore, No 1, cases	lb	.34½ - 35
Singapore, No. 2, cases	lb	.24 - .25
Kauri, No 1, cases	lb	.65 - .67
Ordinary chips, cases	lb	.18 - 20
Manjak, Barbados, bags	lb	09 - 09½

Shellac

Shellac, orange fine, bags ..	lb.	$0.72 - ..
Orange superfine, bags......	lb.	.74 - .76
A. C. garnet, bags..	lb.	nominal
Bleached, bonedry.......	lb.	.82 - .84
Bleached, fresh. ...	lb	.70 - .71
T. N., bags............	lb.	.69 - .70

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec.......	sh. ton	$500 00-........
Asbestos, shingle, f.o.b., Quebec	sh. ton	$65.00 - $85.00
Asbestos, cement, f.o.b., Quebec	sh. ton	20 00 - 25.00
Barytes, grd., white, f.o.b. mills, bbl..	net ton	16.00 - 20.00
Barytes, grd., off-color, f o.b. mills bulk..	net ton	13.00 - 15 00
Barytes, floated, f.o.b. St. Louis, bbl ..	net ton	28 00 -
Barytes, crude f.o.b. mines, bulk ...	net ton	10 00 - 11 00
Casein, bbl., tech.	lb.	.22½ - .25
China clay (kaolin) crude, f.o b Ga	net ton	7.00 - 9 00
Washed, f o b Ga..	net ton	8 00 - 9 00
Powd., f o b Ga.	net ton	14 00 - 20 00
Crude f.o b Va.....	net ton	8 00 - 12 00
Ground, f o b Va...	net ton	14 00 - 20 00
Imp., lump, bulk	net ton	15 00 - 20 00
Imp., powd	net ton	45 00 - 50 00
Feldspar, No 1 pottery..	long ton	6 00 - 7 00
No. 2 pottery ..	long ton	4 00 - 5 50
No. 1 soap ...	long ton	7 00 - 7 50
No. 1 Canadian, f.o.b. mill	long ton	20 00 - 22 00
Graphite, Ceylon, lump, first quality, bbl	lb	06½ -
Ceylon, chip, bbl.	lb.	05½ -
High grade amorphous crude	ton	15 00 - 35 00
Gum arabic, amber, sorts, bags ..	lb	.15 - .16
Gum tragacanth, sorts, bags	lb	.50 .60
No 1, bags	lb	1.60 - 1 65
Kieselguhr, f o b Cal...	ton	40 00 - 42 00
F o b N Y	ton	50 00 - 55 00
Magnesite crude, f o b Cal	ton	14 00 - 15 00
Pumice stone, imp., casks	lb	03 - 05½
Dom., lump, bbl	lb	05 - .05½
Dom., ground, bbl	lb.	.06 - 07
Silica, glass sand, f o b Ind	ton	2 00 - 2 50
Silica, sand blast, f o b Ind	ton	2 50 5 00
Silica, amorphous, 250 mesh, f o b Ill	ton	17 00 - 17 50
Silica, bldg sand, f o b. Pa.	ton	2 00 - 2 75
Soapstone, coarse, f o b Vt, bags	ton	7 00 - 8 00
Talc, 200 mesh, f o b, Vt, bags	ton	6 50 - 9 00
Talc, 200 mesh, f.o.b Ga, bags ...	ton	7 00 - 9 00
Talc, 200 mesh, f.o b Los Angeles, bags.	ton	16 00 - 20.00

Mineral Oils

Crude, at Wells

Pennsylvania. ...	bbl.	$3 50 - ..
Corning......	bbl	2 00 -
Cabell	bbl.	2 16 -
Somerset...	bbl	1 95 -
Illinois	bbl	2 17 -
Indiana.	bbl	2 18 - .
Kansas and Oklahoma, 28 deg	bbl	1 40 -
California, 35 deg and up	bbl	1 04 - .

Gasoline, Etc.

Motor gasoline, steel bbls	gal	$0 22 -
Naphtha, V M & P. deod, steel bbls	gal	21½
Kerosene, ref tank wagon..	gal	14 -
Bulk, W. W export...	gal.	.07 - .
Lubricating oils:		
Cylinder, Penn., dark	gal.	27 - .30
Bloomless, 30@31 grav..	gal.	.20 - 22
Paraffin, pale	gal.	.24 - 25
Spindle, 200, pale	gal.	.25 - 26
Petrolatum, amber, bbls ...	lb.	.05 - .05½
Paraffine wax (see waxes)		

Refractories

Bauxite brick, 56% Al_2O_3, f o b. Pittsburgh ...	ton	$45-50
Chrome brick, f.o.b. Eastern shipping points	ton	50-52
Chrome cement, 40-50% Cr_2O_3	ton	23 27
40-45% Cr_2O_3, sacks, f o b Eastern shipping points.	ton	23 00
Fireclay brick, 1st quality, 9-in shapes, f o b Ky wks	1,000	40-4[illegible]
2nd quality, 9-in shapes, f o b wks	1,000	36-41
Magnesite brick, 9-in. straight (f.o b wks)	ton	65 [illegible]
9-in arches, wedges and keys	ton	80 [illegible]
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o b. Chicago district	1,000	48-50
Silica brick, 9-in sizes, f o b. Birmingham district..	1,000	48-50
F o b. Mt Union, Pa	1,000	42 44
Silicon carbide refract brick, 9-in.	1,000	1,100 [illegible]

Ferro-Alloys

Ferrotitanium, 15-18%, f o b. Niagara Falls, N. Y.	ton	$200 00 - $225 00
Ferrochromium, per lb. of Cr, 6-8% C ..	lb.	.11½ 11¾
4-6% C....	lb.	.12 - .13
Ferromanganese, 78-82% Mn, Atlantic sea.bd. duty paid..	gr. ton	120 00 -.......
Spiegeleisen, 19-21% Mn.	gr. ton	40 00 -......
Ferromolybdenum, 50-60% Mo, per lb Mo ...	lb.	2 00 - 2.[illegible]0
Ferrosilicon, 10-15%.....	gr. ton	48 00 - 50.00
50%..............	gr. ton	75 00 -. ..
75%................	gr. ton	150.00 - 160.00

Ferrotungsten, 70-80%, per lb of W........	lb.	$0.90 - $0.95
Ferro-uranium, 35-50% of U per lb of U..	lb.	6.00 - ....
Ferrovanadium, 30-40%, per lb. of V.......	lb.	3.50 - 3 75

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$6.00 - $9.00
Chrome ore Calif. concentrates, 50% min Cr_2O_3	ton	22 00 - 23 00
C i f Atlantic seaboard	ton	20 50 - 24 00
Coke, fdry, f o b ovens	ton	7 00 - 7 50
Coke, furnace, f o b ovens	ton	6 00 - 6 50
Fluorspar, gravel, f.o b mines' Illinois	ton	20.00 - 21 50
Ilmenite, 52% TiO_2	lb.	.01¼- .01½
Manganese ore, 50% Mn, c i f Atlantic seaport	unit	.33 -........
Manganese ore, chemical (MnO_2)	ton	75.00 - 80.00
Molybdenite, 85% MoS_2, per lb MoS_2, N Y	lb.	.65 - .70
Monazite, per unit of ThO_2, c i f., Atl seaport	lb.	.06 - 08
Pyrites, Span, fines, c i f Atl seaport	unit	.11½- .12
Pyrites, Span, furnace size, c i f Atl seaport	unit	.11½- .12
Pyrites, dom fines, f o b mines, Ga	unit	.12
Rutile, 95% TiO_2	lb.	.12 -........
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.50 - 8.75
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	8.00 - 8.25
Uranium ore (carnotite) per lb of U_3O_8	lb.	3.50 - 3 75
Uranium oxide, 96% per lb U_3O_8	lb	2 25 - 2 50
Vanadium pentoxide, 99%	lb	12.00 - 14 00
Vanadium ore, per lb V_2O_5	lb.	1.00 -.. ...
Zircon, washed, iron free, f.o.b. Pablo, Fla......	lb.	.04½- .13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	16¼ 16½
Aluminum, 98 to 99% ...	23-24
Antimony, wholesale, Chinese and Japanese	7¾- 8¼
Nickel, virgin metal	28 30
Nickel, ingot and shot	30-
Monel metal, shot and blocks.........	32 00
Monel metal, ingots	38 00
Monel metal, sheet bars	45 00
Tin, 5-ton lots, Straits	44 00
Lead, New York, spot	7 75
Lead, E St Louis, spot	7 58
Zinc, spot, New York	7 10
Zinc, spot, E. St. Louis............	6.75

Other Metals

Silver (commercial) ..	oz.	$0 67⅞
Cadmium	lb.	1.00
Bismuth (500 lb lots).....	lb.	2 55
Cobalt	lb.	2 65@ 2.85
Magnesium, ingots, 99%.....	lb.	1.25-
Platinum..............	oz.	115 00
Iridium	oz.	260 00@ 275 00
Palladium	oz	79 00
Mercury .	75 lb.	68 00-69 00

Finished Metal Products

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled...........	25 50
Copper bottoms	30 75
Copper rods	25 25
High brass wire	19 50
High brass rods	17 00
Low brass wire	21 10
Low brass rods	22 00
Brazed brass tubing	24 25
Brazed bronze tubing	29 00
Seamless copper tubing	25 25
Seamless high brass tubing.......	23.50

OLD METALS —The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible......	11 30@ 11 50
Copper, heavy and wire	11 25@ 11 50
Copper, light and bottoms.........	9 25@ 9 50
Lead, heavy	5.75@ 6 00
Lead, tea	3.50@ 3 75
Brass, heavy	6.25@ 6 40
Brass, light	5 35@ 5 75
No. 1 yellow brass turnings..........	6.30@ 6 50
Zinc..........................	3.50@ 4.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes..............	$3.29	$3.14
Soft steel bars................	3.19	3.04
Soft steel bar shapes..........	3.19	3.04
Soft steel bands...............	3 29	3.19
Plates, ¼ to 1 in. thick.........	3.29	3.14

Industrial

Financial, Construction and Manufacturing News

Construction and Operation

Arizona

GLOBE—The New Dominion Copper Co will make extensions and improvements at its plant to cost approximately $250,000, including the installation of additional equipment

Arkansas

EL DORADO—The Richardson Oil Co has tentative plans under consideration for the rebuilding of the portion of its plant destroyed by fire, April 18 with loss estimated at $75,000, including equipment

California

SAN FRANCISCO—The Paraffine Companies, Inc, 31 1st St, has plans in preparation for extensions and improvements in its 3-story plant on South Brannan St, near 3rd St, 275x275 ft, estimated to cost close to $40,000 The company has also broken ground for a plant addition at Antioch

SAN BERNARDINO—The Inland Oil Refinery Co, recently organized, has acquired property on West Rialto Ave for the construction of a new refining plant, to consist of a number of units Plans are under way for the first unit estimated to cost about $100,000, with machinery

LOS ANGELES—The Royal Dutch-Shell Oil Companies Inc., 343 Sansome St., San Francisco, has negotiations under way for the purchase of property at Watson Station, Wilmington, Los Angeles, as a site for a new refining plant It is reported that the initial works will cost in excess of $500,000.

FULLERTON—The Newton Process Co. has acquired a tract of land totaling about 30 acres, as a site for a new gasoline-refining plant, to operate under a recently perfected process. Plans will be prepared immediately. The company previously operated a plant at Santa Fe Springs, Calif. J. H and George Wentz, Anaheim, are heads

Colorado

DENVER—The Producers' & Refiners' Corp, California Bldg, has construction in progress on a new oil refinery at its properties in Wyoming, and plans for the early installation of machinery The initial unit will have a capacity of 10,000 bbl. per day.

Illinois

CHICAGO—The Standard Glass Co, 2533 Cottage Grove Ave, has filed plans for a new 2-story plant, 30x50 ft, at 2629 South Park Ave. R. A Williamson, 15 South LaSalle St, is architect

ARGO—The Corn Products Refining Co will commence immediately to rebuild the portion of its local plant destroyed by fire April 20, caused by an explosion. The estimated loss has not been announced.

CHICAGO—The National Lead Co., 900 West 18th St, will build a 1-story addition 35x100 ft., at its plant, 1711 Peoria St.

Indiana

VINCENNES—The Blackford Window Glass Co. will expend close to $500,000 for machinery for installation at its new local plant on which construction has been commenced. The works will cost approximately $800,000, complete

SHELBYVILLE—The Shelbyville Mirror Co., 450 East Henricks St., has tentative plans for the construction of a new plant, estimated to cost close to $50,000 with equipment.

HUNTINGTON—The Indiana Rubber Products Co., recently organized, has commenced the remodeling of its proposed local works, comprising the former plant of the Rapid Rim Co., and will convert for a modern rubber factory The installation of machinery will soon be commenced. C H. McDermott is president

Kentucky

OWENSBORO—New gas-purifying and scrubbing equipment will be installed at the local artificial gas plant of the Kentucky Public Service Co, estimated to cost approximately $35,000

Louisiana

SWARTZ—The Century Carbon Co has awarded a contract to the Rumbarger Engineering Co, Monroe for the construction of a new carbon black plant on local site recently acquired, estimated to cost approximately $250,000, including machinery.

Maine

RUMFORD—In connection with proposed improvements and new equipment at its local mill to cost about $250,000, previously announced the Oxford Paper Co purposes to build a complete new plant unit estimated to cost approximately $1,000,000, with machinery Plans will be drawn at an early date

Maryland

BALTIMORE—The United States Industrial Chemical Co has completed plans for the construction of a 1 story addition to its plant on the Patapsco County Rd., 50x250 ft

Massachusetts

STOUGHTON—The Meade Rubber Co. has commenced the construction of a 2-story addition, to increase the plant output about 50 per cent A list of machinery to be installed will soon be arranged E R. Simpson, 176 Federal St, Boston, is engineer.

AMHERST—The State Agricultural College has perfected plans for the immediate resumption of construction on the proposed chemical laboratory on the campus, and purposes to push the structure to completion It will be 3-story, 44x112 ft., estimated to cost close to $300,000, with equipment.

CAMBRIDGE—The Lever Brothers Co., Portland St, manufacturer of soaps, washing compounds, etc, will commence extensions and improvements in its plant to cost approximately $30,000.

LEOMINSTER—The Viscaloid Co., manufacturer of composition products, has construction under way on a new 2-story plant, 40x100 ft, on Lancaster St, estimated to cost $27,000

Michigan

STURGIS—D. A Hopping is perfecting the organization of a company to take over and operate the plant of the Utility Mfg. Co, recently acquired for the manufacture of paper products. The structure will be remodeled and improved, and equipment installed

Minnesota

MINNEAPOLIS—The Twin City Brass & Aluminum Foundry Co, 815 Washington St, S E, has tentative plans for the rebuilding of the portion of its plant destroyed by fire, April 21, with loss approximating $25,000.

ST PAUL—The Waldorf Paper Products Co will soon take bids for the construction of a new mill, estimated to cost close to $100,000, including equipment

Mississippi

JACKSON—The Buckeye Cotton Oil Co., Mill St., is perfecting plans for the rebuilding of the portion of its plant recently destroyed by fire with loss estimated at about $30 000. Additional equipment will be installed.

Missouri

JOPLIN—The General Explosives Co. will rebuild the portion of its plant destroyed

by an explosion on April 25. An official estimate of loss has not been announced.

ST. LOUIS—The Columbia Oil Co., 3417 Papin St., has plans for the construction of a new storage and distributing plant to replace its works lately destroyed by fire with loss estimated at about $75,000, including equipment.

Montana

GREAT FALLS—The Sunburst Refining Co. has increased the appropriation for its new oil-refining plant on site recently acquired at West Great Falls, and the initial unit will be enlarged. It is estimated to cost about $300,000, with machinery. W. M. Parker is construction engineer, and E. T. Wyatt general manager.

New Jersey

NEWARK—Kaufherr & Co., 42 Garden St., operating a leather tannery, have filed plans for the erection of a 1-story addition and will commence work at once.

BLOOMFIELD—The Condensite Co., Grove St., has broken ground for the construction of a new addition to its rubber insulation plant estimated to cost approximately $35,000.

New York

BROOKLYN—The Ancasco Chemical & Color Co., Inc., 123 Nostrand Ave., is arranging for the immediate occupancy of its proposed new plant at 61-63 Taaffe Pl., where property recently was leased. It will be equipped for the production of shellac, wood finishers and kindred products.

TONAWANDA—The National Roofing Co., Fillmore Ave., manufacturer of composition roofing products, is planning for the rebuilding of the portion of its plant destroyed by fire, April 20, with loss estimated at $75,000, including equipment.

TOTTENVILLE, S. I.—The Tottenville Copper Co., Arthur Kill Rd. and Bethel Ave., has authorized plans for the rebuilding of the portion of its plant destroyed by fire April 22, comprising eleven buildings with machinery, with loss estimated at close to $1,000,000. The rebuilding will cost approximately a like amount. Benjamin Lowenstein is president.

Ohio

MIDDLETOWN—Officials of the Paul A. Sorg Paper Co. have organized a subsidiary company to be known as the Frank Smith Paper Co., with capital of $1,500,000, to construct and operate a local mill. Plans have been completed for a 1-story mill unit, 250x600 ft., estimated to cost about $750,000, with machinery. Pretzinger & Musselman, Reibold Bldg., Dayton, O., are architects.

SEBRING—The Sebring Pottery Co. has work in progress on a new addition for increased production, estimated to cost about $30,000.

CINCINNATI—The Chemical Utilities Co., 1516 West 6th St., has plans for the rebuilding of the portion of its plant recently destroyed by fire with loss estimated at $50,000.

Oregon

ASTORIA—The Crown-Willamette Paper Co., 248 Battery St., San Francisco, Calif., has tentative plans under consideration for the construction of a new pulp mill at Young's River Falls, near Astoria, to cost more than $150,000 with equipment.

OREGON CITY—The Oregon Pulp & Paper Co. will soon commence the erection of a 3-story addition, estimated to cost about $75,000.

Pennsylvania

PHILADELPHIA—Woodward & Dickerson, Inc., 14 South Delaware Ave., manufacturer of fertilizer products, will make extensions and improvements in its plant at 143-5 Front St.

LEWISTOWN—The Pennsylvania Wire Glass Co., Pennsylvania Bldg., Philadelphia, is completing plans for the erection of the first unit of a new local plant, 100x500 ft., to cost in excess of $200,000, with machinery. Frank A. Hayes is engineer.

PITTSBURGH—The Standard Sanitary Mfg. Co., Bessemer Bldg., has filed plans for the erection of two additions to its plant at Preble Ave. and Ontario St., estimated to cost $70,000.

SPARTANSBURG—The Spartansburg Oil & Gas Co., lately organized, has broken ground for the construction of a new oil-refining plant to cost close to $200,000, with machinery.

South Carolina

LORIS—Rhodes & Hardwick are planning for the installation of a fertilizer plant in a local building, with initial capacity of about 75 tons per day.

Tennessee

KNOXVILLE—The Knoxville Glass Co. is arranging for the immediate erection of a new 2-story plant on North Broadway, estimated to cost close to $50,000. H. G. Kinney is head.

ERWIN—The Southern Potteries Co. is perfecting plans for the erection of a new plant addition, estimated to cost close to $100,000, with machinery. Charles W. Foreman is head.

Texas

ELSINORE—The Phillips Petroleum Co., Bartlesville, Okla., has commenced the construction of four new gasoline-refining plants at Bunger, Oil City, South Bend and Herron City, all in the same district, to cost about $700,000, including machinery.

HOUSTON—The Pinetree Products Co., West Bldg., has acquired property at Harrisburg, near Houston, for the erection of a new plant for the production of turpentine, paint, varnish, etc., with initial capacity of about 6,000 gal. per day. J. W. Barnes is general manager.

ROCKDALE—The Austin Petroleum Co. will commence the construction of an addition to its local oil-refining plant to increase the capacity by about 100 bbl. per day. The company was organized recently with A. C. Baldwin as president.

SAN ANTONIO—The San Antonio Portland Cement Co. has completed plans and will commence the construction of an addition to its mill for considerable increase in production. Willard E. Simpson is engineer.

BRECKENRIDGE—R. W. Raney is perfecting plans for the organization of a new company to construct and operate a plant in this vicinity for the manufacture of carbon black. It will cost about $200,000, including machinery. Permission has been granted and work will soon be commenced.

EL PASO—J. B. Spears, an official of Wells, Stilwell & Spears, Inc., has acquired a local building and adjoining site for the establishment of a new cottonseed oil mill. The structure will be improved and extended. The machinery installation is estimated to cost close to $60,000.

Virginia

RICHMOND—The Calcium Phosphate & Fertilizer Corp. has preliminary plans for the installation of additional equipment at its plant.

RICHMOND—The Economy Concrete Co., Inc., recently organized with a capital of $100,000, has acquired a tract of about 5 acres of land and plans for the construction of a new plant. It will cost about $45,000, including equipment. J. Scott Parrish is president.

Washington

ABERDEEN—The Western Oil Co. is planning for the construction of a new oil storage and distributing plant to cost about $10,000, including equipment. A similar plant will also be built at Hoquiam, Wash., to cost approximately a like amount.

Opportunities in the Foreign Trade

Parties interested in any of the following opportunities may obtain all available information from the Bureau of Foreign and Domestic Commerce at Washington or from any district office of the bureau. The number placed after the opportunity must be given for the purpose of identification.

CHEMICALS and all kinds fertilizers. All cattle feeding cakes. Purchase or agency.—6185.

LAUNDRY TABLETS in cake form. Bergen, Norway. Manufacturers' agency. Samples with offers desired.—6189.

CAMEL-HAIR FILTER-PRESS CLOTH. Alexandria, Egypt. Purchase. A sample showing the quality of cloth desired was forwarded and may be examined at the bureau or its district offices. (Refer to file 88,793.)—6193.

PARAFFIN and general drugs and chemicals. Oporto, Portugal. Purchase.—6205.

NITRATE OF SODA, about 10 tons; muriate of potash, about 15 tons; and phosphoric acid, about 10 tons. San Jose, Costa Rica. Purchase.—6206.

New Companies

WYATT RUBBER & CHEMICAL CO., 4000 Gough St., Baltimore, Md.; chemicals and rubber products; $50,000. Incorporators: Charles M. and C. E. Wyatt, and J. Lewis Warner.

PROTECTIVE COATINGS CORP., Kenilworth, N. J.; waterproofing products; 7,000 shares of stock, no par value. Incorporators: Thomas D. Osbourne, J. N. Dimmick and A. R. MacConnell, all of Kenilworth.

AMERICAN OLYMPIC OIL & REFINING CO., Bangor, Me.; refined petroleum products; $980,000. Frank Fellows, president, Raymond Fellows, treasurer, and James M. Gillian, Bangor, clerk and representative.

NEWTOWN BY-PRODUCTS MFG. CO., Brooklyn, N. Y.; oils, greases, etc.; $100,000. Incorporators: E. P. Arnold, E. R. Bohart and F. E. Ames, Brooklyn. Representative: F. J. Knorr, Albany, N. Y.

LIME BY-PRODUCTS CORP., Charleston, W. Va.; cement, lime, etc., $500,000. Incorporators: M. F. Matheny, J. S. Horan and G. L. Hartley, all of Charleston.

PACIFIC COAST FIBRE CO., Seattle, Wash.; fiber products, $750,000. Incorporators: Cassius E. Gates, S. F. Harwood. Representative: Hulbert, Gates & Helsell, 901 Alaska Bldg.

HIMMELEIN & BAILEY, INC., Camden, N. J., operate a leather tannery; $200,000. Incorporators: Frederick and F. E. Himmelein, and William G. Oaks, 807 Cooper St., Camden. The last noted is representative.

GELTAN CO., New York, N. Y., glue and other adhesive products; $300,000. Incorporators: John K. Tullis, Henry G. Stone and Edward M. Roche. Representative: Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del.

NORTH BRANCH OIL CORP., Olean, N. Y., refined petroleum products, $500,000. Incorporators: H. L. Jacoby, J. I. Trenkle and A. E. Yahn. Representative: J. P. Quigley, Olean.

ENTERPRISE PAPER CO., Philadelphia, Pa.; paper products, $125,000. Nathan D. Isen, 2002 North Eighth St., is treasurer and representative.

ACME TILE MFG. CO., St. Petersburg, Fla.; cement tile and kindred products, $25,000. Harry Forkel, president, and Robert Arnold, secretary and treasurer, both of St. Petersburg.

GORDON REFINING CO., Wilmington, Del.; refined petroleum products, $5,000,000. Representative: Capital Trust Co. of Delaware, Dover, Del.

SOAP PRODUCTS CORP., St. Louis, Mo.; soaps, washing powders, etc.; $50,000. Incorporators: W. C. Harris, C. B. Brockett and F. S. Henderson, all of St. Louis.

UNITED PLATE GLASS CORP., Bridgeport, Conn.; glass products; $125,000. Incorporators: M. Cohen and Irving Elson, 400 Meigs Bldg., Bridgeport.

W. P. COLLINS OIL CO., 2619 Mary St., Chicago, Ill.; refined oils; 900 shares of stock, no par value. Incorporators: John J., Thomas P. and William J. Collins.

UNITED STATES SHEEPSKIN TANNING CORP., Brooklyn, N. Y.; leather tanning, $25,000. Incorporators: A. E. Wolz, H. Oppenheim and T. J. Healy. Representative: M. P. Schaffer, 1457-63 Broadway, New York.

AMERICAN CACTUS RUBBER PRODUCTS CO., Wilmington, Del.; rubber goods, $500,000. Representative: Colonial Charter Co., Ford Bldg., Wilmington.

STANDARD SOAP CORP., Oakland, Calif.; soaps, washing compounds, etc.; $1,000,000. Incorporators: John M. Simpson, Irving D. Hicok and A. E. Lees. Representative: Benjamin F. Woolner, First National Bank Bldg., Oakland.

DYDRA CHEMICAL PRODUCTS CO., Akron, O.; chemicals and chemical byproducts; $10,000. Incorporators: J. C. Timberous and C. E. Mills, both of Akron.

CUSTER PETROLEUM CORP., Wilmington, Del.; petroleum products; $250,000. Representative: Corporation Service Co., Equitable Bldg., Wilmington.

INTERSTATE REFINERIES, INC., Kansas City, Mo., operate oil refineries, $50,000. Incorporators: R. L. Langley, W. M. Bonner and J. O. Galloway, all of Kansas City.

EXCELSIOR CHEMICAL CO., 485 California St., San Francisco, Calif.; chemicals and chemical byproducts; organized with Anton Schaffhauser as head.

UNITED SUGAR CO., Kennebunk, Me., operate a sugar refinery; $2,000,000. John P. Deering, president; John C. Emmons, treasurer and representative, both of Kennebunk.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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Nitrogen Again To the Fore

A THOROUGH technical study of all important phases of the nitrogen industry has long been needed. During the war period and shortly thereafter, the Nitrate Division of the War Department made a significant study of nitrogen sources and possibilities, but this work was limited largely to the military aspects of the case. More recently the Fixed Nitrogen Research Laboratory, now under the auspices of the Department of Agriculture, has studied extensively the technology of nitrogen fixation and the possibilities of utilizing some nitrogenous raw materials such as cyanamide, but here again the problem has been largely that of one user interest—namely, the agricultural demands for inorganic nitrogen. Now fortunately the problem is to be approached from a different angle—the commercial and international aspects of nitrogen supply for all branches of industry.

Secretary HOOVER clearly regards this work as one of the most important phases of the survey of raw materials that was authorized in the closing hours of the last Congress. He rightly indicates that both agricultural and industrial considerations must be studied in order that adequate supplies of fixed nitrogen at reasonable prices may be available in the United States. Such study will, in part at least, answer the question: What are the prospects for a new nitrogen-fixing industry that may be made possible through further technical development of the cyanamide, the Haber, the cyanide and the arc processes? Or more specifically, what price limits must they meet in order to compete commercially?

It is a demonstrated fact that ammonia, nitric acid or any one of the important compounds of these two sources of inorganic nitrogen can be made successfully on a large scale by either the cyanamide or the Haber process. The cyanamide plant at Muscle Shoals was a complete technologic success. The Haber process plant at Syracuse has had most gratifying, and one might even say almost unexpected, success. Several other procedures for nitrogen fixation are equally promising from a technical point of view. But what of their commercial future?

The answer to this question will be determined by several independent factors. One of these factors is the minimum cost at which Chilean nitrate can be delivered in the United States. This, in turn, is fixed by the efficiency of nitrate recovery methods in Chile, by the magnitude of the export tax that Chile places upon nitrates, by ocean freight rates, and possibly even by American tariff protection. Another basic factor in determining the range and the average of inorganic nitrogen market prices will be the extent to which byproduct coke ovens are developed in the United States. Even at high prices for sulphuric acid, the modern coke oven cannot afford to operate without manufacturing ammonia liquor or ammonium sulphate. The ammonia is inevitably produced in the raw gas and in general it must be recovered before this gas is used or sold. The quantity of ammonium sulphate so produced is a factor in determining market tendencies; and at the present time with imposing increases in the byproduct coke-oven industry, this factor assumes enlarged importance.

All of these important influences will be analyzed in the survey contemplated by the Department of Commerce. Nor will this department work alone, for by law its efforts are to be supplemented by co-operation from all of the other branches of the government concerned. There is no question that all these agencies will gladly co-operate in the study, which is of mutual interest and importance.

Both Secretary HOOVER and Dr. KLEIN, director of the Bureau of Foreign and Domestic Commerce, in which the work will be done, appreciate the complexity and the importance of the task before them. However, they look forward with confidence to the result. They are particularly fortunate, too, in having selected for the task a man who knows this industry thoroughly. Dr. HARRY A. CURTIS, who will be in immediate charge of the investigation, has previously served as a captain in the Nitrate Division and as executive officer of the Fixed Nitrogen Research Laboratory of the Department of Agriculture. Thus he is well acquainted with the problems on which the government is equipped to assist. He also knows the situation at Muscle Shoals from extensive personal experience there; and the problems of the coke industry are well known to him through his experience during the past 3 years as a technical executive in that industry.

Every interest affected by the production or the supply of inorganic fixed nitrogen will be concerned in this study. The conclusions reached in it will be of large influence in determining the disposition of the government's properties at Muscle Shoals. They will largely determine the course of further industrial development in the industry during the coming decade, but with the favorable conditions which attend the beginning of this work, all can look forward with confidence and satisfaction. The Department of Commerce will do its work thoroughly. It will produce a well-balanced, constructive and fair report. It will doubtless upset the plans of some of the would-be industrialists who have desired a slice of the Muscle Shoals melon. It may even disturb the plans of some influential politicians. But in the end the results will be good, and industry should stand ready to give every possible assistance to the department, that its results may be achieved with the minimum of effort and the maximum of speed.

Electrochemical Society Honors E. G. Acheson

TO RECORD the award of honorary membership in the American Electrochemical Society to Dr. EDWARD G. ACHESON is a pleasant privilege These distinctions are worth while, eminently worth while, provided always good judgment prevails. There does not seem to be any method of rewarding the hard work that brings negative results, although many a fine life has been devoted to determining what not to do in the search for nature's secrets. But rewards of honor and distinction to those who reach important goals and who are the mediums of great contributions to human knowledge are none the less proper and worthy. They mark the high spots in achievement, and Dr. ACHESON has reached several of these All over the world methods of industry have been changed by his far-reaching activities in the study of conditions, in imagination, and in the will power and diligence to put his findings through.

Like a number of other American inventors, he was at one time associated with THOMAS A. EDISON. And like several of these, he also preferred to follow his own leads and to become, so to speak, an institution in himself.

The leads of Dr. ACHESON were practically all within the great domain of electrochemistry. Nearly every month some new use of one or another of the products of his inventions is discovered and the efficiency of manufacture is promoted. Why shouldn't such a benefactor be distinguished? The rewards of research in wealth are sometimes big and much more often they are very slight; but these honors have no bearing upon property. They are, in a way, unworldly; they outlast life and pass the name on into history. The occasion is unknown to the ignorant; the ceremony is modest; there are no great applauding crowds; but to the ear of the imagination there are, at such a time, ghostly trumpets and drums that sound the music of enduring fame.

Transportation And Our Prosperity

THERE may be some division of opinion as to the permanence of our present prosperity, but there can be no dissent from the view that its continuance depends in a large measure on the maintenance of adequate transportation facilities. Therefore, when the Chamber of Commerce of the United States, at its eleventh annual meeting, chose to discuss "Transportation in All Its Phases," it hit upon a theme of primary interest to every branch of business.

Freight rates are a significant item in manufacturing costs, particularly in industries such as ours that supply basic materials for further fabrication. But even more important is the element of delay and the great blight on industry resulting from the periodic shortage of cars and shipping facilities. It has been estimated that due to insufficient transportation during the past year the scarcity of coal alone penalized industry by an amount equivalent to more than half of all the freight charges paid on this commodity. Obstructions in the distribution of finished products may not always be as evident, but they are equally expensive to the ultimate consumer.

Under private management the railroads have made a remarkable comeback. By economies in operation and improved efficiency they have recently been able to handle a larger volume of traffic than ever before in their history. But during this time they have not been free from attack, and there is still the danger that radical legislation and ill-advised regulation will entirely throttle their progress. Pending before Congress at its last session were 134 separate bills designed to regulate the railroads and reduce their net incomes by lowering rates or revising valuations and rates of return. This antagonistic attitude threatens the investing public's confidence in railroad finances at a time when money is sorely needed for new rolling stock and other equipment as well as additional terminal and shipping facilities. It is evident from recent utterings of Senator LA FOLLETTE and other self-termed "progressives" that this campaign of destruction will be continued, and unless the saner representatives of the public vigorously oppose it, great harm will be done to the railroads and, therefore, to industry.

What is really needed is a sound national policy toward transportation that will provide adequately for future expansion, and at the same time properly co-ordinate the interests of both shipper and carrier. Good transportation is the crux of good business conditions and all who are interested in our permanent prosperity should recognize the seriousness of the present situation.

Up to Date In Going Backward

ACCORDING to CHARLES R. GOW, president of the Associated Industries of Massachusetts, taxes in the United States consumed in 1912 6.36 per cent of the nation's production. In 1921 this had increased to 16.7 per cent. That is, whoever worked at a gainful occupation, even if he worked 365 days in the year, spent 61 days to earn his proportionate share of taxes.

Before the war we used to consume 76 per cent of our production, leaving 24 per cent for taxes and new enterprises. If we consumed the same proportion last year--and we do not seem to have grown more provident since the war—we had left for taxes and new enterprises about $12,500,000,000. Of this sum, taxes took, roughly, about $8,500,000,000, leaving $4,000,000,000 for development. It is estimated that about $6,000,000,000 is needed to meet the reasonable expansion of our industries and the facilities to meet normal growth, so that we are as a nation about $2,000,000,000 short of our annual needs for legitimate progress.

Every dollar spent in public expenditures must be earned by somebody before it can be collected in taxes, so that, according to Mr. GOW, in order to get ahead we must produce more, spend less in taxes, or reduce the standards of living.

A large part of our taxes is for war debts, which, as Secretary WEEKS points out, are not properly to be considered as current military expenditures. No matter how peace loving we may be, we can't dodge debts. To be sure, there is great waste in the national budget, but there is also great neglect. We believe, however, that a careful analysis of government expenditures would show that, despite our preposterous Indian Bureau with its 5,000 to 6,000 clerks, the log-rolling river and harbor bills and bonuses and all sorts of easy-going munificences with public moneys there are works which should be undertaken and completed that would inhibit

even an ideal government from reducing expenses in any great measure. The change should be from useless outlays to useful ones.

Again, the old notion that money spent for luxuries and high living is kept in circulation and thus enriches somebody, no matter who he may be, will not go down any more. That is like paying men to carry stones from one field into another, and then to carry them back from the second field to the first. The men have earned a living and supported their families by the proceeds of their work, but there is no advancement in the process. We're not getting ahead by it. It is wealth consumed but not invested.

The only real way to meet the threat which Mr. Gow's figures represent is to save the pennies; to spend less than we earn and to put the money aside; to live modestly, to follow the homely advice of old BEN FRANKLIN. The most foolish ambition on earth is the desire to be up to date when we are going backward.

Changing Our Datum Points

UNITS of measurement and datum points are prime considerations to the technical man. They are fundamental in attacking any problem, and until they are settled definitely and precisely there can be no record of progress. Perhaps it is because HERBERT HOOVER is addicted to the engineer's methods of thinking that in his address last week before the Chamber of Commerce of the United States he felt the necessity for calling attention to our present methods of gaging business. "We must get our minds away from the notion that pre-war standards of living and volume of business are normal now." And, he added, "We must not be frightened when our output of steel, or textiles, or automobiles, or lumber, or corn, or our car loadings mount to figures far in excess of those that would be implied alone in a normal growth of population."

It was this necessity for changing our datum points that President BARNES of the National Chamber also stressed in a recent talk to the Merchants' Association of New York. The decade 1913-1922 witnessed tremendous expansion in business, he pointed out, due in no small measure to progress in science and invention, to labor-saving devices and other improvements in production processes, and to better management and administration. Briefest reference to business statistics shows how marked has been this change. From 1913 to 1922 our population increased from 95 000,000 to 110,000,000 and our annual income from $33,000,000,000 to $50,000,000,000. Savings almost doubled and national bank balances jumped from $6,000,000,000 to $16,000,000,000. But this growth in men and money was not without increased production efficiency and greater economy of human effort. Per capita earnings rose from $200 in 1890 to $600 in 1920 and the volume of factory production increased 95 per cent between the census years 1900 and 1920. But this progress is most striking when measured in terms of individual effort. From the metal industries, for example, we learn that pig iron production per worker in 1889 was 267 tons, and in 1919 it was 709 tons. In 1909 the output of automobiles amounted to 1.6 cars per person employed in the industry. By 1919 this had increased to 4.1 cars, while the capital investment per car had been lowered from $1,400 to $1,100.

Secretary HOOVER characterized the accomplishments of this decade in a single sentence: "A rough estimate would show that we could supply each person in the United States with the same amount of commodities he consumed 10 years ago and lay off 2,000,000 people from work." Fortunately, however, consumption and distribution have in general kept pace with production, so that this tremendous increment in output is marketed and consumed with but little apparent difficulty.

Perhaps some of our oldest industries have approached very near to saturation, but there is another great group that is only at the beginning of its development. In this category are many of our chemical and chemical engineering industries. Their growth can no more be measured in terms of 1913 production than can their future expansion be gaged on the basis of present performance. Who can say, for instance, what will be the saturation point for synthetic resins, or pyroxylin lacquers, or a special alloy, or some new food product? It is apparent that the time has come for us to change our datum points and to measure business progress on the basis of individual initiative and enterprise.

Ice Cream That Will Not Melt

IT IS not infrequent in our office to receive a call from a dignified, successful man in the, let us say, ice cream business. He has a scientific goal. He wants to produce ice cream that will not melt. No, really, we are not joking. Of course it is our duty to point out the fact that since the melting point of ice cream is considerably below room temperature, his desideratum is impossible.

If we did it in just that way, however, he would mistrust us and leave the office in the firm conviction that we would probably steal the idea or that science was bunkum. Actually we do suggest, for example, that unless considerable cornstarch is used the ice cream will melt out of shape but that with cornstarch or some other similar substance the ice cream would probably hold its shape even after it had melted. Of course it would no longer be ice cream and probably wouldn't taste very good, but perhaps it might be worth while getting someone to work on the problem.

So we get his royal ear, so to speak, and then we sow some real propaganda. Naturally, we say, the technical man you get to work on this job may not ever get non-melting ice cream, but he will solve a lot of other problems for you quite incidentally. For example, the corrosion of ice cream containers is a big expense; he may be able to help you there. This is bound up with the kind of salt you use in freezing. In addition there are raw materials and flavorings that have both an economic and a commercial side. On the one hand these should be cheap and on the other they must give a desirable product. On all these problems the technical man can work, and his work will be a positive benefit and a constructive factor. Thus non-meltable ice cream may become the minor end rather than the main problem.

And not infrequently we have been able to urge the business man to try out technical help. True, no ice cream manufacturer has come to us, but some men with ideas equally as foolish as non-meltable ice cream have come and seen and been persuaded. It is one of the ways of doing our bit for progress and humanity and the technical men.

Readers' Views and Comments

An Open Forum for Subscribers

The editors invite discussion of articles and editorials in *Chem. & Met.* or on other topics of pertinent interest

Manufacture Of Chromium Steel

To the Editor of Chemical & Metallurgical Engineering

SIR:—A recent issue of *Revue de Métallurgie* contains a digest of an article by F. T. Sisco appearing in *Chemical & Metallurgical Engineering* for Jan. 11, 1922 (vol. 26, p. 71). In this article, entitled "The Manufacture of Chromium Ball-Bearing Steel in the Heroult Furnace," the author states: "The manufacture of electric high-carbon chromium ball-bearing steel has until recently been accompanied by the difficulty of producing a product which is free from surface seams and internal hair lines. This statement should not be construed to mean that no good ball steel is as yet made in the electric furnace. There are many manufacturers that are producing an excellent steel for this purpose, but the fact is they are not doing it consistently."

Your readers will doubtless be interested in learning that we have been making important quantities of ball-bearing steels by my system at Ugine, Savoy, at the "Forges & Aciéries Electriques P Girod" since 1912. During the war production of this analysis was at the rate of 6,000 tons per year, and for many years our plant has supplied practically the entire needs of French ball-bearing manufacturers. That this electric-furnace steel is not the least inferior to the best Swedish steels is proved by many tests—among them I may cite those made under the auspices of Hoffman, the distinguished technical administrator of the Compagnie d'Applications Mécaniques, and published in the official *Bulletin* of the Chambre Syndicale des Constructeurs d'Automobiles for July, 1922.

Fifteen bars were studied, three of each of the following analyses:

	C	Mn	Si	S	P	Cr
Swedish steel	0 97	0 30	0 30	0 01	0 03	1 49
Girod steel	1 03	0 24	0 17	0 07	0 02	1 19
Electric steel "C"	1 01	0 31	0 24	0 02	0 01	1 22
Electric steel "W"	1 03	0 17	0 29	0 01	0 01	1 58
Electric steel "K"	1 02	0 30	0 21	0 01	0 01	1 17

These bars were annealed to Brinell hardness of 200, making sure that their microstructure was comparable. Tension tests gave very uniform results, when individual samples are compared, indicating great uniformity in the bars. The test pieces show a pronounced neck, a very slight cup and cone fracture, and fine grain. Results follow:

	Elastic Limit	Ultimate Strength*	Elongation	Contraction
Swedish steel	99,100	183,000	39	24
Girod steel	104,800	183,000	44	24
Steel "C"	104,000	173,000	46	24
Steel "W"	110,000	185,000	41	23
Steel "K"	104,000	187,000	46	23

* Figured on area at neck

For testing in static flexure, pieces were machined 10x10x120 mm., heated for 5 minutes at 790 deg. C. in a salt bath, quenched in water, and gradually drawn back, reaching 180 deg. C. in 10 minutes. The pieces were tested on knife edges, 100 mm. apart, loaded centrally, and all broke with an excessively fine and silky grain. Breaking loads are as follows:

Swedish steel	1,550 kg	1,500 kg
Girod steel	1,500 kg.	1,500 kg
Steel "C"	1,700 kg	1,600 kg.
Steel "W"	1,550 kg.	1,600 kg.
Steel "K"	1,750 kg	

Thus no sensible differences can be noticed for these test samples, whether made by Swedish crucible process or by at least two styles of electric furnaces.

To make this steel, we at Ugine have always used a fusion with complete oxidation and without excessive temperature (which would produce suroxidation of the iron—a condition very difficult to correct), followed by a deoxidation stage at a temperature as low as is consistent with maintaining a fluid slag. Mr. Sisco recommends that in a Heroult furnace it is best to melt with only partial oxidation and deoxidize on a very hot bath. We have found that partial oxidation gives variable steel unless the raw materials are of very good quality and of uniform composition, whereas a consistently fine quality of steel may be made of rather variable raw materials if melted with complete oxidation. Our practice is followed not only for high-chromium carbon steel but also for other special steels, especially for armor-piercing shells.

From 20 years' experience with alloy steels, I have concluded that the faults found in electric steel are not due to chemical combinations, but most often to a high pouring temperature. Notably in chromium-nickel steel this results in abnormal crystallization, which is extremely difficult to break up and refine, even by very careful reheating.

PAUL GIROD.

Cannes, France

The Resolution of Petroleum Emulsions

To the Editor of Chemical & Metallurgical Engineering

SIR:—In an article appearing in your journal[1] some time ago, Harold V. Dodd, writing on "The Resolution of Petroleum Emulsions," stated that the presence of asphalt is assumed to be the reason for the emulsion in crude petroleum oils. He also explained a number of elaborate measurements for combating the action of this asphalt.

If the asphalt is the interfering substance, why not remove it? The writer took a sample of Texas crude which had been in emulsion for about 10 years and on breaking the emulsion found it contained more than 50 per cent water. The resultant oil showed no emulsion by the centrifugal test.

These results were obtained by filtration, using infusorial earth as a filter-aid to hold back the colloidal carbon and asphalt.

I should be glad to hear of anyone who has had similar experience.

E. H. WILLIAMS.

Chicago, Ill

[1] *Chem. & Met.*, vol. 28, No. 6, pp. 249-53, Feb. 7, 1923.

British Chemical Industries

FROM OUR LONDON CORRESPONDENT

LONDON, April 18, 1923.

PRICES of chemical commodities are still firm, and this may be ascribed mainly to the situation in the Ruhr, competition from Germany being so small that it can almost be left out of account, although small stocks from Hamburg and Antwerp are still being offered. The fact is that production costs of British manufacturers are now in many cases below those on the continent, and with America consuming the bulk of her own production, there is likely to be considerable activity in British chemical industries during the next few months, a fact that is reflected to some extent by the recent remarkable rise in prices of chemical companies' stocks and shares. The budget introduced into the House of Commons 2 days ago, including as it did the 50 per cent reduction of the corporation tax on limited companies, together with the immediate prospect of a further reduction in railway rates, has not been without effect on the chemical trade.

INDUSTRIAL AND GENERAL DEVELOPMENTS

Speculation is rife as to the reason for the recent considerable appreciation in the shares of the British Cellulose Co., and important announcements are expected next month in regard to the production of acetyl cellulose silk and also in regard to the activities of Nobel industries. The subject of nitrogen fixation is again coming to the fore, and the breezy discourses of E. Kilburn Scott, whose activities in America are probably familiar to readers of *Chem. & Met.*, are very opportune, because public and governmental opinion in regard to empire nitrogen fixation has become somnolent and apathetic. There has been a tendency to assume that Brunner Mond and synthetic ammonia will have it all their own way and are too strong for others, but there can be no doubt that, at any rate in outlying parts of the empire, the arc and also the Häusser process will find application, while the latter can also be usefully developed alongside synthetic ammonia or cyanamide plants.

The increased use of decolorizing carbons has brought forth the usual crop of "new" processes, and there is certainly more competition at the present time in these products. It seems extraordinary that so little appears to be understood about the physical chemistry and constitution of these materials, which are only too often manufactured in a most unscientific and haphazard manner and without regard to economy or scientific control. This also applies to compound mixtures of decolorizing carbons with infusorial and other earths, and generally speaking the literature and information on the subject seem very deficient. Some interest has been aroused recently by the use of decolorizing carbons for medicinal purposes, and this presents a promising field for further investigation.

Further progress is reported in the various processes that are being developed by the Thermal Industrial & Chemical Research Co. in regard to the use of a bath of molten lead for the heat-treatment of various materials, particularly in cases where it is desired to reduce the time of treatment or reaction to a minimum. This company is a subsidiary of Woodall, Duckham & Jones and the pioneer work is being done by J. S. Morgan, who recently read a paper before the Coke Oven Managers' Association describing the application of the process to the low-temperature carbonization of shale and the like. It was stated that with a time of passage through the lead of less than 15 seconds, a lead bath 3 ft. 6 in. by 1 ft. 3 in. by 6 in. would treat 5 tons of material per day. A number of patents have been taken out for the treatment of other substances, and the same firm has also taken a hand in the barium carbonate process of nitrogen fixation, for which success has been claimed at the works of the British Cyanides Co.

The Departmental Committee on the Industrial Use of Lead and Leadless Paints has now reported against their abolition and considers that the chief danger has been the dry rubbing down of old paint, which should be adequately overcome by precautions directed toward wetting during rubbing down. This would merely involve the use of waterproof sandpapers and the matter is to be further considered by a technical commission to work in co-operation with the Department of Scientific and Industrial Research.

Combustion Myth to Be Settled

To establish or refute the general impression that salt or salt solutions, when sprinkled over fuel, have a beneficial effect, the Minister of Interior and Mines of Canada instructed the Dominion Fuel Board to undertake a series of experiments. From time to time liquids and powder have been placed on the market and extensively advertised, with the claim that they had the property of producing greater heat when applied to raw coal or to unburned cinders. In many of these preparations salt formed the basis, consequently the result of the experiments with this material are exceedingly valuable.

The tests were conducted under conditions identical to those which ordinarily apply in domestic heating furnaces, and, as completed, clearly demonstrate that salt, when sprinkled over fuel, has no beneficial effect, unless it be that the soot produced in combustion is packed down in the stove or furnace pipes.

The experiments were conducted at the Fuel Testing Station of the Mines Branch, where further tests on other materials which are claimed to have a beneficial effect upon fuel are being carried out.

Insecticide and Fungicide Symposium

Some recent developments in the use of insecticides and fungicides were brought out during the meeting of the American Chemical Society at New Haven. A symposium on the subject was conducted by the Division of Agricultural and Food Chemistry.

Analysis of the light and of the heavy white arsenic samples that show peculiar differences are explained partly by the different solubilities resulting from different sized crystals. The idea was set forth that this difference in size of crystals at least partly controlled the different results in use of this material as an insecticide. Addition of small amounts of lime influence the solubility of arsenic in the form of lead arsenate.

Bordeaux mixture is improved by the addition of a small amount of casein to one of the constituents of the mixture, when these two are put up in separate containers for dry storage. A mixture of 2 parts of copper sulphate to 1 part of lime is recommended.

The Chlorine Industry in the United States

An Economic Analysis of This Vitally Important Industry Shows That the Situation Is Serious With No Relief in Sight—This Article Presents the Data and Offers a Solution

BY PAUL S. BRALLIER

THE past 2 years has been a very trying time for the chlorine manufacturer. The fact that the same statement may be made of practically every other industrial division brings little comfort and no relief; for the troubles of the chlorine industry are the direct result of an extraordinary war expansion. The purpose of the following discussion is to present as accurate a picture of present conditions in the industry as available data will permit, and to suggest a means of overcoming the difficulties that are only too evident.

To begin with, the chlorine industry includes a great deal more than the preparation of chlorine by electrolyzing a salt brine in a suitably designed cell. The byproduct caustic liquor must be evaporated, and its salt content separated before caustic soda is ready for market; and the chlorine gas must be compressed and liquefied, or be combined with other reagents, before it is ready for sale. Thus the chlorine manufacturer must not only prepare the chlorine, but must absorb it as well, and his present problem can be stated very briefly as one of finding a suitable absorbent. For the purpose of this paper, the chlorine industry includes only those producers who market chlorine or its direct products.

A Few Notes on Size, Extent and Growth

As an indication of the size and importance of the chlorine industry, Bureau of Census figures for 1919 indicate a total annual tonnage of the various products, including caustic soda, of approximately 212,000 tons, with an aggregate value of about $16,000,000. This compares with a total valuation of $694,000,000 for all chemicals produced during the year. Chlorine and chlorine products have become necessities in a wide variety of industries and processes. They are indispensable in the paper industry; are finding increasing application in metallurgy; are widely used in general chemical and dye manufacture, and in the preparation of medicinal chemicals; are generally conceded to be most effective in sanitation and in water purification; have been applied to the refining of oils, and have played a most important rôle in warfare. The chlorine industry is therefore an essential industry, and any factors affecting its welfare are matters of general concern to industry as a whole.

The installed capacity for chlorine production in the United States is about 372 tons per day. This includes only the chlorine that is made for sale as chlorine or its direct products, and does not include chlorine made and used in the same plant, nor the chlorine capacity of the government plant at Edgewood Arsenal. Table I shows how this capacity is distributed among the various types of cell now in use.

The installed capacity is computed on the assumption that all cells installed are working at full load all the time. The actual continuous working capacity may be taken as approximately 300 tons per day. On this basis, and assuming that all the chlorine was made by the electrolysis of sodium chloride, the caustic soda produced by plants marketing chlorine and chlorine products during 1918 when all available chlorine capacity was being utilized would be 24 per cent of the total caustic production. The census figures for 1919 indicate 28.5 per cent of the total caustic soda production as electrolytic; but this includes caustic produced in plants consuming their own chlorine, so that 24 per cent seems to be a fair figure. A survey of the caustic soda manufacturing capacity of the country made by the War Department in 1917 showed that 20.6 per cent of the total capacity was electrolytic. Taking this lower ratio for the years 1914 to 1917 inclusive, and the higher for 1918 to 1922, the average daily chlorine production calculated from published data on caustic soda production is as shown in Table II. These figures are considered sufficiently broad to include the chlorine produced in the manufacture of caustic potash.

Going a step farther, and using the data of the census of chemical industries, the distribution of the chlorine produced among the various chlorine products has been tabulated in Table III.

These capacity, production and distribution data are presented with some misgivings, since they are for

TABLE I—INSTALLED CAPACITY OF VARIOUS CHLORINE CELLS

Cell	Tons Per Day	Cell	Tons Per Day
Nelson	79	Gibbs	64
Allen-Moore	55	Billiter-Siemens	31
Townsend	60	Wheeler	10
Castner	63	All others	10
			372

TABLE II—AVERAGE CHLORINE PRODUCTION IN THE UNITED STATES

Year	Tons Per Day	Per Cent of Working Capacity
1914	102	
1915	144	
1916	196	
1917	244	
1918	300	100
1919	180	61
1920	220	74
1921	133	45

TABLE III—CONSUMPTION OF CHLORINE AND CHLORINE PRODUCTS

Product	Tons Per Day 1919	Tons Per Day 1921	Tons Chlorine 1919	Tons Chlorine 1921	Per Cent of Total 1919	Per Cent of Total 1921
Bleaching powder	198	165	69	58	38.5	43.6
Liquid chlorine	47	49	47	49	26.1	36.8
Carbon tetrachloride	13	7	13	7	7.2	5.3
Chloroform	2.3	1.2	5	2.5	2.8	1.9
Tin chlorides	12.3	?	5	?	2.8	?
Aluminum chloride	11.7	11.7	10	10	5.6	7.5
Sulphur chlorides	3.2	?	2	?	1.1	?
Hydrochloric acid						
Antimony chloride						
Chlor benzols						
Benzaldehyde	....	..	29	6.5	15.9	5.2
Benzoic acid						
Chlor acetic acids						
All others						

the most part indirect. Installed capacity data for the Nelson and Allen-Moore cells were supplied by H. R. Nelson and by Kent R. Fox, of the Electron Chemical Co., respectively, and the figures for the Townsend cell have been published by A. H. Hooker in a paper read before the American Institute of Chemical Engineers. Installed capacities for the Billiter, Castner and Gibbs cells were figured from the percentages given in the government survey of caustic soda production in 1917, using the Hooker capacity as the basis of comparison. In the case of the actual daily chlorine production from 1914 to 1922, the applying of a flat percentage of total caustic soda production may be questionable; but the reticence of the chlorine fraternity prevents obtaining more reliable information.

Even with the above limitations in mind, however, the data given indicate a serious excess chlorine-producing capacity. The normal consuming capacity seems to be about 180 tons per day; and the remaining 120 tons working capacity represents a large capital investment that must necessarily lie idle, and that places an abnormal overhead charge against the actual production. Still more important is the fact that this excess capacity induces such keen competition among the various members of the industry that prices reach a level where amortization and depreciation charges are slighted, and expansion and development work curtailed, so that the future of the industry is endangered. A manufacturer should receive such a price for his products as to allow him a reasonable margin above his actual operating costs for replacement of capital invested, for obsolescence of equipment and for improvement, extension and expansion in whatever line of production he may be engaged. The buyer may profit temporarily by a lower price; but he will lose eventually in the failure of his source of supply. Healthy competition and friendly rivalry among various members of an industry are essential to the growth of that industry; but warfare is as much a destructive agency in business as in international relations.

Probable Development in the Chlorine Industry

Development in the chlorine industry will come under the two general heads of improvement of present apparatus and processes, and extension of the uses of chlorine and its compounds. Apparatus and process improvement would naturally be concerned first of all in reducing the cost of manufacture of chlorine gas. The principal items which the chlorine manufacturer buys are salt, fuel, power and labor; and local conditions at the various plants determine their relative importance. Salt and fuel efficiencies are purely individual plant problems; but all manufacturers would be interested in modification of cell design so as to raise the power efficiency and lower maintenance charges. The average chlorine cell shows an energy efficiency of approximately 60 per cent. The remaining is lost as heat, due principally to the internal resistance of the cell, which in turn is a function of current density. The recently described Marsh cell claims a higher efficiency due to lower current density brought about by the use of grooved anodes and corrugated cathodes designed to give increased electrode surface for the same over-all dimensions. The principal maintenance charges on cells are caused by graphite anode disintegration, and, with the exception of the Castner cell, by diaphragm stoppage. A study of these factors might very well be co-operative.

The second point of attack under process and apparatus improvement would be in the manufacture of chlorine products. Referring to the table of chlorine product distribution, it will be seen that bleaching powder is by far the biggest item. The data, of course, are for 1919 and 1921; and present conditions might show a larger percentage to liquid chlorine and a smaller percentage to bleach. Even so, bleaching powder is unquestionably the largest single chlorine consumer. While its manufacture dates from 1799, it is only within the past 15 or 20 years that any decided effort has been made to improve the method of manufacture. Practically all the bleaching powder made in this country today is made in "chambers," although mechanical bleach chlorinators have been used in Germany for some time. In the chamber process, hydrated lime of definite moisture content is spread in a layer about 4 in. thick over the floor of a room 15 to 20 ft. wide, 40 to 100 ft. long, and 5½ to 6½ ft. high. In the floor are imbedded cooling coils through which water is circulated in cold weather, and refrigerated brine in hot weather. Dilute chlorine gas is led into the chamber and is absorbed by the lime. When the lime has been saturated, the chamber is cleared of chlorine, and workmen enter and scrape the finished powder to outlets in the floor, through which it drops into the can-loading apparatus.

The spreading of the lime and the collecting of the bleaching powder are disagreeable jobs, and labor is consequently inefficient and expensive. A recent bleaching powder installation made by the Belle Alkali Co. and described in this journal[1] has utilized modern conveying systems to handle the lime to the chambers and the finished powder from them; but the most disagreeable part of the work, the collection of the powder, must still be done by hand. To get away from this high labor cost, one large company is said to be scrapping its present chambers and installing German mechanical chlorinators, which consist of a tier of nearly horizontal cylinders either rotating or with rotating paddles. The lime passes successively from one cylinder to the one immediately below, and chlorine is fed into the lowest cylinder and passes up through the system in counter-current to the lime. Another proposal that seems feasible is made by J. W. Moore in U. S. Patent 1,272,880 (1918), which covers the use of a rotary kiln not much less than 80 ft. long through which hydrated lime and chlorine are passed in counter-current. These mechanical chlorinators may be expected to replace the chambers quite generally if bleaching powder continues to be made in large quantities.

Liquid Chlorine a Growing Product

With development in the art of chlorine liquefaction and transportation, however, and increased experience on the part of consumers in handling the liquid, chlorine in this form is very likely to replace bleaching powder. Bleaching powder is not an ideal product even aside from its present method of manufacture; for it is disagreeable for the consumer to handle, is subject to considerable variation in chlorine content and in dissolving and settling properties, and deteriorates, especially in warm weather, so that it can be stored for only a limited length of time. By buying lime and liquid chlorine, the consumer may readily make his own bleach liquor by absorbing the chlorine in a

[1] Vol. 26, No. 22, p. 1038, May 31, 1922.

milk of lime of suitable strength. He is thus assured of his bleach supply with a decided saving in handling charges, as well as a more nearly uniform quality of bleach.

The various processes of chlorine liquefaction now used or proposed—pump, tower, and absorption—differ only in the means of getting the chlorine under pressure. In the pump process, the problem of lubrication was a serious one, since chlorine acted on lubricating oils. This was overcome by Knietsch in 1888 by the use of a sulphuric acid piston in a U-shaped compartment. Within the past 10 years a French pump has been developed that has a metal piston lubricated with sulphuric acid. This French machine has been tried out in this country during the past year and has been found to be very satisfactory in operation, and to have a capacity many times that of the German pump. Its initial cost is low and maintenance charges are small.

In the tower system, chlorine is drawn into a descending column of sulphuric acid through a modified injector, and the tower is made high enough so that the weight of the column of acid is sufficient to compress the gas for liquefaction in refrigerated condensers.

The absorption system parallels the ammonia absorption system very closely. The chlorine is dissolved from a more or less dilute gas by some suitable solvent. Goldschmidt patented the use of tin tetrachloride, and more recently C. T. Henderson has proposed the use of carbon tetrachloride. To obtain concentrated solutions, the solvent must be refrigerated. By heating the concentrated solution, the chlorine is driven off periodically and condensed, the necessary pressure being generated by the evolution of chlorine.

The pump and tower processes are the only ones in use in this country at the present time, and neither seems to have any great advantage over the other. Liquid chlorine can scarcely be expected to be a low-priced material, since the cost of liquefaction averages around $15 per ton, and the charge for containers, including inspection, valve repair and replacement, and return on capital invested is considerable, especially on the smaller sizes. During the war 1-ton and 15-ton containers were developed and have been in use for the past 4 years with uniformly good results. Where chlorine is required in sufficient quantities, these containers should prove much more satisfactory to the consumer and be much less expensive to the producer than the smaller "bottles."

Liquid chlorine is used at the present time quite extensively for water purification. This market is limited, however; for if the entire urban population of the United States were supplied with 130 gal. per capita per day of water treated with 2 lb. chlorine per million gallons, the chlorine consumption would be only 7 tons per day. Liquid chlorine is also used in the "aging" or bleaching of flour, the average dosage being given as 150 lb. chlorine per million pounds flour. Here again, if all the flour consumed in the United States were chlorine-treated, the daily chlorine requirement would be only about 6 tons. The high degree of purity and the convenience of liquid chlorine make it a desirable product in many other applications; but the consuming capacity is evidently covered by present production if contract price quotations are any index.

What is to be done to remedy the situation? The law of natural selection may be allowed to take its course, and the industry be stabilized by a process of elimination. This would result in a capacity not greatly in excess of our present consumption, and in the loss of millions of dollars of invested capital. On the other hand, the chlorine manufacturers of the country may get together on a program of research and education, and build up the consuming capacity to the present producing capacity or even farther. The first is a passive destructive solution; the second, active and constructive; and the chlorine producers must decide which course shall be followed, and must be responsible for the results of that decision. The saying, "He profits most who serves best" applies with equal force to industries and to individuals.

With one exception, the remaining chlorine products listed in the consumption table offer very little hope of expansion in volume of demand. A price war in carbon tetrachloride is on at the present time, and so far as low prices are concerned there is every inducement for the development of new uses for it. Chloroform is likely to be limited to pharmacal and very special solvent use, since for most solvent and extraction work it can be replaced by the less expensive carbon tetrachloride. Tin chlorides are expensive materials due to the high price of tin, and their use is limited to the silk and dye industries. Hydrochloric acid manufacture from hydrogen and chlorine is constantly competing with the salt-sulphuric acid process, so that while the volume consumed, equivalent in 1921 to 80 tons per day of chlorine, is quite satisfactory, the chlorine manufacturer can scarcely afford to take more than a limited percentage of the business. The war-time demand for monochlorbenzol and sulphur chlorides led to the installation of producing capacity far beyond peace-time requirements, so that conditions have been favorable for an expansion in their use for the past 4 years, with no evidence of any such development.

Aluminum chloride is the one hopeful item in the list. Its effectiveness in increasing gasoline yields in oil distilling has been demonstrated, and unless prohibitive royalties on the basic patents of the process interfere, the demand for anhydrous aluminum chloride is almost certain to increase as oil supplies decrease and the price of gasoline goes up. If only 10 per cent of the average daily gasoline production for the first 9 months of 1922 had been produced by aluminum chloride cracking, and if 50 per cent of the aluminum chloride had been recovered and re-used, the demand for fresh chloride would have exceeded 300 tons per day. Each ton of aluminum chloride requires in its manufacture something over 1,600 lb. of chlorine.

Up to a short time ago anhydrous aluminum chloride was produced altogether by the action of chlorine on metallic aluminum. The metal has been used in the form of pigs and clippings, but principally in the form of a dross collected in the Hall process of aluminum manufacture and containing 25 to 35 per cent metallic aluminum. Even the dross, however, has been an expensive source of metal, and a more extended use of the chloride has been prevented by its high cost. Numerous patents have been granted for various modifications of the general process of chlorinating a mixture of

bauxite and carbon, but it is only recently that the largest producer of the chloride has shifted from dross to bauxite as a source of aluminum. There are many factors that make this chlorination a difficult one to handle on a large scale, but the biggest single problem is the matter of supplying heat to maintain the bauxite-carbon mixture at the proper temperature, and at the same time introducing chlorine.

New Uses for Chlorine

The possible extension of the uses of chlorine and chlorine products has been very thoroughly discussed by V. R. Kokatnur in a paper presented before the American Electrochemical Society in 1918; and it would serve no useful purpose to review that discussion here. It may be said, however, that since the publication of that paper a chlorination process has been developed and successfully applied to the recovery of nickel and cobalt from arsenical ores; and it is entirely possible that other metallurgical uses may be found for chlorine, particularly if a type of furnace that can be heated in the presence of chlorine is developed. Another application that is interesting is the recent Henderson-Haggard process for killing offensive odors by injection of chlorine into the odorous gases. Chlorine has also been successfully applied to the production of pure cellulose from woody fibers; and while chlorine so used would displace a percentage of the bleaching powder now consumed in the paper industry, adoption of this process would mean an increase in chlorine consumption. Chlorine in the form of bleaching powder has recently been found a very satisfactory sweetening agent in gasoline refining.

The situation in the chlorine industry of the United States, then, is that with a producing capacity of about 300 tons per day, the normal consuming capacity seems to be less than 200 tons per day. Four years of unrestricted competition with all its attendant virtues has failed to increase to any great extent the demand for chlorine or chlorine products. Even assuming that present producers can continue to operate under prevailing conditions, the consumer must be paying a premium over and above the actual cost of the products he buys to take care of the overhead charges on this excess capacity. If consuming capacity can be increased, both producer and consumer will gain by the increased stability of the industry. The failure of the competitive period to bring about any marked increase in consumption of chlorine indicates that the problem is too big for individual producers to solve. It requires the co-operative effort of the whole industry.

Co-operation of Consumer and Producer Needed

This co-operation could take the form of the collection and publication of reliable production statistics for the industry. It could consist of the outlining and carrying out of a definite and comprehensive research program, to replace the present system of development, by individual producers, of the same products, which is wasteful in its duplication of effort, if for no other reason. It could take the form of a systematic education of industry as a whole in the use of present chlorine products, and such new products or uses as may be found. All three of these functions, the gathering of statistics, the carrying on of research, and of education, are beyond the capacity of the individual company. They are vital to the industry, and should be promoted and maintained by the industry.

This idea of co-operation is, of course, not new. In fact none of the ideas presented in this article have any claim to originality. All these things have been suggested and talked about before—and nothing has been done. The purpose throughout this discussion has been to present the facts again, fortified with such figures as were available, in the hope that, if the argument is repeated often enough, something will be done.

Arsenic Trichloride Affects Industrial Workers

Extensive laboratory research and factory investigations have shown that the local caustic action of arsenic trichloride and the absorption of the poison through the skin or through the lungs frequently result in death or serious disability. The current *Monthly Labor Review* of the U. S. Department of Labor describes these investigations, points out the effect of the poison when encountered in various ways, and also suggests a few precautions that may be taken to preserve the health of workers in industrial plants where the compound is manufactured.

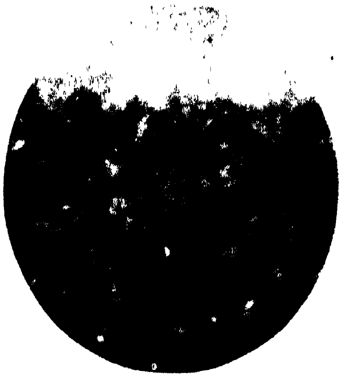
Applied to the skin, arsenic trichloride kills the tissues very rapidly, the action being somewhat retarded by washing the part affected within one minute. In this case, however, the final result is not affected. Within a few hours after such application arsenic can be recovered from most of the tissues and organs of the body. Inhalation of 1 part of arsenic trichloride to 40,000 parts of air kills mice within 5 minutes.

The compound is very diffusible and enters readily into various combinations, forming visible particles where the air contains moisture. Vapors are quite likely to be invisible when the air is unsaturated. Experiments show that the atmosphere throughout the vicinity of apparatus in which arsenic trichloride is manufactured contains considerable amounts of the poison. Special ventilating arrangements are required to remove the fumes that arise when this compound is necessarily exposed to the air in filling drums and sampling their contents. Air containing fumes so removed can be purified by a fine water spray before being discharged into the atmosphere. Persons employed in this industry should wear impervious clothing, and only experience can show whether they should not also wear suitable gas masks.

Selenium Oxychloride Cleans Cylinders

Paint, japan or varnish may readily be removed by a treatment with the solvent selenium oxychloride, which was discovered by Prof. Victor Lenher of the chemistry department of the University of Wisconsin. Rubber, both pure and vulcanized, and resinous and glue binder substances, including the natural resins, glues, gelatins, celluloid, varnish, lacquer and paints, are soluble when treated with selenium oxychloride.

This solvent may also be used advantageously for the removal of carbon from the cylinders of gas engines. Such deposits usually consist of particles of carbon, more or less cemented together with hydrocarbons, such as partly carbonized oils or deposits from oils, including gasoline. Selenium oxychloride, alone or compounded with other substances, will sufficiently dissolve the binder constituents of the carbonized mass to cause the disintegration of them and the cleansing of the cylinders.



FIGS 1 TO 3

Fig 1—Mag 160 Thickness 0.0047 in., or 0.1193 mm This paint was allowed to stand for 2 weeks, during which time the material became noticeably more viscous This was used in preparing a three-coat film from which Figs 2 and 3 were photographed In these the drying was more rapid No separation of the oil and pigment could be noticed

Fig. 2—Mag 250 Thickness 0.0072 in., or 0.1828 mm.
Fig. 3—Mag 440 Thickness 0.0072 in., or 0.1828 mm

Microstructure of Paint Films

An Attempt to Determine Relation Between Microstructure and Protective Value of Certain Paints and Pigments

By Harold L. Maxwell
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THE use of photomicrography in examining paint films is relatively recent. Toch[1] photographed the surfaces of freshly applied red lead paint and recorded a separation of the oil from the pigment. Coye,[2] in making a study of the protective value of various paints on structural steel, prepared photomicrographs from the surfaces of the weathered test pieces after 1 and 2 years' exposure. Photomicrographs of cross-sections of paint films have been prepared by Gardner. In one[3] he shows the cross-section of a barytes paint film in which three layers or coats are easily distinguishable. In another[4] is shown a lateral view of a white enamel on oilcloth. This latter paper shows also, at relatively low magnification, the surface effect of too rapid drying of paint by evaporation of the volatile constituents, as well as the appearance of needle scratches on brittle and elastic varnishes.

The purpose of this work is to examine, at both high and low magnifications, cross-sections of some of the common paint films and to determine if possible a relation between the microstructure and protective value.

How Films Were Prepared

The films were prepared by painting on smooth tinfoil laid over glass. After the drying of this and additional coats, the tinfoil-paint film was taken up from the glass and cut into strips for convenience in handling. The strips were placed, as suggested by Gardner,[3] on the surface of mercury contained in a porcelain vessel. The tin amalgam formed dissolved in the excess of mercury, leaving the paint film clean except for traces of amalgam which were removed on a dry towel.

A piece of the film about 2 cm. square was pressed between two blocks of plastic, medium melting paraffine and allowed to set. It was found advisable to trim away the ragged edges and dip the block in melted paraffine After this protection, the block was dipped quickly into cool water, so as to harden the surface only, leaving the inner portion relatively less rigid. This prevented a breaking away of the paraffine from the paint film and insured a smooth, uniform surface when sectioned by means of a microtome.

The paint used for the red lead films was prepared from commercial boiled linseed oil and commercial red lead (85.22 per cent Pb_3O_4, 0.28 per cent insoluble matter, 14.50 per cent PbO by difference) approximately at the rate of 25 lb. of the pigment to 1 gal. of oil, which is a proportion widely used in practice. The white lead films were made from commercial boiled linseed oil and Dutch Boy white lead.

A photomicrograph of a three-coat film of red lead paint is shown in Fig. 1. Each coat was applied immediately after mixing. From the fact that the surfaces of the lead oxide particles reflect light better than the surrounding oxidized oil in the dry paint film, it is possible to determine the distribution of the pigment particles in the various coats. It is evident from the photomicrograph that a partial separation of the pigment has taken place.

Red Lead Priming

It is a well-known fact that red lead paint undergoes a marked change on standing. The red lead oxide,

Fig. 4—Mag. 56. Thickness normal film, 0.0089 in., or 0.2260 mm.; ridge, 0.0145 in., or 0.3683 mm.

[1] "Chemistry and Technology of Paints," 2d Edition, page 58.
[2] Bulletin 54, Eng Exp Station, Ames, Ia.
[3] "Paint Technology and Tests," p. 88.
[4] Circular 110, Paint Manufacturers' Assoc. of America.

Fig. 5—Mag. 200. Thickness ridge, 0.0145 in., or 0.3683 mm.

Fig. 6—Mag. 800. Thickness red lead two coats, 0.0039 in., or 0.1001 mm., sublimed blue lead one coat, 0.0023 in., or 0.0584 mm.

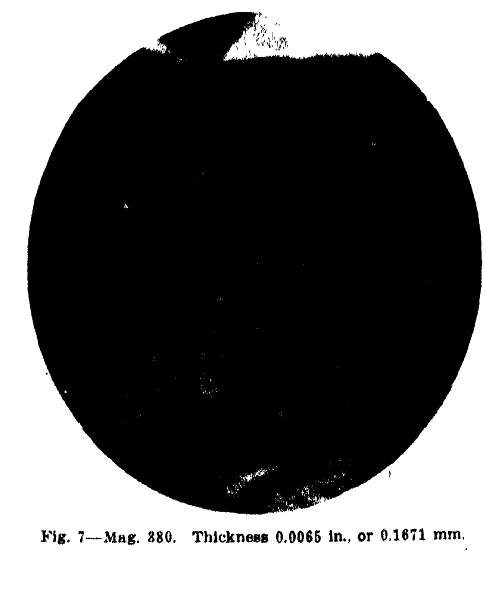


Fig. 7—Mag. 380. Thickness 0.0065 in., or 0.1671 mm.

Pb_3O_4 is slightly soluble in linseed oil, especially if the latter has a moderate or high acid number. The lead monoxide, PbO, having a lower valence, is less acid or may be said to be more basic than Pb_3O_4 and hence is more readily acted upon by an oil of a given acid number than is the higher oxide.

The so-called red leads of commerce vary in composition from less than 75 per cent of Pb_3O_4 to more than 99 per cent, the remainder being largely PbO. The latter oxide will dissolve in the oil to a greater or less degree depending upon the temperature of the system and the relative subdivision of the two oxides. The drying of the paint, promoted by the catalytic effect of lead compounds in the oil, allows less time for the heavier particles to settle out. A more uniformly distributed pigment results.

The marked increase in viscosity due to the interaction of the oil and pigment is often objectionable. In the painting of structural steel it is quite common for the men to complain of great fatigue in the arms, particularly when paste red lead is used, and there is a tendency to flow the material on quite thickly. These thick layers dry in wrinkled, non-uniform films, which are thought to give uncertain protection. Cross-section slides of these ridges were prepared and photographed.

In Fig. 4 may be seen the relative depth of the ridge as compared to the normal film.

A more highly magnified view of the ridge is shown in Fig. 5, where it is apparent that, even with this collection of excess material, the pigment particles are well distributed.

Under conditions of use and exposure these ridges are objectionable for the reason that they collect dust and present an unsightly appearance. It is common practice on steel bridges to use one coat of red lead and follow with a smooth drying paint that covers well, such as sublimed lead or sublimed blue lead. A cross-section of such a film is shown in Fig. 6. In this instance there was used one coat of sublimed blue lead over two coats of red lead. The upper surface of the red lead, which forms the line of contact between the red and blue paint, is irregular, due to the uneven application of the former and the too vigorous drying that followed. The final coat of sublimed lead dried to a smooth and glossy surface, making the retention of dust or moisture less probable.

In the microscopic study of paint films it is often desirable to determine the number of paint coats in a given film. Gardner' photographed a section of a three-coat barytes film and was able to point out three distinct layers. Efforts to duplicate Gardner's results with white lead paint in this laboratory were unsuccessful. The separate coats could not be distinguished at 850 diameters magnification. It was thought probable by the writer that barytes, being a more inert material, would separate out in strata and present a microscopic appearance unlike a typical lead or lead zinc paint.

USE OF STAINS

A three-coat film of white lead paint was made and a cross-section was photographed as soon as the film was dry enough. The pigment particles were apparently dispersed throughout the film as shown in Fig. 7. A section of the same film was stained with alcoholic gentian violet and photographed with results as shown in Fig. 8. The latter picture, although quite unsatisfactory from a photographic standpoint, suggested the

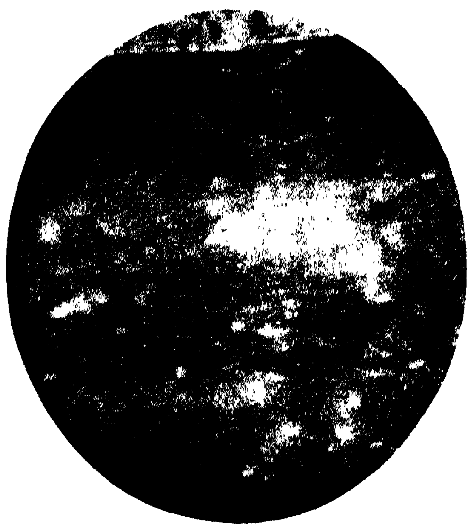


Fig. 8—Mag. 380. Thickness 0.0065 in., or 0.1671 mm.

Fig. 9—Mag. 350. Thickness 0.00511 in., or 0.1305 mm.

Fig. 10—Stained with alk. methylene blue. Same magnifications and dimensions as in Fig. 9

possibility of determining the number of paint coats in a film by dyeing, provided a stain capable of more detail be employed.

Another white lead film prepared from the same material and in the same manner, but at a different time, was allowed to dry for about 75 days. Fig. 9 shows a section of this film not stained, while Fig. 10 shows the appearance after staining with alkaline methylene blue. The following stains were used in attempts to find one best adapted to paint films: gentian violet, malachite green, acid fuchsine, methyl violet, neutral methylene blue and methylene blue made slightly alkaline with sodium carbonate. The latter reagent was found to be uniformly satisfactory.

Summary

In summary, it may be said that photomicrographs of cross-sections of red lead paint films show a setting of the red lead pigment particles in the freshly prepared and applied paint, and the well-distributed pigment particles where the prepared commercial red lead paint has been allowed to stand. Further, it has been found possible to determine the number of paint coats in a white or tinted paint by staining a section of the film with mildly alkaline methylene blue. This method of paint investigation by staining, as here outlined, is believed by the writer to be new.

This work was done in the division of physical chemistry and metallography of the Department of Chemistry, Iowa State College, which is under the direction of Dr. Anson Hayes, to whom the writer is indebted for his criticism of the present paper.

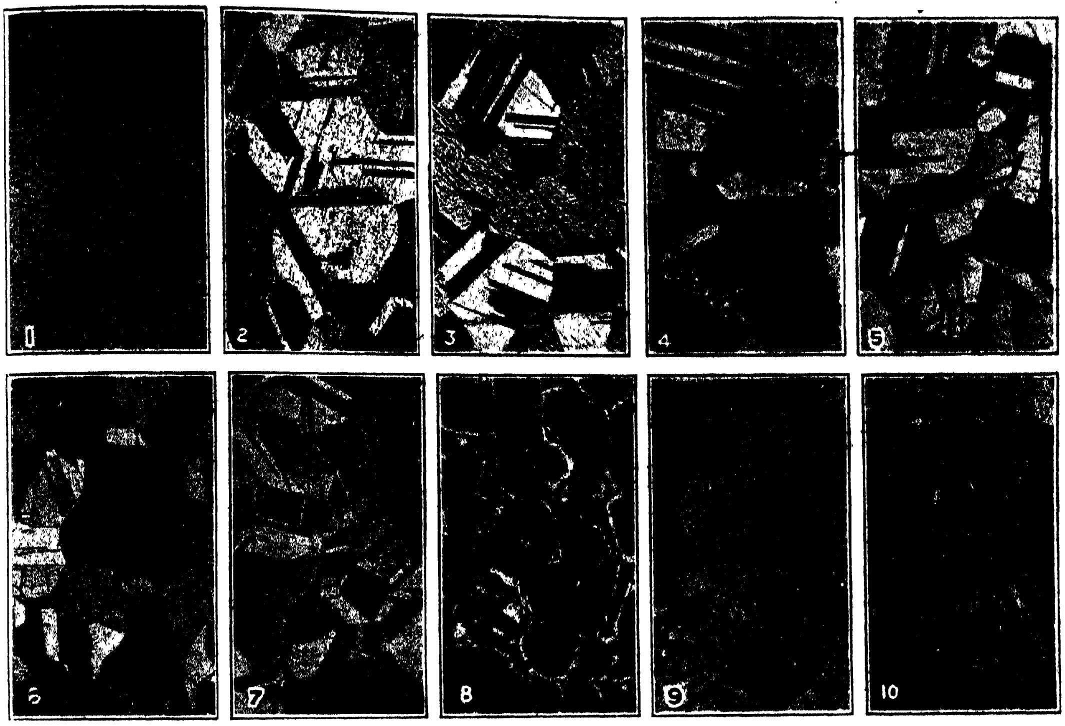
Etching Aluminum Bronze

By Jerome Strauss
Chief Chemist, U. S. Naval Gun Factory

In Scientific Paper 435 of the U. S. Bureau of Standards attention was called to the generally unsatisfactory results obtained in etching rolled aluminum bronze. The usual reagents for developing the microstructure of copper-base alloys had been tried, together with several new combinations, but with rather indifferent results. The present author has been working for several years with various aluminum bronzes and after many unsuccessful attempts has developed a method which, though far from perfect, may still be of some value to those who may use these metals.

Binary alloys of copper and aluminum containing 4 to 8 per cent of aluminum, though relatively strong, possess very low elastic limits, are very soft and extremely ductile; in fact, by suitable methods of preparation, alloys may be had that will show close to 100 per cent elongation on the standard 2-in. gage length specimen. These properties undoubtedly bear a close relation to the polishing characteristics of the metals. It is very difficult, when finishing with the usual grades of levigated alumina, completely to avoid scratches on the polished surface; this is particularly true when minute oxide particles frequently found in these alloys are present. Magnesia, as recommended by Rosenhain for aluminum alloys, to some extent avoids these troubles and at the same time produces a superior surface after etching.

No single etching reagent has been found that will serve even for all the commercial aluminum bronzes. But in the early work, various mixtures of nitric and



FIGS 1 TO 10—ALUMINUM BRONZES × 100

Fig 1—Alloy 283, HF and Reagent B Fig. 2—Alloy 283, HF and Reagent A, magnesia not used in polishing. Fig. 3—Alloy 283, HF and Reagent A, polished with magnesia Fig. 4—Alloy 283 HF and Reagent C. Fig. 5—Alloy 283, HF and Reagent D. Fig 6—Alloy 283, HF and Reagent E. Fig 7—Alloy 283, HF and Reagent F. Fig. 8—Alloy 4981, HF and Reagent B. Fig. 9—Alloy 8086, Reagent D only Fig. 10—Alloy 8086, Reagent A only

chromic acids seemed to give greatest promise and were carefully studied. Ferric chloride solutions yielded fair results with alloys containing a duplex structure, but failed to show some features of the microstructure and in alloys containing over about 3.5 per cent iron it not only dissolved out the third constituent but destroyed its characteristic outlines by the time the general structure had been developed. But all of these reagents leave surfaces which are more or less stained, producing some patches showing a fairly well-defined structure and others with no structure whatever. The behavior was such as strongly to indicate the presence of a protective film, and to destroy this hydrofluoric acid was tried and found suitable. Too great concentration or too long an etching period are harmful, the adopted practice being to immerse the specimen in 10 per cent HF in water for 2 to 5 seconds to remove the film, wash in cold water and quickly transfer to the desired etching solution. Various alkaline solutions have been tried to replace the HF without satisfactory results.

The photographs that are reproduced herewith were obtained with the following alloys and solutions:

Alloys No	Al	Fe	Cu	Condition
283	6.65	0.13	93.32	0 40 sheet-annealed
8086	6.96	1.21	91 86	0 20 sheet-annealed
4981	8 79	3 69	87 53	sand cast

Reagents						
A	50 cc	HNO_3;	20 gm	H_2CrO_4.	30 cc	H_2O
B	5 cc	HNO_3;	20 gm	H_2CrO_4.	75 cc.	H_2O
C	10 gm	$FeCl_3$;	30 cc	HCl.	120 cc	H_2O
D	30 cc	HNO_3;	70 cc	H_2O.		
E	10 cc	NH_4OH;	5 cc.	H_2O_2.		
F	NH_4OH + stream of O_2					

Reagent B develops only the grain boundaries of the 7 per cent aluminum alloy; variations in color or depth of shadow with changes in orientation are absent (Fig. 1). Improvement produced by the use of magnesia as a final polishing agent is readily observed by comparing Figs. 2 and 3. The use of ammonia water (sp.gr. 0.90) through which a flow of oxygen is maintained, as used by Rawdon and Lorenz at the Bureau of Standards, gives the excellent results shown in Fig. 7, but it required a period of 30 minutes to produce this condition. Occasionally specimens may be found which without the use of HF will etch in spots sufficiently well to give fair photographs; the grains, however, are not as clear or as sharply defined as when HF is employed (Figs. 9 and 10).

Fig. 8 shows a sample of aluminum bronze containing a high percentage of iron as well as sufficient aluminum to produce the beta solution. Some reagents may develop single features of this structure, but here are clearly observable the coring of the alpha, the details of the beta, an indication of what are most probably twins in the alpha and the third constituent due to the iron sharply outlined. The latter is found as nodular particles varying in color after etching from blue-gray to dark brown, thus accounting for the light and dark ones appearing in this illustration.

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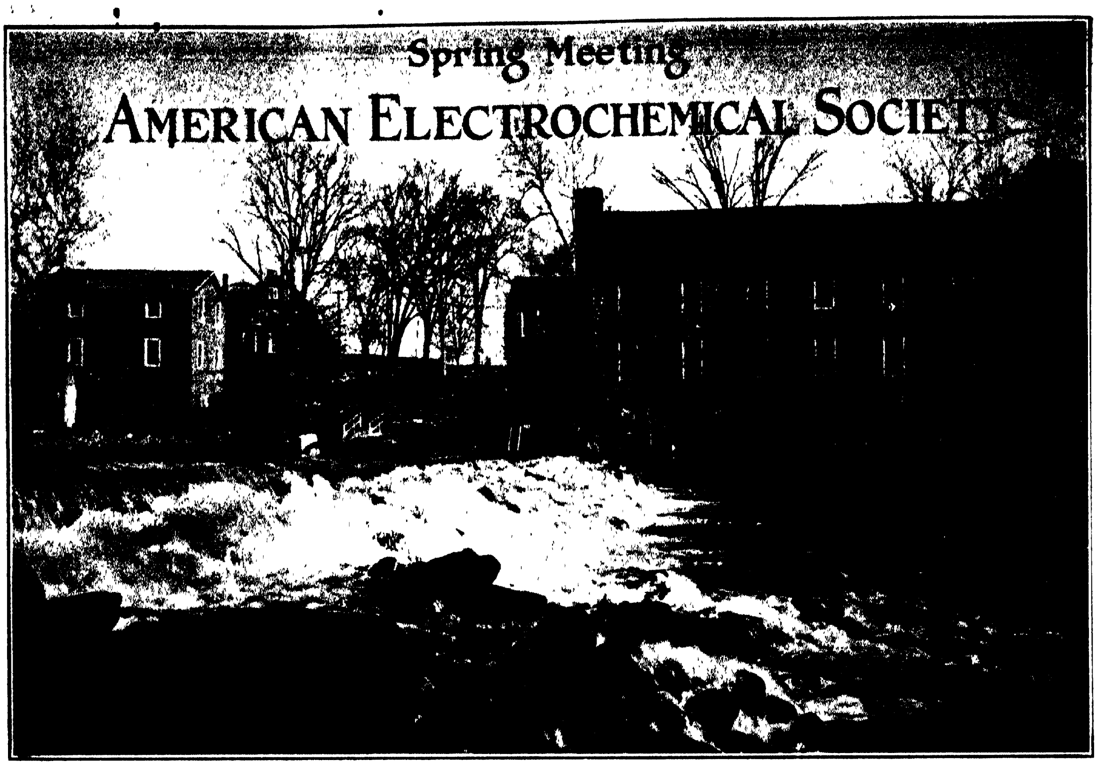
U. S Naval Gun Factory,
Navy Yard, Washington, D. C.

Correction

On page 635 of the April 9 issue of *Chem. & Met.* an article appeared giving figures on aluminum production for 1922. The facts published were abstracted from the United States Geological Survey Bulletin. We wish to take this opportunity of acknowledging the source of this material, credit for which was inadvertently omitted in the published article.



EDITORIAL STAFF REPORT

THE forty-third general meeting of the American Electrochemical Society was held at the Hotel Commodore, New York City, May 3, 4 and 5, 1923. The meeting was unusually well attended, due largely to the very attractive program. The technical papers time and again drew forth animated and valuable discussions. Of particular interest was the session on Electrode Potentials, Thursday morning, and that on the Rare Metals, Saturday morning. The local committee under the very able guidance of its chairman, Irving Fellner, had arranged for a number of social functions that added greatly to the enjoyment and delight of the meeting.

ELECTRODE POTENTIALS

The Thursday morning session was devoted to papers on Electrode Potentials and was in charge of Dr. W. G. Horsch. Prof. Hugh S. Taylor of Princeton presented the first paper, "The Newer Aspects of Ionization Problems." He referred to the work of Born, Fajans, Haber and others on the problem of energy changes accompanying the conversion of some solid crystalline substances and of the hydrogen halides into dissolved ions. In calculating the individual value of the heat of hydration of the hydrogen gas ion, it was apparent that the calculation involved the magnitude of the heat change associated with the electron emission from the metal used as the hydrogen gas electrode. It is well worthy of experimental investigation how or whether the characteristics of the hydrogen electrode change as a consequence of the alteration of the metal used as electrode material. Platinum as electrode has been carefully investigated and tantalum is to be tried next.

In discussing Professor Taylor's paper Dr. S. C. Lind of the Bureau of Mines, Washington, called attention to the fact that we do not know positively whether the chlorine gas ion is identical with the chlorine ion of an aqueous solution. Perhaps with the aid of our newer physical conceptions and our improved methods of investigation this point might be established. Prof. John Johnston of Yale agreed that the ionic theory of 25 years ago was not satisfactory in accounting for many of the newer experimental findings and phenomena observed in electrochemistry. For example, we have no satisfactory explanation for the hydration of ions. Dr. William C. Moore of the U. S. Industrial Alcohol Co. Research Laboratory, referring to the remark by Dr. Lind that sodium ion as gas would according to the Lewis-Langmuir theory be expected to be inert, stated that he had found in his investigation of the flaming arc that the potassium of KCl vapor carried three positive charges. It is possible, however, that the number of charges varies with the temperature, as Wilson had suggested.

H. C. Howard of Princeton University reported briefly on his studies of the "Oxygen Overvoltage of Artificial Magnetite in Chlorate Solution." He found that the oxygen overvoltage of magnetite is much lower than that of smooth platinum. Although it is possible to oxidize chlorates to perchlorates at a platinum electrode, the reaction does not take place if magnetite is used instead. This affords a further confirmation of the hypothesis that there is a direct relationship between the overvoltage of an electrode and its oxidizing or reducing power.

Mr. Howard's paper was discussed by Dr. Max Knobel of the Massachusetts Institute of Technology. He was of the opinion that Howard's conclusions are too general. Dr. Colin Fink of Columbia commented on the great importance of the overvoltage factor in the insoluble anode research. He had found repeatedly that

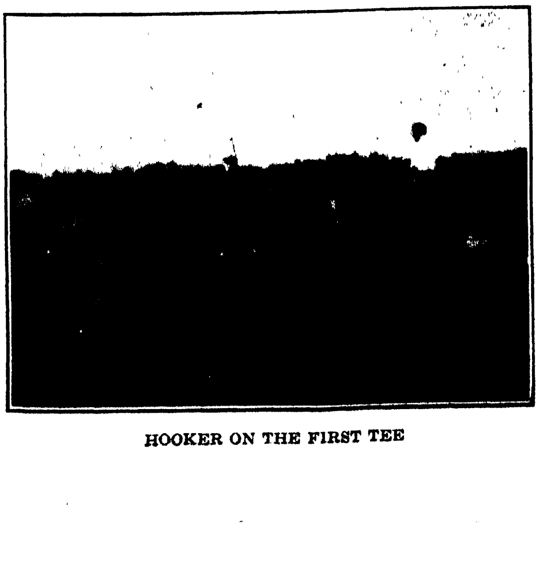
alloys fairly soluble under ordinary conditions could be made to serve as insoluble anode alloys providing a good adherent film was developed which would catalyze the formation and evolution of oxygen gas.

"The Effect of Current Density on Overvoltage" was the title of a paper presented by Dr. M. Knobel covering an investigation that he, together with P. Caplan and M. Eiseman, had carried out. Electrodes of a large variety of metals and alloys were tried out in acid, alkali and salt solutions. In the case of the hydrogen overvoltages it was found that the current density-overvoltage curves, although of a logarithmic nature, cannot be translated into any simple logarithmic equation. Metals generally specified as having a high overvoltage, as Pb, Hg, Cd, rise sharply to a high overvoltage at low current densities and then increase but little with increasing current density. Metals such as Cu, usually reputed as having a "low" overvoltage, show a more gradual increase of overvoltage with current density, but in general, with the exception Pt and Au, finally attain as high an overvoltage as "high overvoltage" metals. Platinized platinum maintains its low overvoltage even at the highest current densities. Even at 1,400 amp. per sq.ft. the overvoltage was but 0.05 volt.

In the discussion Dr. Carl Hering of Philadelphia referred to experiments made with an iron electrode. The current density was increased to a point when arcing through the gas film took place and eventually the iron electrode was melted under the solution.

N. Howell Furman of Princeton submitted his findings on "Electrotitration With the Aid of the Air Electrode." He has found that the "oxygen electrode-calomel electrode" cell may be used to construct titration curves that are in large measure analogous to those obtained in the familiar hydrogen electrode titrations. Satisfactory results were obtained both in absence and presence of oxidizing agents such as chromates.

Commenting on Mr. Furman's investigation, O. C. Ralston of the Pacific Station, Bureau of Mines, stated that the station had been using the air electrode for some time and had found it very satisfactory in following the purification of inorganic salts such as copper sulphate or zinc sulphate. In the case of a solution of copper sulphate plus ferrous sulphate, as soon as you come to the point when most of the ferric salt is hydrolyzed, a distinct kink in the voltage curve is noticeable. For this purpose the air electrode has been more reliable than the hydrogen electrode; and straight chemical



HOOKER ON THE FIRST TEE

THE START OF A GOOD SLICE

methods are very unsatisfactory. In the case of the elimination of iron from aluminum sulphate and following up the purification, the air electrode has been an indispensable piece of apparatus.

An exceptionally interesting paper was that by Prof. A. H. W. Aten of the department of chemistry, University of Amsterdam, Holland. Professor Aten found that when a hydrogen electrode, saturated with hydrogen, is in equilibrium with 0.1 *N* HCl, it is in the same state of equilibrium with 1.0 *N* HCl, and *vice versa*. This is not the case, however, when the solution of an alkali is used in place of an acid. When a hydrogen electrode in equilibrium with 1.0 *N* NaOH is put in 0.1 *N* NaOH, or the reverse, a considerable time period is required to reach a new equilibrium. The same phenomenon is observed in a more marked degree when the electrode is changed from 0.1 *N* NaOH to 0.1 *N* HCl, or the reverse. The explanation suggested is that the electrode must absorb Na or give it off, as the case may be, in order to reach an equilibrium with the final solution.

Professor Aten's paper was discussed at length by Dr. Horsch of the Chile Exploration Co. and by Dr. William Blum of the Bureau of Standards.

"The Reactions of the Lead Storage Battery" were investigated by Dr. Max Knobel, and he reported that his experiments are in entire accord with the theory advanced by Gladstone and Tribe which may be represented by the equation:

$$Pb + PbO_2 + 2H_2SO_4 = 2PbSO_4 + 2H_2O$$

The theory of Fèry based on the assumption that Pb_2O, or Pb_2O_3 is formed appears untenable.

J. R. Brossman of the Pittsfield Works, General Electric Co., pointed out the difficulties he had encountered in trying to separate the different lead oxides. Mrs. Helen Gillette Weir of the National Carbon Co., referring to her own investigations on the lead battery, took exception to a number of the statements made by Dr. Knobel, in particular in regard to his finding less than the theoretical amount of acid. Mrs. Weir stated that under ideal conditions very close to the theoretical amount of acid is consumed.

The concluding paper of the session was that by Dr. Alexander Lowy and H. S. Frank of the University of Pittsburgh. They had investigated the "Electrolytic and Chemical Chlorination of Benzene" and found that it is possible to chlorinate benzene by stirring it in with aqueous HCl and electrolyzing. Aqueous NaCl can also be used.

The yield of chlorbenzene increases with increase of

temperature up to 60 deg. C. and is affected by the rate of stirring. The introduction of iodine as a carrier increases the yield. The amount of higher chlorinated products formed increases in general with rise in temperature. The amount of benzene decomposed to CO by anodic oxidation increases with the temperature. Increase in current density rapidly increases the alkali-insoluble product. Water acts as a carrier in the chemical chlorination of benzene. No substitution takes place when dry chlorine is passed into dry benzene. However, chlorine forms addition products of the type of benzene hexachloride.

Luncheon at McGraw-Hill Co.

Three large buses conveyed the members from the Commodore Hotel to the plant of the McGraw-Hill Co., Inc., where a complimentary buffet luncheon was served, and then the members were conducted through the various departments of the printing and publishing plant. The society enjoyed the visit very much indeed and few members realized the tremendous amount of detail involved in the publishing of a technical paper such as *Chem & Met*. At the conclusion of the inspection trip animated moving pictures were shown depicting the construction and operation of the Diesel engine.

Annual Business Meeting

The first part of the Thursday afternoon session was devoted to the various society reports covering the past year. The report of the secretary showed that since the last spring meeting four volumes of the society had been published, bringing the entire printing up to date. On the basis of the report of the tellers of election the officers of the society for the year 1923-1924 are as follows: President, A. T. Hinckley, Niagara Falls, N. Y.; past president, C. G. Schluederberg; vice-presidents, H. C. Parmelee, A. H. Hooker, W. S. Landis, L. Addicks, G. K. Elliott, Henry Howard; managers, Carl Hering, J. V. N. Dorr, F. A. J. FitzGerald, W. M. Corse, William Blum, F. M. Becket, C. B. Gibson, R. A. Witherspoon; treasurer, F. A. Lidbury; secretary, Colin G. Fink, Columbia University, New York.

The Electrodeposition Division elected the following officers: Chairman, S. Skowronski, Perth Amboy, N. J.; vice-chairman, Charles A Mann; secretary-treasurer, William Blum, Bureau of Standards, Washington, D. C.; members at large, L. Addicks, F. C. Mathers, M. R. Thompson and F. R. Pyne.

The Electrothermic Division's new officers are:

GIBSON AND PRESIDENT SCHLUEDERBERG

FELLNER, GIVEN, ROTH AND MOORE IN GOOD COMPANY

Chairman, G. K. Elliott, Cincinnati, Ohio; vice-chairman, Dorsey A. Lyon; secretary-treasurer, Acheson Smith, Niagara Falls; members at large, F. M. Becket, Bradley Stoughton, J. H. Parker and W. J. Priestley.

Interesting reports were submitted by the committee on dry cells, committee on radioactivity, committee on organic electrochemistry, and others.

E. G. Acheson Made Honorary Member

Immediately following the business meeting, President Schluederberg announced the election of Dr. Edward G. Acheson to honorary membership of the society. The announcement was received with great enthusiasm and sustained applause. Mr. F. A. J. FitzGerald in fitting terms outlined the remarkable career of Dr. Acheson, commenting on his many discoveries and inventions which have made him world famous. President Schluederberg presented Dr. Acheson with the illuminated certificate of honorary membership. In accepting it Dr. Acheson spoke briefly of the early days of the society and of the men who made America the foremost country in electrochemistry.

The retiring president, Dr. C. G. Schluederberg, delivered a very inspiring address on "Opportunities of the American Electrochemist Abroad." He had been very fortunate in studying conditions at close range, having during the past year spent 4 months in the South American republics and another 4 months in Asia. We expect to publish this address in full in an early issue of *Chem. & Met.*

Electrodeposition of Metals

William Blum and H. S. Rawdon made a study of the "Influence of the Base Metal on the Structure of Electrodeposits" and reported at the session on Electrodeposition upon the results obtained. The meeting was presided over by G. B. Hogaboom. Blum and Rawdon had found that if copper is deposited electrolytically upon cast or rolled copper which has been cleaned with alkali, the structure of the base metal does not apparently affect that of the electrodeposit. If, however, the surface of the base metal had also been treated with nitric acid, the electrodeposited copper possesses both the crystal form and orientation of the base metal. A series of microphotographs showed the effect very strikingly.

In the discussion of the paper Charles H. Eldridge, research metallurgist, Metropolitan Museum of Art, suggested that a practical application of the influence of the structure of the base metal might be made in electro-refining of copper, zinc, etc., by the proper selection of starting sheet material. It would seem possible to control thus readily the coarseness of crystal structure of the deposited metal. Dr. A. Kenneth Graham of the

University of Pennsylvania drew a distinction between the structure of a deposit which is an exact reproduction of the structure of the base metal and the structure of the deposit which is a direct continuation in growth of the crystals of the base metal. Dr. W. D. Richardson of the Westinghouse Lamp Co. mentioned that he had observed distinctly different effects depending upon whether the base metal had been cleaned anodically or cathodically. Plating chromium on nickel steel wire, anodically cleaned, produced a very closely adherent deposit so that it was difficult to detect the joint. Mr. Hogaboom, who was the first to observe the effect reported upon by Blum and Rawdon, referred to his experiments on silver plating flat ware. The difference in structure would even become apparent upon polishing.

A second contribution by the Bureau of Standards was a paper on "Current Distribution and Throwing Power in Electrodeposition" by H. E. Haring and W. Blum. "Throwing power" in electrodeposition may be defined as the deviation of the actual metal distribution from the primary current distribution. It was shown mathematically and experimentally to be dependent upon (a) the rate of change of cathode potential with current density, (b) the resistivity of the solution, and (c) the cathode efficiency at different current densities. A simple apparatus for the measurement of throwing power was demonstrated and developed which had been applied to the study of copper sulphate and cyanide solutions.

"Primary current distribution" is that produced when no polarization is involved. It is a dimensional function. "Secondary current distribution" is determined by the composition and electrochemical properties of the solution. "Metal distribution" is determined by the secondary current distribution and the cathode efficiencies.

"The Electrodeposition of Nickel on Zinc" was carefully investigated by Dr. A. Kenneth Graham at the University of Pennsylvania. Dr. Graham found that there was a distinct advantage, when plating nickel or zinc, to use a very high current density at start. The zinc is covered so rapidly at the higher densities that not only is the possibility of secondary reactions reduced to a minimum while plating, but within 75 sec. at 5 amp./sq.dm. and 60 sec. at 6 amp. sq.dm. the potential had become positive enough (—0265 v. to the solution used as compared to —0.473 v. for sheet zinc) to eliminate entirely the danger.

Commenting on Dr. Graham's paper, Charles P. Madsen of New York, originator of the ductile nickel deposits, emphasized the importance of closely adhering to prescribed conditions if good, adherent deposits of nickel on zinc are desired.

M. R. Thompson of the Bureau of Standards submitted a detailed contribution on "The Effect of Iron on the Electrodeposition of Nickel." The work at the bureau indicates that if the p_H is properly controlled, the presence of iron in the nickel solutions does not necessarily cause cracking or peeling of the deposits, as it has often been supposed to do. Deposited iron has a primary effect upon the crystalline structure of nickel deposits, rendering the latter finer grained and therefore probably harder, although more brittle. Occluded basic precipitates containing iron may injure a deposit by making it porous, or dark in color.

THE SOCIETY AT THE WESTPORT PLANT OF THE DORR ENGINEERING CO.

Mr. Thompson's paper gave rise to a very lively discussion. Dr. E. A. Vuilleumier of Dickinson College was of the opinion that the peeling of nickel deposits was dependent upon two factors: the extent to which the metal as deposited tends to contract, and the degree of its adhesion to the surface plated. He found that the addition of 1 gram of ferrous iron per liter greatly increased the deposited nickel to contract. It may be that in Thompson's experiments the adhesion of the metal was greatly improved upon so that the peeling tendency was not apparent. E. O. Benjamin of New York referred to the possibility of the occurrence of small iron crystals in the deposited nickel. Dr. Graham complimented Dr. Vuilleumier upon his contractometer and emphasized the great need of similar apparatus for studying other properties of electrodeposits. Dr. Fink

inquired as to the relative corrodibility of pure nickel plate and nickel plate containing iron and suggested further study on the deposition of nickel-iron alloys with comparatively high percentages of iron along lines similar to those followed by him in the deposition of nickel-cobalt, nickel-chromium and ferrochromium alloys. Dr. Blum of the Bureau of Standards replied that they had found that the addition of iron to the nickel gave rise to a very fine crystalline deposit that was more resistant to corrosion than the ordinary nickel

SPICER, TEMPLE, DORR AND OTHERS AT WESTPORT

plate. Mr. Hogaboom pointed out that the corrosion of the base metal covered with the nickel plate may often be due to porosity of the plate. On that account it was always advisable to flash iron or steel with copper before depositing the nickel. Particles of free graphite on the surface of the iron will coat over readily with copper but not with nickel.

"Notes on the Electrodeposition of Iron" were presented by Harris D. Hineline of Pittsburgh. The problem presented was that of depositing a substantial thickness of iron onto rather irregularly shaped rubber articles, this involving a process for preparing a conducting coating, a plating bath which would give good heavy deposits, in thicknesses up to 12.5 mm. (½ in.), and have a high throwing power to insure filling the crevices.

Electric Furnaces and Insulating Materials

J. C. Woodson of the Westinghouse company discussed at length "Heat Insulating Materials for Electrically Heated Apparatus." Dr. Hering suggested that the thermal ohm was the preferable unit for purely electrical engineering calculations but less serviceable when dealing with calories and B.t.u.'s. There is very often an enormous heat increase at the joint of two materials or pieces of the same material. With fluffy, finely divided or highly porous material the insulating quality improves as the compression increases, reaches a maximum and upon further compression the insulating quality gets worse. F. A. J. FitzGerald of Niagara Falls cited an instance in his experience: Two graphite electrodes were butt-connected. Passing from one to the next electrode there was a very sharp drop in temperature. It would be interesting to ascertain whether a similar drop in electric resistance occurred.

The next paper, by Frank W. Brooke of Pittsburgh, dealt with "Methods of Handling Materials in the Electric Furnace and the Best Type of Furnace to Use."

Prof. M. deKay Thompson and P. K. Froehlich of M. I. T. had investigated the "Conversion of Diamonds to Graphite at High Temperatures" and found that diamonds change slowly at 1,650 deg. C. to a substance that gives the Brodie test for graphite and that the velocity of this reaction is increased about twenty-six times by an increase of 100 deg. above this temperature.

A. E. R. Westman of the University of Toronto gave an account of his findings in the study of the "Relation Between Current, Voltage and the Length of the Carbon Arcs." For currents between 300 and 400 amp. and potential differences over the arc 55 to 20 volts, the potential difference in volts is approximately equal to the distance between the electrodes in millimeters; for currents of 700 amp. or so the voltage is less than the distance.

"Electric Furnace Detinning and Production of Synthetic Gray Iron From Tin Plate Scrap" was the title of the paper submitted by C. E. Williams, C. E. Sims and C. A. Newhall of Seattle. A study was made of the possibilities of converting tin-plate scrap or used tin cans into a marketable steel or cast-iron product by electrothermal means. It was concluded that in the electric furnace complete detinning is impossible and any detinning is impractical. Attempt was made to use NaCl, FeS and oxidizing slags to remove the tin. No tin is volatilized ordinarily when scrap is melted in the electric furnace, although cupola melting may remove up to 50 per cent tin depending on oxidizing conditions. Study was also made of the possibility of producing gray cast Fe without removing the tin, since under conditions prevailing in many parts of the country tin-plate scrap cannot be profitably treated by any established method. Since 1 per cent or less of tin has been found to have no serious effect on cast Fe, scrap may be usefully and efficiently melted in the electric furnace after being diluted with tin-free scrap.

Excursion to Westport, Conn.

The social program arranged for Friday was pronounced by many the liveliest and most enjoyable ever experienced by the society. Dr. Dorr and Mr. Spicer invited all the members to the Westport mill, where amid the most beautiful and idyllic surroundings a bounteous luncheon was served. The mill is situated on a river and many couples spent the afternoon rowing. Others went on to the Westport Country Club, where a very exciting golf tournament was staged by the men while the ladies enjoyed bridge or walks. During the dinner, which was tendered by the New York section of the society and for the arrangements of which Irving Fellner was responsible, the golf prizes were awarded as follows: A beautiful silver loving cup, donated by Mr. Dorr, to Frank J. Vosburgh. A fine golf stick, as booby prize, to Robert Burns. The members were then entertained by a hilariously funny song, a parody of Mr. Gallagher and Mr. Shean, sung by Mr. Lidbury and Mr. Hinckley.

The dance that followed in the evening was so thoroughly enjoyed that when time was called at 9:30 there was universal groaning at the thought of returning home. Members, however, were in such good spirits that they kept up the jollification in the private trolleys and the private coaches, and great was the applause and enthusiasm as Mr. Saunders led the singing of the Famous A.E.S. classic, "We're From Niagara."

Saturday morning was devoted to papers on the rarer metals, their production and utilization. This session will be reported in full in our next issue.

Foundrymen Meet at Cleveland

Hold Very Important Exhibition of Labor-Saving Machinery —Notes on Technical Sessions Devoted to Non-Ferrous Metals and the Testing and Reclamation of Foundry Sand

TECHNICAL and engineering societies in the United States may be roughly divided into two general classes—namely, those not conducted for profit, and those that are in business. The latter in turn may be subdivided into those in the publishing business, and those in the exhibition business. Inspection of the exhibit of the American Foundrymen's Association held early in May and which overflowed the arena, stage, cellar and corridors of the new Cleveland Auditorium, gives the impression that, whatever the balance sheet from a society publication, it certainly must pay to run a "show." The finances of the Foundrymen and of the Steel Treaters—which has been in business only one-quarter as long—reflect this happy state of affairs. It apparently is easier to sell space in an exhibit than in a journal—a conclusion which can be recommended to the careful consideration of professional societies generally. And judging from the throngs of people moving about, the purchasers of space must have obtained "value received."

Labor Saving Equipment Featured

That a newly completed auditorium could be obtained to house a foundry show containing much equipment in operation is evidence that the modern foundry is rapidly growing away from the smoky, dark sheds and dirty, dusty, back-breaking toil of but a few years ago. Well-ventilated steel buildings are housing the new plants, and their equipment consists of a wide variety of labor-saving machinery. Every step of the work can now be done by the aid of special machines—in fact at least two-thirds of the space in the Cleveland Auditorium was occupied by such apparatus. Not so long ago it was necessary to display machine tools at these shows in order to attract the mechanical superintendents and engineers; now the demand for better working conditions to keep contented the dwindling labor supply, and the widespread use of machines where once human labor was the sole motive power, bring all members of the production staff to a meeting where they can absorb new ideas to apply to their individual problems.

Institute of Metals

As usual, the Institute of Metals Division of the Mining Engineers held some joint sessions, where were discussed the problems of the brass founder and the properties of cast alloys.

Junius D. Edwards and C. S. Taylor, of the Aluminum Co. of America, presented a short paper on the Density of Magnesium. Using methods already described in *Chem. & Met.* (vol. 24, p. 61), the following results were secured:

Density at 20 deg. C. (gram per cu. mm)	1.7388
Thermal expansivity (20 to 500 deg) $L_t = L_0\,[1 + (25\ 07t + 0\ 00936t^2)\ 10^{-6}]$	
Density of solid at melting point (650 deg. approx.)	1 642
Density of liquid at freezing point	1.572
Density at 673 deg. C.	1 562
Density at 822 deg. C. (approx.)	1.478

A voluminous study of Linear Contraction and Shrinkage of Light Aluminum Alloys was presented by Robert J. Anderson, of the Bureau of Mines. It was found that under uniformly good foundry practice the linear contraction or patternmakers' shrinkage (defined as the difference in length between a casting and the pattern from which it was produced) varied from 1 to 2 per cent. Consequently it is unsafe to make important patterns for a new analysis unless its behavior is definitely known in advance. (See Table I.) Even then it must be remembered that variation in melting, pouring and molding conditions which cause a greater or lesser number of gas cavities, shrinks and pin holes will greatly influence the patternmakers' shrinkage.

TABLE I—LINEAR CONTRACTION OF CERTAIN ALUMINUM ALLOYS

Analysis	Per Cent Contraction	Analysis	Per Cent Contraction
92 8 Al Mg	1 15	90 8 2 Al.Cu Mg	1 08
92 8 Al Cu	1 34	90 8 2 Al Cu Si	1 17
92 8 Al Sn	1 38	90 8 2 Al Cu Ni	1 25
92 8 Al Ni	1 42	90 8 2 Al Cu Sn	1 26
		90 8 2 Al.Cu Fe	1 29
		90 8 2 Al Cu Zn	1 29
		90·8 2 Al Cu Mn	1 40

A similar list of linear contractions of several brasses and bronzes was presented by R. J. Anderson and E. G. Fahlman. With these, as with aluminum alloys, the shrinkage varies as the pouring temperature and size of casting, but Table II gives representative data.

Alpax

Modified aluminum:silicon alloys (recently discussed at length in our columns) formed the subject of the annual exchange paper submitted by the French Association Technique de Fonderie. It was especially interesting because Dr. Pacz, whose patents cover the methods described for making the so-called alloy Alpax, was in the audience and entered into the discussion. He pointed out that the high-silicon alloys, at or above eutectic composition, need to be "modified," whereupon they become extremely useful because of their low shrinkage and generally excellent founding characteristics, a high elongation and tensile strength, and good

TABLE II—LINEAR CONTRACTION; ALLOYS OF COPPER

Nominal Composition	Pouring Temp., Deg. F.	Linear Contraction, Per Cent High and Low Pouring Temp
56 40·1·1 5:1 5 Cu:Zn·Fe.Al Mn	1,900	2.17—2 19
60.40 Cu:Zn	1,900	1 80—1.89
70·30 Cu Zn	2,000	1 75—1.77
60 38:2 Cu Zn:Sn	1,900	1 69—1.875
70·29:1 Cu:Zn:Sn	1,950	1.65—1 67
86·4:6·3.1 Cu·Ni:Sn·Zn:Pb	2,300	1 43—1.425
85.5:5 5 Cu:Sn·Zn.Pb	2,300	1.425-1.47
87 7·5 1 Cu:Sn:Zn:Pb	2,250	1 40— ....
80:20 Cu·Sn	2,200	1.375—1.55
76 7 4.13 Cu.Sn.Zn:Pb	2,300	1.37—1.37
88·10:2 Cu:Sn.Zn	2,350	1.33—1.30
88:8.4 Cu:Sn:Zn	2,300	1 33— ....
86:11:3 Cu:Sn:Zn	2,300	1.33—1.39
90:6:3:1 Cu:Sn:Zn:Pb	2,300	1 33—1.43
84·10:5.1 Cu:Sn:Zn:Pb	2,300	1 32—1.35
84:11:5 Cu:Sn:Zn	2,300	1 32—1.36
85:15 Cu:Sn	2,300	1.31—1.45
89:8:10:0.2 Cu:Sn:P	2,400	1.275—1.28
90:10 Cu:Sn	2,400	1 275—1.30
89:5:10:0 5 Cu:Sn:P	2,400	1.26— ....
80:10:10 Cu:Sn:Pb	2,300	1.25—1.31

resistance to salt-water corrosion. However, they are not as stiff as other aluminum alloys—thus the proportional limit of a typical Alpax alloy is about 6,000 lb. per sq.in.; 92:8 Al:Cu alloy (No. 12) is 8,000; while heat-treated and aged alloy like duralumin is 15,000 lb. per sq.in. Alloys containing about 5 per cent silicon are also extremely useful in the foundry. Due to their low contraction on freezing they may be used to produce very difficult castings, impossible to be made in other analyses. Their tensile strength is low, but they require no special treatment or "modification."

Melting and Pouring Practice

Some very instructive "Notes on the Proper Melting and Pouring of Brass and Bronze" were presented by F. L. Wolf and William Romanoff, of the Ohio Brass Co. In their opinion the great damage to tensile properties observed after pouring at only 100 deg. F. above the correct temperature is due to gasification occurring in hot furnaces, rather than any chemical oxidation. If overheating is the only thing wrong with a melt, it will produce good results if cooled before being poured. After comparing the action of the indirect arc furnace, the Schwarz gas furnace and the Steel-Harvey crucible furnace, it was hard to decide which was best—any type would give excellent results. Crucible furnaces melted cheapest and gave castings of intermediate strength. Electric furnaces cost most to operate, gave best physical tests, and kept zinc fumes down to the minimum. The authors report they have been able to use any percentage of return scrap in their mixes, as long as it is clean. Expensive fluxes are unnecessary when melting good metal. Deoxidizers must also be used with judgment and in great moderation. Aluminum ruins a water-tight casting; silicon is also bad for a brass containing a little lead.

While it is well known that annealing will reduce internal stresses in worked material, R. J. Anderson has experimented on similar treatment of cast bronze rings. It has been known that 1 year's aging is required to produce stability in size in such castings of 87:7:5:1 (Cu:Sn:Zn:Pb. 3/16-in. rings, 5 3/8-in. diameter, were cast, sawed at one place and definite stresses (below the elastic limit) induced by wedging. It was then found that heating to 400 deg. C. relieves most of this stress quickly, 1 hour at 500 deg. removes nearly all. Very little effect was noted on the ordinary physical properties; suppression of cored structure is the only observable change. Such treatment will insure that a flat casting will remain flat after machining.

Testing of Molding Sand

Several long investigations on the selection of foundry sand and its reclamation after use have been in progress, under the general direction of R. A. Bull. As the result of these labors, a series of tests was reported by R. E. Kennedy, of the University of Illinois, whereby the principal properties of hand-molding sand can be measured.

First, a test for bond: Well-mixed sand, having a known amount of moisture, is riddled into a special molding box 1 in. wide, 10 in. long and 1 1/2 in. high from a known height. As each portion of sand is added, the tops of the little piles in the mold are leveled with a series of strikes, each of which just touches the high spots. In this way the mold is filled with loose sand, a closely fitting cover[1] laid on and the sand compacted under six blows of a 20-lb. weight, falling 16 in. The sides and ends of the mold are then carefully dismantled, and the prism pushed slowly over the end of the bottom board. The average weight of the pieces which overhang and break off is a measure of the bond or cohesiveness. Since the thickness of the compacted sand varies with its origin and moisture content, it is recommended that the weight be figured back to that of a fragment of a prism of dry sand, exactly 1 in. thick.

Second, a test for "grain," or fineness: A sample of dried sand is shaken one hour in a 1/20 per cent NaOH solution to deflocculate the clay or bonding substance contained on the grains. Washing is done by shaking the sand with fresh water, settling for 5 minutes and siphoning off the liquid from a point 2.5 cm. from the residue, repeating the operation until the wash water is clear. The residue is filtered under suction, dried 30 minutes at 105 deg. C. and then screen-sized for 15 minutes in a "Ro-tap" machine. In this way amounts of sand remaining on 6, 12, 20, 40, 70, 100, 140, 200 and 270 screens may be weighed; the results are best expressed by plotting weight of the fractions against the size of sieve opening.

Permeability of Molding Sand

Third, a test for permeability: This property permits the passage of gases and allows the mold to properly "vent." Consequently the test measures the flow of air through a standard sample. First dry the sand carefully, and then mix with a measured quantity of water. This may be done on a plate inclosed in a little tent made of moist muslin. Screen twice and store in an airtight jar while checking the moisture content. A tolerance of ± 0.2 per cent is permissible. Sufficient sand is then placed in a 2-in. brass cylinder to make a briquet 2 ± 0.08 in. high after being rammed three times by a 14-lb. weight dropping 2 in. This briquet is then placed in a container, and air forced through it. A recommended form of apparatus consists essentially of a calibrated vessel from which air is displaced by water flowing in from a reservoir under a constant head of 22 1/2 in. Air so expelled passes through the sand sample, and the resistance to this flow sets up a pressure in the exit tube which is measured by a simple manometer. A stop watch measures the time required to pass each liter of air.

$$Permeability = \frac{Air\ passed \times height\ of\ specimen}{Pressure \times area\ of\ specimen} \times \frac{60}{Time}$$

(All measurements in c.g.s. units.) The committee recommends that 2 liters of air be forced through; and with the standard specimen the equation becomes

$$Permeability = \frac{30{,}070}{Pressure \times seconds}$$

In addition to these three simple tests, an auxiliary test is suggested as desirable. It is called the dye adsorption test, and is a measure of the quality of clayey material present in the sand. In general these materials are hydrated silicates in the colloidal condition; a considerable quantity is usually associated with a sand of strong bonding qualities. To execute the test, a given weight of sand is shaken with water and alkali, and the suspended material removed by siphon or decantation. A measured amount of crystal violet is then added to the liquor and the resulting color compared against standard solutions; 1,200 to 1,500 mg. of dye will be adsorbed by the colloids in 100 grams of sand if it has a strong bond; weak bonds adsorb as little as 200 mg.

[1]A thick block of wood laid edgewise.

Machinery and Appliances for Production and Control

Equipment News

From Maker and User

Materials and Accessories for Chemical Industries

Steel Belt Conveyors

Steel belt conveyors have been made and sold on the European market for a number of years by the Sandvik Steel Works, of Sandviken, Sweden. During the past year this company has brought its product to the American market, and there are already a number of installations in operation and several more are being erected.

These conveyors are similar in design to a flat belt conveyor using a rubber or canvas belt. The novelty consists in the use of a flexible steel belt. This belt is made of cold-rolled, hardened and tempered Swedish charcoal steel. It is supplied in lengths up to 350 ft. and can be easily pieced where greater lengths are required. Widths can be had up to 18 in. and thicknesses from 0.8 mm. to 1.0 mm.

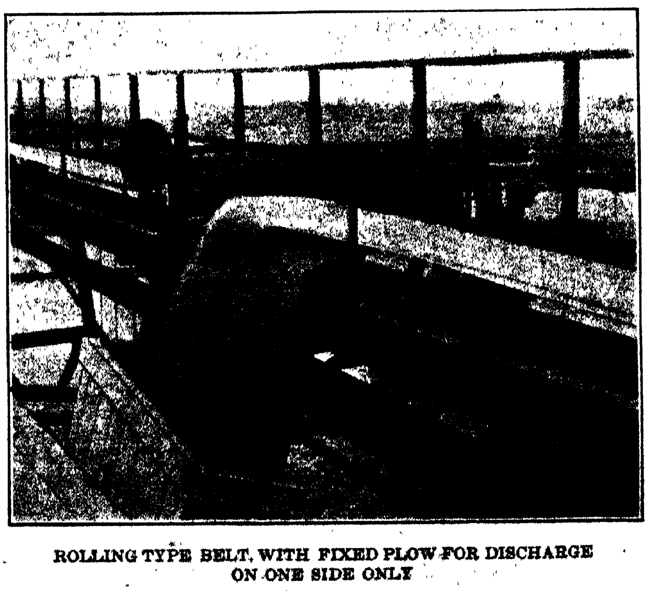
This belt cannot be troughed but it is claimed by the makers that, due to its rigidity, it can be loaded over almost its entire width—so that an 18-in. steel belt has a carrying capacity about equal to a 30-in. flat rubber or fabric belt and the same as an 18-in. troughed fabric or rubber belt. When handling non-abrasive materials the belt can be run at the bottom of a wooden or steel trough, built narrower than the belt and clearing it, or built wider with ample clearance for the edges of the belt and a greater capacity thus obtained than with a standard troughed belt.

The installations of this belt are made in two ways, which are called the "sliding type" and the "rolling type" of conveyor. The sliding conveyor, for handling non-abrasives, has the steel belt sliding on wooden runners which acquire such a high polish that the friction is nearly negligible. In the rolling conveyor belt strands are carried on idlers, according to usual belt conveyor practice. At times these two types have been used in combination.

Where the Steel Belts Are Installed in the United States and Canada

	No. of Units	Material Handled
Mathieson Alkali Works, Saltville, Va.	2	Phosphate rock
Penn-Allen Cement Co., Nazareth, Pa.	1	Limestone
Michigan Portland Cement Co., Chelsea, Mich	3	Hot clinker Cold clinker
Hercules Cement Co., Hercules, Pa	1	Lump coal Hot clinker
Waukesha Lime & Stone Co., Waukesha, Wis.	1	Crushed rock
Phosphate Mining Co., Nichols, Fla.	1	Phosphate rock
Stevens Bros. & Co., Stevens Pottery, Ga.	2	Clay
American Sugar Refining Co., Brooklyn, N. Y.	1	Wet sugar
Kearns-Gorsuch Bottle Co., Zanesville, Ohio	1	Coal
Installations Under Process of Construction		
Crane Co., Chicago, Ill.	1	Sand
Dodge Bros., Detroit, Mich.	2	Sand
Canada Sugar Refining Co., Ltd., Montreal, Canada	4	Wet sugar
Great Western Sugar Co., Greeley, Colo.	1	Coal

ROLLING TYPE BELT, DISCHARGING HALF BY PLOW AND HALF OVER END



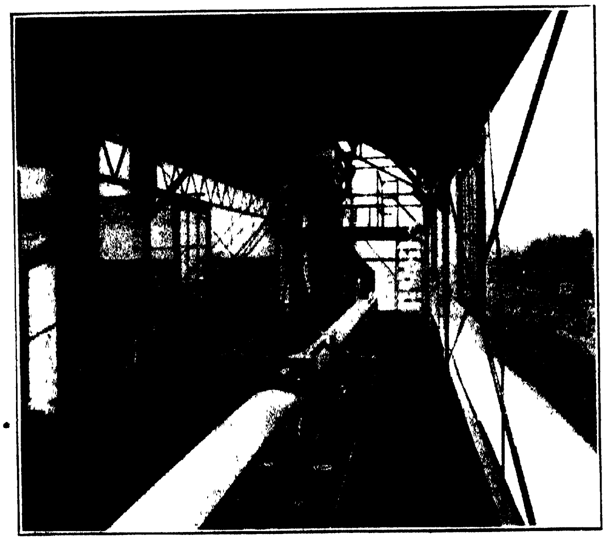
ROLLING TYPE BELT, WITH FIXED PLOW FOR DISCHARGE ON ONE SIDE ONLY

Many advantages are claimed by the makers for the steel belt conveyor. Among these might be mentioned: It can be used for handling hot, sticky or abrasive materials which a rubber or textile belt cannot handle satisfactorily. It is very easily kept clean on account of its smooth surface—such sticky material as sugar, for instance, can be easily and efficiently scraped off with a steel scraper. It is rust resistant—it can be used in the chemical field handling wet and hot materials, and can be run in the open air in all kinds of weather. It can be made perforated without appreciably influencing its life and can be then used handling materials where a great deal of liquid must be eliminated. Another advantage is the discharge feature—materials can be discharged at any desired point without the use of cumbersome and expensive trippers. The belt does not stretch and the

tension devices are very simple; care must be taken only of trifling variations in length, caused by temperature changes.

Conditions Governing Use

The operating speed when using steel belt depends on the length of the conveyor. This speed varies ordinarily between 135 and 300 ft. per minute. For the average conveyor 200 ft. per minute is found to be best. The terminal pulley diameter should be about 1,000 times the belt thickness. In passing over this pulley the belt is subjected to a stress of from 28,000 to 30,000 lb. per sq.in., but it has been found that, with a bending frequency for any section of the belt of about once per minute the molecular structure of the steel is not affected. The manufacturers recommend the belt for a great many materials, among which may be mentioned: clinker, cement, sand, rock, ore and ore concentrates, coal, coke and charcoal, carbide, silica, soda, salt, sugar, cassettes and beet pulp, milk powder, yeast, vegetables, candies and chocolate, deals, battens, slabs, edgings, chips and sawdust, clay, gypsum, brick and briquets, bags, boxes, packages, steel forgings, guncotton and glass. Over 1,400 of these conveyors have been installed in different phases of industry all over the world. A large number have been installed in the South Sea Islands for handling phosphate rock.



SLIDING TYPE BELT, WITH MOVABLE PLOW FOR DISCHARGING ON BOTH SIDES

Water Softeners

At the present time there are several commercial zeolite water softeners on the market. These substances have undergone considerable change since the first successful softener of this type appeared. The different zeolites vary in weight, in ability to absorb hardness from water and in quantity of salt needed to restore the so-called initial exchange capacity. Most of these use the natural green sands or marl beds in the vicinity of Medford, N. J., as the base of their composition. The finished products are usually very fine, greenish to reddish in color, have limited exchange capacity and high physical loss or depreciation in capacity.

Exchange capacity refers to the amount of $CaCO_3$ a zeolite substance will remove in terms of its own dry weight or the number of gallons of water softened per pound of mineral used. The process is sometimes referred to as one of selective absorption or "substitution," as none of the salts in a natural water are eliminated, but only change in form. The exchange capacity depends upon the physical structure of the mineral, which grades from colloidal, to crystalline, to amorphous substances. The latter have a hard bricklike consistency with little exchange value. The former have high reactive value, will soften water instantly and permit water to flow through at a rapid rate. A zeolite distributed by Graver Corporation, East Chicago, Ind., falls into the former class. It is an artificial mineral prepared by the precipitation of sodium aluminate with sodium silicate. The resulting product is filtered, washed and dried and has the appearance of white, small porous granules which do not dissolve in water. This mineral has two to three times the exchange capacity of some other zeolites. Each pound will absorb 9.1 grams of hardness expressed in terms of calcium carbonate. One-tenth of a pound salt is required per pound of mineral, which is equivalent to 5 grams of salt per gram of hardness removed. In some of the older zeolites a salt ratio of 8 to 1 is quite common.

The Graver zeolite will operate uniformly for a period of 10 to 12 hours. It will operate at an overload of 500 per cent in water 30 grains hard and 200 per cent in water of 12 grains hardness per U. S. gallon. This is a valuable property, as it takes care of fluctuating loads or excessive peaks 200 to 500 per cent above normal. It is a quick regenerating zeolite. The salt solution is not over 20 minutes in contact with the mineral bed, and the entire process of regeneration or restoration does not occupy an hour. As the salt requirement is very low, no artificial method of salt recovery or salt reclamation is used to lower the amount of salt required. Such methods are open both to mechanical and chemical objections. A simple gravity flow is used and by means of a specially designed brass lateral system immediately above mineral bed, the top of the salt tank is no higher than top of steel shell. This conserves head room, obviates the necessity of a pit or placing the brine tank on a second floor level. It is more positive than the siphon method used with ground operated salt tanks. This zeolite will regenerate repeatedly without depletion of original exchange ability. Many charges have operated for over 1,000 regenerations and have given a uniform grade of soft water. It produces "zero" water by soap test. By chemical analysis the water does not contain over 0.5 grain of equivalent $CaCO_3$. As many zeolites cannot do better than 0.8 to 1.4 grains, it is possible by the use of a precipitated zeolite almost to approach the distilled water standard.

Catalogs Received

General Electric Co., Schenectady, N. Y.—Catalog 6002. A catalog of railroad supplies covering the General Electric Co.'s full line of supplies for use with electric railways of different types This catalog supersedes all others on the subject, and contains a price list supplement with prices correct to October, 1922.

J. H. R. Products Co., Willoughby, Ohio —Leaflet describing the J. H. R. products, chiefly barium peroxide.

Bristol Co., Waterbury, Conn—Catalog 1006. A new catalog describing the Bristol line of recording gages for pressure and vacuum.

Detroit Range, Boiler & Steel Barrel Co., Detroit, Mich.—A new pamphlet descriptive of the various styles of steel barrels and drums manufactured by this company.

Synopsis of Recent Literature

Aluminum Bronze as an Engineering Material

By aluminum bronze is meant, not the gray-white metallic coating used on radiators, but rather a strong, reliable metal resembling 0.35 per cent carbon Swedish bessemer steel to a remarkale degree. The color, of course, is different, but the mechanical properties are much the same. It resists alternations of stress unusually well and is superior to nearly all of the non-ferrous alloys except Monel metal in this respect. Aluminum bronze is essentially 90 to 92 parts of copper and 8 to 10 parts of aluminum, while Monel metal is approximately two parts of nickel to one part of copper. Naturally, the two metals behave differently with respect to corrosion, but they are much alike in strength and hardness. Both hold their strength much better than other alloys when exposed to elevated temperatures, a fact of importance to the engineer.

Properties — Aluminum bronze is about the color of 10-carat gold, has a tensile strength of 70,000 lb. per sq.in., and an elongation of 15 per cent. Its Brinell hardness number is 100-110. These properties place it in the class of strong bronzes suitable for the most exacting service. Particular mention should be made of its resistance to alternating stress or fatigue. In the Landgraf-Turner endurance-testing machine the aluminum bronzes resisted 4,500 blows before fracture, while the manganese bronze resisted about 500.

The other strong bronze, manganese bronze, has many admirable properties, but it is not adapted for bearing surfaces. Aluminum bronze has proved its worth in this field in such parts as worm-wheel gears. Every day's output of 1,000 Ford trucks carries 12,000 lb. of this metal in gears. Extensive tests of aluminum-bronze gears against phosphor bronze in one-man tanks during the war proved the superiority of the former for this most difficult service.

Almost constant trouble was experienced with large spur gears on the locomotives on the Mt. Washington Railway until aluminum bronze was tried. Its service there has proved eminently satisfactory.

Pickle-crate equipment made of aluminum bronze has been found to withstand the action of sulphuric acid well. This fact, combined with its strength, fits it for this purpose. The property of resisting abrasion is useful for gears, but aluminum-bronze trolley wheels have been found to give remarkable service for the same reason. The toughness of the alloy is useful here as well, because the effect of a severe blow can be readily corrected under the hammer without breakage.

Adaptability—Aluminum bronze is tough when cold, but is more so when red hot. This property makes forgings possible and also helps materially in the manufacture of die castings from this metal. The process is a commercial one, for the dies are made so that they will withstand at least 10,000 openings in most shapes. The solving of the die problem is of equal importance with the metal problem, for one cannot proceed without the other. The property of toughness is useful also in Jordan bars for beating engines. With its freedom from corrosion, the tough aluminum-bronze Jordan bar has been an increasing success in the paper industry.

Machinability—Many excellent properties of aluminum bronze have been mentioned, but it has its drawbacks. First, at least at present, is the difficulty of machining, compared with other bronzes or brasses. This does not mean that it cannot be machined readily under proper conditions, but that, compared with ordinary brass or bronze, its toughness makes it more difficult to handle in the machine shop. Sharp tools, kept so, of the proper angle are essential to success. Ample lubrication is necessary. With these precautions a most excellent job can be done as is evidenced every day at the Ford factory in Detroit. Aluminum bronze most nearly resembles mild steel in its machinability.

When one sees the stacks of golden-bronze worm wheels in the gear department of the Ford company and examines the polished surface of the gear teeth left after the machining operation, there can be no doubt that aluminum bronze as an engineering material has arrived and that its excellent properties have been made available to the engineer because scientific research solved the problems of its manufacture in the foundry.

The second objection to aluminum bronze might be its cost, which is about 25 per cent more than that of brass or bronze. But when compared with special bronzes with somewhat similar properties the difference in cost disappears.

Like all high-grade metals, it must be manufactured under careful supervision, and more than usual care must be used in the casting shop and foundry.

Wrought Aluminum Bronze—Most of the remarks thus far have referred to cast aluminum bronzes, but as rolled or wrought alloys are commercial products and are manufactured in large quantities the author quotes from W. H. Bassett, whose experience with these alloys gives authority to his statements:

"Copper-aluminum alloys can be made in wrought form in any proportions up to an aluminum content of approximately 10 per cent. Three alloys, however, are used principally. These contain 5, 8 and 10 per cent aluminum, respectively. All three alloys hot-roll easily, and these same remarks would apply to the cold-rolling of the 5 and 8 per cent. The 10 per cent aluminum bronze does not cold-roll readily, in fact would not be considered a cold-working alloy.

"The 5 per cent aluminum bronze is furnished principally in the form of sheets. It has, when cold-rolled, a tensile strength as high as 100,000 lb. per sq.in., depending upon the degree of hardness or cold-rolling, and an elongation in 2 in. of 10 per cent. When annealed this alloy has a tensile strength of 55,000 lb. per sq.in. with an elongation of 75 per cent in 2 in. This high elongation for annealed 5 per cent aluminum bronze is characteristic of the material, and it is rarely equaled in the other non-ferrous alloys.

"The 8 per cent aluminum bronze is manufactured extensively in both rod and sheet form, and is supplied, when resistance to wear is also required, in connection with the other general physical properties given for aluminum bronze.

Important Articles In Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem & Met*. The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. Those that are of unusual interest will be published later in abstract in this department, but since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage. The magazines reviewed have all been received within a fortnight of our publication date.

SOME GENERAL CONSIDERATIONS OF THE GUMMY METER PROBLEMS IN THE GAS INDUSTRY. R. L. Brown. *American Gas Association Monthly*, May, 1923, p. 309.

THE DISTILLATION OF AMMONIACAL LIQUOR. W. Mason. *Gas Journal*, April 25, 1923, p. 219.

THE FUNCTIONS AND DUTIES OF THE CHEMIST AND THE BEARING OF CHEMISTRY ON THE GAS INDUSTRY. G. H. Gemmell. *Gas Journal*, April 25, 1923, p. 220.

COKE OVENS AND TOWN'S GAS SUPPLY. Walter Chaney. *Gas Engineer* (London), April 1923, pp. 79-81.

WASTE OF MATERIALS. H. M. Sutton. *Bulletin* of the Taylor Society, April, 1923, pp. 77-78.

BUILDINGS FROM THE MANAGER'S VIEWPOINT, PART III. G. L. H. Arnold. *Management Engineering*, May, 1923, pp. 329-333.

MISPLACED MODESTY IN THE USE OF COSTS. L. M. Lamb. *Paper Trade Journal*, April 26, 1923, pp. 57-58.

FURTHER INVESTIGATIONS INTO THE PHYSICOCHEMICAL SIGNIFICANCE OF FLASH POINT TEMPERATURES. W. R. Ormandy and E. C. Craven. *Journal of the Institution of Petroleum Technologists*, February, 1923, pp. 33-68.

LABOR HANDICAPS PHILIPPINE RUBBER CULTURE. F. A. Suberling. *Rubber Age*, April 25, 1923, p. 63.

AN OUTLINE OF BRITISH PROOFING METHODS. M. M. Heywood. *India Rubber World*, May 1, 1923, pp. 491-191.

A STUDY OF LIME KILNS. (To be cont'd.) A. E. Truesdale. *Rock Products*, May 5, 1923, pp. 28-29.

THE MODERN TREND IN FERTILIZER PLANT OPERATION. E. H. Armstrong. *American Fertilizer*, April 21, 1923, pp. 23-25.

"This alloy is in more general use than any of the other wrought aluminum bronzes. In the form of sheets when cold-rolled the tensile strength may be as high as 130,000 lb. per sq.in., with 4 per cent elongation. When annealed this same material has a tensile strength of 60,000 lb. per sq.in. and an elongation of 60 per cent. The generally high tensile strength makes this material very valuable for many engineering purposes.

"Rods in 8 per cent aluminum bronze can also be supplied with approximately the same physical properties as sheet metal. However, it is customary to furnish them in a medium temper with a tensile strength of about 85,000 lb per sq.in. and an elongation of 30 per cent

"The 10 per cent aluminum bronze has, of course, the highest tensile strength and lowest elongation of this series. Owing to the fact that it can be only very slightly cold-worked, it does not have the range in physical properties as shown by the other alloys. Its tensile strength may be taken as 75,000 lb. per sq.in. and elongation as 25 per cent. There is not a great demand for this class of material, but when supplied it is usually furnished in the form of hot-rolled sheets, hot-rolled or extruded rods, and extruded shapes. This alloy can also be heat treated to some extent, in a manner similar to steel. By heating and quenching, its physical properties are improved to some extent, depending upon the exact composition of the material. It has been found that an addition of iron up to about 3 per cent in 8, 9 and 10 per cent aluminum bronzes improves their physical properties, workability, resistance to corrosion, etc."

The author's experience with a large variety of alloys from the manufacturing and the engineering viewpoint confirms his belief that the aluminum bronzes as a class are valuable additions to our list of engineering materials, and if he has pointed out some of the salient points, sufficient to arouse the interest of the engineer to investigate their merits further, the purpose of this paper will have been accomplished.—*W. M. Corse, Chairman, Division of Research Extension, National Research Council, in "Mechanical Engineering," May, 1923.*

Lignite Char: Its Production and Possibilities

At the spring meeting of the American Society of Mechanical Engineers, in Montreal, Canada, O. P Hood, chief mechanical engineer of the U. S Bureau of Mines, will read a paper on this subject. In this paper, preprinted in *Mechanical Engineering* for May, 1923, Mr. Hood says in part that the greatest difficulty with our lignite is the fact that in nearly every district where it should be the natural fuel it is put in competition with high-grade fuel. We are all spoiled by having been blessed with an abundance of the best, so that we are impatient with the limitations of lower-grade fuels. If we had been obliged to go down 2,000 ft. or more and win good coal from thin seams in scattered districts as they do in Europe, we should long ago have worked out a successful technique for utilizing our lignites. Canadian and North Dakota lignite must compete with anthracite and with Pittsburgh and Illinois bituminous coal; our Texas lignite must compete with gas, oil and Oklahoma bituminous coal. It is evident, however, that there must be a price at which the lower-grade fuel will begin to be attractive. In round numbers the ratio is somewhere in the neighborhood of half the price of good coal. With the rising price of bituminous coal we are fast approaching the time when this ratio will be common

The handicaps of lignite are well known but not always properly valued. The heating values of high-moisture fuels are somewhat misleading. The heat carried by the moisture is recovered and measured in the calorimeter, but it is not fully utilized in a boiler funace. The B.t u. ratios, therefore, do not give the relative possible steaming values of the fuels if comparison is made between a high-moisture lignite and a low-moisture bituminous coal. Although the ash percentage may be low, there is usually a larger total amount of ash to handle in a plant using lignite. The fusing temperature of the ash is usually low, making high rates of combustion difficult and requiring larger grate areas and furnace volumes than with higher-grade coal. Notwithstanding these handicaps, with present technique, raw lignite can be used in large operations, and good efficiencies and reasonable capacities can be obtained. The problem is largely an economic one. When raw lignite is cheap enough in comparison with better coals it will be used in large steam-raising operations.

Improvement of Raw Lignite for Fuel Purposes

The search for a means to improve the fuel, however, must continue. A fuel classed as lignite in northern Bohemia, and weathering much as does our lignite, is as carefully prepared for market as is our anthracite. Seven prepared sizes are offered to the market. Raw lignite can probably be somewhat improved for steam raising by sizing the product more closely than is common practice. It is probable, however, that an improved lignite product must first cater to a special trade that will pay a special price. This is illustrated by the vision that has been so frequently held of improving the lignite by some process involving briquetting. Unlike the German "Braunkohle," our lignites do not make a stable and satisfactory briquet simply by drying the lignite and briquetting by heat and pressure. They lack sufficient inherent binder to consolidate and waterproof the mass. The necessary added binder increases the cost and hardly improves the quality. A quite satisfactory fuel can, however, be made by briquetting lignite char, and it is probable that some day such a fuel will be in common use.

There have been hopes that through the recovery of byproducts sufficient credits might be obtained to materially lessen the cost of briquets. Profit can be shown on paper, but such a process is essentially a large-scale operation requiring a large investment and very substantial financial backing by those familiar with technical enterprise. It is difficult, therefore, to start such an industry, for there is no opportunity to begin small and grow up, returning profits into an improved plant. Capital familiar with technical enterprise finds less hazardous ventures, and capital unfamiliar with such enterprise is apt to be misled and lost.

Lignite Char and Its Possibilities

With these facts in mind, the United States Bureau of Mines is investigating the possibilities of a somewhat different program which has for its main features an inexpensive carbonizing device and the use of the lignite char direct, without briquetting. If a market for the char can be developed, and the small mine can produce char, there would be provided means for a natural evolution of an industry that in time might realize the larger vision of briquetting and recovery of byproducts.

Lignite char can best be described in a few words as a fuel rather near in analysis to anthracite coal, but softer, with a little more volatile matter, and thus kindling easier. In size it grades from pea coal to smaller sizes, and is a stable product. Whether a market can be developed for such a fuel at prices around five dollars a ton at the mine remains to be shown, but it is at least encouraging to know that Germany used last year 400,000 tons of similar material for domestic heating and cooking. This fuel burns well with natural draft where a thin fuel bed, about 1½ in. in thickness can be maintained. Base burners, cook stoves and other heaters can be adapted to use the fuel satisfactorily. The Germans have developed a special stove, burning the fuel on a bed of ash in an inclosed drawer. There is no loss of fuel in the ash and our lignite char used in such a stove heats an oven sufficiently for baking operations and will boil water. It makes a very clean fire, is smokeless, and the char is clean to handle. It is, however, slow in getting under way as compared to a gas range.

Production of Lignite Char

To produce the char a very simple oven has been devised that greatly reduces the investment from that needed for ovens heretofore proposed. If lignite be passed through a combustion zone, moisture is first driven off; then combustible gases are distilled, and finally the solid carbon is burned. There is a considerable shrinkage in volume and a complete absence of caking quality. These steps are fairly distinct one from the other, so that the flow of lignite through the combustion zone may be so regulated that but little

of the fixed carbon is burned. The combustion zone can be maintained by burning some of the distilled gases within the moving mass of lignite, and such direct heating is more efficient than where heat must be transmitted through refractory walls. The hot gases of combustion also pass through the mass, driving off the moisture and departing fairly cool. It is something like an open-top lime kiln. The process has proved simple and efficient. Of the gas driven off, much of it is used in the combustion zone, and in addition, less than 5 per cent of the weight of the original lignite is burned. That is to say, the fixed-carbon loss in the process for drying and distilling is lower than is usually found for drying alone where separate driers are used. Passing the combustion zone the lignite enters a lower section protected from the air, where it cools and is then removed. The char obtained by such a process may, of course, be briquetted.

An oven of this sort was operated at Grand Forks, N. D., during the past summer, and about 400 tons of various North Dakota lignites passed through. In February about 100 tons of Saskatchewan lignite was tried to discover whether this presented any special problems.

About 2½ tons of raw lignite reduce to 1 ton of char, and the heating value is about 12,000 B.t.u. per lb. The moisture is very low, and the char can be stored without danger of fire or degradation in size. Where the freight charge is heavy it would be an advantage to ship char instead of raw lignite.

Review of Recent Patents

Decolorizing Acidic Boro-Silicate Glasses With Neodymium Oxide—The color produced by iron oxide in acidic boro-silicate glasses is yellow, whereas in ordinary glasses it is green. Thus manganese dioxide, nickel oxide and selenium, so effective in neutralizing the green tint of ordinary glasses, only intensify the yellow, making the glass more of an amber. William Chittenden Taylor, of Corning, N. Y., has found that neodymium oxide, Nd_2O_3, is quite well suited for decolorizing such glasses. Instead of the pure oxide, there may be used what is commercially known as didymium oxide, a mixture of neodymium oxide and lanthanum. From 0.5 to 1 per cent of N_2O_3 is sufficient for decolorizing, and it has been found advisable to use an oxidizing batch (such as one containing a small amount of $NaNO_3$), as the color produced by neodymium is more nearly complementary to that produced by oxidized iron than by reduced iron. Boro-silicate glasses sufficiently acidic to be decolorized may be grouped as follows according to composition: Not less than 80 per cent silica; not less than 75 per cent silica, with boric oxide not less than 40 per cent of constituents other than silica; not less than 70 per cent silica, with boric oxide not less than the alkali content; boric oxide not less than 50 per cent of total constituents other than silica; not less than 60 per cent silica, with boric oxide not less than 25 per cent of constituents other than silica. A typical composition would be: Silica, 81; boric oxide, 13; sodium oxide, 4; alumina, 2. (1,449,793. Assigned to Corning Glass Works. March 27, 1923.)

Removing Colloidal Matter From Mineral Pulp—Colloidal slimes interfere with many metallurgical operations and it has been proposed to coagulate or flocculate the colloids. According to Walter O. Borscherdt, of Austinville, Va., the presence of the flocculated colloidal constituents in the pulp is very often objectionable and he suggests a procedure that is directly opposed to the one just mentioned. The colloids are dispersed by the addition of a suitable reagent such as silicate of soda and separated from the pulp in decantation tanks or thickeners. The colloid-free pulp may then be submitted to the desired treatment. Partial removal of colloids may be used to assist selective flotation. (1,448,515. Assigned to New Jersey Zinc Co. March 13, 1923.)

Manufacture of Artificial Magnesia Spinel—By fusing together in an electric arc furnace magnesite or any suitable ore high in magnesia and bauxite or other material high in alumina, a molten mass is produced which cools to a rock-like mass of a greenish or brown color consisting of masses of spinel crystals. A typical mixture may consist of 64.7 per cent aluminous abrasive fines and 35.3 per cent of a high-grade calcined magnesite. The fines used contain about 92 per cent alumina and is a byproduct of the abrasive industry. (1,448,010 Frank J. Tone, of Niagara Falls, N Y., assignor to the Carborundum Co. March 13, 1923.)

Aluminous Abrasives — Aluminous abrasives are ordinarily produced by feeding a mixture of calcined bauxite, coke and iron borings into an electric furnace of the arc type having two depending electrodes until the furnace is completely filled. The current is then shut off, electrodes removed and the molten mass allowed to cool into a pig, which is removed, crushed, treated to remove any injurious impurities and made into grinding wheels or other articles. Using carbon to reduce the oxides of titanium, silicon and iron which occur as impurities in the bauxite often results in the formation of aluminum carbide and other reduced alumina material which causes slow disintegration of the abrasive. Thomas B. Allen, of Hamilton, Ont., substitutes metallic aluminum for coke as the reducing agent, thus obviating the possibility of forming aluminum carbide. With a calcined bauxite of the composition H_2O, 0.5; Al_2O_3, 88.0; TiO_2, 4.0; SiO_2, 5.0; Fe_2O_3, 2.5, the proportions used are 1,000 calcined bauxite, 113 aluminum and 100 iron borings. The function of the iron is to alloy with the reduced oxide impurities and by increasing their specific gravity permit a better separation from the aluminous material. They also render the alloy more readily attacked by chemical reagents. (1,448,586. Assigned to Abrasive Co. March 13, 1923.)

Purifying Clay—As a deflocculating reagent for the purification of clay, William Feldenheimer and Walter W. Plowman, of London, England, propose to use solutions of rosin in caustic alkali, alkali silicate or carbonate. It is claimed that these reagents will deflocculate clays which are not amenable to treatment by or which demand comparatively close adjustment of the concentration of reagents commonly used. (1,447,973. March 13, 1923.)

Conical Mills—This invention concerns an apparatus for entraining and removing fines from conical mills. In the conical mill, because of its construction, there is an inherent classifying action in which the fines travel automatically toward the apex of the cone, while the coarser material remains behind until it is reduced to the desired fineness. In some cases this classification of material and subsequent discharge of the fines are not sufficiently rapid and the purpose of this invention is to provide a mechanical means for aiding this action.

A current of what the inventor calls "elastic motive fluid" and might be more simply called "gas" is caused to enter the drum of the mill through a suitable inlet near the inlet of the mill and to flow parallel to the axis of rotation of the mill through the conical outlet and so out. Or an ejector may be set up in the outlet and by this means a suction set up through the mill and a current of air or other gas drawn through it in a similar manner.

This current of air or other gas flows while the mill is rotating and in this way the fines which are practically floating at the apex of the cone are entrained in the current and carried out. As the rotation goes on, fines are brought to the surface, and these are also entrained and carried out. In addition, the air current also penetrates the material to a certain extent and dislodges other fines and carries them away. (1,450,289. Harry W. Hardinge, New York, N. Y. April 3, 1923.)

Conical Mills—In the operation of a conical grinding mill with certain substances, a percentage of over-size material will be discharged with the fines. This invention is concerned with a method for returning this over-size material to the main body of the mill so

that it may be reduced to the desired size. The particular application of this invention is when the mills are operated at an overload.

A classifier of cylindrical, conical or other form is provided at the discharge end of the drum, so that the ground material is discharged into this classifier. In order to return the over-size material from the classifier to the main body of the mill, there is employed a conveyor pipe running into the mill and discharging into the same from the classifier. This pipe is provided with branches inside of the classifier so arranged as to scoop up the over-size material, which will be at the outer periphery of the classifier, and, due to the rotation of the classifier, force this material along the pipe and so deliver it back to the grinder. (1,450,290. Harry W. Hardinge, New York City. April 3, 1923.)

Sizing Composition—If Karaya gum is mixed with a small amount of oxalic acid it becomes soluble in water. In this condition it is suitable for use as a size and as such gives superior results in certain kinds of work. It is especially adapted for use in treating, coating and printing papers and textiles as a substitute for glue, soluble gums, casein and various farinaceous materials. This size is patented by R. Kaiser, of New York City. (1,448,847. March 20, 1923.)

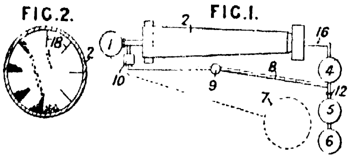
Treatment of Rubber Waste—If finely divided rubber and foreign fiber is treated with water, by sprinkling, it is acted upon by relatively cool and dilute sulphuric acid which will remove the undesirable fiber. The acid, of gravity not exceeding 30 deg. Bé., is poured over the mass, which has previously been placed in bins with screens at the bottom. The mass is left to drain 24 hours and at the end of that time another addition of acid is made. Finally water at a temperature of from 60 to 80 deg. C. is poured over the mass and allowed to percolate through. This invention, made by R. A. Terhune, Fairhaven, Mass., while involving the use of lead-lined bins, results in increased economy of the amount of sulphuric acid used and does away with the injuries effects of the old process in which sulphuric acid was used at boiling temperature. (1,450,462. April 3, 1923.)

British Patents

For complete specifications of any British patent apply to the Superintendent British Patent Office, Southampton Buildings Chancery Lane, London, England.

Carbonization—In the low-temperature carbonization of coal, lignite, peat, shale, wood and similar carbonaceous materials, hot gas after passage through a rotary retort containing the material is cleaned and preheated before being again circulated through the retort, a part of the gas and distillates being removed from time to time.

FIG.2. FIG.I.



Hot gas from a producer 1 is passed through the rotary retort 2 and the resulting gases and vapors passed by a pipe 16 through a tar extractor 4 and forced by a pump 9 along a pipe 8 and through a reheater 10 back to the retort. A portion of the gases may be drawn off by a valve 12 and passed through condensers and scrubbers 5, 6 to a gasholder 7. The reheater may be supplied with gas either from the holder 7 or the producer 1.

The retort may have internal shelves 18 which serve to shower the material and which may be corrugated or set at an angle to the axis of the retort. By this construction when the feed is interrupted, the circulation of gas is continued and the retort maintained at a temperature suitable for carbonization. (Br. Pat. 192,040. W. C. White, Westminster, London. March 14, 1923.)

Dyeing Cellulose Acetate — Goods made from cellulose acetate are dyed with vat or sulphur dyes in hydrosulphite vats kept weakly alkaline by ammonia, only sufficient caustic alkali being present to form the leuco-compound; preferably salts such as barium, calcium or magnesium chloride, and protective colloids such as boiled-off liquor, gelatine, glucose or starch, are added to the vats. Examples are given of dyeing with Bromindigo and Pyrogenindigo. Specification 182,830 is referred to. (Br. Pat. 191,553. R. Clavel, Basel, Switzerland. March 7, 1923.)

Gas Condensers—In a gas condenser having oblong or rectangular tubes, the tubes are fitted at intervals with in-

American Patents Issued May 1, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem & Met* readers They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis

1,453,285—Apparatus for Gathering and Transferring Molten Glass J. F Rule, Toledo, Ohio, assignor to the Owens Bottle Co., Toledo, Ohio

1,453,289—Process of Separating Zinc and Lead E. H Snyder, Salt Lake City, Utah.

1,453,290—Method of and Means for Feeding Molten Glass L. D. Soubier, Toledo, Ohio, assignor to the Owens Bottle Co, Toledo, Ohio

1,453,292—Heat Exchange Apparatus. H. I. Steffa, Chicago, Ill

1,453,310-11—Screen Filter and Rotary Filter G. Engel, Brooklyn, N. Y., assignor to the Buffalo Foundry & Machine Co., Buffalo, N. Y

1,453,323—Mixing Apparatus. W. E. Palmeter, Elmwood, Neb

1,453,408—Grinding Mill J. P. Ruth, Jr., Denver, Colo.

1,453,435—Method and Apparatus for Nitrogen Fixation C H. Buettner, Cincinnati, Ohio.

1,453,457—Process and Composition of Matter for Coloring Mortars. F H. Haldeman, Cleveland, Ohio, assignor to the Master Builders, Inc, of Cleveland, Ohio.

1,453,468—Process for Making Refractory Products L. P. Kraus, Jr., New York City

1,453,479—Process of Treating Hydrocarbon Oils J P Persch, Houston, Tex., assignor of one-fifth to B. Tolles, Hohokus, Tex.

1,453,494—Air Washing and Cooling Apparatus P A Dennon, Grand Island, Neb

1,453,515—Process of Making Vulcanization Accelerators P I. Murrill, Plainfield, N. J, assignor to R T. Vanderbilt Co, Inc., New York City.

1,453,562—Process for the Production of Alkali-Earth-Metal Permanganates R E Wilson, L W. Parsons and S L. Chisholm, Washington, D C

1,453,571—Process for Treating Phosphate Rock. E P. Stevenson, Newton, Mass

1,453,605—Coke Oven W. E Roberts, New York City, assignor to Foundation Oven Corporation, New York City

1,453,655—Process for Gas Making. H. R. Berry, Brooklyn, N Y., assignor to Petroleum Research & By-Products Co., of Wilmington, Del

1,453,659-60—Intermediate Products for the Manufacture of Dyestuffs and Process of Making Same. Azo Dyestuffs and Process for the Manufacture of Same. G de Montmollin, G Bonhote and J. Spieler, Basel, Switzerland, assignors to Society of Chemical Industry in Basel, Basel, Switzerland

1,453,678—Centrifugal Separator S. S Howell, Chicago, Ill, assignor to United Chemical & Organic Products Co, Chicago, Ill.

1,453,723—Composition for Use in Finishing Dry-Cleaned Leather. V. O. Olsen, Chicago, Ill., assignor to Charles McAdam Co., Chicago, Ill

1,453,726—Insulating Composition and Method of Making the Same. T. C. Prouty, Los Angeles, Calif, assignor to Proutyline Products Co., Hermosa Beach, Calif

1,453,734—Method of Refining Iron and steel H Thomas, Cleveland, Ohio.

1,453,735—Distillation Apparatus R. H Twining, Marquette, Mich.

1,453,749—Apparatus for the Dewatering, Classification and Counter-Current Washing of Solid Particles Mixed With Liquids. N. C. Christensen, Salt Lake City, Utah

1,453,750—Apparatus for Drying Granular Products N. C. Christensen, Salt Lake City, Utah.

1,453,764—Liquid for Treating Fabrics A Neusella, Chicago, Ill, assignor of one-half to A. A. Patterson, Chicago, Ill

1,453,766—Catalyst and Method of Making the Same. E. H. Payne and S A. Montgomery, Woodriver, Ill., assignors to Standard Oil Co., Whiting, Ind

1,453,767—Sugar-Packing Machine. C. C. Reese, San Francisco, J. T. Buzzo, Oakland and R. S. Woodward, Crockett, Calif

1,453,789—Preparation of Pure Selenium Oxychloride G. J. Fink, Niagara Falls, N Y., and E D Giauque, Niagara Falls, Ont, assignors to Hooker Electrochemical Co., New York City.

1,453,928—Aluminum-Silicon Alloy and Method of Making It. J. D. Edwards, Oakmont, Pa., assignor to Aluminum Co of America, Pittsburgh, Pa

1,453,976—Composition for Detonators B. Grotta, Tamaqua, Pa., assignor to Atlas Powder Co, Wilmington, Del

1,453,984—Manufacture of Ammonium Perchlorates. R. A. Long, Tamaqua, Pa, assignor to Atlas Powder Co., Wilmington, Del.

1,453,988—Method of Briquetting Sawdust, Peat, Coal Dust and Similar Pulverous Substances. H. A. Mueller.

1,453,993—Metallurgical Refractory Material and Process of Producing the Same. C. Payton, Douglas, Ariz., assignor of fifty-five one-hundredths to Phelps Dodge Corp. of N. Y

1,454,002—Lubricator. C. Verniaud, Quincy, Ill, assignor to G. M. C Metallic Grease Co, Quincy, Ill.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

clined stationary baffle plates for diverting hot air away from the exterior surface of the tubes and allowing cold air to take its place. The inclined baffle plates may extend beyond one or both edges of the sides of the tubes and be connected by horizontal or inclined plates to deflect the heated air further away from the tubes. (Br. Patent 191,-644. W. Blakeley, Beechwood, Church Fenton, Yorkshire, England. March 7, 1923.)

Book Reviews

THERMODYNAMICS AND THE FREE ENERGY OF CHEMICAL SUBSTANCES. By *Gilbert Newton Lewis* and *Merle Randall.* 653 pages. Published by McGraw-Hill Book Co., Inc., New York, 1923. Price, $5.

In disclosing their purpose in writing this book the authors make the following statement in the preface:

> If during the course of the book we help disclose to the student some of the beauty and simplicity of the thermodynamic method, if we convince a few practical chemists of the extreme practicality of the results of thermodynamic calculations, if we contribute in some measure toward making chemistry an exact science, our task is rewarded.

To exhibit the beauty, practicality and exactness of chemistry is a purpose most laudable and one in which the authors have made a conspicuous success.

The material of the book is divided into three parts; the first lays the foundations of thermodynamics, the second is concerned with the applications of these fundamental principles, while the last part is devoted to a systematic consideration of the data of thermodynamic chemistry. The authors state that the average reader is not expected to read the book rapidly and consecutively, for many chapters can be mastered only by arduous study and exercise.

In the first chapter the authors point out several facts that are of extreme interest to the "practical" man. For example:

> The widespread prejudice against any practical use of thermodynamics in chemistry is not without reason, for the propagandists of modern physical chemistry have at times shown more zeal than scientific caution.

This is beautifully illustrated in the almost universal misplaced confidence in the importance of heats of reactions. Thus: "Thermodynamics shows us whether a certain reaction may proceed, and what maximum yield may be obtained, but gives no information as to the time required."

> To the manufacturing chemist thermodynamics gives information concerning the stability of his substances, the yields which he may hope to attain, the methods of avoiding undesirable substances, the optimum range of temperature and pressure, the proper choice of solvent, the limitations of methods of fractional distillation and crystallization.

Who concerned with chemical production would not give his eye teeth to be able to calculate accurately, in advance, just these data? Millions are spent annually for research that produces negative results, which could have been predicted by the man who knows the fundamentals of thermodynamics. Much of the so-called "chemical intuition" is the unconscious knowledge of thermodynamic principles.

It is not only the clearness of thought and expression that the authors use to impart their knowledge, but also the practical problems they have interspersed throughout the text. No one can work these problems and not fail to grasp the facts and principles set forth in the text.

Most engineers are familiar with the "cyclical process" method of teaching thermodynamics, a pitiful system at its best. Thermodynamics is a mathematical science and should be taught that way. No elaborate mathematics is needed, however. The authors have appreciated this viewpoint and the simple calculus used is reviewed in an early chapter, in order that the reader may grasp the real significance of the mathematical operations that are used later. The authors realize, however, the shortcomings of mathematics, as is indicated by the following philosophical statement:

> Mathematics offers a wonderful shorthand for the precise formulation of well-standardized ideas. On the other hand, the expressions of mathematics are lacking in humor, which is to say that they are not a suitable medium for those finer shades of thought which are often necessary in the exposition of ideas on the way toward standardization.

In order to present thermodynamics in a clear and exact manner the authors are forced to devise many quantities and factors that are unfamiliar to chemists not conversant with modern thermodynamics—for example, partial molal quantities, escaping tendency, fugacity, activity and free energy. Great pains are taken to define each term and to point out its practical importance. These new tools are the result of a natural development and serve to broaden the scope of thought.

The authors attack the subject first from a so-called "ideal" state and then lead up to actual conditions. Too often the books on thermodynamics confuse the reader by failing to set up a clear line of demarcation, or by placing too much importance on laws that hold only over limited fields, are filled with empirical constants and have no fundamental or theoretical significance.

"Entropy," that mysterious factor that is used by so many and understood by so few, is spoken of as the "degree of degradation," and some of the mystery has been disseminated. **"Free energy" is treated as simply as heats of reactions and with remarkably practical results. Einstein's principles of relativity are used to show the definite relationship between energy and mass. The second law is stated as follows:**

> When any actual process occurs it is impossible to invent a means of restoring every system concerned to its original condition.

The third law is stated as follows:

> **Every substance has a finite entropy, but at the absolute zero of temperature the entropy may become zero, and does so become in the case of perfect crystalline substances.**

The authors realize that thermodynamics is at the beginning of its development and not at the end. This is evinced by the following statement:

> It is conceivable that systems might be found in which these micro-organisms would produce chemical reactions where the entropy of the whole system, including the substances of the organisms themselves, would diminish. Such systems have not as yet been discovered, but it would be dogmatic to assert that they do not exist.

Approximately one hundred and fifty pages are given over to the calculation and use of free energy values. If this book can further the use of those values that are known and can create a demand for more data, it will have added more to the development of civilization and the increase of human comfort than any other chemical treatise in all history. The ideal text exposing the fundamentals of one great phase of chemistry has been approached as closely as the human intellect can accomplish it at the present day.

DONALD B. KEYES.

New Publications

THE EXPLOSIVES ENGINEER is the title of a new monthly magazine published by the Hercules Powder Co., Wilmington, Del., the first issue of which appeared the middle of March.

"THE NEW ERA IN THE STEEL INDUSTRY," by Leon Cammen, is a pamphlet describing recent developments in the process of casting iron, steel and alloys in rotating molds of metal. It is especially pointed out that thin-walled steel pipe of large diameter may be split, flattened out and marketed as plate.

THE CHEMICAL AGE YEAR BOOK, Diary and Directory for 1923 has recently been issued by *Chemical Age*, Benn Brothers, Ltd., 8 Bouverie St., London, E. C. 4, England. As indicated by its title, the volume contains a variety of material ranging from advertisements of manufacturers of chemicals and plant equipment to technical information of the kind usually appearing in engineering handbooks.

IN *Business Chemistry*, vol. 1, No. 1, sponsored by Skinner, Sherman & Esselen, Boston, Mass., it is stated that its purpose is "to turn the light of modern chemistry on the problems of business and the profits hidden in the waste-piles of industry and latent in its processes and byproducts."

THE UNIVERSITY OF ILLINOIS, Urbana, Ill., has issued Engineering Experiment Station Circ. No. 10, on "The Grading of Earth Roads," by Wilbur M. Wilson, and Bull. No. 134, on "An Investigation of the Properties of Chilled Iron Car Wheels," by J. M. Snodgrass and F. H. Guldner.

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS, 166, Piccadilly, London, W. 1, England, has published its "Official Directory of Members With Classified List of Their Manufactures." The object of the publication is to facilitate business relations between manufacturers and chemical firms and purchasers all over the world. Copies may be had from the address above at 10/6d.

"WHERE TO BUY" (Everything Chemical) is the title of a book, published in January, 1923, by S. Davis & Co., 30/31 St. Swithin's Lane, London, E. C., England, which contains sections on general chemicals, fine chemicals, plant, material and apparatus and index to trade names. Price 2s.

WERBY LABORATORIES, consulting and analytical chemists and engineers, 88 Broad St., Boston, Mass., have issued a 16-page brochure entitled "Do You Use a Chemist in Your Business?" by James H. Collins.

THE EDISON LAMP WORKS of the General Electric Co., Harrison, N. J., has issued the following booklets: Bull. L. D. 140, Index 74, on "The Lighting of Paper and Pulp Mills"; Bull. L. D. 143, Index 72, on "Lighting of the Food Industries"; Bull. L. D. 110A, Index 68, on "The Lighting of Textile Mills"; Bull. L. D. 144, on "Street Lighting With Mazda Lamps"; Bull. L. D. 141, Index 99, on "Automobile, Garage and Display Room Lighting," and Bull. L. D. 142, Index 63, on "The Lighting of Woodworking Plants."

Men in the Profession

I. V. BRUMBAUGH, of the Bureau of Standards, addressed the Baltimore Section of the American Society of Mechanical Engineers on May 9 His subject was "Causes of Carbon Monoxide Poisoning in Baltimore."

Dr. HARRY A. CURTIS has been appointed to take charge of the investigation of nitrates in the Department of Commerce survey of essential raw materials produced under monopoly conditions abroad. The major purpose of the investigation, Secretary Hoover declared, is to safeguard American consumers, both agricultural and industrial, in obtaining adequate supplies at reasonable prices.

ALFRED C. ELKINTON, president of the Philadelphia Quartz Co. of California, San Francisco, has recently returned to that city after a 7 months' tour of the Far East and antipodes.

ECKARDT V. ESKESEN, president of the New Jersey Terra Cotta Co., New York, has been elected vice-president of the National Terra Cotta Society.

F. FRANK, general manager of the Frank Laboratories, of San Francisco, Calif., expects to leave New York in the near future for an extended trip abroad. He will visit France, England, Germany, Italy, Austria, Rumania and Russia, and expects to be absent about 5 months.

C. D. GARRETSON, vice-president and general manager of the Electric Hose & Rubber Co., Wilmington, Del., has been elected president of the local Rotary Club.

T. C. HAGEMAN of Christiania, Norway, formerly consulting engineer to the Norwegian nitrogen industries, is now in the United States on business. His headquarters are at 564 79th St., Brooklyn, N. Y.

FRED J. HARTMAN, of Pittsburgh, Pa., has resigned as secretary of the Pennsylvania State Industrial Board, effective May 15, a position he has held for the past 4 years, to become assistant to Thomas S. Baker, president of the Carnegie Institute of Technology, Pittsburgh.

Dr. EDWARD P. HYDE, who organized the Nela Research Laboratories in 1908 and who in recent years has occupied the position of director of research of the National Lamp Works of the General Electric Co., has tendered his resignation to take effect June 30 of this year. Dr. Hyde will take a prolonged rest abroad.

Dr. ZAY JEFFRIES gave two lectures at the College of Engineering, Carnegie Institute of Technology, Pittsburgh, Pa., April 30 and May 1, on the subjects of "The Hardening of Non-Ferrous Metals" and "The Hardening of Steel."

RAYMOND B. LADOO, of the engineering staff of the Bureau of Mines, has resigned to become general manager of the Southern Minerals Corporation. Mr. Ladoo has specialized during his service with the Bureau of Mines in the non-metals. The Southern Minerals Corporation is planning the development of some of the non-metalliferous resources of the South. The company is a close corporation, formed by the interests that have made a conspicuous success of the operations of the Magnesia Talc Co. in Vermont. The officers of the company are J. S. Patrick, Burlington, Vt., president; J. T. Smith, Waterbury, Vt., vice-president, and R. L. Patrick, of Burlington, treasurer. For the present the general offices will be maintained in the Continental Trust Building, Washington, D. C.

MARSHALL C. LEFFERTS, president of the Celluloid Co., Newark, N. J., has resigned from this office to become chairman of the board of directors, a position just created. He has been president since the organization of the company in 1890. HENRY RAWLE, vice-president of the company since 1912, has been elected president to succeed Mr Lefferts.

Dr. HENRY LEFFMAN, of the research division of the College of Pharmacy and Science, Philadelphia, Pa., gave an interesting lecture on May 2 in the college auditorium on "Explosives and Explosions."

ARTHUR E. RICE, president of the Pennsylvania Salt Co., Philadelphia, has been elected director of the Market Street Title & Trust Co. of that city.

C. A. ROSE, previously connected with Guggenheim Brothers in an important capacity, has been appointed general manager of the British America Nickel Corporation, Ltd., with offices at Ottawa, Canada.

Dr. C. G. SCHLUEDERBERG, of the Westinghouse Electric & Manufacturing Co., returned to the United States the latter part of April, in time to attend the meeting of the American Electrochemical Society May 3 to 5, in New York.

Dr. E. W. SCHWARTZE, of the Bureau of Chemistry, has received a medical fellowship from the National Research Council for a year's study with Sir William M. Bayliss, professor of general physiology at the University College, University of London.

CARL J. ZIMMERMAN of Long Island City, N. Y., has been elected president of the Carbola Chemical Co., Inc., with mines and plant at Natural Bridge, N. Y. V. E. Maher was former president.

The Chicago Chemists Club, at its annual meeting May 1, elected the following: President, A. V. H. MORY; first vice-president, A. E. SCHAAR; second vice-president, H. G. WALKER; secretary, R. S. SHUEY; treasurer, O. H. WURSTER, and trustees, S. L. REDMAN and F. J. ROOT.

Obituary

Dr. FREDERICK SALATHE, chemist and geologist, died on May 7, at Santa Barbara, Calif., aged 57 years.

JOHN GILBERT WARD, treasurer of the Babcock & Wilcox Co., died on April 22.

Society Calendar

AMERICAN ASSOCIATION OF CEREAL CHEMISTS will hold its ninth annual convention at Hotel Sherman, Chicago, June 4 to 9.

AMERICAN ELECTROPLATERS SOCIETY will hold its eleventh annual meeting at Providence, R. I., July 2 to 5

AMERICAN GAS ASSOCIATION will hold its annual convention the week of Oct. 15 at Atlantic City. An elaborate exhibition of gas-making and gas-utilization equipment is planned.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its summer meeting June 20-23 at Wilmington, Del.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W. Va., June 7, 8 and 9.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold its spring meeting May 28 to 31 in Montreal, Canada.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

CANADIAN INSTITUTE OF CHEMISTRY will hold its annual meeting in Toronto, May 29 to 31.

NATIONAL ASSOCIATION OF MANUFACTURERS OF THE UNITED STATES OF AMERICA will meet in annual conference May 14 to 16, inclusive, at the Waldorf-Astoria, New York City.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (NINTH) will be held in New York Sept. 17-22

NATIONAL FERTILIZER ASSOCIATION will hold its thirtieth annual convention at White Sulphur Springs, W. Va., the week of June 11.

NATIONAL LIME ASSOCIATION will hold its fifth annual convention at the Hotel Commodore, New York City, June 13 to 15.

NATIONAL SYMPOSIUM ON COLLOID CHEMISTRY will be held at the University of Wisconsin, June 12 to 15.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month

PACIFIC DIVISION, American Association for the advancement of Science, will hold its seventh annual meeting at the University of Southern California, Los Angeles, Sept. 17 to 20, in conjunction with the summer session of the national association and a meeting of the Southwestern Division of the National Association.

SOCIETY OF CHEMICAL INDUSTRY, Canadian Section, will meet in Toronto, May 29 to 31.

SOCIETY FOR STEEL TREATING — Eastern sectional meeting will be held June 14 and 15, in Bethlehem, Pa.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

Industry and Trade

Current News and Market Developments

News Section

May 14, 1923

CHEMICAL & METALLURGICAL ENGINEERING

Tenth Avenue at 36th Street, New York

H. C. PARMELEE, *Editor*

Market Section

The Summary of the Week

Intersection meeting of A.C.S. at Urbana, Ill., largely attended and many papers of industrial importance presented.

Suit of government against the Chemical Foundation Inc., postponed till June 4, at Wilmington, Del.

Treasury Department announces it has no authority to transfer calcium arsenate to free list.

Lower duties are asked on linseed oil, cresylic acid, and phenolic resin, under flexible provisions of tariff act.

War Minerals Relief Commissioner recommends award to Grasselli Chemical Co. as partial recompense for losses incurred in operating a pyrites mine during the war period.

A lower price schedule for German potashes was announced last Wednesday.

The Nitrate Association, comprising leading factors in Chile, has issued new prices on nitrate of soda, covering shipments over the next year.

Figures compiled by the Department of Commerce show that exports of chemicals and allied products in March exceeded those of February to the extent of $2,500,000.

The customs service announces that members of the trade may make suggestions relative to the standards of dye strengths, which are to be adopted as a basis of levying duties, up to May 14 instead of May 7, as was first announced.

Importers have not been active in placing orders for future shipments of permanganate of potash and foreign markets are expected to feel the loss of such business.

Domestic producers of arsenic have sold round lots under the prices quoted in the open market. Imported grades are unsettled in price but show no material price changes.

Under the leadership of cottonseed oil, the entire vegetable oil list sold off in price during the week.

The movement of new crop production at a time when consuming demand had fallen off brought out another sharp decline in the prices for pure spirits of turpentine, the decline amounting to 20c. per gallon for the week.

Bichromates, both soda and potash, were advanced in price. Production is reported to be curtailed owing to scarcity of competent labor, and higher producing costs in general add to the strength of the market.

Increasing Output of Carbon Black

INFORMATION to the effect that new companies in Texas, Louisiana and West Virginia were preparing to engage in the manufacture of carbon black has reached the trade within the past 2 weeks. This is encouraging to consumers of this material, as it gives assurance that production will be along broader lines. Consumption of carbon black has increased rapidly in recent years and at times the call for deliveries has proved too heavy to be met by the producing capacity of existing plants. With increased call from the industries, producers did their best to increase the volume of output, but scarcity of offerings still featured the market, and the introduction of new producing factors will be welcomed as an evidence of a more equal balance between supply and demand.

To some extent the greater use of carbon black may be attributed to the natural expansion of the various consuming trades, but more than anything else, it has resulted from an abnormal outlet in the rubber industry. Up to 1914 the rubber trade took but small amounts of carbon black and its value to that trade was solely in the nature of a coloring agent. Then it was found that carbon black possessed qualities that made it an excellent filler for rubber. Later reports were heard that it increased the tensile strength of rubber, gave it increased toughness and resistance to abrasion. As a result the rubber trade in 1921 was classed as the largest consumer of carbon black, with annual requirements of about 20,000,000 lb., as compared with 12,000,000 lb. for the printing ink trade, which was second on the list.

The latest figures on production that are available cover the year 1921 and show that in that year the output was 58,632,700 lb., as compared with 51,321,892 lb. in the preceding year. It is generally agreed that production in 1922 showed a healthy gain over that of 1921, but the advance in production was met with an equal—if not a larger—advance in consuming demand and the rubber trade, especially the rubber tire branch, was responsible for absorbing this record output. The various trades which are consumers of carbon black have been operating on an unusually active scale so far this year and it is reasonable to suppose that their increased use of raw materials has extended in a proportionate way to carbon black. To take care of increased home consumption and to conserve our export trade, it is necessary to keep production figures at a level which will permit of unrestricted buying and the news that several new companies were entering the carbon black industry is of interest to consumer and producers alike.

Treasury Decision Retains Calcium Arsenate on Dutiable List

No Authority Under Tariff Act to Transfer It to Free List—Consumers Are Expected to Petition for Reduction in Duty

CALCIUM ARSENATE will remain on the dutiable list of the 1922 tariff act, there being no authority in the law to transfer it to the free list, according to a decision announced May 9 by McKenzie Moss, Assistant Secretary of the Treasury.

Southern Senators and Representatives and others acting in behalf of cotton planters who consume considerable quantities of calcium arsenate in combating the boll weevil had asked the Treasury Department to reverse its ruling that the commodity is dutiable at 25 per cent ad valorem as a chemical compound, under the basket clause of paragraph 5 of the new tariff. They pointed out that at the request of Southern Senators, white arsenic, the principal ingredient of calcium arsenate, had been put on the free list before the act was passed and that omission of specific mention of calcium arsenate obviously was an oversight.

Attorney-General Daugherty was asked for an opinion by Secretary Mellon. He replied that the matter was one for the Treasury to handle. After consideration, Assistant Secretary Moss decided that the decision holding calcium arsenate dutiable at 25 per cent must stand, as under the law all commodities not mentioned or described in the free list must be classified in the dutiable list, and there is no paragraph of the free list into which calcium arsenate might be read.

While the Treasury decision came as a disappointment to the petitioners for removal of duty, it is reported that plans are now being worked out to secure relief from the duty as now operative. It is probable that application will be made to the Tariff Commission, asking for a reduction in duty of the maximum amount of 50 per cent allowable under the flexible provisions of the tariff act.

Award to Grasselli Co.

Recovers Part of Losses for War-Time Operation of Pyrites Mine

An award of $44,244.05 to the Grasselli Chemical Co. has been recommended by the War Minerals Relief Commissioner. The recommendation covers a portion of the losses of that company in connection with the war-time operation of a pyrites mine at Mineral, Va.

Under former owners the property had been one of the largest producers of pyrites in the South. When the Grasselli company took it over, practically all of the ore had been removed from the old workings, which necessitated the deepening of the shaft and the opening of the ore bodies at lower levels. The Grasselli company paid $100,000 for the lease of the property and the option to purchase it on payment of a further $200,000.

Under the War Mineral Relief Commissioner's interpretation of the act, no part of the actual purchase is an allowable item. He holds, however, that the chemical company is entitled to a fair rental for the machinery and equipment in addition to the net operating loss.

Since the War Minerals Relief Commissioner must establish whether or not other war-time operations resulted in profit, an affidavit was secured from Charles M. Hicks, in charge of the ore department of the Grasselli company, to the effect that all of these mining operations were unprofitable. He stated that the company has made no claim for losses on other properties because the operations were undertaken without government stimulation.

Frank H. Rosengarten Dies

Frank H. Rosengarten, 80 years old, prominent as a chemist before his retirement from business in 1897, died on Monday, May 7, at his home 1905 Walnut St., Philadelphia, Pa., following an attack of heart disease. Mr. Rosengarten was a native of Philadelphia, being the son of the late George D. Rosengarten, founder of the firm of Rosengarten & Sons, manufacturing chemists. The Rosengarten firm in 1905 was consolidated with the firm of Powers & Weightman, becoming Powers, Weightman & Rosengarten. He was a member of the Union League. A sister, Miss Fannie Rosengarten, and two sons, J. Clifford and Samuel R., all of Philadelphia survive him. The funeral was private.

New York Chemists' Club Holds Annual Election

The New York Chemists' Club, meeting on May 2, was presented with 500 shares of the stock of the Chemists' Club Building Corporation. Dr. W. H. Nichols, the donor of this stock, which is valued at $25,000, was one of the charter members of the club. The annual election held on the same evening awarded the chairs for the coming year as follows: President, F. J. Metzger; resident vice-president, Allen Rogers; non-resident vice-president, E. R. Weidlein; treasurer, A. G. Robinson; secretary, Herbert G. Sidebottom; trustees, A. A. Holmes and Thomas R. Duggan. The latter was appointed to the place left vacant by the death of Stephen K. Reed, who died after his nomination had been announced.

Calendar

The following important technical meetings are scheduled for the immediate future:

SOCIETY OF CHEMICAL INDUSTRY Chemists' Club, New York City, May 18

AMER. SOCIETY MECHANICAL ENGRS Montreal, May 28-31

CANADIAN INSTITUTE OF CHEMISTRY Toronto, May 29-31

SOCIETY OF CHEMICAL INDUSTRY Canadian Section Toronto, May 29-31

AMER. ASSN CEREAL CHEMISTS Chicago, June 4-9

AMER. LEATHER CHEMISTS ASSN. White Sulphur Springs, W. Va., June 7-9

NAT'L FERTILIZER ASSOCIATION White Sulphur Springs, W. Va., June 11-16

NATIONAL LIME ASSOCIATION New York City, June 13-15

SOCIETY FOR STEEL TREATING Eastern Sectional Meeting Bethlehem, Pa., June 11-15

AMER. INST CHEMICAL ENGRS. Wilmington, Del., June 20-23

AMER SOC. FOR TESTING MATERIALS Atlantic City, June 25-29

Engineering Societies Will Investigate Coal Storage

Appointment of four members to conduct an investigation of the storage of coal is announced by the Federated American Engineering Societies. They are: P. F. Walker, dean of engineering, University of Kansas; S. W. Parr, professor of applied chemistry, University of Illinois; H. Foster Bain, director of the U. S. Bureau of Mines; L. E. Young, Union Light & Power Co., St. Louis. The chairman is W. L. Abbott, chief operating engineer of the Commonwealth Edison Co., Chicago.

A bibliography of the subject is already in course of preparation, as well as a compilation of data and records that have already been made by other organizations. Plans are being developed for securing additional original information which, when enlarged and approved by the committee at a meeting in May, will be put into operation immediately.

New Price Schedule for German Potash

The Potash Importing Corporation of America, which took over the sale and distribution of German potash, on May 1, has announced a new and lower price schedule, covering shipments from May to September. The new prices are on a basis of $34.55 for muriate 80-85 per cent; $43.67 for sulphate 90-95 per cent; $25.72 for double manure salt 48-53 per cent; $16.03 for manure salt, minimum 30 per cent; $10.55 for manure salt, minimum 20 per cent; $7.22 for kainit 12.4 per cent. These prices are per ton of 2,000 lb., net weight, c.i.f. Atlantic and Gulf ports. The prices are subject to discounts of: 1 per cent on purchases of 1,000 tons; 3 per cent on purchases of 3,000 tons; 4 per cent on purchases of 10,000 tons; 6 per cent on purchases of 15,000 tons; and 10 per cent on purchases of 20,000 tons.

Official Figures Verify Expansion In Export Trade for Chemicals

March Exports Valued at $2,500,000 in Excess of February Totals—Soda Compounds Figure Prominently in Outward Movement

CHEMICALS and allied products to the value of $11,857,049 were exported in March. This is an increase of $2,500,000 over the value of similar exports in February, and an increase of nearly $1,500,000 over the value of these exports in March of 1922. March exports of coal-tar products were valued at $1,133,815, as compared with $986,-545, the value of coal-tar products exported in February.

Sodas and sodium compounds to the extent of 35,329,636 lb. were exported in March, an increase of nearly 2,000,000 lb. over February and of nearly 4,000,-000 lb. over March of 1922.

Exports of pigments, paints and varnishes during March showed an increase of $500,000 over the export movement in February, with practically the same increase over those of March, 1922. The value of the exports of pigments, paints and varnishes in March of 1923 was $1,583,169.

Fertilizer exports contributed their part to the March increase. In that month these exports were valued at $1,715,186. This compares with $1,448,-804 in February, and $1,520,188 in March, 1922. Exports of sulphate of ammonia in March were valued at $959,-663. The increase over February, however, was in value rather than in tonnage. Exports, in the order of their importance, were to the following countries: Japan, Dutch East Indies, China, Phillippine Islands and Cuba. Spain, which was a large consumer in March, 1922, was the destination of no shipment of sulphate of ammonia in March of 1923.

There was a decided upturn in the amount of explosives exported in March. In that month 3,254,747 lb. was shipped out of the country, whereas in February the movement totaled 1,485,011 lb.

Some of the more striking contrasts in export movement during March, 1923, as compared with the corresponding month of 1922, are shown by the following figures compiled by the Department of Commerce:

	1922 Lb	1923 Lb.
Aniline oils and salts	10,660	89,515
Misc intermediates	22,033	153,198
Coal-tar dyes and stains	712,404	1,606,168
Sulphate of quinine	* 41,872	148,225
Sulphuric acid	1,003,128	702,355
Aluminum sulphate	1,788,040	2,396,408
Acetate of lime	2,541,897	1,964,833
Calcium carbide	1,106,905	442,531
Copper sulphate	915,482	153,346
Dextrine	926,398	2,099,563
Chlorate of potash	61,764	1,618,054
Bichromate of potash	648,086	1,033,857
Cyanide of soda	74,102	273,320
Borax	778,194	4,185,983
Caustic soda	18,612,225	9,855,416
Zinc oxide	535,442	1,622,912
Carbon and lamp black	2,364,444	1,696,174

* Ounces

Institute Holds Busy Zinc Meeting at St. Louis

The fifth annual convention of the Zinc Institute was held at St. Louis May 7 and 8. The technical addresses included one on "Zinc Oxide and Lithopone" by E. V. Peters of the New Jersey Zinc Co.; one on "Zinc" by C. H. J. Trench of the American Metal Market, and one on "Improvement of Milling Practices" by H. H. Wallower of the Golden Rod Smelting & Refining Corporation, Joplin, Mo.

H. H. Wallower was elected president for the coming year. A. P. Cobb, New Jersey Zinc Co., New York; J. G. Starr, Quinton Spelter Co., Joplin, Mo., and C. F. Kelley, Anaconda Copper Mining Co., New York, were elected vice-presidents.

H. I. Young, American Zinc, Lead & Smelting Co., Mascot, Tenn., was re-elected treasurer, and S. S. Tutthill, New York, was re-elected secretary.

Chicago Chemists' Club Elects New Officers

At the annual meeting of the Chicago Chemists Club, Tuesday evening, May 1, the following were elected officers: President, A. V. H. Mory; first vice-president, A. E. Shaar; second vice-president, H. G. Walker; secretary, R. C. Shuey; treasurer, O. H. Wurster; trustees, S. L. Redman and F. J. Root. Formal business concluded, the remainder of the evening was devoted to a lively round-table discussion of club plans and activities.

Johns Hopkins to Give Course in Gas Engineering

Various gas industries and public service corporations have guaranteed Johns Hopkins University $6,000 a year for 5 years for a chair in gas engineering. The donors are located in sixteen Southern states.

The principal purpose of the new courses will be to train graduate students in this special field. It is hoped that the development of these courses will include particular attention to research in the problems arising in the gas industry. The university is particularly well equipped for this work, as it has had for several years a laboratory for experiments in the recovery of the various byproducts of gas manufacture.

A 4-year undergraduate course in gas engineering will also be offered. During the first 3 years these courses will be closely related to the courses already existing in mechanical engineering and chemistry. During the fourth year principal attention will be given to training in the methods of gas manufacture and usage.

News Notes

Reparations dyes will not be sought by the United States before Congress again convenes. The State Department expains that this is due to lack of machinery for suitable distribution of such dyes should they be obtained.

A new calorizing company has been formed in Deleware to take over the Calorizing Company of Pittsburg. The latter concern has developed a commercial heat-treating process for surfacing iron, steel and other metals with aluminum.

"Nothing takes the place of leather" is the slogan of the Tanners' Council of America in launching its $1,250,000 campaign for the education of the American people in the uses of this commodity and in the status of the industry. Every modern means of gaining publicity is to be utilized.

Alabama's iron industry is picking up. The Sloss-Sheffield Steel & Iron Co. is to start fires in one of the Sheffield furnaces about June 15, according to a recent report. Belief exists at Sheffield that the Sloss company ultimately will erect a steel plant or rolling mills there. The new units which the company has acquired gives it an output of pig iron in this district of about 1,000 tons daily.

The Newark Technical School is to confer the degree of Bachelor of Science upon eleven graduates from the college of engineering at its first commencement on May 14. The event is of interest because chemical engineers are included in the first class to graduate from this school.

Picric acid export taxes during the war were properly levied, according to a decision handed down on May 3 by Federal Judge Learned Hand. The suit of American Synthetic Dyes, Inc., was thereby lost. A total sum of $15,000,-000 from this and from similar suits is said to be gained by the government by this decision.

Damage of $100,000 was done by fire in the plant of the United States Cast Iron Pipe & Foundry Co., at Scottdale, Pa., on May 2. A building filled with valuable patterns and which also included a molding floor was destroyed.

Face brick interests held a meeting on May 11 with the division of simplified practices of the Department of Commerce at Washington. At the conference the advisability and practicability of reducing the number of types and sizes of brick were discussed.

The Syracuse Section of the A.C.S., meeting at Barone Hall on April 27, elected as officers for the ensuing year: President, Ross A. Baker; vice-president, W. B. Hicks; secretary, J. H. Nair; treasurer, P. S. Craig; local councilor, A. W. Kimman.

The fall meeting program of the A.C.S. is already being planned by the various divisions. The meeting is to be held at Milwaukee Sept. 10 to 14.

Intersectional Meeting at Urbana Draws Large Attendance

Good-Fellowship Keynote at 2-Day Meeting of Mid-Western Chemists—Group Programs So Arranged as to Permit Ample Time for Presentation

CENTERING about the Chemistry Building at the University of Illinois, Friday and Saturday, May 4 and 5, there transpired a series of events which again serves to demonstrate beyond all doubt the value of intersectional meetings in the American Chemical Society. In response to an invitation from the Illinois Section, about 150 members representing ten other sections gathered at Urbana for 2 days of inspiration and good-fellowship. Including local members, the total attendance was well over 200, which indicates a most hearty interest in these meetings.

In welcoming the visiting chemists, Prof. W. A. Noyes outlined briefly the organization of the chemistry department at Urbana, indicating in a general way the character of the research work being conducted in the various departments. President E. C. Franklin outlined some of the fundamental facts concerning the ammonia system of compounds upon which his attention has centered for many years. Dr. L. F. Nickell, of the Monsanto Chemical Works, followed with a talk on the present needs of the organic chemical industry. Census figures for 1921 indicate an alarming drop in the production of many organic intermediates and finished products. Dr. Nickell attributed this to such factors as loss of export, duplication of effort through the production of the same commodity by too many firms, the employment of untrained chemists, failure to scrap obsolete equipment and processes. Until these conditions are rectified, development of the organic chemical industry will be hampered.

Time Found for Social Gathering

At the conclusion of the general meeting automobiles were in readiness to carry the party to the Urbana Country Club, where an exciting game of indoor baseball was soon in progress between teams representing Chicago-Illinois on the one hand and Indiana on the other. The final score stood 18 to 6 in favor of Chicago-Illinois. Returning indoors, a social hour before the open fireplace preceded the buffet supper. Then followed an informal talk by President Franklin, an amusing selection of home-grown poetry by Prof. W. Lee Lewis and entertainment by members of Alpha Chi Sigma, Iota Sigma Pi and Gamma Pi Upsilon fraternities.

Saturday morning's activities opened with a popular lecture by Dr. P. N. Leech, of the American Medical Association, on "Home Remedies — Their Claims Versus Composition." At 9:30 group meetings began, the programs presented being as follows: Physical and inorganic, 9 papers; industrial, 8; organic, 5; educational, 4. Some of the papers are given in abstract in the following paragraphs.

Industrial Group Meeting

Experiments on the combustion of hydrogen and carbon monoxide in the presence of various heated oxides were reported by M. J. Bradley, of the University of Illinois. Many oxides were tried either alone or with small amounts of other oxides as catalyzers, but the best results were obtained with copper oxide which was in process of being slightly reduced. Application of these findings in the developments of an improved apparatus for fuel gas analysis was discussed by F. E. Vandeveer, also of the University of Illinois.

As reported by Prof. C. W. Parmelee, investigations in progress in the ceramic department, University of Illinois, include the determination of the heat energy required to burn pure grades of clay to different temperatures, viscosity and surface tension of glass, a phase-rule study of the system Na_2O-CaO-SiO_2, translucency of porcelain by the use of a photo-electric cell.

Acid Car Construction Described

Expense of maintaining muriatic tank cars led the Monsanto Chemical Works to investigate methods for increasing the life, and a design which promises to solve the difficulty was described by Dr. L. F. Nickell. A tank is built up of 3⅞-in. fir staves and heads, the latter being reinforced with 4x6 yellow pine checkerwork. The inside is then treated with a coating of Positive Seal B asphalt cement, which is thoroughly ironed in. The wooden tank is then slipped into a steel tank car which allows 3 in. clearance on all sides. After filling the wooden tank with water to prevent softening of the cement, 160 deg. pitch is blown into the spare between the tank and the steel shell, completely filling it. With this construction, the inevitable acid spills corrode only the outside of the steel shell. A spare 4 ft. square immediately under the dome is bricked over in order to prevent penetration of the cement coating when iron measuring rods are used. The cars are emptied by siphoning out with rubber hose. They have been in service for some time with excellent results.

Dr. E. W. Engle discussed a new electrolytic rectifier using tantalum and lead electrodes in a sulphuric acid solution which has now been placed on the market as a result of investigations of the behavior of tantalum as an electrolytic valve.

A new development in the agreement whereby the Public Health Institute of Chicago maintains research fellowships on organic arsenic and mercury compounds at Northwestern University is the full-time employment by the institute of a chemist whose sole duty is to prepare for the research students intermediate products which are not obtainable in the market. This arrangement, which greatly increases the time devoted to pure research, was discussed by Prof. F. C. Whitmore.

Practical data on the construction of granular graphite resistor furnaces for temperatures up to 1,600 deg. C. were given by M. M. Austin, of the University of Illinois. The furnace must be easy to repack, and this should be done on every other heating. The incoming electrode must be pushed tightly against the graphite. Electrodes should be very rugged in construction in order to carry current up to 500 amp. without the necessity of water cooling, which is troublesome.

Frank P. Brock, of the Redmanol Chemical Products Co., concluded the program with some interesting reminiscences of the problems that attended the early attempts to place Redmanol on the market.

Steel Institute Announces May Program

On Friday, May 25, the twenty-third general meeting of the American Iron and Steel Institute is to be held in New York. The following papers are to be presented at the Hotel Commodore, where the Institute's headquarters are to be:

Address of the president, Elbert H. Gary, chairman, United States Steel Corporation, New York; "The Value of Chemistry in the Iron and Steel Industry," W. A. Forbes, United States Steel Corporation, New York; "Motor-Driven Rolling Mills," H. E. Davis, electrical engineer, Interstate Iron & Steel Co., South Chicago, Ill.; "The Standardization of Steel Mill Practice by Time Studies," Robert Gregg, president, Atlantic Steel Co., Atlanta, Ga.; "Gas Producer Practice in Steel Works," Waldemar Dyrssen, United States Steel Corporation, New York; "Methods in Waste Elimination," H. T. Morris, metallurgical engineer, Bethlehem Steel Corporation, Bethlehem, Pa.; "The Disintegration of Fire-brick Linings in Blast Furnaces," C. E. Nesbitt and M. L. Bell, research engineers, Carnegie Steel Co., Pittsburgh, Pa.

Dye Strength Suggestions Close May 14

The time limit for the receipt of criticisms of its tentative list of standard dye strengths has been extended by the customs service until May 14.

Many requests for an extension of time have been received since May 7 was set as the last day suggestions might be received, with the result that this extension has been granted.

H. D. Ruhm Elected President of N. Y. Paint Club

Widely Known Chemical Expert Chosen to Direct Local Organization —Has Acquired Enviable Reputation in Engineering and Chemical Manufacturing Circles

HERMAN DAVID RUHM, who may boast of 29 years of civil, mining and chemical engineering experience, now heads the Paint, Oil and Varnish Club of New York. At the annual meeting, held on Thursday evening, May 10, at Delmonico's, the members were unanimous in electing Mr. Ruhm the thirty-sixth president of the club. The Paint, Oil and Varnish Club of New York is one of the most influential organizations in trade circles and a pioneer in promoting better relations and a spirit of co-operation among members of the industry. The club is affiliated with the National Paint, Oil and Varnish Association, whose membership includes 1,500 firms. Mr. Ruhm became associated with the New York club in 1916 and his rapid rise to highest honors is a tribute to his ability, pleasing personality and untiring efforts in behalf of the organization.

Mr. Ruhm is well known in the field of chemical engineering, yet, in a truly modest way, he said that he could not quite understand why a chemist should have been singled out to guide the club for the ensuing year. But in the course of an interview he was not at all backward in upholding his profession and pointed out that it is a grave error to differentiate between chemistry and industry. Perhaps it was just this thought that prompted the committee on nominations to select Mr. Ruhm to head the club.

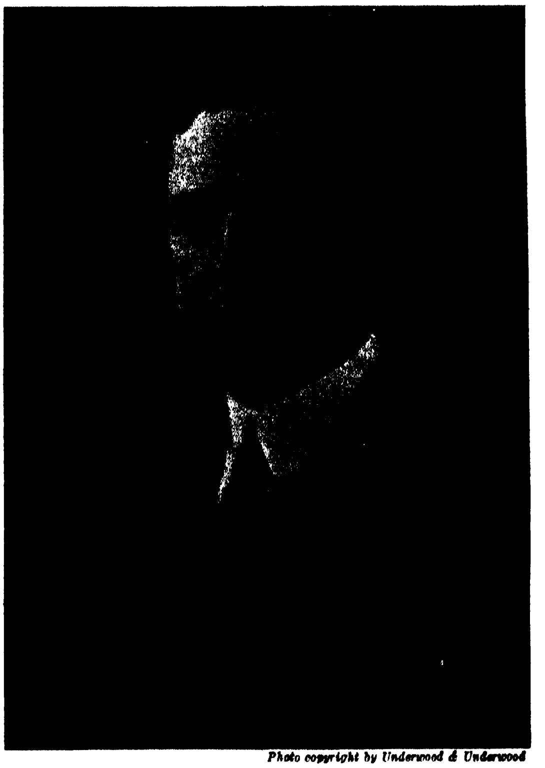
He was born on June 6, 1871, at Nashville, Tenn. After receiving his preliminary education at Fogg High School, he entered Vanderbilt University of Nashville, and was graduated with the class of 1892.

Early in his business career he devoted some time to civil engineering and engaged in construction work for the Nashville & Western Railway Co. and the North Carolina & St. Louis Railway. Later, while a member of the firm of Ruhm & Wilson, engineers and surveyors, he assisted in the United States Government survey of the Cumberland River.

The development of the phosphate rock deposits at Mt. Pleasant and Centerville, Tenn., always has been one of the subjects uppermost in the mind of Mr. Ruhm and he has been identified with this industry since 1893. In the way of achievement in the chemical industry he holds the honor of being the first man to perfect a method of producing caustic potash in this country on a profitable basis as well as on a commercial scale. From 1909 to 1916 he was vice-president and general manager of the Niagara Alkali Co., Niagara Falls, N. Y. In 1916 he became associated with the Marden, Orth & Hastings Corporation as manager of the chemical department. Mr. Ruhm also was vice-president of the Calco Chemical Co., producing coal-tar products.

In 1920 Mr. Ruhm again went into business for himself as a broker and dealer in chemicals and consulting mining and chemical engineer. He is vice-president of the Ruhm Phosphate & Chemical Co.

A Southerner by birth, he has shown more than passing interest in the fight to exterminate the boll weevil and is working out a plan to combine calcium arsenate with calcium phosphate so that the distribution of the poison may be accomplished in a more economical way. He is the author of several brochures on the development of a potash industry in the United States.



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Herman David Ruhm

Mr. Ruhm is a member of the American Chemical Society, New Jersey Chemical Society, American Institute of Mining Engineers, Drug and Chemical Club, Chemists' Club, American Association for the Advancement of Science, American Electrochemical Society, Beta Theta Pi Club, Englewood Golf Club and Columbia Yacht Club.

Mr. Ruhm, in conducting the affairs of the Paint Club for the coming year, will be assisted by Charles J. Roh, vice-president; H. G. Sidebottom, secretary, and G. H. Tomlinson, treasurer. The newly elected executive committee comprises E. V. Peters, chairman; A. G. Fairweather, R. W. Murray, H. G. Sidford, A. S. Somers and Frank Waldo. The arbitration committee will have G. W. Fortmeyer as chairman and will be rounded out by D. E. Breinig, J. B. Bouck, Jr., H. Gates and Eugene Merz. Other committees will be appointed later by President Ruhm.

At the meeting Thursday night delegates were selected to represent the local club at the thirty-sixth annual convention of the National Paint, Oil and Varnish Association, which will be held in Chicago next November. R. O. Walker, an ex-president of the local club, heads the delegates and eight other ex-presidents of the club are included among the delegates.

Lower Duties Asked for Linseed Oil, Cresylic Acid and Phenolic Resin

Tariff Commission Will Grant Hearings on These Commodities—Efforts to Place Calcium Arsenate on Free List Unsuccessful

RENEWING its consideration of applications for changes of duty under the flexible tariff section of the new law, the Tariff Commission has ordered inquiries into several chemicals and other commodities.

Among these investigations is one into linseed oil, paragraph 54, in which an application for a decrease in duty has been filed by the Bureau of Raw Materials for American Vegetable Oils and Fats Industries, representing paint, varnish and soap manufacturers. The duty under the 1922 act is 3.3 cents per pound, which compares with an equivalent of 2 cents per pound in the act of 1909 and 1⅓ cents per pound in the act of 1913. Not only is the duty higher than ever before but a withdraw on the cake residue from the crushed flaxseed is permitted when this product is exported, thus indirectly increasing the protection of linseed.

A reduction in duty on synthetic phenolic resin, a coal-tar product in paragraph 28, dutiable at 60 per cent ad valorem, American valuation, plus 7 cents per pound, or an increase in products made of this resin was asked by the National Importing Co., New York. Under the special act of 1916, the duty on this resin was 30 per cent, foreign valuation.

James F. Ballard, Inc., St. Louis, applied for a reduction in duty on phenol, a coal-tar intermediate in paragraph 27, dutiable at 55 per cent, American valuation, and 7 cents per pound. The duty in the act of 1916 was 15 per cent, foreign valuation.

A reduction in the duty on cresylic acid, in the same paragraph with phenol and with the same comparative duties, was asked by the Insecticide and Disinfectant Manufacturers' Association, New York.

Other Investigations Ordered

Investigations also have been ordered by the commission into smokers' articles made of synthetic phenolic resin, reduction asked by Kaufman Bros. & Bondy and others; briar wood pipes, equalization because of alleged unfair practices of foreign manufacturers asked by the Reiss-Premier Pipe Co.; taximeters, increase asked by the Pittsburgh Taximeter Co.; and print rollers, increase asked by the National Print Cutters' Association, Jersey City.

There has been persistent opposition to reopening tariff discussions on vegetable oils, but this has been directed more against the oils that enter into edible trades than against linseed oil. Last Monday a delegation headed by Thomas G. McLeod, Governor of South Carolina, filed with the President a protest against docketing an application that sought a reduction in the duties on vegetable oils. The President replied that filing petitions for modifications could not be prohibited, but he called attention to the fact that the Tariff Commission makes a preliminary survey to determine whether the facts warrant recommending a hearing. He also gave assurance that tariff modifications, either way, would be justified only on the most striking evidence of the necessity for such changes.

Calcium arsenate is another chemical on which tariff changes have been asked. It differs from most of the other materials under discussion, inasmuch as the flexible features of the tariff law have not been invoked, but rather an official ruling that it has not been specially provided for in the tariff and should be placed on the free list because it is an arsenic derivative and arsenic is duty free. According to Treasury decisions, calcium arsenate is classified as a chemical compound, not specially provided for, and is held to be dutiable at the rate of 25 per cent ad valorem.

Cotton growers in the South brought the question before Attorney-General Daugherty with the request that he hand down a decision on this question. Early last week the Attorney-General declined to pass on the matter and gave as an opinion that it was the duty of the Treasury Department to classify merchandise under the proper paragraphs of the tariff act.

To Record Coal-Tar Imports at Port of New York

The Chemical Division of the Department of Commerce has expanded its service at the port of New York so as to record imports of the coal-tar products covered in paragraph 27 and paragraph 28 of the tariff act. Paragraph 27 comprises a lengthy list of coal-tar intermediates and products, while paragraph 28 adds coal-tar colors, dyes or stains, together with numerous coal-tar chemicals.

Increased Call for Zinc Dust in South Africa

Reports from Johannesburg state that zinc dust is being used more extensively in the production of gold. The installation of Crowe and Merrill processes on two new mine extensions has been completed and other mines are expected to follow suit. It is found that nearly 0.1 lb. of zinc dust is used for each ton of ore milled, and when all the mines of the Transvaal and Southern Rhodesia are using zinc dust, they will consume about 2,000 tons of the latter annually.

To Establish Plant for Glass Making in Peru

A company has now been formed in Lima for the establishment of a glass factory, the machinery and plant for which will be purchased in the United States. It is purposed to turn out all types of coarse bottles for industrial purposes, as well as window and sheet glass. No attempt will be made to produce fine colored glasses or glasses for optical purposes. Tank furnaces will be employed heated by producer gas. A fine greenish glass can be turned out locally from sand, limestone or chalk and dry sodium carbonate. Of other materials used—marl, clay, barium sulphate and basaltic rock—many are readily obtainable. Wide-mouthed jars and bottles will be produced by machinery, but it is not expected that for some time to come the output will obviate importations from abroad.

Chemical Foundation Suit Adjourned Till June 4

Testimony of Badische Representative Held Under Advisement by Judge Morris in District Court

The government's suit against the Chemical Foundation, Inc., for the return of 4,700 patents has opened. Whether or not these patents, purchased for $250,000, shall be placed again in the hands of the Alien Property Custodian is the question to be decided.

At a hearing held May 8 by Judge Morris in the United States District Court in Wilmington, Del., Dr. Karl Holderman, head chemist and general manager of the Badische company, testified that the patents taken by the United States during the war were worth $17,000,000 to the German chemical industry. Mr. Kresel, attorney for the Chemical Foundation, stated that this estimate was made 10 years ago and that the patents are practically worthless now. Dr. Holderman admitted that he was one of "a community of interests" of German chemical and dyestuff manufacturers. Kresel contended that Holderman was not a competent witness because the Badische company was interested in another suit to recover the patents.

A motion to lay aside Holderman's testimony was taken under advisement by Judge Morris. June 4 was set for hearing arguments on the motion.

It will be remembered that of the 4,700 patents seized only about 8 per cent have been used. In most cases the only object in obtaining these patents in this country was to protect Germany's home industry. For that reason the key step in various procedures was ordinarily left out of the American patent. Of the patents involved, those concerning manufacture of Salversan, of ammonia by the Haber process, of synthetic tanning materials and of various dyestuffs and pharmaceuticals are of considerable importance.

Fertilizer Merger Is in Sight

A number of small but important companies in the fertilizer trade are negotiating a merger. The total capitalization involved amounts to approximately $50,000,000. John J. Watson, Jr., vice-president of the International Agricultural Corporation, which, with the Davison Chemical Co., is expected to form the nucleus of the consolidation, said recently that plans for bringing other companies into the combination are being discussed in the belief that present conditions in the industry afford an excellent opportunity to bring them together under one management.

It was stated that neither the American Agricultural Chemical Co. nor the Virginia-Carolina Chemical Co. will be included in the projected amalgamation. The independents named as likely to enter the merger along with International Agricultural and Davison Chemical are the Phosphate Mining Co., the Standard Acid Phospate Co., of Baltimore; the Federal Chemical Co., Louisville, and the Reed interests, of that city. It is also reported in the financial district that the fertilizer department of Swift & Co. has been approached.

Stabilization the Object

The purpose of the proposed merger, according to the promoters, is to stabilize the fertilizer industry, which, despite prosperity in other lines of business, is not operating on a profitable basis. This has been reflected in recent weakness of the securities of the fertilizer companies. It is believed that a combination of producers of raw materials, including phosphates with mixers, would cut overhead and make for steady prices in a market that is now extremely irregular. Competition among the independent mixers, particularly in Baltimore, has been an unsettling factor in the fertilizer situation for some time.

The International Agricultural Chemical Corporation owns extensive deposits of phosphate rock in Florida, while the Davison Chemical Co. is an important producer of sulphuric acid.

Use of Gas Increasing

Contrary to the belief of many, the gas industry is growing steadily and at quite a rapid rate. Facts of national interest appear in a recent report of the New York State Committee on Public Utility Information.

"While use of gas for illumination has gradually decreased, amounting to only 20 per cent of the total production in 1921," it states, "the advantages of gas over coal for cooking, house heating and numerous industrial processes have brought demands which are causing utility companies to operate their plants at capacity a considerable part of each year and to build larger ones in many cities.

"Reports to the Census Bureau give the total value of products of gas plants as $411,195,500 for that year, as compared with $829,278,000 for 1919, and $220,237,700 for 1914, an increase of 25 per cent from 1919 to 1921, and of 87 per cent for the 7-year period, 1914 to 1921.

"The total production of manufactured gas for 1921 was more than 326,000,000,000 cu.ft., of which the companies of New York State produced more than 100,000,000,000 cu.ft., or nearly one-third.

"Total sales of manufactured gas for 1922 by the entire industry are estimated by engineers of the industry at $450,000,000, with a production of about 375,000,000,000 cu.ft. The increased efficiency of the industry is indicated both by the larger yearly output and the decreasing number of wage earners required to make it."

Financial Notes

Devoe & Raynolds Co., Inc., has listed an issue of $2,000,000 first preferred stock of the company for trading in the New York Stock Exchange.

Fluctuations in the stock of the Mathieson Alkali Works have directed attention to the operations and unofficial reports say the company's earnings are on a basis of approximately $10 per share. Dividends on the common are not looked for this year.

The Eastman Kodak Co. has declared its regular quarterly dividend of $1.25 per share and, in addition, an extra dividend of 75c. per share.

In a report to stockholders, H. B. Thompson, president of the United States Finishing Co., said: "We closed our year with more goods on order than we have had since 1920, and the outlook for the coming year is favorable. Our printing business, which has on the whole been subnormal for the past 2 years, indicates a revival, particularly in dress fabrics."

The Diamond Match Co. is reported to have made arrangements to retire, on Nov. 1, the outstanding $5,735,200 15-year 7½ per cent debentures, due 1935. The retirement price is given as 105.

Ceramic Laboratory Proposed

At the recent annual meeting of the United States Potters' Association at New York, F. P. Judge, president of the association during the past year, urged that the organization give serious consideration to the establishment of a ceramic-chemical laboratory. Such an institution would be designed for the benefit of members who do not employ ceramic engineers or chemists. It would be primarily for the manufacturers of general ware and would be utilized for the most part for the solution of problems arising in this branch of production. It is purposed to give attention to the recommendation and to work for the establishment of the laboratory.

Trade Notes

Further reductions have been made in export tax on copra from Fiji. The rate is now 5s. per ton or fraction thereof.

The Federal Trade Commission has given Dings & Schuster of Long Island City 30 days to file an answer to charges of misbranding certain of its products. The commission charges that the respondent has placed upon the market two brands of shellac, the first composed solely of shellac gum dissolved in alcohol, while the second is made up of shellac gum and substitutes and is marketed with no qualifying words to indicate that the product is made of other than pure shellac gum.

The steamship "Kongosan Maru" arrived at San Francisco on May 7, from Dairen, with 500 bbl. soya bean oil, 1,125 cs. camphor, 50cs. menthol, 470 bbl. perilla oil and 3,058 bg. linseed.

C. M. Struven, of C. M. Struven & Co., Baltimore, dealers in fertilizer materials, was in New York last week.

An American Chamber of Commerce has been formed at Port-au-Prince, Haiti. There are 98 charter members, and an active campaign is planned to develop commercial relations between Haiti and the United States.

J. F. Wischhusen, manager of the Superfos Co. of New York City has gone to Europe in the interests of his company. Mr. Wischhusen will visit central European countries as well as northern Europe and plans to be away about 10 weeks.

Joseph Guerin, president of the Guerin Mills, died at his home in Woonsocket, R. I., on May 6. He controlled seven large yarn, worsted weaving and dyeing plants, capitalized at $7,000,000.

The Northern Chemical Works of Chicago has filed application calling for the dissolution of that company.

Hoskinson Gates, who for the past 13 years has been associated with the Eagle Picher Lead Co., has severed his connection with that company. Mr. Gates is a former president of the Paint, Oil and Varnish Club of New York.

M. Winter has been elected president of the Texdel Chemical Co. He succeeds J. M. Marshall. The plant of the company has been moved to Nutley, N. J.

Eugene Suter, head of Eugene Suter & Co. of New York, left for Europe on Saturday.

Albert J. Berwin has been appointed receiver for the Jacksonville Chemical Co. of 246 Water St., New York. The liabilities of the company are placed at $35,000 and assets at about $10,000.

On May 1 the Potash Importing Corporation formally entered the potash field by taking over the marketing and distributing business, in this country and Canada, of the German Potash Syndicate.

Facts and Figures That Influence Trade in Chemical Products

Market Conditions

Current Prices
Imports and Exports
The Trend of Business

Slowing Up in Demand Creates Easier Feeling in Market for Chemicals

Lower Prices Established for German Muriate of Potash—Shipment Prices Over Next Year Announced for Nitrate of Soda—Arsenic Sells at Lower Prices—Permanganate of Potash Weak—Bichromates Higher

CONSUMING demand for chemicals has reached the stage where many sellers describe the market as slow. Call for contract deliveries is holding up well and this is accounting for a good part of the domestic output. New business, however, has fallen off in volume and this fact, combined with competition from foreign offerings, is giving an easy tone to many materials in the chemical list.

Exchange Weakens Foreign Markets

Declines in exchange has had some effect in lowering values for many chemicals of foreign origin. This has been manifest more by causing importers to hold off placing orders, rather than in drastic price changes for imported goods, but the effect is noticeable in opinions widely held that selling pressure will arise in foreign centers, which in turn will bring about price concessions. In some cases imported goods held in the spot market have been pressed for sale, in an effort to bring buyers into the market. Among the items so affected may be mentioned permanganate of potash, hyposulphite of soda, prussiate of soda and prussiate of potash.

New Contract Prices

New price schedules were announced during the week on important materials. The Nitrate Association in Chile made public its quotations on nitrate of soda, covering shipments for the year from July to June. These prices had been generally anticipated and were about in line with the quotations which importers had been making recently. The sales agents for German potash producers also announced a new price schedule for potash salts. The revised prices showed a decline as compared with the prevailing quotations but suffer somewhat with the prices which have prevailed in recent transactions in the local market.

Higher Producing Costs

Domestic producers of bichromates advanced prices in the preceding week and followed this with another rise in quotations last week. Higher producing costs was given as the explanation for the advances. Similar conditions are reported in the case of caustic potash, oxalic acid, acetic acid, acetate of lime, and numerous other commodities, so that it may be said that weakness in price is evident largely in the case of chemicals where a good part of domestic requirements are filled by imported manufactures.

The metal markets were lower during the period, but this was not followed closely by the metal salts, although some of the latter may be revised downward unless the metals show immediate signs of recovery.

Acids

Acetic Acid—There has been no further change in acetate of lime and acid producers who use the latter have had no occasion to change their asking prices. The lower grades of acetic acid are finding less competition than the higher grades and are firm at 3.38c. per lb. for 28 per cent, with corresponding increases based on quantity and package. For 56 per cent the quotation for round lots is 6.75c. per lb. Glacial shows more of a range according to seller, with 12c. per lb. as an inside figure, although most producers are quoting above that price.

Boric Acid—The tone to prices remains easy and consuming demand has not been stimulated to any extent by the recent reduction in price. Round lots in bbl. are offered at 10½c. per lb.

Citric Acid—Domestic makers are pretty well sold ahead and while they are holding prices on an unchanged basis of 40@50c. per lb., the quotation is little better than nominal in some quarters. Imported has been meeting with an improved call and prices show a tendency to stiffen, with 52c. per lb. generally quoted for spot or shipment.

Formic Acid—Arrivals of imported material reached the local market during the week but offerings for nearby shipment are not free and predictions of higher prices are heard, especially if buying becomes more active. Imported on spot was held at 14¾@15c. per lb. Domestic is unchanged at 16c. per lb. and upwards according to quantity.

Oxalic Acid—Increasing costs of production are given as the reason for higher prices for domestic oxalic and the best price heard is 13½c. per lb., f.o.b. works. Imported oxalic was in poor demand throughout the week and holders were open to bids with the result that 13¼c. per lb. could be worked by buyers.

Tartaric Acid—The advance as announced last week has been well maintained in the case of domestic made goods and 37½c. per lb. is asked for powdered and crystals. Imported was higher this week and cables received were on a basis of 37c. per lb., duty paid.

Potashes

Bichromate of Potash—Prices were again higher and in some directions 11¼c. per lb., works, was held as an inside price. It was possible, however, to do 11⅛c. per lb. Increased cost of manufacture is given as an explanation of the stronger position of the market.

Caustic Potash—The market presents an unusual appearance, inasmuch as goods of domestic manufacture are firmly held and 9c. per lb. and upwards is asked at the works. Sellers say the higher prices are rendered necessary by increased cost of operating. Imported caustic is decidedly easy. Goods afloat were offered late in the week at 8c. per lb., but in the spot market there were offerings as low as 7⅝c. per lb. The weakness in imported material serves to detract from the strength in domestic.

Carbonate of Potash—The feature in this market is the fact that there are spot offerings of 90-95 per cent at 6½c. per lb., whereas 80-85 per cent is generally held at 7c. per lb. For the 96-98 per cent there were sellers at 7½c. per lb. Inquiry is more active for the 80-85 per cent than for the other selections.

Chlorate of Potash—Sales of imported chlorate were made at 7¼c. per lb. and on firm bids it was reported that this price could be done at the close. The general asking price, however, was higher, with 7¾c. per lb. generally held as the open quotation. There was no revision in prices for domestic, and

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	177.69
Last week	179.28
May, 1918	270.00
May, 1919	248.00
May, 1920 (high)	280.00
May, 1921 (low)	143.00
May, 1922	159.00

Weakness in linseed oil, cottonseed oil, and chemically pure glycerine caused a downward revision in the week's index number of 159 points.

sellers continued to ask 8½c. per lb., works, for round lots, with the usual premiums for smaller lots.

Muriate of Potash—On Wednesday a new price list covering German potashes was issued. Muriate 80-85 per cent is quoted at $34.55 per short ton, in 200-lb. bags, f.o.b. Atlantic ports. This price is subject to discounts, varying according to the amounts purchased. Alsatian muriate is offered rather freely and the market is largely a matter of private terms, with sales reported under the level quoted for German.

Permanganate of Potash — Demand has not been heavy enough to hold prices on a steady basis. Advices from primary points say that no material changes have taken place but it is thought that selling pressure will appear at any time and some well posted members of the trade say the drop in values will become more pronounced unless buying orders come to hand in sufficient volume to uphold the market. On spot permanganate is held at 21c. per lb., but this is not a firm price. Shipments are freely offered at 20c. per lb. but are not attracting attention. About a month ago shipments sold at 18½c. per lb. and buyers are looking for values to drop back to that level.

Prussiate of Potash — Yellow prussiate was a little easier with sellers openly offering at 36½c. per lb. Demand is slow and this adds to the general weak appearance of the market. Red prussiate was still available at 70c. per lb., although there is considerable range for the latter according to seller.

Sodas

Bichromate of Soda—There were spot offerings at 8¼@8½c. per lb., with sales at the inside figure. The market, however, was higher, with first hands marking up quotations to 8½c. per lb., carlots, at the works. Competition among producers is not keen and the absence of selling pressure combined with higher production costs has established the market on a higher price level.

Caustic Soda — Export buying was again of smaller proportions and this gave an easy tone to f.a.s. quotations. Outside brands were offered at 3.30c. per lb., f.a.s., and standard makes were quoted at 3.40@3.45c. per lb. A report from Brazil, which has been a prominent buyer of caustic, states that the market there is dull. The report further states that the caustic soda war has been ended, and the leading British and American exporters have agreed that prices are not to drop below 0.950 milreis per kilo. In the domestic trade prices are holding at 2½c. per lb., carlots, works, basis 60 per cent.

Chlorate of Soda—Imported chlorate is meeting with a slow call from consumers but this is offset by firm markets abroad and also by the fact that spot holdings have been reduced. Prices are generally given at 6¾c. per lb., but it is probable that 6½c. per lb. could be done. Some offerings of inferior grade have been on the market and this has made buyers cautious. Domestic chlorate is firmly held at 6¾@7c. per lb., works, with a seasonable movement to consumers.

Cyanide of Soda — A very routine market is reported. Arrivals of imported are noted, with prices for the latter ranging from 20c. to 22½c. per lb., according to grade and sellers. Domestic cyanide is moving fairly well, but trading is not active and prices are stationary at 19½c. per lb. and upwards on a quantity basis.

Nitrate of Soda—A graded scale of prices for the coming year was made operative during the week. These prices were fixed by producers in Chile and are as follows, the quotations referring to metric quintals: July, 19s. 8d.; first half of August, 18s. 5d.; second half of August, 19s. 7d.; first half of September, 19s. 9d.; second half of September, 19s. 11d.; first half of October, £1 3d.; second half of October, £1 3d.; first half of November, £1 5d.; second half of November, £1 7d.; first half of December, £1 9d.; second half of December, £1 11d.; Jan. 1-June 15, £1 1s.; second half of June, 19s. 3d.

These prices work out at a range of $2.47½ to $2.60 per 100 lb. for Atlantic coast ports and are about in line with what the trade had expected.

Prussiate of Soda—Domestic producers are holding values steady at 17½c. per lb. There is some competition from imported material and sales of the latter were reported at 17¼c. per lb. There also were offerings of imported for shipment at 17¼c. per lb. Buying is not active either in domestic or foreign.

Miscellaneous

Acetate of Lime—Producers still complain of high producing costs and report that the market is well maintained at the higher price level as recently announced. Quotations are 4@4.05c. per lb. for acetate.

Arsenic—Domestic producers have sold large amounts for nearby shipment at 12½c. per lb. They also have sold smaller amounts for immediate shipment at prices ranging from 13½c. to 14½c. per lb. On deliveries over the second half of the year they quote 11c. per lb. In the open market prices were generally held at 15c. per lb. with spot sales reported at that figure. Prompt shipment from Canada was offered at 14¾c. per lb. Heavy arrivals from Japan were noted during the period and some of this material was sold ex-dock with prices irregular, although it is admitted that there were offerings as low as 14¾c. per lb.

Copper Sulphate—It was reported that distressed imported material sold at concessions early last week. Towards the close, however, prices showed no important change contrasted with those of a week ago. Imported was offered at 5½c., all positions. A cable from Hamburg quoted 11¾c. per kilo on copper sulphate. Domestic producers took little note of the increased competition with the foreign goods and prices were maintained at 6@6½c. per lb., according to the seller, etc.

Cream of Tartar—The advance in tartaric acid has had no influence on cream of tartar. Producers still quote 26½c. per lb. Imported grades are offered at 26@26½c. per lb. with a rather firm tone to cables from producing centers.

Formaldehyde—While some scattered lots might have been picked up at 14¾c., most traders refused to shade 15c., the price demanded in producing circles. Demand was routine only, but prices reflected a steady situation in raw materials.

Glaubers Salt—Buyers have been showing very little interest in the market and prices are unsteady. The nominal quotation is $1 per 100 lb. for imported offerings, but this price is decidedly weak and according to reports it was possible to do 85c. per 100 lb.

Lead Acetate—The sharp decline in pig lead offset the strength in the other basic materials and talk of a higher market seems to have vanished. Demand was up to normal for this season of the year. Leading producers continued to quote the white crystals at 13½c. per lb., in barrels. On the brown, broken, in casks, 12½c. was asked.

Sal Ammoniac—Importers continued to quote on the basis of 7c. per lb., but admitted that some material changed hands around 6¾c. The foreign markets underwent little change. Cable advices from Hamburg quoted 11c. per kilo. The duty on this commodity is 1½c. per lb.

Tin Oxide—There was an irregular market for the metal, but net changes for the week were not important enough to bring out a revision in the prices for tin oxide. Demand was limited all week, yet leading factors held out for 50c. per lb.

Alcohol Steady

Offerings of denatured alcohol were not pressing on the market and while business could not be called active, prices generally closed steady. Producers offered the No. 1 special at 38c. per gal. in drums, or at 39c. per gal. in barrels. The completely denatured, 188 proof, No. 1, held at 41c. per gal., in drums. Ethyl spirits, U. S. P., 190 proof, was available at $4.70 per gal., cooperage basis. Methanol was unchanged at $1.18 per gal. for the 95 per cent and $1.20 per gal. for the 97 per cent grade.

Canada Increases Exports of Calcium Carbide

A report from the Dominion Bureau of Statistics at Ottawa, Canada, states that there has been an important increase in exports of calcium carbide from Canada. During March outward shipments amounted to 59,994 cwt. (112 lb.), valued at $250,563.

Coal-Tar Products

Heavy Imports of Crude Naphthalene—Market Abroad Barely Steady—Spot Phenol Nominal at 55c.—Cresylic Acid Unsettled

THE movement of naphthalene into this country from foreign sources has taken on larger proportions, and this has served to take the edge off the market. Some traders even reported a slightly easier import basis for the crude. Cresylic acid was unsettled at the close and lower prices were named on scattered lots of foreign material. The decline in exchange had some influence on the situation. The announcement from Washington that the Tariff Commission has ordered an investigation into the phenol, cresylic acid and phenol resin situation led many to believe that the rates of duty on these commodities will ultimately be lowered. It is understood in trade circles that domestic producers of cresylic acid will offer no objections to a reasonable reduction in the existing tariff rates. Salicylic acid presented a firmer appearance, reflecting the strength in basic materials, but first-hands maintained prices at former levels. Demand for salicylic was routine only.

Benzene was in better request, the movement into channels situated outside of the motor fuel field improving steadily, the prices for the pure closing firm in all directions. The decline in gasoline should have little or no influence upon the benzene situation, according to producers. The output of solvent naphtha is moderate and a tight situation is reported, yet prices are not likely to change. Xylene, pure, is in a strong position because of the limited output. Demand for benzyl chloride is fair and consumers are now interested in offerings for shipment, notwithstanding the recent uplift in prices. Beta-naphthol is barely steady. Aniline oil is nominally unchanged.

Benzene — Intermediate makers showed more buying interest, and some traders reported a fair volume of orders. The demand from motor fuel quarters also picked up a little. The drop in gasoline prices had no influence upon the situation. The 90 per cent grade, held at 27@30c. per gal. in tanks or drums f.o.b. works. For the pure prices ranged from 30@33c. per gal., as to quantity and style of container.

Aniline Oil—A steady undertone featured the market and small lots changed hands on the basis of 16½c. per lb., immediate delivery. On round-lot transactions it would have been possible to do 16c. per lb., prompt and nearby delivery.

Cresylic Acid—The spot market on imported material was unsettled toward the close. Demand was routine only and there was more disposition to offer this material. The offerings from the other side were freer. Closing quotations ranged from $1.20@$1.35 per gal., as to quality, etc. Domestic makers reported a sold-up condition, with prices wholly nominal.

Beta-Naphthol - The market was barely steady, with sellers at 22½@23½c. per lb., immediate delivery. Producers, as a rule, held out for 23@23½c., the price depending upon the quantity.

Benzyl Chloride—No further price changes were made. First hands offered July shipment benzyl chloride on the basis of 45c. per lb., 95 to 97 per cent refined.

Naphthalene—Sales of flake on spot went through at 9c. per lb. For the ball the market settled at 9¼@9½c. per lb., some traders reporting business at the outside figure. The demand was good early in the week, but slackened later. The importations of crude were quite heavy and with cables no longer so firm offerings here increased. Nominal import prices on crude for shipment ranged from 3@3½c. per lb., as melting point.

Phenol — Scattered lots of U.S.P. phenol sold on spot at 55c. per lb., indicating that the market underwent scarcely any change. There was a fair inquiry for spot as well as nearby material, but the ideas of buyers were a shade under the market. The prospects for a larger supply in the near future made buyers cautious.

H-Acid—Offerings were moderate because of the restricted output, and prices held at 85@90c. for spot goods. On shipment business 80c. might have been done.

Salicylic Acid—The demand again was quiet, but prices ruled firm in all directions. Leading makers quote 47@48c. per lb. as the firm trading basis on the technical variety.

Xylene—The spot market for the pure was wholly nominal and second hands said that $1 per gal would have to be paid for outside lots. Producers have been taking on contract business in the pure at 75c. per gal.

Extend Time for Filing Export Licenses for Ruhr Trade

Unofficial advices have reached the National Council of American Importers & Traders that the time limit for filing export licenses covering shipments from the occupied sections of Germany would be extended. The recent ruling in regulations governing foreign trade with these sections of Germany was that foreign buyers, at their option, were authorized to apply for export licenses antedating Feb. 10, 1923, such applications to be filed not later than May 10. Those securing these licenses will be called upon to pay only such duties as were in effect at the time the order was placed.

Urges Rubber Growing in Philippine Islands

Harvey S. Firestone, president of the Firestone Rubber Co., in an address last Wednesday before the Chamber of Commerce of the United States urged American rubber manufacturers to take some action to bring about better conditions in the rubber industry. He stated that the Philippines offer natural advantages for growing rubber. He referred to a recent statement made by Pedro Guevara, Resident Commissioner of the Philippines, who declared that the islands have the greatest possibility in the world for the successful production of rubber.

Freight Rates on Barytes Held Unreasonable

Freight rates on barytes in carloads from Evington, Va., to South Charleston, W. Va., in the opinion of Interstate Commerce Commission Examiner Paul O. Carter, were unreasonable during a portion of 1919 and he has recommended that the carriers reimburse the Rollin Chemical Corporation for all freight charges collected to the extent that they exceeded $2.50 per ton.

Latest Quotations on Industrial Stocks

	Last Week	This Week
Air Reduction	66½	67
Allied Chem. & Dye	69¾	69⅛
Allied Chem & Dye, pfd.	109¾	110¼
Am. Ag. Chem	25⅛	25
Am. Ag. Chem., pfd.	47	46½
American Cotton Oil	12	12⅛
American Cotton Oil, pfd.	21½	25⅛
Am. Drug Synd.	5⅝	5⅝
Am. Linseed Co.	29	28⅝
Am. Linseed Co., pfd.	52	48
Am. Smelting & Refining	59⅝	60⅝
Am. Smelting & Refining, pfd	98¾	98⅞
Archer-Daniels Mid. Co., w.i.	39	39
Atlas Powder	173	175
Atlas Powder, pfd.	87½	87½
Casein Co. of Am.	*60	*60
Certain-Teed Products	44	39
Commercial Solvents A	29	28
Corn Products	128½	131⅛
Corn Products, pfd	117¼	117¾
Davison Chem.	27	27¾
Dow Chem.	40½	40⅜
Du Pont de Nemours	140	140
Du Pont de Nemours, db	88	87½
Freeport-Texas Sulphur	15⅞	15⅝
Glidden Co.	9⅝	9
Grasselli Chem	130	130
Grasselli Chem., pfd.	105	102
Hercules Powder	*107	*107
Hercules Powder, pfd.	*103½	*102½
Heyden Chem.	1¾	1⅞
Int'l Ag. Chem. Co.	*7	7
Int'l Ag. Chem. Co, pfd.	*29	29
Int'l Nickel	13½	14½
Int'l Nickel, pfd.	76½	78
Int'l Salt	*90	*90
Mathieson Alkali	49¾	49¼
Merck & Co.	85½	86
National Lead	122	122½
National Lead, pfd.	112¼	112½
New Jersey Zinc	172	165
Parke, Davis & Co.	79½	79½
Pennsylvania Salt	92⅝	92½
Procter & Gamble	*140	*140
Sherwin-Williams	*29⅞	*29⅝
Sherwin-Williams, pfd.	*102	*101
Tenn. Copper & Chem.	10⅝	10½
Union Carbide	61	61
United Drug	80	80½
U. S. Ind. Alcohol	57	58½
Va.-Car. Chem. Co.	13⅝	13¾
Va.-Car. Chem. Co., pfd.	38½	39½

*Nominal. Other quotations based on last sale.

Vegetable Oils and Fats

Lower Prices Named for Linseed, Cottonseed, Coconut, Corn and Palm Oils—China Wood Weak—Tallow 8c.

WITH no improvement in demand and general weakness in outside speculative commodity markets the tendency of prices again was downward. Prospects for ample stocks of flaxseed brought out an easier feeling in futures in the linseed oil trade and large consumers refused to take hold. Cottonseed was subjected to pressure on the decline in lard. Coconut oil was available at lower prices both here and on the Pacific coast. Corn and sesame oils were easier in sympathy with cottonseed oil, while the decline in palm oils could be traced to the weakness in tallow. Late in the week extra tallow sold down to 8c. delivered. Fish oils were neglected.

Linseed—Crushers announced a 3c. reduction in spot prices, establishing the carload quotation at $1.14 per gal., cooperage included. June delivery oil was revised to $1.12 per gal. while on July forward nominal quotations ranged from $1.03@$1.05 per gal., carload lots, cooperage basis. In the absence of any important buying futures were regarded as wholly nominal, especially in view of the fact that the prevailing price for October seed in the Duluth market permits of the production of oil at approximately 90c. per gal., based on a fairly low price for the cake. Buenos Aires quoted June shipment seed (option market) at $1.93 per bushel, a decline of almost 10c. for the week. The Argentine shipments since January 1, 1923, have reached a total of more than 28,000,000 bushels, a record quantity for 4 months. Argentine shipments to the United States since the first of the year amounted to 12,500,000 bushels. Receipts of domestic seed at Minneapolis and Duluth from September 1, 1922, to date amounted to approximately 8,200,000 bushels. With indications of a larger acreage in the United States and freer offerings from Argentina as well as India, traders seem to favor the bear side, notwithstanding the liberal increase in domestic consumption of linseed oil. Imported oil was neglected and "distressed" material sold on spot at less than $1.00 per gal. Foreign markets were lower, while easier exchange also was a market factor.

Cottonseed—Weakness in grains and lard had a depressing influence on the option market on the Produce Exchange and prices were irregular nearly all week. For a time the May position steadied on reports that a short interest was about to come in, but subsequent pressure from local bears made quite an impression on the list. The liberal hog movement surprised the longs. Cash trade in cottonseed oil and its products was routine only. The drop in tallow was a market factor. Crude cottonseed sold at 9⅝c. per lb., sellers' tanks, f.o.b. mills Texas. A round-lot of bleachable was disposed of on the basis of 10¼c., Texas common points, with rumors of one transaction as low as 10c. per lb. New crop offerings of crude could not be located, but an easy feeling prevails on prospects for a 10 per cent increase in the cotton acreage. Lard compound was lowered to the extent of ½c. per lb., establishing the carload trading basis at 13@13¼c. Prime summer yellow on spot, in barrels, settled at 11⅞@12¼c. per lb. Lard in the Chicago market was easy around 10⅝c., May option.

China Wood Oil—Several bulk shipments of China wood oil arrived at New York last week. The spot market was easier on resale offerings and it would have been possible to shade 35c. On nearby oil there were sellers at 32@34½c. per lb. On the Pacific coast there were offerings of June-July oil at 25c., tank car basis. Prices were considered too high by varnish makers and no important buying took place.

Coconut Oil—Prices weakened in all quarters until the market reached 8½c. asked, coast, and 8⅞@9c. per lb., New York, basis sellers' tanks. The decline of ¼c. failed to arouse buying interest and at the close prices were little more than nominal. Copra was offered at 5½c., c.i.f. New York, shipment from Manila.

Corn Oil—Crude corn oil sold at 10c., sellers' tanks, f.o.b. point of production in the middle west, a decline of ½c. for the week.

Palm Oil—No buying interest was shown in futures and another drop in tallow brought out an easier feeling. Lagos for shipment from abroad, May-June, closed at 7⅞@8c. per lb. Niger for shipment was offered at 7⅝c. per lb., with no buyers.

Sesame Oil—Spot oil, refined, was lowered to 11⅞@12c. per lb., cooperage basis, without arousing any business of consequence. On forward shipments the market settled at 11⅜c., c.i.f. New York.

Soya Bean Oil—The coast market was easier, May-June-July closing at 10¼@10⅜c. per lb., sellers' tanks, duty paid. Demand was quiet. The output of soya beans in Manchuria is estimated at 89,000,000 bushels, a normal crop.

Fish Oils—The market for crude menhaden futures was a dull affair, reflecting unsettlement in competing oils and facts. The producers continued to name 50c. as the nominal quotation, tank car basis, f.o.b. factory. Newfoundland cod oil was nominally unchanged at 70c. per gal., in barrels, spot New York.

Tallow and Greases—The sale of 5 cars of extra special tallow was reported at 8c. per lb., delivered, a decline of ½c. in less than 10 days. City special settled nominally at 7⅜c. At the weekly London auction 1,560 casks were offered and 554 casks were sold at a decline of 6 pence. Yellow grease in the local trade was lowered to 7⅜c. Oleo stearine closed at 10¼c. asked. No. 1 oleo oil was quiet at 14¼c. per lb.

Miscellaneous Materials

Casein—Importations continued at a healthy rate and with domestic offerings on the increase the market presented an unsettled appearance. Leading domestic producers offered the technical grades at 22½@25c. per lb. Demand was described as fair.

Glycerine—Refiners established the market for chemically pure glycerine at 17½c. per lb. in drums, carload lots, a decline of ½c. from the nominal quotation of a week ago. There was some misunderstanding in connection with the price during the week, as an outside party came out with a quotation of 17c. The 17c. basis was not recognized by leaders in the trade. In some directions it was said that quite a number of contract orders went through. Chicago quoted c.p. at 17½c. per lb. in drums, carload lots. Dynamite settled at 16¼c. per lb. in drums, carload lots, f.o.b. point of production, but trading continued quiet. Crude soap-lye, basis 80 per cent, loose, held at 11@11¼c. per lb., New York territory. One car was traded in early last week at 10⅞c. Saponification, 88 per cent, held at 12½c., loose, with no sales.

Shellac—Sentiment generally was bearish and with trading inactive prices at the close were more or less nominal. T. N. on spot closed at 64@66c., as to quantity and seller. Superfine orange was offered at 70c. on spot and 68c. for shipment. Bleached, bonedry, closed at 78@80c. per lb.

Naval Stores—Another sharp downward revision in prices occurred in the market for turpentine, which, naturally enough, did not encourage buyers to take hold. Spirits of turpentine settled at $1.08@$1.10 per gal., a drop of 20c. per gal. in one week. The new crop offerings increased in all directions. Rosins also went off, registering declines of 10@15c. per bbl.

Lithopone—With no change in the barytes situation the market held on a fairly steady basis. The arrival of 1,580 casks of lithopone from Antwerp was reported here last week. Domestic makers quote 7@7¼c. per lb., the inside figure obtaining for round-lots in bags.

White Lead—The decline in pig lead caused much comment in trade circles and led many to look for a lower trading basis in the lead pigments. But, up to the close, corroders announced no changes. The metal closed the week at 7¼c., New York, which compares with 7⅝c. a week ago. The decline was attributed to the developments in the European situation. Standard dry white lead (basic carbonate) held at 9⅝c. per lb., carload lots, in casks.

Imports at the Port of New York

May 4 to May 10

ACIDS — 82 dr. cresylic, Rotterdam, Lunham & Moore, 147 demijohns formic, Hamburg, Innis, Speiden & Co., 74 dr. formic, Hamburg, Order; 300 bl. stearic, Rotterdam, Strohmeyer & Arpe Co, 10 cs. stearic, Rotterdam, Parsons & Plymouth Organic Lab.; 18 dr. cresylic, Liverpool, W. E. Jordan & Bros.; 65 dr. cresylic, Liverpool, Order; 134 keg solid carbolic, Liverpool, Order, 139 carboys formic, Rotterdam, R W Greef & Co.; 76 dr cresylic, Glasgow, Order, 500 csk. citric, Palermo, Order, 83 bbl citric, Palerma, F. Vitrano, 44 bbl. tartaric, Palermo, F. Vitrano

AMMONIUM—200 dr., Hamburg Hans Hinrichs Chem. Corp; 45 csk. sulphate, Hamburg, Harriman Nat'l Bank, 20 csk. carbonate, Liverpool, Brown Bros & Co., 20 cs. chloride, Liverpool, Wing & Evans

AMYL ALCOHOL—7 cs., Hamburg, Hensel, Bruckmann & Lorbacher.

ARSENIC—83 csk, Rotterdam, Lunham & Moore; 8 keg, London, Order, 51 csk., Hamburg, Roessler & Hasslacher Chem Co.; 100 csk., Hamburg, J. Marcus, Inc.; 52 csk. and 50 cs., Rotterdam, Order, 300 cs., Kobe, G. F. Taylor & Co., 250 cs., Kobe, H. Sundheimer, Inc, 100 cs, Kobe, S. L. Jones & Co; 59 cs., Kobe, J D Lewis, 75 cs., Kobe, China-Am. Tobacco & Trading Co.; 288 cs., Kobe, S. W. Bridges & Co., 712 cs., Kobe, Order; 800 cs, Yokohama, Chapman Chem. Eng. Co, 229 bbl, Antwerp, Order.

BARIUM CHLORIDE—51 csk., Hamburg, A. Klipstein & Co

BARIUM NITRATE—27 csk, Hamburg A. Klipstein & Co.

BARIUM PEROXIDE—19 csk, Hamburg, W A Brown & Co.

BRONZE POWDER—12 cs, Bremen, E F. Drakenfeld & Co.

CALCIUM CHLORIDE—859 bbl, Hamburg, Irving Bank-Col. Trust Co., 336 dr., Hamburg, Pfaltz & Bauer; 96 bbl, Hamburg, Order

CAMPHOR—200 cs, Hong Kong, Suzuki Co.; 100 cs, Kobe, Nat'l Park Bank

CASEIN—400 bg, London, Brit. Bank South America, 400 bg., Hamburg, Order; 200 bg Rotterdam, N. Y Trust Co., 50 bg., Auckland, Asia Banking Corp.; 50 sk., Wellington, Equitable Trust Co., 23 bg., Hamburg, Bank of Manhattan Co.

CHALK—500 bg, Antwerp, American Express Co, 1,500 bg, Antwerp, Irving Bank-Col. Trust Co.; 400 bg., Antwerp, Reichard-Coulston, Inc., 300 bg., Antwerp, B. Crystal & Co

CHLOROFORM—3 cs, Hamburg, Morgenstern & Co.

CHEMICALS—254 bbl., Antwerp, Roessler & Hasslacher Chem. Co., 63 csk, Bremen, Hummel & Robinson, 102 csk., Bremen, Am. Exchange Nat'l Bank, 61 cs, Hamburg, Elmer & Amend; 10 cs, Hamburg, Merck & Co

CHINA CLAY—2,766 tons, Fowey, Moore & Munger, 1,938 tons, Fowey, Eng China Clay Sales Co.; 500 tons, Fowey, Hammill & Gillespie.

COPPER SULPHATE—201 csk., Antwerp, Order

COLORS—3 cs. aniline, Southampton, Irving Bank-Col Trust Co.; 10 csk. dry, Southampton, Order; 2 csk. dry, Bremen, H. G. Lange & Co, 30 pkg., Rotterdam, H. A. Metz & Co, 6 bbl, Rotterdam, Wetterwald & Pfister, 11 csk. aniline, Rotterdam, B. Bernard, 7 csk. do., Rotterdam, F. Donners, 3 csk do, Rotterdam, Order; 4 csk., Hamburg, Kutroff, Pickhardt & Co.; 15 kg. aniline, Hamburg, Franklin Imp. & Export Co, 26 csk. aniline, Genoa, Am. Exchange Natl Bank; 33 csk. do., Genoa, Irving Bank, 12 bbl., Havre, Carbic Color & Chem. Co, 35 csk, Havre, Geigy Co.

DEXTRINE—100 bg., Rotterdam, Spier, Ilmmons Co.; 50 bg., Rotterdam, Order.

DEGRAS—90 bbl., Antwerp, Lunham & Moore; 29 csk, Bremen, C. H. Hilbert; 50 bbl., Bremen, Pfaltz & Bauer.

DYES—78 pkg., Antwerp, Am. Exchange Nat'l Bank; 3 csk., Southampton, Am. Exchange Nat'l Bank

FERTILIZER—1,370 bg. nitrogenious, Hamburg, Hollingshurst & Co.; 336 bg., London, Carter's Tested Seeds, Inc.

FERROCHROME—500 cs., Hamburg, Hardy & Rupertl.

FERRIC CHLORIDE—38 bbl., Hamburg, Mallinckrodt Chem. Works.

FUSEL OIL—22 dr., Rotterdam, Caldwell & Co; 16 dr., Rotterdam, Order; 31 dr., Hamburg, Maas & Waldstein; 18 csk., Hamburg, Guaranty Trust Co.; 117 dr., Hamburg, Order.

GAMBIER—521 cs, Singapore, Order.

GLAUBERS SALT—200 bbl., Hamburg, Order

GLYCERINE—125 dr, Buenos Aires, Thornett & Fehr; 305 csk., Marseilles, Order, 28 dr., London, Marx & Rawolleo

GUMS—1,250 bg. arabic, Sudan, Order; 150 bg arabic, Sudan, Anglo-Egyptian Bank, 64 bg. damar, Singapore, Paterson, Boardman & Knapp; 128 bg damar and 50 bg copal, Singapore, L. C Gillespie & Sons, 256 pkg damar and 64 pkg. copal, Singapore, Order; 20 bg copal, Manila, Order, 38 cs. tragacanth, London, Thurston & Braidich; 182 bg. copal, Singapore, Baring Bros & Co.; 172 bg copal, Singapore, Irving Bank-Col. Trust Co; 500 pkg. damar, Singapore, Order; 23 bg. sandrac, London, G. H. Lincks; 259 pkg kauri, Auckland, Brown Bros. & Co., 119 cs. do., Auckland, Chemical Nat'l Bank; 503 cs do., Auckland, J D. Lewis, 339 cs. do., Auckland, Irving Bank-Col. Trust Co., 75 cs do., Auckland, Guaranty Trust Co., 125 cs do, Auckland, L. C. Gillespie & Sons, 637 sks do., Auckland, Am Foreign Banking Corp, 657 pkg. do., Auckland, Order 300 bg yacca, Adelaide, W. Schall & Co., 100 cs damar, Batavia, Bank of America, 1,000 cs damar, Batavia, Nat'l City Bank, 200 cs. damar, Batavia, Central Union Trust Co., 210 bg damar, Singapore, Baring Bros. & Co.; 385 bg damar, Singapore, Kidder, Peabody & Co., 70 bg do, Singapore, L. C Gillespie & Son; 50 bg copal, Singapore, Order, 462 bg. copal, Singapore, Baring Bros. & Co, 288 bg copal, Singapore, France, Campbell & Darling, 243 bg. copal, Singapore, Order.

HYDROGEN PEROXIDE—64 cs, Antwerp, Order

IODINE—138 bbl., Iquique, Nash, Watjen & Bangs

IRON OXIDE—77 csk., Liverpool, Reichard-Coulston, Inc, 10 csk., Liverpool, J H Rhodes & Co, 72 csk., Liverpool, E M & F. Waldo.

IRON SULPHATE—100 bbl, Antwerp, Order.

IRON SULPHIDE—44 bbl., Antwerp, Truempy, Faesy & Besthoff.

LEAD ARSENATE—451 csk, Hamburg, Order

LITHOPONE—1,500 csk, Antwerp, B. Moore & Co., 80 csk., Antwerp, E. M. & F Waldo.

MAGNESITE—8,400 bg, Madras, Order; 83 csk. calcined, Rotterdam, Order; 105 csk., Rotterdam, Speiden, Whitfield Co.; 1,085 pkg., Rotterdam, Innis, Speiden & Co, 1,250 bg. and 152 bbl calcined, Rotterdam, Innis, Speiden & Co.

MAGNESIUM—72 bbl. chloride, Hamburg, Speiden, Whitfield & Co.

MANGROVE BARK—4,000 pkg, Singapore, Order.

MENTHOL—75 cs., Kobe, S W. Bridges & Co, 35 cs, Kobe, F A. Cundill & Co, 25 cs., Kobe, Stanley, Jordan & Co.

NAPHTHALENE—285 pkg., Rotterdam, Lunham & Moore; 250 bg., Hamburg, White Tar Co.; 616 bg, Hamburg, R. W. Greef & Co.; 441 bg., Hamburg, Calco Chem Co., 300 bg., Rotterdam, W C. Jordan & Bros; 3,443 bg., Rotterdam, Order

NUX VOMICA—341 bg., Cocanada, Order.

OCHER—125 csk., Marseilles, J. L. Smith & Co; 90 csk., Marseilles, F. B. Vandegrift & Co.; 290 csk., Marseilles, Am. Exchange Nat'l Bank; 24 bbl., Marseilles, Osborn & Co.

OILS—Cod—300 csk., St. Johns, National Oil Products Co.; 330 csk., St. Johns, R Badcock & Co.; 260 csk., St. Johns, Bowring & Co.; 200 csk., Bergen, Fidelity Union Trust Co. **Castor**—140 bbl., Antwerp, Order. **China Wood**—59 csk., Rotterdam, Order; 25 dr., London, A. A. Stillwell & Co; 760 tons (bulk), Hankow, Balfour, Williamson & Co.; 1,557,366 lb. in bulk, Hong Kong, Mitsui & Co. **Coconut**—107 pipes, Cochin, Order; 875 tons (bulk) Manila, Spencer Kellogg & Sons. **Linseed**—100 bbl, London, Order; 581 bbl., Rotterdam, Nat'l Lead Co.; 286 bbl., Rotterdam, Smith, Weihmann Oil Co.; 145 bbl., Rotterdam, Lockwood Co.; 574 bbl, Rotterdam, W. Benkert Co.; 143 bbl., Rotterdam, Meteor Products Co.; 171 bbl., Rotterdam, Order; 598 bbl., London, W. R. Grace & Co; 599 bbl., London, Balfour, Williamson & Co. **Olive Oil Foots**—100 bbl., Seville, Nat'l City Bank; 145 csk., Leghorn, Am. Co. for Int'l Comm.; 100 bbl., Naples, F. Boehm, Ltd.; 400 bbl., Naples, Order. **Palm**—201 csk., Rotterdam, African & Eastern Trading Co.; 100 csk., Liverpool, Fourth St., Nat'l Bank; 306 csk., Liverpool, D. Bacon; 294 csk., Liverpool, Niger Co., 110 csk., Liverpool, Order; 128 csk., Hamburg, African & Eastern Trading Corp.; 258 csk., Hamburg, Order; 79 bbl., Belawan Deli, Nat'l City Bank. **Palm Kernel**—59 csk., Liverpool, Niger Co. **Perilla**—400 bbl., Darien, Balfour, Williamson & Co, 100 bbl., Kobe, Mitsui & Co.; 150 bbl., Kobe, Bank of N. Y. **Sesame**—291 bbl., Rotterdam, Nat'l City Bank.

OIL SEEDS—Castor—42,973 bg., Cocanada, Order; 2,296 bg., Para, Central Union Trust Co; 1,782 bg., Santos, Bank of N. Y & Trust Co. **Linseed**—69,018 bg., Buenos Aires, Order; 8,700 bg., Rosario, Order, 26,764 bg., Rosario, L. Dreyfus & Co.; 16,609 bg., Buenos Aires, Order; 124,944 bg., Buenos Aires, Order; 8,111 tons, Buenos Aires; L. Dreyfus & Co.; 17,451 bg., Rosario, Order; 6,127 tons, Rosario, Spencer Kellogg & Sons.

PITCH—12 bbl., Liverpool, Order.

PYRIDINE—10 dr., Rotterdam, P. E Falkingham; 5 dr do., Rotterdam, Meteor Products Co.; 24 dr., Rotterdam, Lunham & Moore.

POTASSIUM SALTS—100 dr. permanganate, Rotterdam, J. D. Lewis; 2,000 bg. muriate and 50 bbl. sulphate, Bremen, A. Vogel; 88 csk. nitrate, E. Suter & Co.; 10 dr. permanganate, Hamburg, Equitable Trust Co., 648 dr. caustic, Hamburg, A. Klipstein & Co; 29 csk. salts, Hamburg, A Klipstein & Co.; 93 dr caustic, Hamburg, Order; 43 csk. carbonate, Hamburg, Order; 1,025 pkg. cholrate, Marseilles, Asia Banking Corp.; 250 bbl. chlorate, Marseilles, Order, 100 dr. perchlorate, Marseilles, Order; 49 csk. prussiate, Liverpool, Order; 100 dr permanganate, Hamburg, Order; 4,500 bbl. chlorate, Hamburg, Order, 30 csk. metabisulphite, Hamburg, Order; 3,000 bg. muriate and 3,000 bg. sulphate, Hamburg, Order; 2,250 bg. muriate, Antwerp, Soc Comm. des Potasses de'Alsace, 1,250 csk. chlorate, Antwerp, Order, 225 csk do., Marseilles, Order.

QUICKSILVER—60 fl., Vera Cruz, Poillon & Poirier; 1,000 fl., Alicante, Haas Bros, 50 fl, Genoa, Order.

QUEBRACHO—25,053 bg., Buenos Aires, Tannin Corp.

SHELLAC—590 cs., Hangkok, Order, 300 bg., London, Order; 29 cs., Hamburg, A. Murphy & Co.; 25 bg, Hamburg, Irving Bank-Col. Trust Co.

SODIUM SALTS—7,503 bg. nitrate, Iquique, Wessel, Duval & Co.; 10,355 bg, Iquique, E I du Pont de Nemours & Co.; 93 bbl., phosphate, Antwerp, A. Klipstein & Co.; 62 dr., sulphite Hamburg, Order; 150 cs., chlorate, Genoa, C. W. Campbell; 12 csk., prussiate, Liverpool, Order; 200 csk. hyposulphite, Hamburg, Order; 160 bg. silicate, Hamburg, Order; 216 csk. nitrite, Brevik, Order, 4,105 bg. synthetic nitrate, Brevik, Order; 7,815 bg. nitrate, Antofagasta, W R. Grace & Co.; 9,851 bg. nitrate, Iquique, W. R Grace & Co.

SULPHUR—15 csk. refined, Liverpool, McKesson & Robbins; 6 csk. do., Liverpool, Mallinckrodt Chem. Works; 40 cs. refined, Hamburg, Order.

SUMAC—1,050 bg., Palermo, Nat'l City Bank, 910 bg., Palermo, Order.

TALLOW—147 csk., Buenos Aires, Bank of the Manhattan Co; 278 tc., Montevideo, Battery Park Nat'l Bank; 161 csk., Buenos Aires, Swift & Co.; 152 pkg, Montevideo, Swift & Co.

TARTAR—276 bg., Seville, Order; 220 bg., Marseilles, C. Pfizer & Co.; 427 bg., Marseilles, Tartar Chem. Co.; 306 bg., Alicante, Tarter Chem. Co.

THORIUM NITRATE—50 cs, Hamburg, American, Kruger & Toll Corp.

TUMERIC—507 bg, Cochin, Order: 29 bg, Aleppey, Darragh, Small & Co.

VEGETABLE TALLOW—500 pkg., Hankow, Am Linseed Co.

WAXES—87 bg bees, Antwerp, Elbert & Co.; 222 pkg. carnauba, Ceara, Lazard Freres; 222 pkg do. Ceara, Nat'l Park Bank; 800 bg paraffine, London, Asiatic Petroleum Co.; 283 bg. carnauba, Para, Int'l Acceptance Bank; 177 bg. do, Para, Lazard Freres; 967 bg do, Para, Nat'l City Bank; 167 bg do, Para, Strohmeyer & Arpe; 910 bg do, Para, Order.

WHITING—2,000 bg, Antwerp, Brooklyn Trust Co.

ZINC CHORIDE—138 csk, Hamburg, Order 17 bbl. Hamburg, Order.

ZINC OXIDE—100 csk, Rotterdam, E. M. & F. Waldo.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available. In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb	$0 38	
Acetone, drums	lb.	.25 -	.25½
Acid, acetic, 28%, bbl.	100 lb.	3 38 -	3 50
Acetic, 56%, bbl.	100 lb.	6 75 -	7 00
Glacial, 99½%, bbl.	100 lb.	12 00 -	12.50
Boric, bbl.	lb	.10½-	
Citric, kegs	lb.	.49 -	.52
Formic, 85%	lb.	.14 -	.16
Gallic, tech.	lb	.45 -	.50
Hydrofluoric, 52%, carboys	lb	.12 -	.12½
Lactic, 44%, tech., light, bbl.	lb	.11½-	.12
22% tech, light, bbl.	lb	.05½-	.06
Muriatic, 18° tanks	100 lb	.90 -	1 00
Muriatic, 20°, tanks,	100 lb.	1 00 -	1 10
Nitric, 36°, carboys	lb	.04½-	.05
Nitric, 42°, carboys	lb	.06 -	.06½
Oleum, 20%, tanks	ton	18 50 -	19 00
Oxalic, crystals, bbl.	lb.	.13½-	.13¾
Phosphoric, 50%, carboys	lb	.07½-	.08½
Pyrogallic, resublimed	lb	1 50 -	1 60
Sulphuric, 60°, tanks	ton	9 50 -	11 00
Sulphuric, 60°, drums.	ton	13 00 -	14 00
Sulphuric, 66°, tanks	ton	16 00 -	16 50
Sulphuric, 66° drums	ton	20.00 -	21.00
Tannic, U S P, bbl	lb	.65 -	.70
Tannic, tech, bbl	lb	.45 -	.50
Tartaric, imp. crys, bbl	lb	.37 -	
Tartaric, imp, powd, bbl.	lb	.37 -	
Tartaric, domestic, bbl.	lb.	.37½-	
Tungstic, per lb	lb	1.10 -	1.20
Alcohol, butyl, drums, f o b works	lb.	.26 -	.28
Alcohol ethyl (Cologne spirit), bbl.	gal.	4.75 -	4 95
Ethyl, 190 p'f U S P, bbl	gal	4.70 -	
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 190 proof			
No. 1, special bbl	gal	.39 -	.41
No. 1, special, dr	gal	.33 -	.35
No. 1, 188 proof, bbl	gal	.40 -	.42
No 1, 188 proof, dr	gal	.34 -	.36
No 5, 188 proof, bbl	gal	.38 -	.40
No 5, 188 proof, dr	gal.	.32 -	.34
Alum, ammonia, lump, bbl	lb.	.03½-	.03¾
Potash, lump, bbl.	lb	.02¾-	.03¼
Chrome, lump, potash, bbl	lb	.05½-	.05¾
Aluminum sulphate, com., bags	100 lb.	1 50 -	1 65
Iron free bags	lb	.02½-	.02¾
Aqua ammonia, 26°, drums	lb	.06½-	.07¼
Ammonia, anhydrous, cyl	lb	.30 -	.30½
Ammonium carbonate, powd casks, imported	lb	.09½-	.10
Ammonium carbonate, powd domestic, bbl	lb	.13 -	.14
Ammonium nitrate, tech., casks	lb.	.10 -	.11
Amyl acetate tech, drums	gal	3 50 -	3 75
Arsenic, white, powd, bbl	lb	.14½-	.15
Arsenic, red, powd, kegs	lb	.14½-	.14¾
Barium carbonate, bbl.	ton	78 00 -	80 00
Barium chloride, bbl.	ton	90.00 -	95.00
Barium dioxide, drums	lb.	.18 -	.18½
Barium nitrate, casks		.08 -	.08½
Barium sulphate, bbl.	lb.	.04 -	.04½
Blanc fixe, dry, bbl.	lb.	.04 -	.04½
Bleaching powder, f.o.b. wks, drums	100 lb.	1.90 -	....
Spot N. Y. drums	100 lb	2.40 -	
Borax, bbl.	lb.	.05½-	.05¾
Bromine, cases	lb	.28 -	.30
Calcium acetate, bags	100 lb	4.00 -	4.05
Calcium arsenate, dr.	lb.	.17 -	.18
Calcium carbide, drums	lb.	.05½-	.05¾
Calcium chloride, fused, drums	ton	22.00 -	23 00
Gran. drums	ton	28.00 -	30 00
Calcium phosphate, mono, bbl.	lb.	.06½-	.07
Camphor, cases	lb.	.86 -	.88
Carbon bisulphide, drums	lb.	.07 -	.07½
Carbon tetrachloride, drums	lb.	.09½-	.10
Chalk, precip.—domestic, light, bbl.	lb.	.04½-	.04¾
Domestic, heavy, bbl.	lb.	.03½-	.03¾
Imported, light, bbl.	lb.	.04½-	.05
Chlorine, liquid, cylinders	lb.	.06 -	.06½
Chloroform, tech., drums	lb.	.35 -	.38
Cobalt oxide, bbl.	lb.	2 10 -	2.25
Copperas, bulk, f.o.b. wks.	ton	19 00 -	20.00
Copper carbonate, bbl.	lb.	.19 -	.20
Copper cyanide, drums	lb.	.47 -	.50
Copper sulphate, crys., bbl.	100 lb.	6 00 -	6.25
Cream of tartar, bbl.	lb.	.25½-	.26½
Epsom salt, dom., tech., bbl.	100 lb.	1 90 -	2.15
Epsom salt, imp., tech., bags	100 lb.	1.00 -	1.15
Epsom salt, U.S.P., dom., bbl.	100 lb.	2.50 -	2.60
Ether, U.S.P., drums	lb.	.13 -	.15
Ethyl acetate, com., 85%, drums	gal.	.80 -	.85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 -	1.00
Formaldehyde, 40%, bbl	lb.	$0.14½-	$0.15½
Fullers earth—imp, powd., net	ton	30 00 -	32 00
Fusel oil, ref., drums	gal	3 55 -	4.05
Fusel oil, crude, drums	gal	2 50 -	2 60
Glaubers salt, wks, bags.	100 lb	1 20 -	1 40
Glaubers salt, imp, bags	100 lb	.85 -	.95
Glycerine, c p, drums extra	lb	.17¼-	
Glycerine, dynamite, drums	lb	.16½-	.16¾
Glycerine, crude 80%, loose	lb	.11	.11¼
Iodine, resublimed	lb	4 55 -	4 65
Iron oxide, red, casks	lb	.12 -	.18
Lead:			
White, basic carbonate, dry, casks	lb.	.09¼-	.10
White, basic sulphate, casks	lb	.09½-	....
White, in oil, kegs	lb	.12¼-	.14
Red, dry, casks	lb	.11¼-	.12
Red, in oil, kegs	lb	.13½-	.15
Lead acetate, white crys, bbl	lb	.13½-	.14
Brown, broken, casks	lb	.12½-	
Lead arsenate, powd, bbl	lb	.23 -	.24
Lime-Hydrated, bbl.	per ton	16 80 -	17 00
Lime, Lump, bbl	280 lb	3.63 -	3.65
Litharge, comm, casks	lb	.10¾-	.11
Lithophone, bags	lb	.07 -	.07¼
in bbl	lb	.07 -	.07¾
Magnesium carb, tech, bags	lb	.08 -	.08½
Methanol, 95%, bbl	gal.	1.18 -	1 20
Methanol, 97%, bbl	gal	1.20 -	1.22
Nickel salt, double, bbl	lb	.10½-	....
Nickel salts, single, bbl.	lb.	.11½-	
Phosgene		.60 -	.75
Phosphorus, red, cases	lb.	.35 -	.40
Phosphorus, yellow, cases	lb	.30 -	.35
Potassium bichromate, casks	lb.	.11¼-	.11½
Potassium bromide, gran, bbl	lb	.19 -	.20
Potassium carbonate, 80-85%, calcined, casks.	lb.	.06¼-	.07½
Potassium chlorate, powd.	lb	.07½-	.08
Potassium cyanide, drums	lb	.45 -	.50
Potassium, first sorts, cask	lb.	.09	.09½
Potassium hydroxide (caustic potash) drums	lb	.08½-	.09
Potassium iodide, cases	lb.	3 65 -	3 75
Potassium nitrate, bbl.	lb.	.06¼-	.07½
Potassium permanganate, drums	lb.	.20 -	.21
Potassium prussiate, red, casks	lb.	.70 -	.72
Potassium prussiate, yellow, casks	lb	.36½-	.37
Salammoniac, white, gran., casks, imported	lb.	.07 -	.07½
Salammoniac, white, gran, bbl., domestic	lb.	.07¾-	.08
Gray, gran., casks	lb.	.08 -	.09
Salsoda, bbl.	100 lb.	1.20	1 40
Salt cake (bulk)	ton	26 00 -	28.00
Soda ash, light, 58% flat, bags, contract	100 lb.	1 60 -	1.67
Soda ash, light, basis, 48%, bags, contract, f.o.b. wks.	100 lb.	1.20 -	1 30
Soda ash, light, 58%, flat, bags, resale	100 lb.	1.75 -	1.80
Soda ash, dense, bags, contract, basis 48%	100 lb.	1.17½-	1.20
Soda ash, dense, in bags, resale	100 lb.	1 85 -	1 90
Soda, caustic, 76%, solid, drums, f a.s.	100 lb.	3.30 -	3.40
Soda, caustic, basis 60%, wks., contract	100 lb.	2 50 -	2.60
Soda, caustic, ground and flake, contracts	100 lb.	3.80 -	3.90
Soda, caustic, ground and flake, resale	100 lb.	3.72½-	..
Sodium acetate, works, bags	lb.	.05½-	.06¼
Sodium bicarbonate, bbl.	100 lb.	2.00 -	2.50
Sodium bichromate, casks	lb.	.08¼-	.08½
Sodium bisulphate (niter cake)	ton	6.00 -	7.00
Sodium bisulphite, powd., U.S.P., bbl.	lb.	.04¼-	.04½
Sodium chlorate, kegs	lb.	.06¼-	.07
Sodium chloride	long ton	12.00 -	13.00
Sodium cyanide, cases	lb.	.20 -	.23
Sodium fluoride, bbl.	lb.	$0.09½-	$0 10
Sodium hyposulphite, bbl	lb.	.02½-	.03
Sodium nitrite, casks	lb.	.08 -	.08½
Sodium peroxide, powd., cases	lb.	.28 -	.30
Sodium phosphate, dibasic, bbl.	lb.	.03½-	.04
Sodium prussiate, yel. drums	lb	.17½-	.17¾
Sodium silicate (40°, drums)	100 lb.	.80 -	1.25
Sodium silicate (60°, drums)	100 lb.	2.00 -	2.25
Sodium sulphide, fused, 60-62% drums.	lb.	.04½-	.04¾
Sodium sulphite, crys., bbl.	lb	.03½-	.03¾
Strontium nitrate, powd, bbl.	lb	.12½-	.13
Sulphur chloride, yel drums.	lb	.04½-	.05
Sulphur, crude	ton	18.00 -	20.00
At mine, bulk	ton	16 00 -	18.00
Sulphur, flour, bag.	100 lb	2 25 -	2.35
Sulphur, roll, bag	100 lb.	2.00 -	2.10
Sulphur dioxide, liquid, cyl.	lb.	.08 -	.08½
Talc—imported, bags	ton	30 00 -	40.00
Talc—domestic powd, bags.	ton	18 00 -	25.00
Tin bichloride, bbl	lb.	.12½-	.13¾
Tin oxide, bbl	lb.	.50 -	....
Tin crystals, bbl.	lb	.35½-	.36
Zinc carbonate, bags.	lb.	.14 -	.14½
Zinc chloride, gran, bbl.	lb.	.06 -	.07
Zinc cyanide, drums.	lb.	.37 -	.38
Zinc oxide, lead free, bbl.	lb.	.08 -	.08½
5% lead sulphate, bags	lb	.07½-	....
10 to 35 % lead sulphate, bags	lb	.07 -	.....
French, red seal, bags	lb.	.09¼-	.....
French, green seal, bags	lb	.10¼-	.....
French, white seal, bbl	lb	.12 -	.....
Zinc sulphate, bbl.	100 lb	2.50 -	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb	$0.65 -	$0.80
Alpha-naphthol, ref, bbl	lb.	.75 -	.90
Alpha-naphthylamine, bbl.	lb.	.35 -	.37
Aniline oil, drums	lb.	.16 -	.16½
Aniline salts, bbl	lb.	.24 -	.25
Anthracene, 80%, drums.	lb.	.75 -	1.00
Anthracene, 80%, imp, drums, duty paid	lb.	.70 -	.75
Anthraquinone, 25%, paste, drums	lb	.70 -	.75
Benzaldehyde U.S.P., carboys	lb	1 40 -	1.45
tech, drums	lb	.75	.80
Benzene, pure, water-white, tanks and drums	gal	.30 -	.32
Benzene, 90%, tanks & drums	gal.	.27 -	.30
Benzene, 90%, drums, resale.	gal.	.30 -	.33
Benzidine base, bbl.	lb	.85 -	.90
Benzidine sulphate, bbl.	lb.	.70 -	.75
Benzoic acid, U.S.P., kegs	lb.	.72 -	.75
Benzoate of soda, U.S.P., bbl.	lb.	.57 -	.65
Benzyl chloride, 95-97%, ref, drums	lb.	.45 -	
Benzyl chloride, tech., drums	lb.	.30 -	.35
Beta-naphthol, subl, bbl.	lb.	.55 -	.60
Beta-naphthol, tech., bbl.	lb.	.22½-	.23
Beta-naphthylamine, tech.	lb.	.80 -	.90
Carbazol, bbl.	lb.	.75 -	.90
Cresol, U S P., drums	lb.	.25 -	.29
Ortho-cresol, drums	lb.	.28 -	.30
Cresylic acid, 97%, resale, drums	gal.	1 30 -	
95-97%, drums, resale	gal.	1.20 -	1.25
Dichlorbenzene, drums	lb.	.07 -	.09
Diethylaniline, drums	lb.	.50 -	.60
Dimethylaniline, drums	lb.	.42 -	.43
Dinitrobenzene, bbl	lb.	.19 -	.20
Dinitroclorbenzene, bbl.	lb.	.22 -	.23
Dinitronaphthalene, bbl.	lb.	.30 -	.32
Dinitrophenol, bbl.	lb.	.35 -	.40
Dinitrotoluene, bbl	lb.	.20 -	.22
Dip oil, 25%, drums	gal.	.25 -	.30
Diphenylamine, bbl.	lb.	.50 -	.52
H-acid, bbl.	lb.	.82 -	.90
Meta-phenylenediamine, bbl.	lb.	1.00 -	1.05
Michlers ketone, bbl.	lb.	3.00 -	3.50
Monochlorbenzene, drums	lb.	.08 -	.10
Monoethylaniline, drums	lb.	.95 -	1.10
Naphthalene, flake, bbl.	lb.	.09 -	.09½
Naphthalene, balls, bbl.	lb.	.09¾-	.10¼
Naphthionate of soda, bbl.	lb.	.58 -	.65
Naphthionic acid, crude, bbl.	lb.	.55 -	.60
Nitrobenzene, drums	lb.	.10 -	.12
Nitro-naphthalene, bbl.	lb.	.30 -	.35
Nitro-toluene, drums	lb.	.15 -	.17
N-W acid, bbl.	lb.	1 25 -	1.30
Ortho-amidophenol, kegs	lb.	2.30 -	2.35
Ortho-dichlorbenzene, drums	lb.	.17 -	.20
Ortho-nitrophenol, bbl.	lb.	.90 -	.92
Ortho-nitrotoluene, drums	lb.	.10 -	.12
Ortho-toluidine, bbl.	lb.	.14 -	.15
Para-amidophenol, base, kegs	lb.	1.20 -	1.30
Para-amidophenol, HCl, kegs	lb.	1.25 -	1.35
Para-dichlorbenzene, bbl.	lb.	.17 -	.20
Paranitraniline, bbl.	lb.	.74 -	.75
Para-nitrotoluene, bbl.	lb.	.60 -	.65
Para-phenylenediamine, bbl.	lb.	1.45 -	1.50
Para-toluidine, bbl	lb.	.95 -	.98
Phthalic anhydride, bbl.	lb.	.35 -	.38
Phenol, U.S.P., drums	lb.	.55 -	.57
Picric acid, bbl.	lb.	.20 -	.22
Pyridine, dom., drums	gal.	nominal	

Pyridine, imp., drums	gal.	$2.50 –	$2.75
Resorcinol, tech., kegs	lb.	1.40 –	1.50
Resorcinol, pure, kegs	lb.	2.00 –	2.25
R-salt, bbl.	lb.	.55 –	.60
Salicylic acid, tech., bbl.	lb.	.47 –	.48
Salicylic acid, U.S.P., bbl.	lb.	.50 –	.52
Solvent naphtha, water-white, drums	gal.	.37 –	.40
Crude, drums	gal.	.24 –	
Sulphanilic acid, crude, bbl.	lb.	.18	.20
Thiocarbanilide, kegs	lb.	.35 –	.38
Toluidine, kegs	lb.	1.20 –	1.30
Toluidine, mixed, kegs	lb.	.30 –	.35
Toluene, tank cars	gal.	.30 –	.35
Toluene, drums	gal.	.35 –	.40
Xylidines, drums	lb.	.45 –	.47
Xylene, pure, drums	gal.	.75 –	1.00
Xylene, com., drums	gal.	.37 –	
Xylene, com., tanks	gal.	.32 –	...

Naval Stores

Rosin B-D, bbl.	280 lb.		$6.10 –	
Rosin E-I, bbl.	280 lb.		6.15 –	
Rosin K-N, bbl.	280 lb.		6.20	
Rosin W.G.-W.W., bbl.	280 lb.		6.50 –	7.50
Wood rosin, bbl.	280 lb.		6.00	6.10
Turpentine, spirits of, bbl.		gal.	1.08 –	
Wood, steam dist., bbl.		gal.	1.04	
Wood, dest. dist., bbl.		gal.	.90	
Pine tar pitch, bbl.	200 lb.			6.00
Tar, kiln burned, bbl.	500 lb.		–	13.00
Retort tar, bbl.	500 lb.			12.00
Rosin oil, first run, bbl.		gal.	.45	
Rosin oil, second run, bbl.		gal.	.48	
Rosin oil, third run, bbl.		gal.	.52	
Pine oil, steam dist.		gal.	.80	
Pine oil, pure, dest. dist.		gal.	.75 –	
Pine tar oil, ref.		gal.	.48 –	
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.		gal.	.32 –	.32½
Pine tar oil, double ref., bbl.		gal.	–	.75
Pine tar, ref., thin, bbl.		gal.	–	.25
Pinewood creosote, ref., bbl.		gal.		.52

Animal Oils and Fats

Degras, bbl.	lb.	$0.03½ –	$0.04½
Grease, yellow, bbl.	lb.	.07¼ –	.07¾
Lard oil, Extra No. 1, bbl.	gal.	.90	.92
Neatsfoot oil, 20 deg., bbl.	gal.	1.30	
No. 1, bbl.	gal.	.92	.94
Oleo Stearine		.10½	
Red oil, distilled, d.p. bbl.	lb.	.11	.11¼
Saponified, bbl.	lb.	.11	.11¼
Tallow, extra, loose	lb.	.08	
Tallow oil, acidless, bbl.	gal.	.94	.96

Vegetable Oils

Castor oil, No. 3, bbl.	lb.	$0.14	
Castor oil, No. 1, bbl.	lb.	.14½	
Chinawood oil, bbl.	lb.	.34 –	.35
Coconut oil, Ceylon, bbl.	lb.	.10 –	.10½
Ceylon, tank, N.Y.	lb.	.08½ –	.09
Coconut oil, Cochin, bbl.	lb.	.10½ –	.10½
Corn oil, crude, bbl.	lb.	.12½ –	
Crude, tanks, (f.o.b. mill)	lb.	.10 –	
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.09¼	
Summer yellow, bbl.	lb.	.12 –	
Winter yellow, bbl.	lb.	.13½ –	.13½
Linseed oil, raw, car lots, bbl.	gal.	1.14 –	
Raw, tank cars (dom.)	gal.	1.09 –	
Boiled, cars, bbl. (dom.)	gal.	1.16 –	
Olive oil, denatured, bbl.	gal.	1.10 –	
Sulphur, (foots) bbl.	lb.	.09½ –	.09½
Palm, Lagos, casks	lb.	.07½ –	.08
Niger casks	lb.	.07½	.07½
Palm kernel, bbl.	lb.	.09½ –	
Peanut oil, crude, tanks (mill)	lb.	.13½ –	
Peanut oil, refined, bbl.	lb.	.17 –	
Perilla, bbl.	lb.	.16½ –	.16½
Rapeseed oil, refined, bbl.	gal.	.84 –	.85
Rapeseed oil, blown, bbl.	gal.	.90 –	.91
Sesame, bbl.	lb.	.11½ –	.12½
Soya bean (Manchurian), bbl.	lb.	.13 –	
Tank, f.o.b. Pacific coast	lb.	.10½	.10½
Tank, (f.o.b. N.Y.)	lb.	.10½ –	.10½

Fish Oils

Cod, Newfoundland, bbl.	gal.	$0.70	$0.72
Menhaden, light pressed, bbl.	gal.	.76 –	
White bleached, bbl.	gal.	.78 –	
Blown, bbl.	gal.	.82 –	
Crude, tanks (f.o.b. factory)	gal.	.50	
Whale No. 1 crude, tanks, coast	lb.	.07½ –	.08
Winter, natural, bbl.	gal.	.76 –	.78
Winter, bleached, bbl.	gal.	.79 –	.80

Oil Cake and Meal

Coconut cake, bags	ton	$32.00 –	...
Copra, sun dried, bags, (c.i.f.)	lb.	.05½ –	
Sun dried Pacific coast	lb.	.05½ –	
Cottonseed meal, f.o.b. mills	ton	38.00 –	
Linseed cake, bags	ton	36.00 –	
Linseed meal, bags	ton	38.50 –	

Dye & Tanning Materials

Albumen, blood, bbl.	lb.	$0.45 –	$0.50
Albumen, egg, tech., kegs	lb.	.80 –	.85
Cochineal, bags	lb.	.35 –	.36
Cutch, Borneo, bales	lb.	.04½ –	.05
Cutch, Rangoon, bales	lb.	.13 –	.13½
Dextrine, corn, bags	100 lb.	3.64 –	3.69
Dextrine, gum, bags	100 lb.	3.99 –	4.09
Divi-divi, bags	ton	38.00 –	39.00
Fustic, sticks	ton	30.00 –	35.00
Fustic, chips, bags	lb.	.04 –	.05
Logwood, sticks	ton	28.00 –	30.00
Logwood, chips, bags	lb.	.02½ –	.03½
Sumac, leaves, Sicily, bags	ton	70.00 –	72.00
Sumac, ground, bags	ton	$65.00 –	$67.00
Sumac, domestic, bags	ton	40.00 –	42.00
Starch, corn, bags	100 lb.	2.97 –	3.07
Tapioca flour, bags	lb.	.05½ –	.06½

Extracts

Archil, conc., bbl.	lb.	$0.17 –	$0.18
Chestnut, 25%, tannin, tanks	lb.	.02 –	.03
Divi-divi, 25%, tannin, bbl.	lb.	.04 –	.05
Fustic, crystals, bbl.	lb.	.20 –	.22
Fustic, liquid, 42°, bbl.	lb.	.08 –	.09
Gambier, liq., 25%, tannin, bbl.	lb.	.08 –	.09
Hematine crys., bbl.	lb.	.14 –	.18
Hemlock, 25%, tannin, bbl.	lb.	.04 –	.05
Hypernic, solid, drums	lb.	.24 –	.26
Hypernic, liquid, 51°, bbl.	lb.	.14 –	.17
Logwood, crys., bbl.	lb.	.19 –	.20
Logwood, liq., 51°, bbl.	lb.	.09 –	.10
Quebracho, solid, 65%, tannin, bbl.	lb.	.04½ –	.05
Sumac, dom., 51°, bbl.	lb.	.06½ –	.07

Dry Colors

Blacks, Carbongas, bags, f.o.b. works	lb.	$0.16 –	$0.18
Lampblack, bbl.	lb.	.12 –	.40
Mineral, bulk	ton	35.00 –	45.00
Blues, Bronze, bbl.	lb.	.55 –	.60
Prussian, bbl.	lb.	.55 –	.60
Ultramarine, bbl.	lb.	.08 –	.35
Browns, Sienna, Ital., bbl.	lb.	.06 –	.14
Sienna, Domestic, bbl.	lb.	.03½ –	.04
Umber, Turkey, bbl.	lb.	.04 –	.04¼
Greens, Chrome, C.P. Light, bbl.	lb.	.32 –	.34
Chrome, commercial, bbl.	lb.	.12 –	.12½
Paris, bulk	lb.	.30 –	.35
Reds, Carmine No. 40, tins	lb.	4.50 –	4.70
Oxide red, casks	lb.	.10 –	.14
Para toner, kegs	lb.	1.00 –	1.10
Vermilion, English, bbl.	lb.	1.30 –	1.32
Yellow, Chrome, C.P. bbls.	lb.	.20 –	.21
Ocher, French, casks	lb.	.02½ –	.03

Waxes

Bayberry, bbl.	lb.	$0.28 –	$0.30
Beeswax, crude, bags	lb.	.19½ –	.20½
Beeswax, refined, light, bags	lb.	.32 –	.34
Beeswax, pure white, cases	lb.	.40 –	.41
Candelilla, bags	lb.	.23 –	.24
Carnauba, No. 1, bags	lb.	.42 –	.43
No. 2, North Country, bags	lb.	.23 –	.23½
No. 3, North Country, bags	lb.	.19 –	.19½
Japan, cases	lb.	.14½ –	.15
Montan, crude, bags	lb.	.04½ –	.04½
Paraffine, crude, match, 105-110 m.p.	lb.	.04½ –	.04½
Crude, scale 124-126 m.p., bags	lb.	.03 –	.03⅛
Ref., 118-120 m.p., bags	lb.	.03½ –	...
Ref., 125 m.p., bags	lb.	.03½ –	...
Ref., 128-130 m.p., bags	lb.	.04½ –	.04½
Ref., 133-135 m.p., bags	lb.	.05 –	...
Ref., 135-137 m.p., bags	lb.	.05½ –	.05½
Stearic acid, sgle pressed, bags	lb.	.13½ –	...
Double pressed, bags	lb.	.14½ –	...
Triple pressed, bags	lb.	.15½ –	.16

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb.	$3.25 –	$3.30
F.a.s. double bags	100 lb.	3.85 –	3.90
Blood, dried, bulk	unit	4.25 –	
Bone, raw, 3 and 50, ground	ton	27.00 –	30.00
Fish scrap, dom., dried, wks.	unit	4.00 –	
Nitrate of soda, bags	100 lb.	2.60 –	2.65
Tankage, high grade, f.o.b. Chicago	unit	3.25 –	3.50
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$4.00 –	$4.50
Tennessee, 78-80%	ton	8.00 –	8.25
Potassium muriate, 80%, bags	ton	34.55 –	
Potassium sulphate, bags basis 90%	ton	43.67 –	
Double manure salt	ton	25.72 —	
Kainit	ton	7.22 —	....

Crude Rubber

Para—Upriver fine	lb.	$0.26½ –	...
Upriver coarse	lb.	.23 –	...
Upriver caucho ball	lb.	.25 –	
Plantation—First latex crepe	lb.	.27½ –	.27½
Ribbed smoked sheets	lb.	.27½ –	.27½
Brown crepe, thin, clean	lb.	.25½ –	...
Amber crepe No. 1	lb.	.26½ –	.26½

Gums

Copal, Congo, amber, bags	lb.	$0.12 –	$0.13
East Indian, bold, bags	lb.	.23 –	.23½
Manila, pale, bags	lb.	.20 –	.20½
Pontianak, No. 1 bags	lb.	.20 –	.20½
Damar, Batavia, cases	lb.	.30 –	.30½
Singapore, No. 1, cases	lb.	.34½ –	.35
Singapore, No. 2, cases	lb.	.24 –	.25
Kauri, No. 1, cases	lb.	.65 –	.67
Ordinary chips, cases	lb.	.18 –	.20
Manjak, Barbados, bags	lb.	.09 –	.09½

Shellac

Shellac, orange fine, bags	lb.	$0.68 –	.....
Orange superfine, bags	lb.	.70 –	.71
A. C. garnet, bags	lb.	nominal	
Bleached, bonedry	lb.	.76 –	.78
Bleached, fresh	lb.	.66 –	.....
T. N., bags	lb.	.64 –	.66

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh. ton	$500.00 –	....
Asbestos, shingle, f.o.b., Quebec	sh. ton	$65.00 –	$85.00
Asbestos, cement, f.o.b., Quebec	sh. ton	20.00 –	25.00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	16.00 –	20.00
Barytes, grd., off-color, f.o.b. mills bulk	net ton	13.00 –	15.00
Barytes, floated, f.o.b. St. Louis, bbl.	net ton	28.00 –	....
Barytes, crude f.o.b. mines, bulk	net ton	10.00 –	11.00
Casein, bbl., tech.	lb.	.22½ –	.25
China clay (kaolin) crude, f.o.b. Ga.	net ton	7.00 –	9.00
Washed, f.o.b. Ga.	net ton	8.00 –	9.00
Powd., f.o.b. Ga.	net ton	14.00 –	20.00
Crude f.o.b. Va.	net ton	8.00 –	12.00
Ground, f.o.b. Va.	net ton	14.00 –	20.00
Imp., lump, bulk	net ton	15.00 –	20.00
Imp., powd.	net ton	45.00 –	50.00
Feldspar, No. 1 pottery	long ton	6.00 –	7.00
No. 2 pottery	long ton	4.00 –	5.50
No. 1 soap	long ton	7.00 –	7.50
No. 1 Canadian, f.o.b. mill	long ton	20.00 –	22.00
Graphite, Ceylon, lump, first quality, bbl.	lb.	.06½ –	.
Ceylon, chip, bbl.	lb.	.05¼ –	
High grade amorphous crude	ton	15.00 –	35.00
Gum arabic, amber, sorts, bags	lb.	.15 –	.16
Gum tragacanth, sorts, bags	lb.	.50 –	.60
No. 1, bags	lb.	1.50 –	1.60
Kieselguhr, f.o.b. Cal.	ton	40.00 –	42.00
F.o.b. N.Y.	ton	50.00 –	55.00
Magnesite, crude, f.o.b. Cal.	ton	14.00 –	15.00
Pumice stone, imp., casks	lb.	.03 –	.05½
Dom., lump, bbl.	lb.	.05 –	.05½
Dom., ground, bbl.	lb.	.06 –	.07
Silica, glass sand, f.o.b. Ind.	ton	2.00 –	2.50
Silica, sand blast, f.o.b. Ind.	ton	2.50	5.00
Silica, amorphous, 250-mesh, f.o.b. Ill.	ton	17.00 –	17.50
Silica, bldg. sand, f.o.b. Pa.	ton	2.00 –	2.75
Soapstone, coarse, f.o.b. Vt., bags	ton	7.00 –	8.00
Talc, 200 mesh, f.o.b. Vt., bags	ton	6.50 –	9.00
Talc, 200 mesh, f.o.b. Ga., bags	ton	7.00 –	9.00
Talc, 200 mesh, f.o.b. Los Angeles, bags	ton	16.00 –	20.00

Mineral Oils

Crude, at Wells

Pennsylvania	bbl.	$3.50 – ......
Corning	bbl.	2.00 – ......
Cabell	bbl.	2.16 – ......
Somerset	bbl.	1.95 – ......
Illinois	bbl.	2.07 – ......
Indiana	bbl.	2.08 – ......
Kansas and Oklahoma, 28 deg.	bbl.	1.40 – ......
California, 35 deg. and up	bbl.	1.04 – ......

Gasoline, Etc.

Motor gasoline, steel bbls.	gal.	$0.22½ –	.
Naphtha, V. M. & P. deod., steel bbls.	gal.	.21½ –	....
Kerosene, ref. tank wagon	gal.	.14 –	
Bulk, W. W. export	gal.	.07 –	.
Lubricating oils:			
Cylinder, Penn., dark	gal.	.27 –	.30
Bloomless, 30@31 grav.	gal.	.20 –	.22
Paraffin, pale	gal.	.24 –	.25
Spindle, 200, pale	gal.	.25 –	.26
Petrolatum, amber, bbls.	lb.	.05 –	.05½
Paraffine wax (see waxes)			

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	ton	$45–50
Chrome brick, f.o.b. Eastern shipping points	ton	50–52
Chrome cement, 40-50% Cr_2O_3	ton	23–27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st. quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	40–46
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	36–41
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65–68
9-in. arches, wedges and keys	ton	80–85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	48–50
F.o.b. Mt. Union, Pa.	1,000	42–44
Silicon carbide refract. brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N.Y.	ton	$200.00 –	$225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11½	.11½
4-6% C	lb.	.12 –	.13
Ferromanganese, 78-82% Mn, Atlantic seabd., duty paid	gr. ton	120.00 –	....
Spiegeleisen, 19-21% Mn.	gr. ton	40.00 –	....
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb.	2.00 –	2.50
Ferrosilicon, 10-15%	gr. ton	48.00 –	50.00
50%	gr. ton	95.00 –	....
75%	gr. ton	150.00 –	160.00

Ferrotungsten, 70-80%, per lb. of W........	lb.	$0.90 - $0.95
Ferro-uranium, 35-50% of U. per lb. of U......	lb.	6.00 -........
Ferrovanadium, 30-40%, per lb. of V........	lb.	3.50 - 3.75

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$6 00 - $9 00
Chrome ore Calif. concentrates, 50% min Cr_2O_3.	ton	22 00 - 23 00
C i f Atlantic seaboard. .	ton	20 50 - 24 00
Coke, fdry , f.o.b ovens .	ton	7.00 - 7 50
Coke, furnace, f o.b ovens ..	ton	6.00 - 6 50
Fluorspar, gravel, f.o.b mines' Illinois.	ton	20.00 - 21 50
Ilmenite, 52% TiO_2 .	lb.	.01½- .01¼
Manganese ore, 50% Mn, c i f Atlantic seaport ..	unit	.33 -. . . . .
Manganese ore, chemical (MnO_2)	ton	75.00 - 80.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N. Y	lb.	.65 - .70
Monazite, per unit of ThO_2, c i f , Atl. seaport	lb	.06 - 08
Pyrites, Span , fines, c i f. Atl seaport ...	unit	.11½- .12
Pyrites, Span., furnace size, c i f Atl. seaport .	unit	.11½- .12
Pyrites, dom fines, f.o.b mines, Ga ..	unit	.12
Rutile, 95% TiO_2	lb.	.12 -........
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.50 - 8 75
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	8.00 - 8.25
Uranium ore (carnotite) per lb of U_3O_8	lb	3 50 - 3.75
Uranium oxide, 96% per lb U_3O_8	lb	2 25 - 2 50
Vanadium pentoxide, 99% ,	lb.	12 00 - 14 00
Vanadium ore, per lb. V_2O_5	lb.	1 00 - . . . . .
Zircon, washed, iron free, f o b. Pablo, Fla ..	lb.	.04½- .13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	16¼ 16¾
Aluminum, 98 to 99% .	25 27
Antimony, wholesale, Chinese and Japanese .	7½ - 8½
Nickel, virgin metal	28 30
Nickel, ingot and shot	30-
Monel metal, shot and blocks	32 00
Monel metal, ingots	38 00
Monel metal, sheet bars	45 00
Tin, 5-ton lots, Straits	44 52½
Lead, New York, spot .	7 25
Lead, E St Louis, spot	7 15
Zinc, spot, New York ..	7 27
Zinc, spot, E. St Louis	6 92

Other Metals

Silver (commercial)	oz	$0 66¼
Cadmium	lb	1 00
Bismuth (500 lb lots)..	lb.	2 55
Cobalt .	lb.	2 65@ 2.85
Magnesium, ingots, 99%.....	lb.	1 25
Platinum......	oz	116 00
Iridium ..	oz.	260 00@ 275 00
Palladium....	oz.	81 00
Mercury	75 lb	67 00

Finished Metal Products

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	25 50
Copper bottoms	30 75
Copper rods	25 25
High brass wire	19 37½
High brass rods	17 00
Low brass wire .	21 10
Low brass rods	22 00
Brazed brass tubing	24 25
Brazed bronze tubing	29 00
Seamless copper tubing	25 25
Seamless high brass tubing. ..	23 50

OLD METALS—The following are the dealers' purchasing prices in cents per pound.

Copper, heavy and crucible ..	11 60@ 11 80
Copper, heavy and wire ...	11 50@ 11 60
Copper, light and bottoms	10 00@ 10 10
Lead, heavy	5 75@ 6 00
Lead, tea	3 50@ 3 75
Brass, heavy	6 50@ 6 75
Brass, light	5 75@ 6 00
No. 1 yellow brass turnings.....	6 75@ 700
Zinc.........	3 75@ 4 25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes............	$3 29	$3 14
Soft steel bars	3.19	3.04
Soft steel bar shapes..........	3.19	3.04
Soft steel bands.............	3.29	3.19
Plates, ¼ to 1 in. thick..	3.29	3.14

Industrial

Financial, Construction and Manufacturing News

Construction and Operation

Arkansas

BLATHEVILLE— The Waggoner-Gage Corp. has plans under way for the erection of a new cottonseed oil mill on local site to cost about $250,000, with machinery The plant will consist of a number of buildings and power house.

California

MONOLITH—The Monolith Portland Cement Co. is perfecting plans for enlargements in its plant for considerable increase in capacity It is purposed to increase the output from 3,000 to 6,000 bbl. per day by the close of the year. The initial machinery installation will be designed to advance the capacity to 1,500 bbl daily

LONG BEACH—The Seaboard Refining Co , recently organized, is perfecting plans for the construction of a new oil-refining plant on local site with capacity of about 6,000 bbl daily. It will consist of a number of buildings and is estimated to cost in excess of $750,000, with machinery. The Keck Syndicate, J. L. Keck, president, is interested in the new company

SAN BERNARDINO— The Cajon Lime Products Co , lately formed, has plans in progress for the development of lime deposits and the construction of a plant on property acquired at Camp Cajon, near San Bernardino The initial works will cost about $200,000, including machinery W F Warner, Riverside, Calif , heads the new company

SAN FRANCISCO— The Bass-Hueter Paint Co , 816 Mission St , has awarded a contract to Barrett & Hilp, 918 Harrison St., for the erection of a 4-story plant at Kansas and 24th Sts , estimated to cost $55,000 A. A. Pyle, 918 Harrison St , is architect

COALINGA—The California Asbestos Co has work in progress on a new mill to cost approximately $60,000, including equipment Machinery will be installed at an early date.

LOS ANGELES—The Pan-American Petroleum & Transport Co will build a large storage and distributing plant in connection with its new refinery in the San Pedro district, to provide for a capacity of over 2,000,000 bbl The entire plant will cost close to $5,000,000 E L Doheny is president

Georgia

FORT WENTWORTH —The Savannah Sugar Refining Co., Savannah, is perfecting plans for the rebuilding of the portion of its local plant recently destroyed by fire, with loss approximating $50,000.

Illinois

CHICAGO—The Dryden Rubber Co , 1014 South Kildare Ave , manufacturer of molded and mechanical rubber products, has awarded a general contract to J. H. Clancy & Sons, 189 West Madison St , for the erection of a 1-story plant addition, 69x178 ft., estimated to cost $50,000

CHICAGO—The Commonwealth Varnish Co., 4125 Parker Ave., has commenced the erection of a 1-story building, to be equipped as a laboratory.

OTTAWA—The National Plate Glass Co , General Motors Bldg., Detroit, Mich , has plans in progress for the erection of its proposed new plant addition, consisting of a number of 1-story buildings, and w'll call for bids in the near future. The plant will cost in excess of $5,000,000, with machinery. John Berg is local manager.

CHICAGO—Brenner, Monley & Morris, Inc., care of Fox & Fox, 38 South Dearborn St., architects, is taking bids on a general contract for the erection of a 1-story copper rod mill on Kedzie St., 100x800 ft., estimated to cost $800,000, with machinery. William A. Wood, 50 Church St., New York, is consulting engineer.

Indiana

HAMMOND The Martin Oil & Refining Co , operating at Osborne, near Hammond, plans for the rebuilding of the portion of its plant, destroyed by fire, April 27, with loss estimated at $200,000, including machinery.

MARION—The Upland Flint Glass Works, Inc , manufacturer of hollowware, is perfecting plans for the rebuilding of its local plant, recently destroyed by fire, with loss estimated at $100,000, with machinery. The reconstruction will cost approximately a like amount

ANDERSON The Inter-Continental Tire & Rubber Co , recently organized, has acquired the local plant of the Majestic Tire & Rubber Co , at Cruse and Daly Sts., and will make improvements and extensions in the mill to provide for an initial output of 600 tires per day It is purposed to commence operations at an early date. J. D. Wiggins, president and general manager of the International Rubber Co of America, Inc Anderson, heads the new organization.

Iowa

DUBUQUE— The Ott Rubber Co , Bank & Insurance Bldg , has tentative plans under consideration for the erection of a new 1-story plant with power house, estimated to cost $80,000 J L Ott is president.

Maryland

BALTIMORE The United States Industrial Alcohol Co , Curtis Bay, has plans in progress for the construction of additions to its plant to cost about $750,000, including machinery The work will consist of a large reclaiming plant to be used in connection with the manufacture of potash, with adjoining mill for the production of fertilizers. A new factory will also be constructed for the production of chemicals.

BALTIMORE— The United States Industrial Chemical Co has filed plans for the erection of a 1-story addition, 50x250 ft., at its Fairfield works, to cost about $15,000, exclusive of equipment

BALTIMORE The Wyatt Rubber & Chemical Co , 730 North Eutaw St , recently organized, is planning for the installation of equipment in a local building The company will specialize in the production of rubber cements and kindred products. Charles M Wyatt is president

Massachusetts

EAST BOSTON The Acme White Lead & Color Works, Inc , 266 Border St , has filed plans for the erection of a 1-story plant addition, to replace a portion of its works recently destroyed by fire.

Michigan

HOWLANDSBURG The El-Mora-Lee Paper Co , Kalamazoo, Mich , recently organized with a capital of $600,000, to manufacture kraft and kindred paper products, has tentative plans under consideration for the erection of a new 4-story mill at Howlandsburg, with power house and other mechanical structures, estimated to cost $800,000, with machinery. Irving Hopper is one of the heads of the company, which has established offices at 839 Lake Blvd.

ESCANABA The Universal Magnesite Products Co., has commenced the erection of a new 1-story building, 40x140 ft., for increased production.

Missouri

ELSBERRY —The Crystal Carbonate Lime Co., Louisiana, Mo., will immediately commence rebu'lding the portion of its local plant, recently destroyed by fire, and will install new crushing; mixing and other machinery for the production of commercial fluxing stone.

KANSAS CITY—The American Paper Mfg. Co. will break ground for the construction of a new mill on property recently acquired on Armour Rd., North Kansas City, and will install machinery for an initial daily output of about 30 tons. The plans will cost about $85,000.

New Jersey

TRENTON—The Elite Pottery Co., Enterprise Ave., manufacturer of sanitary earthenware, has awarded a general contract to Harry A. Fasker, Trenton, for the erection of a 1-story addition, to cost about $20,000, exclusive of equipment.

SOUTH MILLVILLE—The Whitall-Tatum Co., manufacturer of druggists' glassware, vials, etc., has preliminary plans under consideration for the rebuilding of the portion of its local plant destroyed by fire, May 3, with loss estimated in excess of $400,000, including machinery Four furnace buildings were seriously damaged, including Plants, 9, 10, 11 and 12.

TRENTON—The Jointless Fire Brick Co., 1130 Clay St., Chicago, Ill, has awarded a contract to James H. Morris & Co., South Broad St, for the erection of the first unit of its new firebrick and refractory plant on New York Ave, Trenton It will be 1 story estimated to cost about $40,000, with equipment

JERSEY CITY—Fire, May 1, destroyed a portion of the plant of the R. T. Claremont Chemical Co., 54 Montgomery St., with loss estimated at about $10,000, including equipment It is planned to rebuild

New York

ROCHESTER Fire April 27, destroyed a portion of the chemical plant at the works of the Eastman Kodak Co, Kodak Park An official estimate of loss has not been made It is planned to rebuild Frank W Lovejoy is general manager

Ohio

BELLAIRE The Bellaire Enamel Co, 18th St, has plans under way for the erection of a new 2-story addition to its plant to cost about $15,000 J V Anderson, Egerter Bldg, Wheeling, W Va, is architect

TORONTO The Board of Trustees will soon commence the installation of a new filtration plant at the municipal waterworks, estimated to cost $125,000

Oklahoma

TULSA The Oklahoma Steel Castings Co has plans nearing completion for enlargements in its plant to double the present output, making a total capacity of close to 30 tons per day E H Cornelius is president

ADA The Athens Glass Works, Inc, Morgantown, W Va, has tentative plans under consideration for the erection of a new branch plant on local site estimated to cost more than $60,000, with equipment

TULSA The Spanish-American Tile Co, recently formed with a capital of $50,000, is perfecting plans for the erection of a local plant for the manufacture of floor and wall tile F W and C J Gallagher, Tulsa, are heads

Pennsylvania

PHILADELPHIA—George D Feidt & Co, 244 North 5th St, manufacturers of chemical products, have plans in preparation for the erection of a new plant at 5th and Buttonwood Sts Clarence E Wunder, 1415 Locust St, is architect

SCOTTDALE—The United States Cast Iron Pipe & Foundry Co is considering the rebuilding of the portion of its local plant destroyed by fire, May 2, with loss estimated at $100,000, including equipment. Headquarters are at 71 Broadway, New York

CLAIRTON—The Pittsburgh Soda Products Co. is arranging for an increase in capital from $100,000 to $200,000, a portion of the proceeds to be utilized for plant expansion J S Nichols is secretary

ARNOLD—The American Window Glass Co, Farmers' Bank Bldg, Pittsburgh, has perfected plans for the rebuilding of the portion of its local plant recently destroyed by fire with loss estimated at $75,000

South Carolina

MARION The Board of Education will install a chemistry and physics laboratory in the proposed new local high school, for which plans will be prepared at an early date

Tennessee

CHATTANOOGA—The Crane Enamelware Co. has commenced the erection of a new plant unit to cost in excess of $150,000, including equipment, and plans to have the initial buildings ready for service at an early date. The company is a subsidiary of the Crane Co., Chicago, Ill.

Texas

STAMFORD—The Rule-Jayton Cotton Oil Co. has acquired the local cottonseed oil mill of the Stamford Oil Co., and plans for additions in the plant for extensive increase in capacity. The crushing output will be increased with additional machinery for a gross of 100 tons per day. C. M Francis is general manager.

FORT WORTH—A new plant for the manufacture of creosote for wood-treating service is being planned by the National Lumber & Creosoting Co, Texarkana, Tex, in connection with a new plant on local site recently acquired. The entire plant is estimated to cost $200,000 John T. Logan is president.

SWEETWATER—The City Commission has authorized the installation of a new filtration plant at the municipal waterworks to cost about $37,000 Work will be placed under way at an early date.

Virginia

STAUNTON The Virginia-Carolina Chemical Co, Richmond is planning for extensions and improvements in its local plant, devoted to the manufacture of fertilizer products, estimated to cost $30,000

HOPEWELL The Hopewell China Co is considering preliminary plans for the rebuilding of its pottery, destroyed by fire, May 1 with loss estimated at $100,000, including machinery.

SOUTH RICHMOND The Economy Concrete Co, recently organized with a capital of $100,000 will commence the immediate erection of a new 1-story plant, 100x160 ft Crushing, grinding, mixing and other machinery will be installed J Scott Parrish is president

Washington

SEATTLE The Superior Portland Cement Co, Seaboard Bldg, has plans for extension in its plant at Concrete, Wash, to include the construction of a hydro electric power plant on Jackman Creek, estimated to cost $175,000

New Companies

CHIN CHIN CHEMICAL CO, 8 South Dearborn St., Chicago, Ill; chemicals and chemical byproducts, $250,000 Incorporators, John A Combs, Percy Kleis and William A Hamilton

HERBST CHEMICAL CORP, New York, N Y, chemicals and chemical byproducts; $20,000 Incorporators M and S. B. Herbst Representative Hyman Bushel, 1482 Broadway.

STAR CHEMICAL CO, Philadelphia, Pa; chemicals and chemical byproducts; $75,000 Incorporators Arthur G McGregor, Omar G Jones and T L Powell Representative Delaware Registration Trust Co, 900 Market St, Wilmington, Del.

SAGINAW RUBBER CO, Saginaw, Mich, rubber products, $10,000 Incorporators: Herbert A. Otto, Robert T Holland and Seward G Andrews, 801 Genesee Ave. The last noted is representative

DIVIDE RIDGE OIL CO, San Francisco, Calif, petroleum products, $500,000. Incorporators: Charles H Holbrook, Jr., William M. Madden and Herman J. Widman Representative. William M. Madden, Crocker Bldg.

QUAKER HILL PAPER CO, New Haven, Conn, paper and pulp products; $50,000. Incorporators: A. W Chambers, H. H. Hitchcock and George P Smith, 185 Church St The last noted is representative.

KERN PRODUCTS CO, Scott and Railroad Sts, Rahway, N. J., organized, chemicals and chemical byproducts. The company is headed by Edgar and Samuel Genstein, 412 West 129th St, New York

GENERAL GLASS CO., Wilmington, Del.; glass products; $1,000,000 Representative: The Colonial Charter Co, Ford Bldg, Wilmington

SHIRLEY OIL CO., INC, Shirley Ill; refined oils, $75,000 Incorporators: Charles W. Hutchinson, John P. Walters and R T Lain, all of Shirley.

BRAENDER RUBBER & TIRE CO., INC., Wallington, N J.; rubber products; $265,000 Incorporators: Benjamin F. Teitelbaum, R E Donahue and David Z Jeselsohn, all of Wallington.

ATLAS PETROLEUM CORP., San Antonio, Tex., petroleum products; $50,000. Incorporators. William and T. R. Levin, and J. E. Mason, all of San Antonio.

AJAX CHEMICAL CO., Wilmington, Del.; chemicals and chemical byproducts; $2,000,000. Representative: Corporation Trust Co. of America, du Pont Bldg., Wilmington.

DEMATTIA INDUSTRIAL ALCOHOLA, INC., New York, N. Y.; industrial alcohol and kindred products; $25,000. Incorporators: M. Demattia, G. H. Phillips and R. M. Walters. Representative: Harold Lee, 36 West 44th St, New York.

DE PREES LABORATORIES, INC., Holland, Mich.; chemical products; $26,000. Incorporators. R. G. Wasey, W. A. and A. J. Diekema, Holland The last noted is representative.

BAY FERTILIZER CO., Tampa Bay, Fla.; fertilizer products; $100,000. Incorporators: S. W. Allen and C. Edmond Worth, both of Tampa Bay.

TITUS CHEMICAL CO., 171 Columbia Ave., North Bergen, N. J., organized; chemicals and chemical byproducts. Thomas A. Titus heads the company

ATLAS PAINT & VARNISH CO., INC., 1923 Blue Island Ave, Chicago, Ill; paints, oils, varnishes, etc, $35,000. Incorporators: John J. Barcal, A. and Frank C. Barta.

RODGERS CHEMICAL CO., Pittsburgh, Pa., organized; chemicals and chemical byproducts Frederick G. Rodgers and J. M. Wellings head the company Representative: Wright & Rundle, Frick Bldg., Pittsburgh.

BESSE SANITARY POWDER MFG. CO, Tulsa, Okla, $5,000, nominal; washing powders, chemical specialties, etc Incorporators: E Besse, E Gray and L. W. Ray, Avant, Okla

FRANK HALVERSEN CO, Jersey City, N. J, paper and pulp products, $100,000 Incorporators Frank Halversen, Allen E Hosking and Frank F. Albietz, 76 Montgomery St Jersey City The last noted is representative

AMERICAN CYANAMID CO Wilmington, Del, calcium carbide and affiliated products, $100,000 Representative Corporation Trust Co of America, du Pont Bldg., Wilmington

WILMINGTON HIDE & TALLOW CO, Wilmington, Ill, greases, oils, etc, $25,000. Incorporators: Aaron Cohen and Samuel G Barnhard, both of Wilmington

SUPERB RUBBER CO OF PENNSYLVANIA, INC, Scottdale, Pa, rubber products; $100,000 Incorporators. W H Grant, James P Strickler and Charles A Miller, Scottdale Representative Corporation Service Co Equitable Bldg, Wilmington, Del

HOWIE GLASS CO, INC, 1260 Grand River Ave, Detroit, Mich.; glass products, $8,000, nominal Incorporators: Joseph L. Hare, Thomas J. Blake and William Howie, 1640 Church St. Detroit The last noted is representative

Opportunities in the Foreign Trade

Parties interested in any of the following opportunities may obtain all available information from the Bureau of Foreign and Domestic Commerce at Washington or from any district office of the bureau The number placed after the opportunity must be given for the purpose of identification.

ARTIFICIAL LEATHER for upholstery, motor car and furniture trades Johannesburg, South Africa. Manufacturers' agency.—6241.

CARBONATE OF POTASH of different grades, in quantity of 20 to 40 tons at a time. Antwerp, Belgium. Purchase—6257.

CHEMICALS, and surgical supplies—Egypt. Manufacturers' agency—6258.

ROSIN, caustic soda, iron and steel products, tin plate, portland cement, paper, and leather. Rio de Janeiro, Brazil. Agency.—6259.

ZINC DUST for Crowe and Merrill metallurgical process Johannesburg. South Africa Agency.—6264

EQUIPMENT for the manufacture of carbon dioxide and cylinders for storing and marketing the gas. Guaynas, Mexico. Purchase.—6267

OIL CAKES, meat scraps, meat cakes, sulphate of ammonia, tankage, etc. Antwerp, Belgium. Purchase.—6280.

TANNING MACHINERY, substantial and modern. Provadia, Bulgaria. Purchase.—6316.

CASEIN, cork stoppers and mineral colors. Prague, Czechoslovakia. Purchase.—6320.

MACHINERY for the extraction of turpentine and byproducts, and implements and supplies for the extraction of the gum from the tree. Guadalajara, Mexico. Purchase—6321.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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Making the Debtor Pay

SOMETHING of the element of surprise accompanied the announcement on May 16 that French and Belgian troops had occupied four of the largest dye plants of the great German combine. Yet it was but a logical step in France's avowed policy of making a bad debtor pay his just debts. When Berlin on Jan. 13 notified the French Government that because of the Ruhr occupation Germany was suspending all reparation deliveries, she inevitably contracted for just such a counter-move on the part of the allies. The fact that it was a store of dyestuffs worth 4,000,000,000 marks that was confiscated was probably of no more significance to France than would have been an equally valuable stock of coal or iron ore. To the chemical industries of the world, however, this move has a more sinister portent.

The dyes seized by the French will come into immediate competition with products of our chemical industry. Directly this competition may appear as "reparation dyes" to be marketed with entire disregard of their real value; or indirectly, as fabrics dyed at far less than competitive costs. But, fortunately, when viewed from a longer range, the occupation may have a more favorable significance. This disruption to production may be the first step in breaking down the long-standing governmental subsidy and monopolistic organization of the German chemical industry.

Permanent occupation of these plants is, of course, impractical and no one realizes it more than the French. Nor are they laboring under the delusion that there are valuable "dye secrets" that can be carefully dug up and successfully transplanted along the Seine. It is certain, though, that the French will not relinquish control until Germany has made good her default in dye payments.

Labor And Banking

ORGANIZED LABOR has established a number of highly successful banks in recent years, such as that in Cleveland operated by the locomotive engineers. In the past few months this movement has been extended to include New York, the nation's financial capital. These banks are sound and, for the present at least, are well managed. Labor's voyage on the seas of capitalism is attended by a fair breeze and smiling skies.

Whatever changes in weather may occur on this voyage, labor cannot fail, in common with all other travelers, to experience some change, some broadening of outlook, as a result of its trip. Through control of capital, those commanders of labor who decide policy must become familiar with capital's problems. In running a bank successfully, they must put themselves in the place of those who for many years past have been their opponents. The spirit of caution and compromise that so marks the banker may become, at least in part, their spirit. As bankers, the middle path which promotes industrial stability will be more appealing than labor has found it in the past. Co-operation between the elements labor and capital should be easier under these circumstances.

But what this really means for industry is difficult to forecast. It may be that labor eventually hopes so to control capital that labor and capital will be one. Whatever does come of it, it cannot fail to bring some changes, changes worthy of observation and study. And, from our present knowledge of the movement, we believe it will be a beneficial one, deserving of the support of all.

Promoting Mutual Understanding Through Intersectional Meetings

IN ANY organization such as the American Chemical Society with members residing in communities scattered from coast to coast and maintaining viewpoints just as divergent, it is quite natural that there should be occasional misunderstandings. The unfortunate circumstance is that all too frequently, through failure to understand the other fellow's point of view, trivial incidents become magnified until they assume serious proportions. It is not difficult to conceive of a solution. If each member of the society were personally acquainted with every other member, most difficulties could be adjusted quite easily. With a large membership, such an ideal state is, of course, almost impossible to attain, but any activity which leads in that direction is worthy of careful consideration as a means of more closely uniting the profession.

Local section organizations and semi-annual general meetings at strategic points hitherto have provided practically the only means for the members of the American Chemical Society to become better acquainted. These are excellent as far as they go, but they do not satisfy the need completely. Granted that a member knows his entire section, he still has only the local point of view. Very well, let him attend the general meetings and broaden his outlook. A most logical suggestion, but what is the practical outcome? He is bewildered by the sea of strange faces, discouraged at the enormous scale on which operations are conducted and finally for relief turns to friends from his own section. This applies especially to the younger men who are most in need of the benefits to be derived from a widening circle of friends.

What, then, is to be the remedy? Having watched the movement develop, particularly in the Middle West, we unhesitatingly answer "intersectional meetings." The recent gathering at Urbana is typical. In form it

resembled the semi-annual conventions. There were general sessions and four simultaneous group meetings, but there were these essential differences: The group programs were so arranged that all of the papers could be presented adequately and be properly discussed; and proportionately a greater share of time was allotted to social functions. Furthermore with an attendance of 250 or less, the process of getting acquainted with everybody was not a discouraging or an impossible task. Entertainment was furnished by the local members so that there was but little financial strain upon the section acting as host and the total cost of attendance was low enough to attract many younger members who seldom get to the general meetings.

Were the intersectional plan adopted throughout the entire society and a logical rotation of meeting places provided, it would not be long before the members of the sixty-five sections would find a great deal more of common interest and understanding. In our estimation no single activity holds greater possibilities for increasing the solidarity of the American Chemical Society.

A Public Servant Goes Into Industry

ON another page in this issue is the news that one of the government's foremost scientists has resigned to take up an important post in commercial work. Unusual significance attaches to the announcement because of the circumstances as well as the persons involved.

The former chief chemist of the Bureau of Mines is one of the outstanding men of science in America. His work on the rare gases, first as assistant to Sir WILLIAM RAMSAY, and later independently, on radio-activity and the chemical separation of radio-active types of matter, on the atomic weights of krypton and xenon, on the change of thorium emanation to helium, the metallurgy of rare metals, the liquefaction of gases and the properties of matter—these are some of his achievements in pure science. Equally distinguished is his commercial work on the large-scale extraction of radium and, along with others in the bureau, in the practical recovery of helium from natural gas—a process reducing the cost of this pure element from $1,200 a cubic foot to 10 cents and promising a further reduction to 3 or 4 cents.

But like most leaders in research Dr. RICHARD B. MOORE is disposed to bestow greatest credit for these achievements upon those associated with him. Numbered among these is the man who will succeed him at the Bureau of Mines—Dr. SAMUEL C. LIND, a scientist eminently qualified to carry on the work. And, too, it is pleasant to record that the government is thus able to turn to its reserves for men so well fitted to meet such great responsibilities.

Why is it, though, that the Bureau of Mines could not keep this rare talent at work on its own many problems? There has been no ruction or disagreement. Dr. MOORE was singularly happy at his post, and he is not a man of expensive habits. The trouble is that unless a worker in government service has means of his own he cannot hope to provide for old age. In the army and navy provision is made for the retirement of commissioned officers, and even of enlisted men. But civilian salaries, which even before the war were very modest for the competent, have lost considerable of their sustaining power since that time. Reclassification measures have remedied this to some extent, to be sure, but the provisions for retirement are still most niggardly. It is but natural, therefore, that the government should fail to hold the public servant once industry bids for his services.

The Dorr Co. is to be congratulated on this eminent acquisition to its staff. We commiserate Washington on losing Dr. MOORE, but we welcome him as a neighbor with delight and with all good wishes.

The Lunatic Fringe In Science

THERE IS, according to his circulars, a Friend of Man in Pittsburgh, who has sent us through the mails his astro-biochemical chart. From it we learn which of the following twelve salts we should take: *Kali phos.*, *Natrium sulph.*, *Kali mur.*, *Calcara flour.*, *Magnesia phos.*, *Kali sulph.*, *Natrium phos.*, *Calcarea sulph.*, "*Silicea*," *Calcarea phos.*, *Natrium mur.* and *Ferrum phos.* They are, he says,

> . . . birth salts, as the body is most susceptible to them and anyone can use the number covering their (*sic!*) birthday to good advantage, if ill or not, as they are a scientific food and no medicine, and food is always appropriate. In fact that is the reason hunger really comes, as the body craves these tissue salts, and after all the body is composed of nothing else but these twelve salts together with hydrogen, oxygen and carbon, and any one of these elements falling below their standard brings disorder from same.

For a dollar he will send a "trinity" of salts (for it seems all persons need three of them) and he will make an astrological diagnosis of each case and give free advice as to whether we need other salts than those indicated on the chart as our "food."

This is an example of what THEODORE ROOSEVELT used to call "the lunatic fringe" of science. We might paraphrase the old almanac, and say, "Look out for astrology and all sorts of mystery tricks during the next 10 years!"

For science is ceasing to be didactic. It cannot afford to be. The greatest advances made in chemistry within the last 10 years have been in physics, and the greatest advances in biology have been in chemistry. The borders of all branches of science overlap one another more and more, so that it is becoming difficult to specify the domains of research. Science is becoming an immense, articulated Whole, with chemistry and physics and mathematics everywhere. But that day is not yet at hand and in the process of organization now going on, the lunatic fringes are bound to show themselves all over the great fields.

Let's take another view of the same subject. Nearly every leader of science is becoming modest in his assertions. He is scrupulously careful as to his findings, but he will not commit himself as to their ultimate significance. The Greeks made no distinction such as we do between material and spiritual things, and there is a tendency among thoughtful persons today to follow the Greek rather than the later method, by seeking the spiritual things in material things. This does not mean looking for ghosts in a graveyard by the dark of the moon, but it does mean a far more profound, more philosophical and more spiritually minded study of the nature of energy and of the fundamental things in Nature, as we may approach them with greater enlightenment and understanding.

Some time ago we heard an earnest man of science tell of his experiences in investigating so-called "psychic

phenomena"—not to discover the cause of them, but to satisfy himself whether, among supposedly supernatural occurrences, there was anything which could not be explained by sleight-of-hand or coincidence. He was still uncertain as to what conclusion he might ultimately reach, but he gave his experiences for what they were worth. There followed him a man who makes moving pictures, who has no scientific background or study, but he essayed to reply on behalf of science. Aside from his Billingsgate language and his abuse of everyone who is open minded, there was not an idea, a notion or a thought uttered that was anything more than denial. In other words, here was the scientific man engaged in research in what the movie man declared to be rank superstition. The charge of superstition emanated from ignorance, not from scholarship.

We can't declare any more that "the scientists all say" thus and so. Some of them are thinking big thoughts that the man on the street could not grasp if he tried for a thousand years. And like many of his kind such a person grows angry at what he cannot understand. There are, however, an equal number of other men on the street who have the will to believe but not the gift to understand. They flood over in crowds to the waving emblems along the lunatic fringes. They learn with happy credulity from the gentleman we have quoted or from similar authorities that nitrogen, for instance, is not contained in the human body. And their faith will remain unshaken until pale experience teaches them to the contrary that "*Natrium sulph.*" is a food.

Aluminum Sulphate As a Soil Corrective

FROM California comes the note that clay is rapidly displacing fullers earth for the decolorizing of petroleum distillates. Until recently, fullers earth was considered essential for this purpose, being burned and re-used after maximum adsorption had taken place. The clay now employed as a substitute is treated with acid, washed, filtered, dewatered, calcined and reground. By standardizing the various operations and by using a raw product of uniform and suitable composition, it is said to be possible to manufacture a substitute for fullers earth that possesses all the advantages resulting from technical control of operations.

Often the economic success of a new industry depends on the discovery of an outlet for its byproducts. In this particular process it is aluminum sulphate that is the byproduct, and while investigating other possible uses for it inquiries have been made as to its availability as a corrective of certain conditions in soils. In this connection it is interesting to note that FREDERICK C. COVILLE, of the United States Department of Agriculture, describes in a recently issued bulletin of the American Horticultural Society the results of several tests on the acidification of soil. It is recognized that some forms of plant life thrive only in soil that is acid in reaction; the plants of the heath family are examples. Tests were made whereby it was demonstrated that the treatment of an ordinary alkaline soil with aluminum sulphate resulted in a rapid and satisfactory growth.

It is pointed out that aluminum sulphate, in amount up to ½ lb. per square yard, may be applied to soils of the ordinary type to insure an acid reaction, which is necessary for several species of ornamental plants that otherwise are difficult to cultivate. It is well to remember, of course, that these investigations have not yet passed the experimental stage and that the application is necessarily limited by the small area of acid soils required. Further research is doubtless needed to establish definitely the value of aluminum sulphate as a corrective for soils of various types as well as to demonstrate the effect of aluminum compounds on the different forms of plant growth.

Encouragement Of Intuition

AT THE conclusion of his inaugural address delivered in London the newly elected president of the Institution of Mining and Metallurgy, R. GILMAN BROWN, paid us the graceful compliment of saying that he had been encouraged in his views on the subject of responsibility by an editorial on the education of the intuitions that appeared in a recent issue of *Chem. & Met.* He spoke of the need for an ordered imagination—that quality that suggests a new departure from established practice. It was imagination, we are reminded, that rescued the gold industry by the development of a chemical process of extraction—cyanidation; it was imagination that conceived the copper converter, so superficially similar and yet so fundamentally different from the bessemer converter. "Imagination is one of our prime assets; as it plays around standard practice it alone leads us to question whether an established method is, in fact, a perfect conception. Our profession constantly offers us opportunity for such a question; it affords a daily challenge to the imagination, a challenge which we run a personal risk in accepting, but which we may not in honor decline."

WILLIAM JAMES has said that visions usually constitute our most respectable contributions to the world in which we play our part. Mr. BROWN points out that engineers and technologists are better off than philosophers, for they can link together vision and accomplishment. Realization is the test. Uncertainty as to developments makes us cautious and full of fear. A close scrutiny of reasonings and conclusions follows, "thus arraigning the vision before the bar of detailed knowledge and experience, and making it show cause why it should not be committed as a vagrant dream." This caution, we are reminded, is born of experience and disappointment; it tempers the imagination. It should not be confused with timidity, which is inimical to progress.

This discussion suggests that a line of demarcation, indistinct perhaps, may exist between the great designers of our time and what Mr. BROWN calls the rank and file. What of them? To answer this query, the parable of the talents may be used to crystallize the thought that the less gifted one is in honor bound obligated to make the best of his opportunities. The determining factor must be recognized. "Nor is this beyond our powers if we look to our own approval, which is lasting, rather than to the fugacious praise of our fellows."

The application of science to industry is not alone concerned with facts and figures. Speculation and the exercise of the imagination play an important part in laying the foundation needed as a preliminary to achievement. Mr. BROWN approves of "recent developments in our technical journals: the enlistment of editors who are something more than technicians"; and he welcomes their increasing tendency to discuss the non-technical problems that influence profoundly the progress and development of technology.

Charles A. Rose

Following a significant career of 20 years as engineer and executive is appointed general manager of technical activities for the British America Nickel Corporation.

WHEN the British America Nickel Corporation resumes operations this month, Charles A. Rose will be general manager of technical activities. Twenty years of metallurgical experience as engineer and executive stand behind Mr. Rose as he accepts his new post.

As a young graduate from the University of Nebraska, Mr. Rose began his career with the Alder Creek Gold Mining Co., at Leadville, S. D. Here he outgrew his position as chemist within a short time and was promoted to be superintendent of mill operations. He then became chief chemist for the Boston & Colorado Smelting Co. at Denver, and when the next call came to advance he joined the staff of the American Smelting & Refining Co. as metallurgical engineer.

Then Guggenheim Bros. "discovered" Mr. Rose. So it was that in 1911, after rising in 7 years from comparative obscurity to the front rank of his profession, he severed his Colorado connection to become consulting expert for the Guggenheims and for the Braden Copper Co. Here for the past 12 years Mr. Rose has been active in many fields as assistant to the vice-presidents of both companies. As part of his work in this capacity he has been in charge of the experimental plant in the development of the Chile Exploration Co.

Mr. Rose is a man whose personality inspires confidence. His career justifies the impression. Quiet and thoughtful in manner, sparing of superfluous speech, yet cordial in bearing, he has the happy faculty of creating that atmosphere which marks a successful executive. Combining as he does the attributes of leader and of straight-thinking engineer, it is not hard to understand the reason underlying his advancement to his present position.

At Nickelton, Ont., where the activities of the British America Nickel Corporation are centered, Mr. Rose will manage a $20,000,000 corporation. The magnitude of its operations is revealed by its production, which will include close to 10,000 tons of nickel and 5,000 tons of copper annually. Since 1921, due to the dull market, the plants of the concern have lain idle. Even at the present time the venture of resuming operations is regarded in some quarters as precarious; therefore Mr. Rose faces a problem which is difficult, which will require all of his well-rounded experience, but which he is ideally fitted to meet.

An Extension of the Theory of Gas-Absorption Towers*

Abandoning the Arbitrary Assumptions Involved in the Use of the Logarithmic Mean Formula, a General Analysis of Factors Has Been Made and a Fundamental Relationship Between the Variables Evolved—This Relationship Has Been Checked by a Plant Experiment

BY WALLACE B. VAN ARSDEL
Chemical Engineer, The Brown Co., Berlin, N. H

THERE is substantial agreement among workers in the theory of gas-absorption towers, feed-water coolers and the like that the rate of transfer of the solute from one phase to the other is proportional to the area of contact of the phases and to a potential factor, or "driving force." The constant of proportionality, analogous to that operating for heat-flow in double-pipe coolers, has been determined in a few particular cases described in recent literature.

The only theoretical difficulty to the problem lies in the correct formulation and calculation of the potential factor, and on this point there remains a rather serious divergence of opinion. The formula taken in the present paper was first explicitly stated by Donnan and Masson:[1]

$$\text{Potential factor} = (km - n)$$

where m = conc. of solute in gas-phase, g. per liter,
n = conc. of solute in liquid-phase, g. per liter
$k = \dfrac{n}{m}$ at equilibrium ("Henry's law" solubility constant).

Another formulation is the one used by Prof. W. K. Lewis[2] and his co-workers[3,4] at the Massachusetts Institute of Technology:

$$\text{Potential factor} = (P - \alpha x)$$

where P = partial pressure of solute in gas-phase, mm. of Hg,
x = concentration solute in liquid phase, mol-fraction,
$\alpha = \dfrac{P}{x}$ at equilibrium.

The constant α is an *inverse* solubility-function. The two forms of expression for the potential-factor are therefore nearly equivalent, the major difference between them being the occurrence in the latter of an extra factor, α:

$$(P - \alpha x) = \alpha\left(\frac{P}{\alpha} - x\right),$$

equivalent to $\alpha(km - n)$

Very recently some experimental evidence has been presented[4] which indicates clearly that this extra term α should be omitted. If this be done, the remaining difference between the two forms is very small; very careful measurements will be necessary for a judgment between them.

The real difficulty lies in the calculation of the potential factor according to any agreed formulation, since in a counter-current gas-absorption tower, for instance, it varies from point to point. Common practice has been[4,5] to use either the arithmetic or the logarithmic mean of its values at the ends of the transferring system. Now while that is justifiable under certain rather restricted conditions, evidence is here presented which indicates that in many common cases the resulting coefficient is badly in error.

The assumptions on which the logarithmic-mean formula is based are as follows: (*a*) The mass of solute transferred is negligible compared to the total mass of the gas; (*b*) the transfer-coefficient is constant from point to point through the apparatus, and (*c*) the equilibrium solubility-coefficient of the gas, and therefore the temperature of the solvent, is constant from point to point. The arithmetic mean is commonly used when the potentials at the ends are nearly equal, since under those conditions the logarithmic and arithmetic means are nearly the same. Since in practice the above assumptions are by no means always fulfilled, it has seemed to be worth while to investigate the attendant errors and if possible to develop a new type of mean which will fit some of the cases properly excluded by these drastic assumptions.

GENERAL ANALYSIS

Certain quantitative relationships between the variables must be established preliminary to the further analysis. It may easily be shown that:

$$V_G = V_G' \frac{d_1 - M_1}{d - m} \qquad (1)$$

where V_G = rate of gas-flow at any point x in the tower, liters per minute,
V_G' = rate of supply of gas to the tower, liters per minute,
d_1 = density of the pure solute-gas at the temperature and total pressure prevailing at the gas-inlet, grams per liter,
d = density of pure solute-gas at the temperature and pressure prevailing at any point x, grams per liter,
M_1 = concentration of solute-gas in gas entering tower, grams per liter,
m = concentration of solute-gas in the gas at point x, grams per liter.

*Adapted, by the author, from a paper presented at the Richmond, Va., meeting of the American Institute of Chemical Engineers, Dec 7, 1922.

[1]F. C. Donnan and I. Masson, "Theory of Gas-Scrubbing Towers With Internal Packing," *J. Soc. Chem. Ind.*, vol. 39, pp. 236-41T (1920).

[2]W. K. Lewis, "The Principles of Counter-Current Extraction," *J. Ind. Eng. Chem.*, vol. 8, pp. 825-33 (1916).

[3]W. G. Whitman and J. L. Keats, "Rates of Absorption and Heat Transfer Between Gases and Liquids," *J. Ind. Eng. Chem.*, vol. 14, p. 186 (1922).

[4]R. T. Haslam, "Absorption and Scrubbing Tower Design," Am. Inst. Chem. Engrs., Richmond meeting, December, 1922.

[5]W. B. Van Arsdel, "Theory of Gas Scrubbing Towers," *Chem. & Met.*, vol. 23, pp. 1115-6 (1920).

For the special case of the total change in gas-volume through the tower, a quantity which occurs frequently in subsequent calculations,

$$V_G'' = \frac{d_1 - M_1}{d_2 - M_2} V_G' = \Delta V_G' \qquad (2)$$

where $\Delta = \frac{d_1 - M_1}{d_2 - M_2}$ and V_G'', d_2 and M_2 refer to conditions at the exit point. Formulating a "solute-balance" equation, taking the liquid volume, V_L, as constant, and simplifying,

$$m = \frac{d(f\Delta M_2 + n - N_1)}{f\Delta d_2 + n - N_1} \qquad (3)$$

$$n = f(d_1 - M_1)\left(\frac{m}{d - m} - \frac{M_1}{d_1 - M_1}\right) + N_1 \qquad (4)$$

where $f = \frac{V_G'}{V_L}$, "flow-ratio,"

n = concentration of solute in the liquid at point x, grams per liter,

N_1 = concentration of solute in the liquid entering the tower, grams per liter.

There is abundant evidence that the solute-transfer coefficient, like the heat transfer coefficient in a double-pipe cooler, is a function of the velocities of flow and temperatures of the fluids, and since we have not restricted the problem to uniform velocities and temperatures, the coefficient itself must vary from point to point. Now the most obviously useful data on such coefficients would refer to invariable velocities and temperatures, since a long tower could be considered as a series of short ones, in each of which the appropriate velocity, temperature and coefficient could be used. Such data must therefore be derived from the results of an actual complex run by correlating with the *mean* velocities and temperatures an *average* value of the coefficient. In a differential section,

$$V_L\delta n = k_1 S\phi k_2(km - n)\delta x \qquad (5)$$

where k_1 = a constant characteristic of the packing, sq.ft. of surface per cu.ft. gross volume,

S = cross-section area of tower, sq.ft.,

k_2 = the *average* transfer-coefficient for the tower, grams per minute per sq.ft. per gram-per-liter concentration-deficit,

ϕ = a dimensionless multiplier of k_2, averaging unity for the whole tower, ϕk_2 being the actual coefficient for the section.

All available experimental work[4] (including some of our own not yet published) indicates that as between different runs, and to a rough approximation, k_2 varies

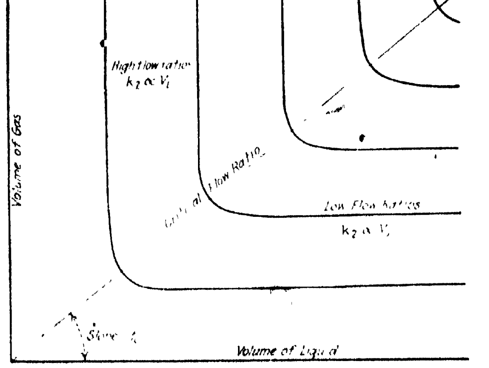


FIG. 1—VARIATION OF TRANSFER-COEFFICIENT WITH CHANGING GAS AND LIQUID FLOW

directly as the gas velocity up to a certain critical flow-ratio, f_c, and directly as the liquid velocity at higher flow-ratios, as suggested diagrammatically by Fig. 1. In addition, k_2 varies inversely as the viscosity of the liquid, η_t, as that is changed by temperature. Moderate change of gas temperature is apparently without effect. Assuming now that for changes in velocity and temperature from point to point in a tower, ϕ varies in the same manner as does k_2 between different runs, four cases may be distinguished by the relation of the actual flow-ratio to the critical flow-ratio, f_c.[9]

	$\frac{U_G}{U_L} > f_c$	$\frac{U_G}{U_L} < f_c$
$\frac{V_G}{V_L} > f_c$	Case (a) $\phi = \frac{U_L \eta_{av}}{U_L \eta_t}$	Case (b) $\phi = \frac{U_L f_c \eta_{av}}{U_G \eta_t}$
$\frac{V_G}{V_L} < f_c$	Case (c) $\phi = \frac{U_G \eta_{av}}{U_L f_c \eta_t}$	Case (d) $\phi = \frac{U_G \eta_{av}}{U_G \eta_t}$

where U_G, U_L and $\eta_{av.}$ are average values of those variables in the given case.

For U_L and η_{av} use the arithmetic mean of the end values. For U_G,

$$U_G = V_G'\left(\frac{1 - \Delta}{\mathrm{Log}_e \frac{d_2 - d_1 + M_1}{\Delta M_1}} + \frac{d_1 - M_1}{d_2}\right)$$

Substituting in equation (5) the value of m from equation (3), and ϕ from this table, simplifying and solving for k_2,

$$(a)\quad k_2 = \frac{V_L}{k_1 h S \eta_{av}} \int_{N_1}^{N_2} \frac{(f\Delta d_2 + n - N_1)\eta_t}{kd(f\Delta M_2 - N_1) + n(kd - f\Delta d_2 + N_1) - n^2}\,\delta n \qquad (6)$$

$$(b)\quad k_2 = \frac{U_G}{k_1 h S f_c \eta_{av}} \int_{N_1}^{N_2} \frac{(f\Delta d_2 + n - N_1)\eta_t}{kd(f\Delta M_2 - N_1) + n(kd - f\Delta d_2 + N_1) - n^2}\,\delta n \qquad (7)$$

$$(c)\quad k_2 = \frac{V_L f_c}{k_1 h S \eta_{av}} \int_{N_1}^{N_2} \frac{d\eta_t}{kd(f\Delta M_2 - N_1) + n(kd - f\Delta d_2 + N_1) - n^2}\,\delta n \qquad (8)$$

$$(d)\quad k_2 = \frac{U_G}{k_1 h S \eta_{av.}} \int_{N_1}^{N_2} \frac{d\eta_t}{kd(f\Delta M_2 - N_1) + n(kd - f\Delta d_2 + N_1) - n^2}\,\delta n \qquad (9)$$

where h = total height of packed portion of tower, feet. Solution of any of these equations depends on the possibility of evaluating k, d and η_t for given values of n; in general, such relations are empirical and the integration will be performed by a step-by-step summation for the range N_1 to N_2.

SOLUTION. CASE 1

When the change in temperature of the liquid may be considered as predominantly due to the heat of solution of the solute, the liquid-temperature and therefore k and η_t become simple functions of n; for evaluation of d, a rough approximation to T (the gas temperature) is sufficient; the change in T may be assumed proportional to the change in t (the liquid temperature). In practice this is a very important and common condition in such absorption towers as those of, say, SO_2 in water; the heat of solution of the SO_2

is almost always far in excess of any accompanying transfer of sensible heat.

It will be noted that the preceding process sidesteps the necessity of determining any space average of the potential factor. Individual values of the potential factor, however, vary inversely as the quantity within the integral in equation (6), (7), (8) or (9), and may be evaluated by comparison with equation (5)

SOLUTION. CASE 2

There is one other case, comparatively unimportant, for which analysis is possible. The restricting assumptions are, (*a*) that transferred sensible heat far exceeds heat developed on absorption of the solute, and (*b*) that changes in the mass and specific heat of the gas are small in comparison with its average mass and specific heat. Summarizing, it may be shown that the liquid temperature then changes from point to point by the exponential law characteristic of heat exchangers, and the solute-concentration by an exactly analogous exponential law; a series of values of $km - n$ may be calculated, and the space-average of these values substituted in the fundamental equation

$$V_L(N_2 - N_1) = k_1hSk_2(km - n)_{av} \qquad (10)$$

REMOVAL AND SATURATION

Two characteristics of tower operation which are nearly always given or required are (*a*) the degree of saturation of the outflowing solution, based on the concentration of gaseous solute entering the tower, and (*b*) the percentage removal of solute from the gas; calling these functions respectively ψ and r,

$$\psi = 100\frac{N_2}{k''M_1} \qquad (11)$$

where k'' = solubility constant for conditions at base of tower.

$$r = 100\left(1 - \Delta\frac{M_2}{M_1}\right) = 100\frac{N_2 - N_1}{fM_1} \qquad (12)$$

For the common case in which $N_1 = 0$,

$$r = \frac{k''}{f}\psi \qquad (13)$$

EXPERIMENTAL CHECK

There is not much experimental material available with which to test the methods of calculation suggested, by actual check of predicted with measured quantities. The following experiment* will serve to show, however, the order of magnitude of the differences from the logarithmic or arithmetic mean methods, in a case which is far from being an extreme test.

A wood-stave tower of 28.25 in. internal diameter was fitted up with nine grids, the bottom six each supporting four layers of 6-in. "spiral brick," the next two grids eight layers, and the top grid four layers. Beneath each grid two spirals of lead pipe were so arranged as to collect fair samples of the gas and solution at that point. Dilute SO_2 gas was blown into the base of the tower and water pumped into the top through a rosette head; the former was measured by a standardized orifice-plate, the latter by the decrease in volume in a storage tank. Gas concentrations at the six lower stations were determined by Orsat apparatus and at the three top ones by Reich apparatus. Solution concentrations were determined by iodine titration.

For this style of packing, $k_1 = 18.06$; the height of packing was 23 ft., cross-section area 4.35 sq.ft.; k_1hS = 1,806.5 sq.ft. Fairly high rates of flow were employed (49.8 cu.ft. of gas per minute per sq.ft. of cross-section and 8.03 gal. of water per minute per sq.ft.) and a low-strength gas, about 6 per cent SO_2 by volume. The resulting data, plotted in Fig. 2, were balanced against one another (individual measurements not being precise enough to allow direct calculation of $km - n$), as follows: A fair curve was drawn through the datum points for n, and then using the "conservation of matter" equation (3), m was calculated from n; this curve agreed reasonably well with the plotted points for m. From the smoothed curve for t and that for m, k was determined on the basis of known solubility data. The curve "$km - n$ measured," in Fig. 3, was the result. The coefficient k_2 was determined as follows by taking δn and $km - n$ in 2-ft. steps:

δn	$km - n$	k_2
0.25	0.40	0.55
0.31	0.48	0.57
0.35	0.56	0.55
0.42	0.64	0.57
0.50	0.71	0.62
0.53	0.76	0.61
0.55	0.80	0.60
0.56	0.815	0.60
0.57	0.81	0.61
0.56	0.79	0.62
0.54	0.75	0.63
0.32	0.71	0.65
	Mean	0.60

Now the temperature change of the water in this run was almost exactly accounted for by the heat of solution of SO_2, and the flow ratio was less than f_c for SO_2 absorption at this temperature, 45.25 as against about 50. Equation (9) above was therefore used, with the following pertinent data:

$G' = 6145$	$M_1 = 0.133$	$t_1 = 23.2$	$d_1 = 2.46$	$k' = 46.3$
$L' = 135.7$	$M_2 = 0.015$	$t_2 = 24.0$	$d_2 = 2.57$	$k'' = 43.1$
$f = 45.25$	$N_1 = 0$	$T_1 = 37$	$\Delta = 0.912$	$\eta_1 = 0.93$ (relative)
$U_G = 5750$	$N_2 = 5.4$	$T_2 = 23$		$\eta_2 = 0.91$ (relative)

Coefficient k_2 is found as 0.594, checking closely with the measured mean k_2 and calculated values of $km - n$ are shown on Fig. 3 to agree well with the curve of measured values.

Calculating the logarithmic mean of $km - n$ at the ends of the tower, k_2 by equation (10) is 0.82; by the arithmetic mean it is 0.785. The reason for the difference from the measured value is obvious from Fig.

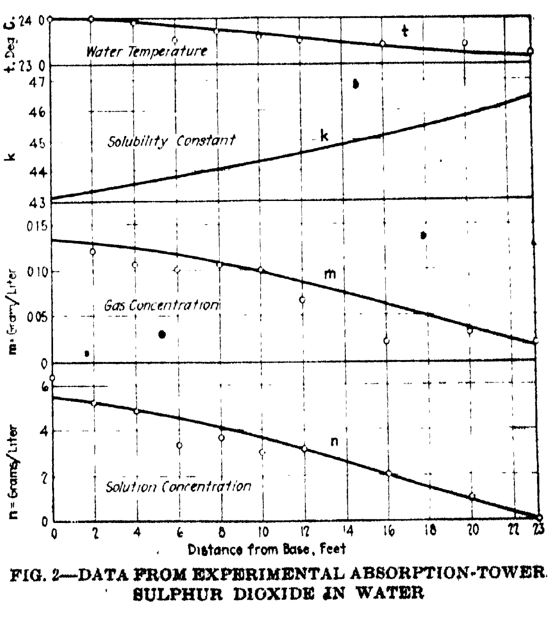


FIG. 2—DATA FROM EXPERIMENTAL ABSORPTION-TOWER SULPHUR DIOXIDE IN WATER

*This experiment, with a number of others which cover the general subject of tower performance, will be more fully described in a future communication.

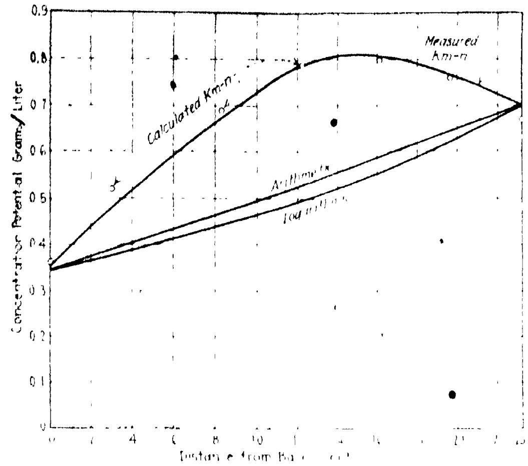


FIG. 3—POTENTIAL FUNCTION EXPERIMENTAL VS CALCULATED

3, in which the calculated potentials according to the logarithmic and arithmetic formulas are seen to have entirely different modes of variation than that of the measured potential.

The observation has sometimes been made that even very large errors in the calculation of the coefficient would have no importance practically, provided the test experiments were run under very nearly the same conditions as are to be realized in the projected installation, for then the errors would cancel This view, however, appears to reduce the coefficient to nothing more than a convenient instrument for interpolation between experimental runs which do not happen quite to fit the desired case. If it be considered what a multiplicity of conditions are possible—volumes of inflowing and outflowing gas and of inflowing liquid, concentration of inflowing gas, temperature of inflowing and outflowing liquid, etc., all variable more or less independently—the desirability of generalizing the data as far as possible will be obvious. For a given type of tower and packing the coefficient should be capable of empirical expression in terms of possibly not more than three independent variables—volumes of inflowing gas and liquid and temperature of inflowing liquid—and a comparatively small number of experiments should open up, by extrapolation, the whole field of possible conditions. But such usage requires at least the accurate calculation of the coefficient.

The experiment described above was carried out in August, 1922, under the supervision of Frank M. Jones, at that time a member of this organization, assisted by six other members of the staff.

Research on Fatigue Resistance

A research into the resistance to fatigue of copper, brass and bronze will become a part of the program of tests at the University of Illinois. It will be remembered that Dr. H. F. Moore and his associates have been engaged in an investigation on endurance of steel for several years, and have published many of their important findings. Finances for the work have been supplied by a member of interested organizations and corporations. The Copper and Brass Research Association is providing funds for the new program on its own material, and will be represented on the advisory board by Messrs. George, Webster and Price.

Light Shed on Oil Shale Distillation

The amount and quality of oil that can be produced from any shale may be made to vary to an important degree by changing the temperature relations existing in the shale charge during destructive distillation, states L. C. Karrick, associate oil shale technologist of the Department of the Interior.

The rate at which the oil is formed from the shale is affected by the rate of heat supply and therefore by the temperature of the shale during its thermal decomposition. The quality of the oil formed may be controlled by alternating the temperature of the shale and therefore the rate of formation of the oil. Variations in the yield and quality of shale oils may be caused by inherent properties of the retort used, but in any event the properties of the crude oil and yield are very largely the result of the extent to which the thermal decomposition has progressed. Recognition of these principles will aid in explaining to a large degree the reasons for the wide variations in oils produced from the same shales by different "processes." These principles also may be applied in the operation of different types of retorts in order that crude oils of a type most profitable to the operator may be produced.

The Bureau of Mines has conducted an extended series of tests in the destructive distillation of oil shales, to determine the wide variations that may be effected in the quality and yield of shale oil by changing the rate and temperature at which the oil is formed. These tests furnished interesting information on the four related points: Yield of oil, quality of oil, temperature required to distill shales, and time required for distillation Serial 2456, which just has been issued by the Department of the Interior, Bureau of Mines, Washington, D. C., gives this information in detail.

Industrial Research on Lime

The extent of the use of lime is a matter of general knowledge among technical men. There need be no elaboration of its many uses here. It is interesting, however, to consider some of the research that is under way under the auspices of the National Lime Association. In the first place, the organization has a research laboratory in Washington where the general subject of the fundamental properties of the commercial lime is being studied. Samples of lime from every part of the country are studied in an attempt to correlate such properties as density, porosity, reactivity, rate of settling, etc., with one another and with perhaps other properties not yet definitely determined.

Together with this fundamental investigation, some units of which have already appeared in *Chem & Met.*, the laboratory deals with other problems such as new uses for lime, control of quick-setting lime mortar, aqueous lime paints and such problems as the new users of lime are facing. In addition to this extensive work, a fellowship is maintained at Ohio State University under J. R. Withrow, who is studying the effect of varying conditions of burning on properties of lime. At Massachusetts Institute of Technology, R. T. Haslam is directing an investigation on the chemical systems in lime mortar and lime plaster. At Indiana University, F. C. Mathers is studying lime and mortar and various uses of lime. And finally, W. E. Emley at the Bureau of Standards is co-operating in a study of the construction uses of lime. This is a constructive program which other national associations could well afford to imitate.

Machinery for Bagging Superphosphate

By Kai Warming

Translated by George Frederick Zimmer

Editor's Note: *This article is most interesting in discussing one of the operating problems of the fertilizer manufacturers abroad. Some phases have only a remote bearing on our own practice. Nevertheless the work is illuminating and well worth careful study.*

MAKERS of superphosphate always find great difficulty in securing the rapid despatch of their large stocks during the busy spring and autumn seasons, because the superphosphate in the stock piles frequently becomes very hard, so that the work of getting it out, breaking it down and packing into bags is a slow and expensive operation which delays the execution of orders.

Drawback of Existing Appliances

The first machines employed for doing this work were set up near the stock pile and the superphosphate was shoveled by one or two men into a bucket elevator, which raised it to the crushing rollers. From these it dropped into bags suspended at the mouth of two chutes; each bag was weighed on leaving the bagger. Although by this method a certain amount of labor was saved in comparison with purely hand work, the machine still had to be fed by hand and was by no means automatic, so that there had to be taken into account the hand labor necessary for breaking down the pile and carrying the superphosphate some distance to the machine. Moreover, work had to be stopped at intervals, in order to shift the machine and weighing apparatus as the men got further into the pile.

The author was therefore led to consider the possibility of devising an apparatus capable of performing all the various operations. When in 1913 he took up the question, he found that it was possible to combine the swinging and digging elevator applied for several years in the warehouses of the German potash manufacturers, with the necessary pulverizers, screens and bagging scales, into a practical and useful labor-saving apparatus for superphosphate handling.

The construction of the machine was planned and carried out in Hamburg in collaboration with the engineer, Paul Burgdorff.

Construction of the Machine

The apparatus consists of a large four-wheeled motor truck driven by an electric motor, current being supplied via a flexible cable. The two large front wheels are driven by separate gearing, so that the truck can turn in a circle of small radius. It can also be run in either direction. The front of the truck carries a bucket elevator, the buckets being provided with cutting edges. The elevator is nearly vertical and is adapted to swing horizontally through an angle of approximately 90 deg. about a large vertical pivot, so that the elevator can cut a trench in the stock pile slightly broader than the overall width of the truck. The swinging and scraping movements of the elevator are imparted by two electric motors, and the change of the swinging direction at the end of each swing is effected automatically on reaching its maximum.

When the machine is set to work the elevator buckets scoop the superphosphate out of the stock pile to a depth of about an inch over an arc corresponding to the radius of the swinging movement, the material being taken out right up to the top of the pile. On the completion of the swing the machine is moved forward a suitable distance without stopping the scooping and swinging movements.

The superphosphate collected by the buckets is discharged onto a screen, and the large lumps are broken in a roll crusher and afterward screened. The sifted product is carried by a shaker and delivered into hoppers at the back of the machine on which the bags are hung; two or three bag scales are arranged underneath the hoppers. As each bag is filled the delivery slide of the hopper is closed and the bag is placed on a conveyor, to be removed, tied and sent off.

Machines of this type are made in several sizes for storehouses, ranging from 10 to 22 ft. in height. The smaller sizes have a capacity of 125 to 150 bags (of 100 kg. each) per hour, while the largest will fill 150 to 180 bags. In the larger machines the hoppers for the fine powdered superphosphate with the bag scales are paced on a separate three-wheeled truck drawn by the motor truck. Furthermore, they have a platform for the operator placed over the shaker conveyor, from where he has a complete view of its workings. Three workmen are needed to operate the machine under the supervision of a foreman, and the latter can learn how to run the apparatus in a few hours.*

It should be noted that in digging the superphosphate out with these devices it is taken uniformly from all strata of the pile. This is an advantage from the manu-

*See also article in *Industrial Management* for March 23, 1922, "The Mechanical Handling of Superphosphate," by G. F. Zimmer.

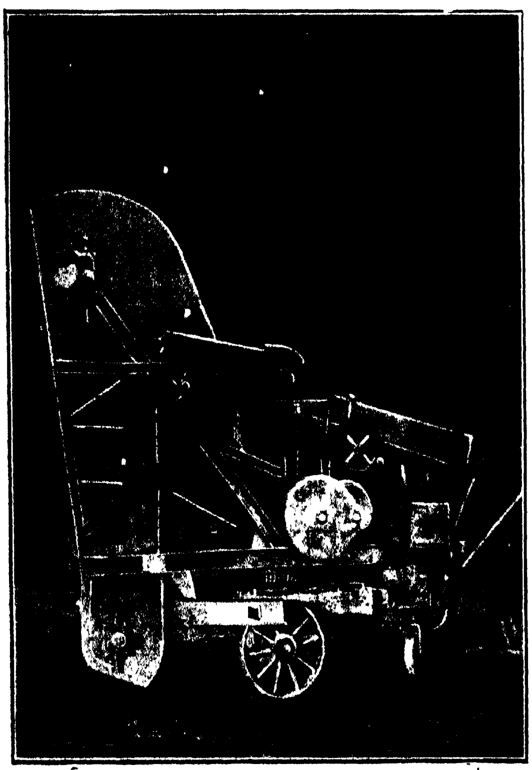
facturers' point of view, since it often happens that some batches of the product do not contain the exact percentage of soluble phosphoric acid desired and consequently have to be covered, in the stock pile, by a layer made with different proportions of ingredients in order to get a true average. In breaking down the pile it is important that these layers of different composition should be thoroughly mixed and a uniform product obtained, which is difficult to do by hand, whereas the machine scoops out the product in the desired proportions, corresponding to the different thicknesses of the superimposed layers. If necessary, this property of the machine can be utilized in the production of blended or compound fertilizers, the various components being superimposed in horizontal layers, so as to get the ingredients in the required proportions, and the pile is taken down in vertical cuts with the machine, thus producing a homogeneous blend.

Comparison of Working Costs

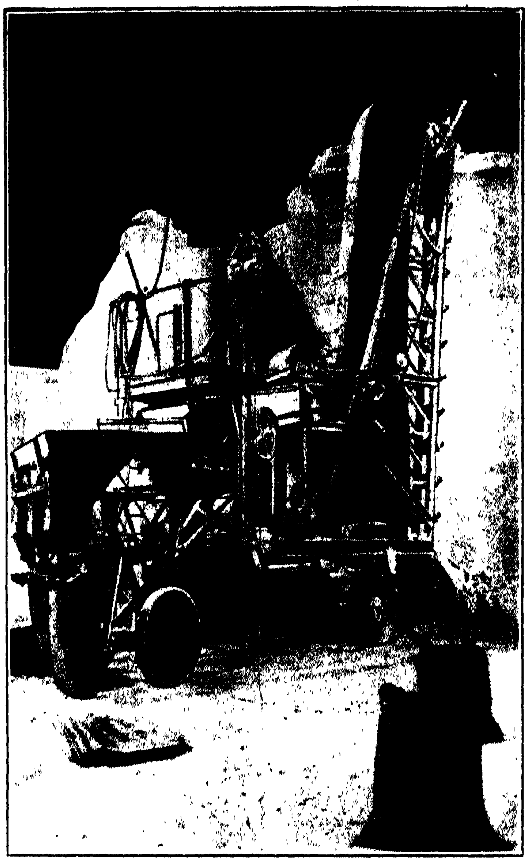
With regard to the relative costs of bagging superphosphate by hand labor and by the machine, the latter works 5 months in the year (the busy season)—that is, for 125 days of 8 hours each, or 1,000 hours in all. The work of bagging, including all the operations necessary for breaking down the pile, screening, crushing, bagging and weighing the superphosphate, tying the bags and loading them on to the wagon, is performed by eight men, at a cost of:

	Francs Per Hr
Labor, 8 men at 3 francs	24
Motive power, 20 hp at 0.25 franc	5
Upkeep of machine	5
Total	34
Output: 150 bags per hour, equivalent to	0.23

With hand labor the same eight men would fill only



ONE OF THE EARLIEST MACHINES



A MODERN BAGGING MACHINE IN ACTION

60 bags per hour, equivalent to a cost of 0.40 franc per bag. The difference is therefore 0.17 franc per bag, or 25.25 francs per hour. In 1,000 hours the profit would be 25,000 francs, which would enable the prime cost of the machine to be written off in a short time.

Increasing Output Per Man-Hour

One of the greatest advantages of the machine is that it enables the output per man to be increased from 750 kg. per hour to 1,800 kg., which is a highly valuable factor during the busy season.

Another advantage accruing from the use of these machines is the greater weight of the full sacks. It seems rather peculiar that the machine could give a greater accuracy of weighing than the ordinary balances, but it has been proved that the vibration of the machine and the weighing scales make those more "living" than ordinary standing scales. The accuracy of the weight has proved not to exceed ½ per cent, in either direction, which gives a considerable advantage both to the seller and to the buyer.

The machines can be used for all such materials as "stands" in piles, such as potash salts, sulphate of ammonia and sodium chloride, which are delivered to the sack in fine powder.

These machines have been experimented upon and successively improved in the Danish superphosphate works, where fifteen of them now replace all the former manual labor. It is impossible to prognosticate the future of such a machine, as the factors vary so much in different countries.

AMERICAN OIL CHEMISTS SOCIETY AT HOT SPRINGS

Fourteenth Annual Convention of American Oil Chemists

THE 1923 convention of the American Oil Chemists' Society in Hot Springs, April 30 and May 1, will go down in the annals of the society as one of the most important in its history. There were more than fifty members present, nearly one-fourth of the entire society. Many of the past presidents, and other leaders in the technology and chemistry of fats and oils, took an active part in the proceedings. All the large packers and vegetable oil producers had from one to ten chemists at the meetings. Several of the soap makers were represented, and most of the commercial chemists of the South were on hand.

The program for the 2-day meeting consisted of reports from various standing committees interspersed with papers and addresses on different phases of the manufacture of edible and technical oils.

Election of Officers

The final session of the meeting closed with the election of officers for the coming year. They are as follows: H. B. Battle, Montgomery, Ala., president; H. J. Morrison, Procter & Gamble, Ivorydale, Ohio, vice-president; P. P. Hinterlang, International Refining Co., San Antonio, Tex., second vice-president; J. R. May, Jr., Barrow-Agee Laboratories, Shreveport, La., third vice-president; Thomas B. Caldwell, Law & Co., Wilmington, N. C., secretary-treasurer; Herbert S. Bailey, Southern Cotton Oil Co., Savannah, Ga., editor, and A. W. Putland, Portsmouth Cotton Oil Refining Corporation, Portsmouth, Va., assistant editor.

These officers constitute the governing committee, the personnel of which is somewhat changed this year owing to the addition of two vice-presidents, the editor and assistant editor as elective officers. Heretofore the committee has consisted of the president, vice-president, secretary-treasurer and the four most recent presidents of the society.

Banquet

Tuesday night, after all the business of the convention was well out of the way, the members with their wives and guests enjoyed a most delightful banquet in the private dining room of the Eastman Hotel. David Wesson as toastmater staged several unique stunts, such as having the waiters fill all the glasses, after the guests were assembled, with perfectly clear water, which immediately turned into delicious *looking* wine. He was suspected of having used a phenolax tablet to perform this classic miracle.

This year for the first time the society had as banquet guests and speakers both the president and the vice-president of the Interstate Cottonseed Crushers' Association.

With the consignment of the loving cup once more to the custody of Mr. Battle, the forteenth annual convention of the American Oil Chemists' Society was brought to a fitting climax.

L. M. Tolman's Presidential Address

The society, in the opinion of L. M. Tolman, retiring president, has during the past 2 years become much more representative of the entire field of fats and oils than under its old name of Cotton Products Analysts. While among its members are to be found nearly all the chemists of the great American edible oil industry, it must continue its efforts to attract those interested in the paint, varnish, soap and other technical oils. He advised against joint meetings with the American Chemical Society, pointing out that at these meetings it would be difficult for those interested in a single field of chemistry to concentrate on their own specific problems.

The greatest contribution the society can make toward the advancement of this country's position in the world's oil industries is, in Dr. Tolman's opinion, along the lines of improvement in methods of analysis. Much has been accomplished by the Smalley Foundation work to perfect the procedures and technique in the determinations of oil and ammonia. The collaborative work of the society should now be extended to cover more thoroughly other analytical methods and increase the proficiency of its members in all lines of laboratory control.

Bleaching Processes Discussed

The problem of how best to bleach an edible oil is today receiving perhaps more attention than any other single phase of the general refining process.

William Kelly of the Filtrol Co. of California read a paper on the bleaching earth Filtrol. Its source is a deposit of impure silica on the edge of Death Valley, hence it is sometimes known as Death Valley clay. The raw material is refined in Los Angeles to a finished product which is pure silica with about 7 per cent of aluminum silicate. It is claimed that besides its ability to absorb coloring matters from vegetable and mineral oils, Filtrol will remove sulphuric acid, free sulphur compounds and moisture. This makes it especially suited to the bleaching of lubricating oils. Since with vegetable oils this earth can be used at a much lower temperature than is commonly employed with fullers earth, there is no tendency for the oils to oxidize or become rancid. To the soap makers this new bleach would be of especial interest if the laboratory results can be duplicated in the factor. Crude coconut and

soya bean oils bleached with it yield soap which will not darken.

In addition to fullers earths most refiners are now using chars or activated carbons in their bleaches. A. A. Jackson, who is with the Darco Sales Corporation, after discussing briefly the development of carbons for the removal of coloring matter from sugars, sirups, glycerines, oils and similar products, described the process by which Darco is made and told of its various uses. He said that while wood chars are good absorbents for gases, as a rule they did not possess any great decolorizing properties.

The decolorizing powers of a carbon may be increased by simply heating it out of contact with air; by impregnating the raw material or char with certain chemicals, heating and then removing the impregnating agent, or by simply heating the raw material in a current of steam or gas to prevent too rapid oxidation during furnacing.

Many materials have been used for the production of so-called activated chars: grasses, hulls, leathers, blood, hoofs, horns, paper mill waste and lignite. It is this latter substance which is the basis of Darco carbon. The plant is located in the Texas lignite field at Marshall. There the raw material as mined is crushed, and furnaced by a special process which is claimed to yield a very active carbon. The color absorptive power is then further increased to "an established point of standardization" by the extraction of impurities with solvents.

In the use of chars for bleaching vegetable oils, it is customary to mix them with fullers earth. Darco, said Mr. Jackson, works admirably in such combinations, but can also be used to advantage by itself. He believed that shortly such chars would largely replace all fullers earth bleaches in the edible oil business.

Vacuum Refining and Super-Deodorization

Two papers covering refining under vacuum instead of at atmospheric pressure were presented on Tuesday. This is a comparatively new idea to the American refiner and these communications aroused considerable interest. Louis C. Whiton, representing the Bataille process, described methods and apparatus not only for neutralizing the free fatty acids but for bleaching and deodorizing under vacuum. He claimed for his refining process that the soap (foots) being dehydrated would settle more readily and with less occlusion of oil than in the present open kettle procedure. Also that one could get a much more intimate contact between the lye and oil without the danger of emulsion formation. This meant the refined oil was of exceptionally low acid content and that the usual saponification loss was somewhat reduced. Bataille recommends a horizontal instead of vertical refining kettle. After neutralization with a fairly strong lye and the evaporation of the water, which takes only about 2 hours, the batch is discharged into a large settling tank. Thus the vacuum apparatus need not be very large (10,000 lb. capacity), as the batches are put through it about ten times as fast as in present practice.

Mr. Whiton believes that there is an advantage to be gained in bleaching with fullers earth in vacuum. Operating data obtained over a period of years in Europe indicate that the loss due to absorption of oil in the bleaching earths or chars is less under vacuum, as only 40 to 60 per cent of the usual amounts of these bleaches is needed. A possible explanation is that at reduced pressure all the moisture which is known to interfere with color absorption is removed from both oil and earth.

Super-deodorization is the term applied by Mr. Whiton to the process of deodorizing at extremely high vacuum and comparatively low temperature. Since the amount of objectionable odors and flavors removed by a given weight of steam is proportional to its volume, the higher the vacuum the more work it will do. The actual daily operating vacuum of the Bataille super-deodorizer is 29.7 in., with a 30-in. barometer. Under this small pressure it is estimated that steam has a volume six times as large as at the usual 28.5-in. vacuum. This high vacuum is obtained in practice by stepping up a high, primary vacuum with a special type of steam ejector. With cottonseed oil the deodorization is carried on at 295 deg. F. and requires from 1 to 2½ hours. Such plants have been in operation abroad for nearly 9 years and more than 100 are in regular use. It is claimed that in these the quality of the finished oil is superior to those obtained where lower vacuum is used, as the Bataille system removes some substances that are not volatile at a higher pressure than is maintained in the "super-deodorizer."

Francis M. Turner, chemical engineer with T. Shriver & Co., in his paper, which was illustrated with many interesting samples, spoke of the dealbuminizing process he is developing for the treatment of crude vegetable oils, and his procedure for vacuum refining. In the dealbuminizing treatment he removes the so-called "gums" or "albumins" by a simple process, the details of which were not disclosed, and then bleaches without refining. A sample of coconut oil exhibited was free from rancidity, although it was 2 years old and had never been refined, merely dealbuminized. Dr. Turner's results with vacuum refining were similar to those obtained by the Bataille process. The soapstocks he showed were hard and dry and nearly free from the disagreeable odor common to most soapstock.

Chemical Constituents of Cottonseed Oil

Two of the most instructive papers, "chemically speaking," were those by George S. Jamieson of the U. S. Bureau of Chemistry. One of the problems his laboratory has been investigating is the composition of the free fatty acids of cottonseed oil. He concludes that the acids are set free by hydrolysis in practically the same proportion as they occur as glycerides in the oils.

Even more valuable were the results reported by Dr. Jamieson on "Some of the Non-Glyceride Constituents of Crude Cottonseed Oil." Practically all of the complex chemical bodies forming the "gums" which gradually settle out of filtered crude cottonseed oil on long standing have now been identified. This gum, which is physically similar to the "foots" of linseed oil, will separate more rapidly if moisture is present in the oil, and changes in temperature also hasten its sedimentation.

At the request of the editor, a special committee was appointed to consider the feasibility of publishing a quarterly to be known as the *Journal of the American Oil Chemists' Society*. This committee made a tentative report stating that it believed it would be possible to finance such a quarterly and hoped to begin issuing with 1924.

The Rarer Metals

A Symposium Held at the Recent Meeting of the American Electrochemical Society

THE outstanding technical feature of the recent New York meeting of the American Electrochemical Society was the session on the "Rarer Metals" conducted by F. M. Becket. The opening address was made by Prof. Charles James of New Hampshire College, who has gained a world-wide reputation through his remarkable researches on the rarer metals. Notwithstanding the fact that much time has been spent searching for methods for detecting the rare elements, in many cases good methods of separation are completely lacking. Present means of separating columbium from tantalum are very unsatisfactory. So far as quantitative analysis is concerned, the greatest problem is found in the case of the cerium and yttrium groups of metals. The separation of the two groups is an extremely tedious matter which is rarely carried out.

When Is an Element Useless?

When an element is condemned as being useless, it is evident that its characteristic properties are deeply hidden. Germanium, which once seemed useless, is attracting much attention in the medical world, because of its action on the blood. The element occurs in argyrodite and canfieldite and to a minute extent in some zinc ores. A very important discovery is a copper sulphide ore of Africa containing as much as 7 per cent germanium. Work at New Hampshire College indicates that the metal can be easily extracted in an exceedingly pure condition. There is therefore a possibility that it will become sufficiently plentiful that its effect upon metals and alloys may be determined. Copper with 5 per cent Ge is a pale gold-colored alloy.

Thulium oxide on careful heating gives a beautiful carmine-colored light, which changes as the temperature is raised, becoming yellow and then almost white. The reduction of beryllium compounds presents very great difficulties. An elaborate investigation is now under way. It is important to develop a simple method for the quantitative determination of Be; such knowledge would allow us to study solubility curves and alloys with rapidity. Indium occurs more commonly than gallium in certain zinc products. Some flue dusts have shown as much as 0.5 per cent of gallium. Many other elements such as lanthanum, dysprosium, holmium and yttrium are being carefully investigated and no doubt the day is not far off when elements at present of little commercial importance will occupy a field of usefulness such as has been achieved by thorium, tungsten and vanadium.

"The Metallurgy of Lead Vanadates" was the title of the paper presented by Dr. Will Baughman of Los Angeles, Calif. He reviewed the various methods of treatment of lead vanadates and then outlined in detail his own method, which has been tried out on the Black Butte ores. In the electrolytic separation, which is an important step in the process, a mercury cathode is used. Tungsten, molybdenum and chromium pass into the amalgam and vanadium separates out as oxide. Separation can also be affected by the volatilization method: Hydrogen is passed over the mixed oxides of vanadium, tungsten and chromium heated to 1,400 deg. C. The vanadium pentoxide is reduced to the trioxide and this is readily distilled off, leaving W, Cr and Ti behind. In the preparation of metallic vanadium Dr. Baughman found lithium to be the best reducing agent. A metal containing 95 to 97 per cent V is easily obtained. Dr. Baughman's paper was discussed by Messrs. Saklatwalla, Fink and Arsem. Mr. Arsem said that the melting point of vanadium was 1,650 deg. C.

C. W. Drury, professor of metallurgical research, Queen's University, referred to the important deposit of cobalt at Cobalt, Canada, which supplies about 90 per cent of the world's demand. The Canadian ore contains about 5 per cent Co, 4 per cent Ni, 10 per cent Fe, 14 per cent As, 1 per cent Cu, 7 per cent S and 20 per cent SiO_2. The process of producing pure cobalt oxide and metal is a long and tedious one. In the production of 1 lb. of cobalt 3,000 lb. of solution is handled. Cobalt is used chiefly in the manufacture of stellite and as one of the main constituents of permanent magnets. The addition of cobalt permits magnets to be made of less than half the weight of those made of ordinary tungsten magnet steel. The demand for cobalt is greater than the supply. E. O. Benjamin referred to the cobalt plating of the iron anode in the electrolytic oxygen cell. He found that Ni-plated anodes were better than those that were cobalt-plated. Messrs. Fink and Ralston pointed out that a very good separation of cobalt and nickel is possible by electrolysis. Kenneth S. Guiterman of New York referred to the production of appreciable quantities of cobalt and nickel as byproducts in the smelting and refining of copper. The A. S. & R. had accumulated large tonnages of cobalt-nickel speiss which locked up appreciable amounts of gold and silver. The Guiterman process consists in sulphating the speiss followed by a solution thereof in water. After the preliminary removal of Fe, As, Cu, etc., NaCl is added and the solution electrolyzed between graphite anode and copper cathodes. Cobalt is precipitated out of solution as a hydrated oxide and the nickel collects on the cathode. The efficiency of the separation is about 98 per cent.

The G. E. Chromizing Process

A simple and efficient method of applying a protective coating of chromium to iron and steel was described by F. C. Kelley of the General Electric Co. The process consists of packing the material to be treated into a powdered mixture of alumina and chromium. The amount of each material used in the mixture is 45 per cent of alumina and 55 per cent of chromium by weight. The material is usually packed into a tube of iron, and then heated at 1,300 to 1,400 deg. C. in hydrogen, in vacuum or in some neutral atmosphere, for lengths of time depending upon the penetration and concentration of chromium desired. The furnaces used for this work consist of alundum tubes wound with molybdenum wire as a heating unit. These tubes are placed in a suitable furnace casing and surrounded with alumina powder, which acts as a heat-insulating material. In chromizing it is necessary to have powdered chromium of at least 95 per cent purity, for chromizing iron which is intended to withstand corrosion. Powdered Al_2O_3 is necessary as a diluting agent, and to prevent excess sintering of the powdered material at high temperatures. It is also necessary to have pure hydrogen, free from moisture and oxygen.

Discussing Mr. Kelley's paper Prof. John Johnston of Yale pointed out that the citation from Spring made by Mr. Kelley—namely, that "alloys might be produced by compression of their constituent metals in a fine state of division"—is without foundation. Johnston had

carefully investigated this matter and found that compression alone does not result in the production of true alloys. Colin G. Fink questioned whether satisfactory results were commercially possible if the chromizing process were carried out in the absence of hydrogen, he regarding hydrogen as a most essential "flux" for this process. L. O. Hart of the Driver Harris Co. suggested that it might be a good deal cheaper to use chromium-iron alloys in place of a chromized surface metal, great improvements having been made in the production of high-percentage chromium-iron alloys. H. K. Richardson of the Westinghouse company referred to his experiments on electroplating chromium on ferronickel wire for lamp seals and said that decidedly below 1,200 deg. C. penetration of the Cr into the alloy below was clearly discernible, the Cr entering the ferronickel lattice.

What Does Metallic Uranium Look Like?

"The Preparation of Metallic Uranium" was investigated by R. W. Moore of Schenectady. Starting out with the tetrachloride of uranium, this was reduced by metallic sodium and a finely powdered uranium metal obtained. The powder was compressed into pellets and these were melted with an arc in atmosphere of argon. The fused metal had the appearance of polished iron. Some buttons could be rolled cold from a thickness of about 5 mm. to small sheets about 0.375 mm. thick.

Dr. Moore's paper drew forth animated discussion. Charles A. Doremus of New York pointed out that the apparatus used by Moore resembles very closely the apparatus used by Robert Hare in 1842. J. W. Marden and H. C. Rentschler of the Westinghouse Research Laboratories have likewise for some time been studying the preparation of metallic uranium. They did not consider the chloride-sodium reduction method reliable and furthermore their metal is not brown, but looks very much like molybdenum.

James A. Holladay and Thomas R. Cunningham gave an account of the "Determination of Uranium by Means of Cupferron. The method was developed at the Union Carbide & Carbon Research Laboratories.

Hugh S. Cooper of the Kemet Laboratories, Cleveland, reported upon the very interesting results he has obtained in the "Preparation of Fused Zirconium." $ZrCl_4$ was reduced with metallic sodium and the product obtained contained 99.28 per cent Zr, the impurities being Fe, Ti and Si. The melting point of this material was determined in the Arsem furnace and found to be about 2,800 deg. C. Alloys of 60 per cent Zr with tin were found to be exceedingly pyrophoric. Zr forms alloys with Ni, Cu, Au, Al, Mg and W. Dr. Cooper showed a number of samples of new alloys.

In the discussion, J. W. Marden of Bloomfield, N. J., said that according to his experience it was impossible to avoid contamination when the zirconium was heated in the Arsem furnace. Accordingly, in recent work at the Westinghouse laboratories a high-frequency, high-vacuum induction furnace was used. The method of analysis for Zr is very difficult and very deceptive results may be obtained. The melting point given by Mr. Cooper corresponds more nearly to that of the oxide or carbide, but not to that of the metal, which is much lower. Dr. Fink felt that the Arsem furnace was one of the most convenient high-temperature laboratory furnaces made, but that time and again experimenters were using it for tests for which the furnace was not intended. There is always an appreciable residual atmosphere of CH_4, CO and probably other gases present which may affect results very markedly. He referred to his determination of the melting point of cobalt; in the Arsem furnace it was 1,490 deg. C. and in his high-temperature hydrogen furnace, 1,610 deg. C. A mere trace of carbon will depress the melting point over a hundred degrees.

A Brilliant Research on Zirconium Steel

F. M. Becket's paper on "Some Effects of Zirconium on Steel" was probably the most important contribution of the session. The Electro Metallurgical Co. has been conducting a series of scientific tests on the addition of zirconium to the steel bath and some remarkable results have so far been obtained. Zr has a greater affinity for oxygen than Si. When Zr is added to steel in excess of approximately 0.15 per cent, this element assures a new rôle by chemically combining with sulphur to form an acid-insoluble compound not detected by ordinary analysis. Zr has a greater affinity for S than Mn. The beneficial effect of small additions of Zr is strikingly demonstrated in the case of heat-treated ordinary carbon steels. The physical characteristics of the product approached those of the highest grade, heat-treated alloy steels. Zr is usually added as a silicon-zirconium alloy. Dr. Becket's paper was discussed at length by E. F. Cone, H. W. Gillett and Dr. St. John.

The report of the detailed investigation on "Treating Steels With U, B, Ti, Zr, Ce and Mo" carried out at the Bureau of Mines, Ithaca, was submitted by H. W. Gillett and E. L. Mack. It was found that Mo has a consistantly beneficial effect. In the types of steel in which the other elements were used they were either of slight effect one way or the other, or decidedly harmful. Mo is a potent alloying element. Prof. Bradley Stoughton discussed the development of super-steels and the elimination of P, S and gases. He also suggested that the elements Gillett and Mack investigated ought to be tried out as additions to pure electrolytic iron. C. P. Madsen, E. F. Cone, C. A. Doremus, Jerome Alexander and Dr. St. John also joined the discussion.

A scholarly discourse on the "Inherent Effect of Alloying Elements on Steel" was delivered by B. D. Saklatwalla of the Vanadium Corporation. He laid stress on the importance of studying the physical conditions, and their alterations by alloying elements, during the period of solidification. Too little attention has been paid to the changes in surface tension of the steel.

The three last papers of the symposium dealt with the physics and chemistry of platinum and its associated metals. Robert P. Neville of the Bureau of Standards described the "Preparation of Platinum and of Platinum-Rhodium Alloy for Thermocouples." The melting was carried out in a Northrup high-frequency furnace in crucibles of lime and thoria. H. K. Richardson referred to his thoria crucibles as being made by regular ceramic methods. Fred E. Carter of Baker & Co. did not consider the metal made in the high-frequency furnace superior to the best grades on the market.

Edward Wichers and Louis Jordan told of the "Investigations on Platinum Metals" carried out at the Bureau of Standards," a very comprehensive study.

Fred E. Carter of Newark, N. J., presented a report of his experiences with the "Metals of the Platinum Group." The tendency to absorb gases is very marked and in consequence difficulties arise during melting. The addition of iridium to platinum raises considerably the temperature required for annealing.

Hardness and Hardening

A Synopsis of Dr. Walter Rosenhain's Lecture, Given at Various Localities During His Recent American Tour—Parallel Phenomena Found in Many Alloy Systems Help Explain Why Steel Is Hard

A CHILD finds whether something is hard or soft by poking his thumb into it, or scratching it with his fingernails. If it dents or scratches it is soft; if it does not, it is hard. We grown-up children do something much like this, only we use a steel ball instead of a thumb, a sharp jewel instead of a nail and a power press for muscle.

Such methods give only a relative idea of hardness. Furthermore, it should be remembered that a pile of sand or brick is extremely hard if one is thrown against it, yet is quite soft toward piecemeal removal. It follows, therefore, that the scale of hardness varies with the tool used.

With these considerations in view, Dr. Rosenhain defined hardness of a material as the power of resisting the local displacement of portions of its substance; to the degree of strength, cohesion or resistance it offers to piecemeal removal. It follows that this property is allied to the unit stress which can be borne without permanent deformation.

How does a material resist applied forces? We here may divide substances into two general classes, viz., those capable and those incapable of plastic deformation under stress. Metals, especially most pure metals, fall into the first category, so consideration must now be given to the nature of plastic deformation. We are also enabled to push our definition of hardness one step further, by noting that it is a function of the resistance a metal offers to plastic deformation.

It is perhaps trite to repeat that plastic deformation in metal occurs by means of block movements within the individual crystals of the aggregate. As a matter of fact elongated grains in severely worked metal are still essentially crystalline—probably highly fragmented, but consisting of crystalline particles. For instance, if a piece of pure iron be squeezed in a vise while constantly under microscopic examination, its smoothed surface will acquire permanent marks, roughly parallel to one another within individual crystals, but in different directions in adjoining ones. Further stress multiplies these lines and develops second or third sets of intersecting conjugate markings. The nature of these markings is shown in Fig. 1. The crystal has been broken into blocks which move slightly past each other and then regain their rigidity. The top surfaces still reflect vertical light directly back into the microscope and appear white; the inclined slips deflect vertical light to the right and appear dark. An exact negative of the view can of course be had by side illumination from a source located in the direction of *A*. Furthermore, a surface such as this can be heavily coated with a protective copper plate, sectioned at 90 deg. and the steps and changes in level can thus be actually observed.

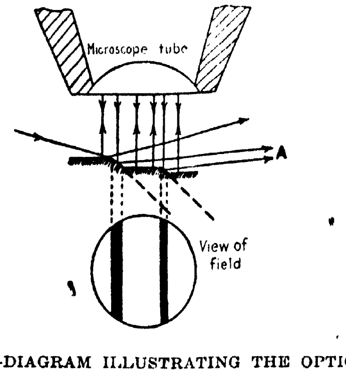


FIG. 1—DIAGRAM ILLUSTRATING THE OPTICAL BEHAVIOR OF SLIP BANDS[1]

[1]Reproduced from Fig. 108, "Introduction to Physical Metallurgy," by Walter Rosenhain.

CRYSTALLINITY CONFERS DUCTILITY

It is not so often appreciated, however, that it is the crystalline character of metals which confers the property of ductility and plasticity—that permits the phenomenon of slip. X-ray investigation has confirmed the belief that the atoms in crystals are arranged in a regular geometric order, repeating itself perfectly in the adjacent infinitesimal elements of the crystal. Very ductile metals like iron and gold crystallize in a cubic arrangement; more brittle zinc builds up a space lattice like a nest of hexagonal parallelopipeds.

Atoms are strongly held to position in these lattices by balanced forces, possibly of electrical nature, exerted by and upon all their surrounding neighbors. In fact the atoms are so strongly held that they are capable of only a relatively small displacement by outside forces. Within this range their displacement varies as the imposed force—they act in an elastic manner. Larger stresses break these interatomic bonds temporarily, and a crystal block slides along some principal cleavage plane, the atoms on each side momentarily making a change of partners.

For practical purposes the main cleavage plane of the cubic system (the 1-1-1 or octahedral plane of the crystallographer) may be regarded as quite smooth—the atoms are spaced along it in a perfectly regular manner in all directions, and they can change partners with considerable facility. In other planes, and along principal planes of more complex crystals, the atomic spacing is not so regular, and an atom once free cannot always find a new partner unless the movement stops after a well-defined interval.

Thus it is that we are naturally led to the conclusion that ease of slip, or ductility, depends upon atomic regularity in the crystal. Conversely, slight irregularities in spacing, or the occurrence of lumps or humps on the gliding planes, decrease the plasticity

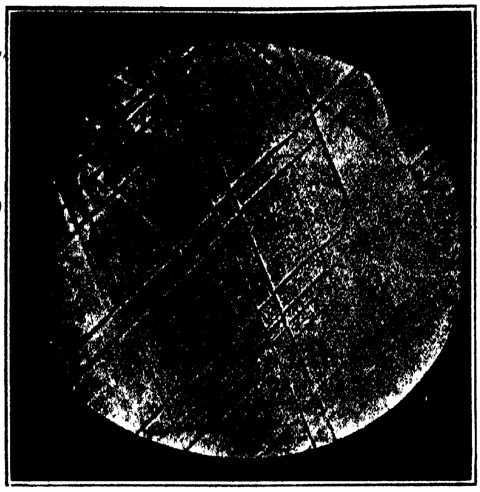


FIG. 2—SLIPS IN A CRYSTAL OF OVERSTRAINED LEAD[1] × 1,000

and increase the force required to start slip—that is to say, increase hardness. It follows directly that slip is inconceivable in amorphous (non-crystalline) material; in such substances actual fracture is necessary to bring about sudden movement.

From these considerations we arrive at the statement that hardness depends upon the smoothness and extent of the available slip planes. From this viewpoint it becomes apparent that ductile metals like iron, aluminum and copper can be hardened in various ways:

First, by producing a multitude of humps on the main crystallographic planes. Dr. Rosenhain has shown in his lecture before the Institute of Metals[3] that this always occurs when two metals enter into solid solution. "Stranger atoms" replace their hosts at the latters' position in the space lattice, but since the balance of interatomic forces is disturbed, the neighbors are slightly displaced. This roughens the slip planes, consequently solid solutions are harder than the constituent metals, often very materially so.

In the second place, a ductile metal can be hardened by fragmenting the large crystals. This is the principal effect of cold work. Although in purest metal it might theoretically be possible for a slipped crystal to remain homogeneous, in practice considerable derangement is always produced at the surfaces of slip. Some atoms always fail to find new partners, and some are more or less uneasy in their new surroundings, at least for some time. Such effects result in an upset in the space lattice, which naturally will be a zone offering considerable resistance to an incipient slip along an intersecting direction, and even greater resistance to second movement on the same plane. Successively infiltering amorphous layers therefore "fault" the crystal in many directions (Fig. 2), increase the resistance to stress; finally the metal reaches a state where ductility is exhausted and it becomes brittle, even though still consisting principally of an assemblage of crystalline fragments.

Third, hardening can be effected by increasing the amount of amorphous material at the crystalline boundaries. Where one atomic orientation meets another there must be an interface (which may be several hundred or perhaps only a few atoms thick) where the space lattice is a compromise between the two. These regions increase hardness of the metal by roughening at the ends of potential slip planes. Considerable end support is also given by adjacent grains. Furthermore, deformation transmitted across a boundary must change direction. These factors are not marked unless the grain size is very small—then they become very important indeed.

Finally, and most important, metal may be hardened by distributing finely divided hard particles throughout the crystal. This can be done by alloying a substance which is somewhat more soluble in the metal at elevated temperatures than at room temperatures. On cooling the then insoluble material precipitates as very fine and highly dispersed particles; if the cooling is at a proper rate these particles cannot coagulate to any extent, and the result is that the crystalline lattice of the mother material is not only interrupted by these particles, but itself is largely in an amorphous condition following the disruption of the lattice necessary to eject the insoluble material. In fact, the latter factor (amorphitization of the solvent material) is the principal reason for the intense hardening possible by this method, in Dr. Rosenhain's opinion.

Three alloy systems were cited by the lecturer to show the remarkable similarity of the hardening phe-

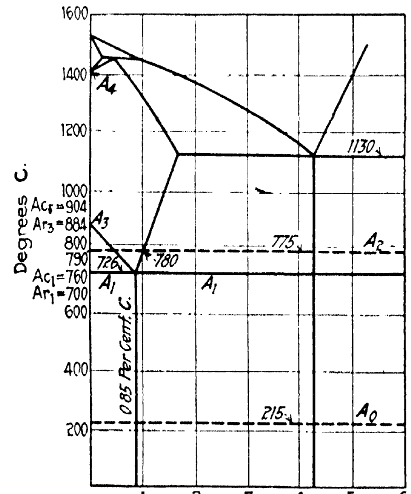


FIG. 3—IRON-CARBON EQUILIBRIUM DIAGRAM, AFTER HOWE

nomena—viz., the well-known iron-carbon series, which includes steel, the system between aluminum and the Compound Mg_2Si (duralumin), and the aluminum-zinc alloys studied by Hanson and Gaylor.[4] Figs. 3, 4 and 5 show the equilibrium diagrams. Draw a vertical line through 82 per cent Zn in Fig. 5 (point *F*) and note how the β field corresponds to the austenitic field in steel, and how a 79 per cent zinc alloy would develop a truly pearlitic structure on slow cooling. It is obvious that the inclined lines bounding the solid solution fields merely indicate how the solubility varies with the temperature.

In all these alloys a quench at a rapid rate from a correct temperature to a sufficiently low temperature will retain the solid solution practically intact, but in

[1]Reproduced from Fig. 100, "Introduction to Physical Metallurgy," by Walter Rosenhain.

[3]*Chem. & Met.* March 7, 1923, p. 442

[4]"A Further Study of the Alloys of Aluminum and Zinc," by D. Hanson and Marie L. V. Gayler, *J. Inst. Metals*, 1922.

an unstable condition, and the metal, while much harder than in the pure state, is much softer than it can be made. The metal may be said to be in the austenitic state. It is a mere detail that the Al:Zn alloy must be quenched and held in liquid air to retain austenite. If the speed of cooling be slightly lower, or if the drastically quenched metal be warmed somewhat, it becomes very hard. Either operation gives the necessary time and atomic mobility so that the unstable solid solution may break down into two phases—viz., minute crystals of a new phase and a disarranged lattice of the original. This condition (known in steel as martensite) will give maximum hardness because offering maximum resistance to slip; gliding planes are almost absent. Again, it is only an incidental fact that the tempering or drawing temperature of duralumin is at or lower than the atmospheric, therefore quenched duralumin "ages" or hardens spontaneously for several days.

Slower cooling or higher tempering will allow the metal to more nearly approach its new equilibrium; the crystals of the second phase (Fe_3C in steel, Mg_2Si in duralumin, and β solution in Al:Zn alloys) will grow in size, and the mass of the material (ferrite in steel, aluminum in duralumin and α solution in Al:Zn alloys) will reorganize its lattice and accumulate into larger crystals. With this the possibility of slip returns, the metal loses hardness slightly, and the microscopic appearance known as troostite may be found. It happens that Al:Zn alloys, quenched in liquid air and warmed to room temperature, temper (that is, separate into two phases) so fast that the latent heat liberated by the chemical and physical reactions will warm them so they cannot be handled with comfort within a few minutes. This phenomenon is a beautiful instance of recalescence occurring at low temperatures.

Changes in the same direction occur if greater freedom is offered. Under the microscope we may observe sorbite and finally a mixture of well-differentiated phases characteristic of pearlite will appear possessing only a moderate amount of hardness, but considerable ductility. Thus it is that the whole theory of hardening and tempering is applicable for a wide variety of

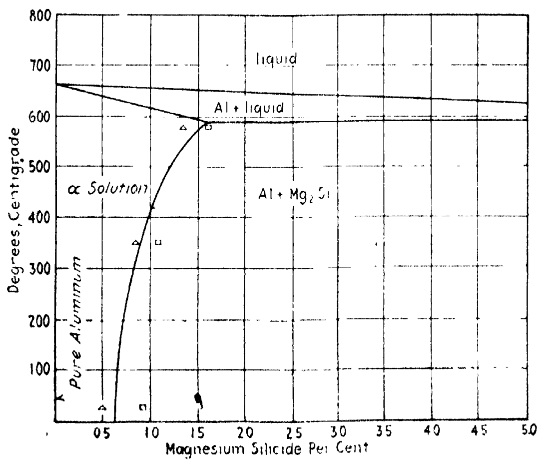


FIG. 4—EQUILIBRIUM DIAGRAM BETWEEN ALUMINUM AND MAGNESIUM SILICIDE[5]

[5]Reproduced from Fig. 36, "Constitution and Age-Hardening of the Alloys of Aluminum With Magnesium and Silicon," by D. Hanson and Marie L. V. Gayler, *Journal Institute of Metals*, No. 2, 1921, vol. 26, p. 321.

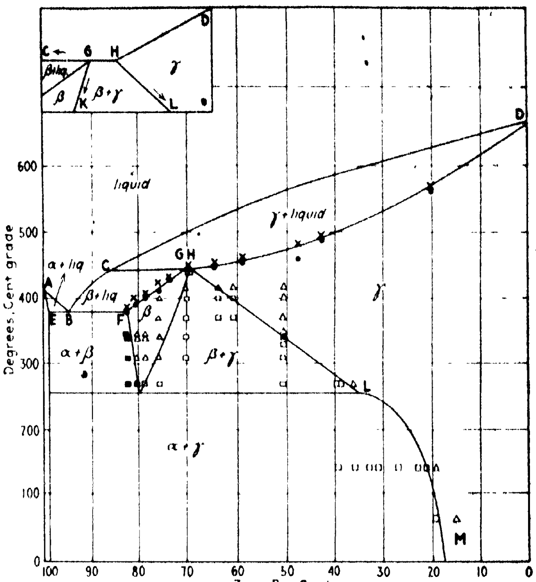


FIG. 5—ALUMINUM-ZINC EQUILIBRIUM DIAGRAM[4]

duplex alloys whose mutual solid solubility increases with temperature and whose crystalline phases are the one quite ductile and the other less so.

While detailed figures on the properties which may be induced in the aluminum alloys by heat-treatment will be covered in a later lecture, it is not amiss to emphasize again the nature of martensitic steels.

Westgren has investigated by X-ray methods the space lattice of carbon steel at 1,000 deg. C. (austenite) and finds it to be face-centered cubic arrangement.[7] If this lattice acts as a host to enough carbon, manganese or nickel atoms so that its normal activities are dampened, it can be quenched to room temperature and appear as relatively soft austenitic steel. But if this austenite decomposes slightly on cooling, it becomes intensely hard. Here again the X-rays tell us that this martensite contains particles with body-centered lattice (i.e., ferrite or alpha iron) crystals so small as to be about the size of colloidal gold—i.e., about 100 atoms in diameter. No spectral lines from the previous face-centered lattice are found. Dr. Rosenhain interprets this fact to mean not that *all* the iron was transformed from gamma to alpha, but that the bulk of the iron is quasi-amorphous—disrupted by the precipitation of carbon and the formation of colloidal grains of ferrite. Such crystals of ferrite have little or no keying action—ferrite in itself is too ductile to halt an impending slip in a surrounding crystal. The true reason for the hardness is the disorganized condition of the matrix. Whether carbide crystals are present at this stage, or whether the molecules of cementite have formed is doubtful. X-ray analysis of martensite shows no lines due to cementite crystals, but for that matter, neither would it if the same steel were annealed to the point where Fe_3C is visible under a microscope. Apparently its spectrum is such that it is masked or diffused unless it is present in great excess.

[7]In the *Journal of the Iron and Steel Institute*, May, 1922, Westgren advanced the view that carbon atoms were inserted into the center of the unit cube, but Dr. Rosenhain understands that he has recently abandoned this view for the one that a carbon atom replaces an iron atom at or near its regular position in the normal lattice. Dr. Rosenhain holds this is the make-up of all solid solutions.

Preventing Dust Fires and Explosions

Although the Explosibility of Many Industrial Dusts Is Easily Demonstrable, the Hazard Is Often Ignored and the Adoption of Effective Control Methods Delayed Until Disastrous Explosions Force Recognition of the Dangers

BY DAVID J. PRICE
Engineer in Charge, Development Work, Bureau of Chemistry

IN MANY manufacturing establishments the creation of dust is essential. The dust itself is the manufactured product, with recognized market value, and its creation is necessary in the various steps and operations followed. It is possible, however, to collect the dust and adopt effective control methods. In fact, it is an indication of efficiency in the manufacture of a product of commercial value to install effective dust-collecting systems which prevent waste of the product and dissemination of the dust throughout the plant.

We now realize that two conditions are necessary for the occurrence of a dust explosion: (1) There must be a proper mixture of dust and air in suspension, which must be of explosive proportions, and (2) this mixture must be ignited by some external source of heat or flame equal to the ignition temperature of the dust. It is now generally accepted that dust explosions cannot occur spontaneously. This must not be interpreted as meaning that there is no such phenomenon as "spontaneous combustion," which is quite a different thing from "spontaneous explosion." It is just as impossible to produce a "spontaneous dust explosion" as it would be to produce a "spontaneous gas explosion." The explosive mixture of dust or gas must be ignited.

EXPLOSIVE INDUSTRIAL DUSTS

Our knowledge of dust explosions is constantly increasing. It has not been many years since it was generally believed that all carbonaceous dusts were explosive. Experimental work has shown that at least one kind of dust which contains a very high percentage of fixed carbon—anthracite coal dust—is not normally explosive (without the presence of flammable gases), while all types of coal dust with lower fixed carbon percentages are explosive. Explosions of aluminum, magnesium and similar metallic dusts have indicated the danger of industrial dusts of this type. A few years ago the grain industry felt that unless the grain were ground and the starchy material released the dust was not explosive. It has since been proved many times, with telling effect, that dust from the handling of grains in ordinary elevating operations is highly explosive.

It must not be concluded that these disastrous explosions are confined entirely to grain handling or lines of milling, such as flour, feed, cereal and starch. All these industries have experienced disastrous explosions and suffered extensive losses. Explosions of a number of other dusts like powdered milk, fertilizer, rubber, soapine, spice, bark, sulphur, cocoa and cork have also occurred. We must expect the possibility of explosions from any type of industrial plant dusts, with the exception of inert dusts, such as shale or limestone.

*Presented before the Midyear Safety Conference held in Chicago, April 17, 1923, under the joint auspices of the Engineering Section of the National Safety Council, Chicago Safety Council and Western Society of Engineers.

It is not necessary to go into detail at this time as to the causes of dust explosions. It is probably sufficient to state that any source that will ignite the dust or cause it to burn may result in dust explosion. Attention is particularly called, however, to the possible electrical causes and other mechanical sources that have been responsible for recent disastrous dust explosions. These causes have been fully discussed in publications of the Department of Agriculture, which are available for interested safety men. It should be sufficient to state that the matter of prime importance is the control of the dust condition in the plant, together with the elimination of any possible sources of ignition.

INDUSTRIAL EXPANSION INCREASES HAZARDS

The question as to why we are having so many dust explosions in industrial plants is very frequently asked. To the investigators that have been engaged in a study of this problem for several years the opposite question seems more proper, "Why do we not have more dust explosions in industrial plants?" The industrial expansion to large-scale operation and the increase in capacity and production have increased the quantity of dust produced and added to the dust explosion hazard. Naturally, the more dust created the greater the possibility of dust ignition and explosion. The introduction of new types of milling machinery and equipment has created new ignition sources that have been responsible for disastrous dust explosions, and it must not be concluded that all the recent dust explosions have occurred from common or previously determined causes. This is not the case. On the contrary, investigators have shown many new causes that had not previously been brought to the attention of the investigating agencies.

In connection with the operation of a paper mill, an explosion recently occurred in a drier used in the manufacture of lignone from waste sulphite liquors. The liquor was sprayed into the drier and the moisture was removed by means of superheated steam. A fire started in the drier and was followed by an explosion that did considerable damage. The fire evidently started on top of the superheater. There must have been an air pocket in the drier to furnish the oxygen for combustion, although the drier was supposed to be free from air and under pressure of approximately 1 in. of water with superheated steam. The point we wish to bring out is the fact that, because of new manufacturing processes and equipment, some equipment may be installed which the manufacturer believes to be safe, yet which, through some faulty design, may increase the explosion hazard. In the case cited there should have been no air pockets in the drier and if the equipment had been operating properly no dust should have collected on the hot superheater coils.

The extent of operation of many of our industrial

establishments has greatly increased the dust explosion hazard, particularly in the grain elevator industry. At present elevators in the terminal markets of the United States and Canada are handling as much grain in a day as would be handled in several weeks on the operating scale of only a few years ago. This has naturally increased the possibility of dust settling and accumulating throughout the plant.

We can fully realize the importance of the removal of static or accumulated dust when we consider that dust explosions, as a rule, occur in two stages, (1) The primary and (2) the secondary explosion. When the explosion occurs in a plant that has recently been cleaned and where effective dust collecting methods are practiced, the nature of the explosion is localized and of a minor extent. When dust is allowed to accumulate, however, the original ignition is accompanied by sufficient concussion to shake loose the accumulated dust, which feeds the flame of the first explosion and permits it to propagate throughout the entire plant. This propagation of flame is very rapid and is accompanied by excessive pressures, which cause great damage to property and extensive life losses.

Pneumatic Sweeping Systems for Removal of Static Dust

Attention is being given to the development of effective pneumatic systems for removing static dust. A system of this nature installed in a large industrial plant collects approximately a carload of dust a day. This system has a total of approximately 2½ miles of piping, with about 650 hose inlet connections distributed throughout the building in such a manner that any part of the building or interior structure can be reached with a maximum of 50 ft. of hose.

An efficient system of this nature, installed in industrial plants where explosive dusts are handled, should be of great value in reducing the hazard of secondary explosions. Reports indicate that progress has been made in developing systems of this type for many lines of industry where recovery of the dust is desirable on account of the commercial value of the product. Engineers who undertake the development of pneumatic sweeping systems of this character should fully appreciate the problems that must be worked out before these systems can be successfully installed and operated in handling many types of explosive industrial dusts. The installation should not be undertaken until previous experimental work has shown that the system recommended is of practical value and will operate at high efficiency in the particular type of industry for which it has been designed. The progress already made by experienced pneumatic engineers is worthy of recognition and encouragement, and, in the particular installation referred to, reports indicate that the system is operating with satisfactory results.

Suggested Plan of Action

It is no longer necessary to wait until an explosion occurs with expensive results to demonstrate that the dust in any particular plant is explosive. The Bureau of Chemistry of the United States Department of Agriculture would therefore like to suggest the following plan of action for safety men in dealing with this hazard:

(1) The company should determine the degree of explosibility of dust created during the operating processes. The Bureau of Chemistry has equipment for testing any samples of dust forwarded, or the bureau can advise the company as to what methods might be followed in conducting tests at the plant. There are a number of simple methods that require very little time for determining definitely the possibility of dust ignition.

(2) The bureau is glad to suggest control methods when requested. Frequently a control method effective in one branch of industry is of value in another line. The engineers of the bureau have studied this matter thoroughly and are continually assisting industrial companies in the installation of improved equipment and control methods.

(3) If a safety committee is maintained in the industrial organization, this committee should pay particular attention to dust accumulating throughout the plant and also observe the efficiency of any dust-collecting systems in operation. We must fully realize that, after all, the proposition must be "sold" to the workman, because he is one of the most important controlling factors in dust explosion prevention. Much depends upon him and he cannot be too fully informed as to the possibility of dust explosions.

(4) All dust explosions and resulting fires should be reported promptly to the Bureau of Chemistry, in order to secure the assistance of the engineers in determining the cause and in considering methods of prevention. It is very important that explosions of limited proportions be reported and that the industrial company does not delay action until there is loss of life or property damage. The investigation of a large number of these explosions has very definitely shown that more valuable data have been secured when the explosion was of a minor nature and the destruction neither complete nor extensive. As a rule, workmen can advance information of value in establishing the circumstances under which the explosion originated, a very definite and helpful contribution to dust explosion prevention that it is possible for every safety man to render. Report the "wee, small occurrences" and thereby help to take the "bust" out of combustible dusts.

International Attention to Dust Explosions

A number of international agencies are now considering dust explosion prevention. The National Fire Protection Association, through its committee on dust explosion hazards, has devoted a great deal of time during the past year to a study of the subject as it relates to various types of industries.

The Chamber of Commerce of the United States, through the National Fire Waste Council, is co-operating with the Bureau of Chemistry in bringing the question of dust explosion control to the attention of the chambers of commerce in industrial centers. A special circular on the subject, containing valuable suggestions along the lines of possible co-operation, has been distributed to the fire-prevention committees of the chambers of commerce.

Committees on dust control in grain elevators have been organized by prominent interests in the United States and Canada, to devise ways and means for the control of dust explosions in this particular industry, in which losses have been very great during recent years.

The efforts of these agencies, combined with the co-operation of the industrial companies, should result in the reduction of losses from disastrous dust explosions and fires.

Machinery
and Appliances
for Production and Control

Equipment News

From Maker and User

Materials
and Accessories
for Chemical Industries

A New Flow Meter

Most flow meters are based on the principle of measuring a pressure difference caused by the insertion of some such element as an orifice, or venturi tube, in the line of flow. The meter will then consist of this element and the means for recording the flow in the pipe line.

A simple way of measuring the pressure difference caused in the line is with a U-tube or manometer filled with mercury half way up each leg and with the sides to the tube connected to the two sides of the line of flow—that is, across the orifice or venturi.

In making its new flow meter, the H.S.B.W.-Cochrane Corporation has followed this simple theory. The U-tube, if mounted on a pivoted frame and permitted to rotate on a knife edge, will take a position such that the center of gravity of the whole supported structure—U-tube, frame and contained mercury—is vertically beneath the point of support. As the pressure difference causes the height of the mercury columns to vary—as between the two legs of the tube—the tube will then rotate. Its rotation can be made to actuate a pen and in this way draw a chart showing the flow over a given period.

For practical reasons, the U-tube is designed to tilt through only a relatively small angle. In order to have a sufficiently long indicator scale for practical use, an indicating pointer is mounted with a pinion on a shaft which rotates on pivots. A gear sector attached to the U-tube meshes with this pinion. Thus a relatively small swing by the U-tube is multiplied to a large angle of rotation of the indicator pointer. A large scale, visible from some distance, can thus be used.

The pen arm is also arranged to rotate on pivots. A toothed sector attached to the pen arm meshes with a second sector attached to the U-tube beam. The radii of these two sectors are in such proportion that a small tilting of the U-tube is multiplied to a suitable pen swing. The pen draws upon a circular, clock-driven chart concentric with the indicator scale. These two records are shown in Fig. 1, which is a photograph of the dial of a Cochrane flow meter.

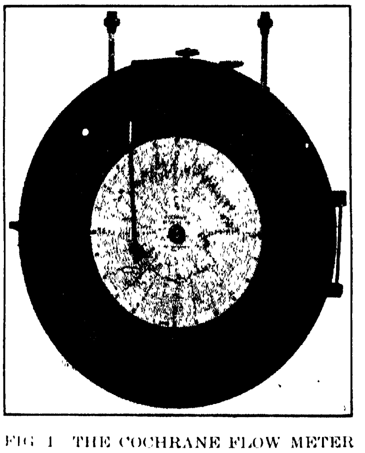


FIG. 1—THE COCHRANE FLOW METER

As the difference between the pressures on the two sides of an orifice varies as the square of the flow, both chart and indicator scale with a simple tilting U-tube would have unequally spaced divisions—that is, the lines would be closer together at low flow, becoming gradually farther apart as the flow increased to maximum.

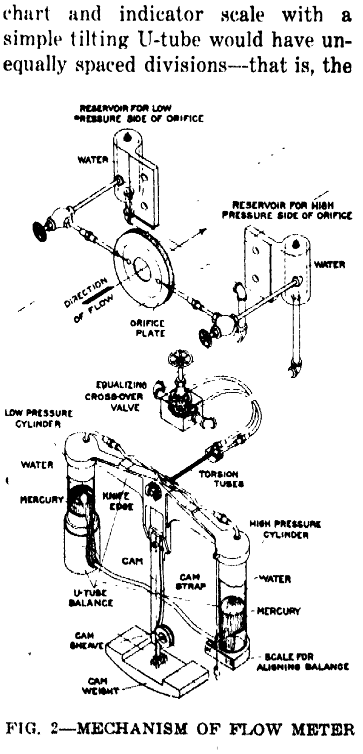


FIG. 2—MECHANISM OF FLOW METER

Uniform scale divisions and a uniformly divided chart are desirable and are obtained by the method shown in Fig. 2. A suitably shaped cam attached to the U-tube beam bears against a flat metal strap kept taut by a weight and guided by a stationary sheave. As the U-tube tilts, an increasing resistance is offered to motion. The cam is so shaped that the tilting is directly proportional to the flow that causes the difference in pressures which acts on the mercury in the U-tube.

The recording pen has a movement in a radial direction on the chart directly proportional to the flow, so that the chart can be integrated with an ordinary radial planimeter. The total pen movement is 4 in. and backlash has been eliminated. A micrometer adjustment provides for setting the pen at zero. The pen, which rests on the chart by gravity, may be lifted to permit replacement of the chart.

The standard element for creating the pressure differential supplied with this flow meter is a sharp-edged orifice in a circular plate of brass or Monel metal, ⅛ in. thick, to be installed inside the bolts, between flanges of the pipe line. Pressure connections to the two sides of the orifice are in this orifice plate itself. In this way these connections have correctly placed and sized openings, and the coefficient of discharge for the orifice is always exactly known.

NH_3 Compressors for Canada

Canadian users of ammonia compressors are to be able, in the future, to procure these machines of Canadian manufacture and standard design. The Canadian Ingersoll-Rand Co., Ltd., of 260 St. James St., Montreal, is placing on the market a line of straight-line and duplex ammonia

compressors for steam, belt, electric motor, or oil engine drive. These machines correspond to those manufactured in the United States by the Ingersoll-Rand Co. of New York. This new service will enable engineers and companies operating refrigerating equipment in Canada to procure compressors of standard design on quick delivery. The Canadian Ingersoll-Rand Co. also handles the full line of machinery, such as pumps, air and gas compressors and similar equipment manufactured by the Ingersoll-Rand Co. in the United States.

Rubber-Lined Barrel

The Cleveland Cooperage Co., Cleveland, Ohio, has recently placed on the market a rubber-lined barrel for the purpose of containing various chemicals which act on ordinary containers or are confined with difficulty and have formerly made necessary the use of glass or lead-lined receptacles.

This barrel was invented by J. H. Gravell, president of the American Chemical Paint Co. It was first used for carrying this company's products. So much interest was aroused in other shippers of similar products that the cooperage company has now undertaken the general sale of the barrel.

The barrel consists of a flexible cylinder of pure rubber suspended in a wooden barrel. The chemical to be transported comes into contact only with rubber surfaces; while the wood barrel serves to protect the rubber container and its contents.

The manufacturers of this container claim for it the following advantages: (1) A saving of 50 per cent in first cost over glass carboys. (2) A saving of 75 per cent of freight charges in long distance hauls as against the glass carboy. (3) Elimination of much breakage and a great saving in depreciation charges over other types of container. (4) A container which is easily rolled, upended, loaded and tiered and hence reduces labor costs. (5) Reduction of the number of accidents which occur when handling acid in glass.

This rubber-lined barrel is offered for the carriage of hydrochloric acid, dilute sulphuric acid, phosphoric acid, spirit varnishes, shellac, extracts, tinctures, ink, castor oil, milk, alcohol and other materials of similar nature. The manufacturers, however, caution users not to use this barrel for nitric acid, gasoline or benzol, carbon tetrachloride, soya bean oil, alcohol containing benzol derivatives or concentrated sulphuric acid.

This line is available, but the makers will sell only to a user who handles a product which test has proved the barrel will hold in a satisfactory manner.

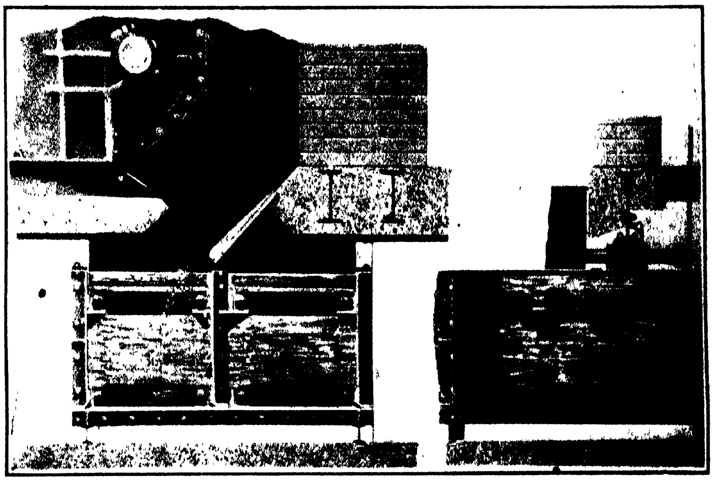
A Unit Ash Conveyor

The medium-sized power plant not large enough to have a railway system running under the boilers for ash handling has long depended on either manual handling of ashes or on various not particularly satisfactory types of mechanical equipment. In order to obviate the difficulties encountered in this work, the Combustion Engineering Corporation, of 43 Broad St., New York City, has introduced a conveyor for this purpose called the "Combusco," which is claimed to be ideal for ash handling.

This conveyor is of the drag chain type with steel scrapers running between two strands of special drop-forged steel chain. The ashes are delivered through a spout to the lower strand of this chain, which runs in a cast-iron trough and carries the ashes out of the boiler house and—generally up a slight incline—delivers them to a storage bin from which they can be carted either by motor truck or freight car. The delivery chute has its delivery end situated inside of the cast-iron trough in which the conveyor runs and this trough is filled with water to such a height that the delivery chute is sealed by water.

It is claimed that by delivering ashes to the conveyor in this manner numerous advantages are realized. First, all dust of fumes and heat in the ash tunnel is prevented. Second, the ashes are quenched as they fall from the furnace. Third, the efficiency of the boilers is aided by the obviation of leakage at the ash discharge. Fourth, when the ashes are quenched in this manner they form a great many small pieces instead of large clinkers and are thereby much easier to handle. Fifth, it maintains a perfect air seal on the combustion chamber.

Besides these advantages claimed for this method of delivery of ash to the conveyor, other advantages are claimed for the equipment in general, such as: It dispenses with all labor except occasional attention to oiling. It permits the boilers to be built on the ground level, as it requires a trench only 4 ft. deep for installation. And because of its long life and elimination of labor it makes the cost of handling ashes per ton during its existence much less than any other method which has been so far developed.



SECTIONS SHOWING WATER SEAL

Catalogs Received

AMERICAN SPIRAL PIPE WORKS, Chicago, Ill.—Catalog 22. A new catalog describing Taylor's spiral riveted pressure pipe, manufactured by the American Spiral Pipe Works. This catalog, besides containing complete information on spiral riveted pipe, also has many illustrations of the various installations which have been made by this company. Appended are a number of valuable tables for the use of those engaged in various kinds of hydraulic engineering.

Readers' Views and Comments

An Open Forum for Subscribers

The editors invite discussion of articles and editorials in Chem. & Met. or on other topics of pertinent interest

Clean Steel

To the Editor of Chem. & Met.:

SIR—Dirty steel causes damage to watch parts in two ways. In the polishing processes used to secure a high polish on the heads of screws and on the faces of wheels, the non-metallic inclusions break out, forming a pit which injures the appearance of the part and causes its rejection. In the second place, the balance staff runs on four sapphire jewels, two of which, called endstones, bear against the ends of the staff. Non-metallic inclusions cut grooves in the endstones, causing the watch to lose its time-keeping qualities. Fig. 1 (× 50) shows such a groove in a sapphire endstone.

Several correspondents have shown photographs of dirty steel. Perhaps some would be interested to know that clean steel can be made. The accompanying photographs show the polished sections of the few samples of clean steel we have secured. These photographs are of polished, unetched, longitudinal sections, magnified 100 diameters, of samples of carbon steel drill rod.

Fig. 2 (× 100) shows the only inclusion in the section examined of a sample received in 1901. Fig. 3 (× 100) shows the only inclusion in the section examined of a sample received in 1907. Fig. 4 (× 100) shows an average section of a sample received in 1922. No other specimen has been examined here that was so free from inclusions. This specimen is polished in relief. No inclusions could be formed that, under a magnification of 100 diameters, appeared larger than a few hundredths of of a millimeter.

I believe, after examining many specimens, that the crucible steel made about 20 years ago was more free from inclusions than that manufactured today. I agree with G. F. Comstock that a specimen to be examined for nonmetallic inclusions need not be hardened before it is polished.

FREDERICK P. FLAGG.

Chief Chemist,
Waltham Watch & Clock Co.,
Waltham, Mass.

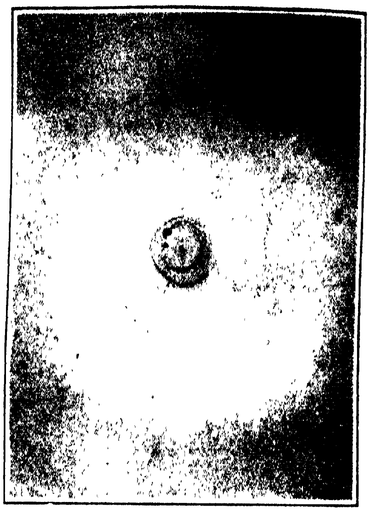


FIG. 1 JEWEL SCRATCHED BY INCLUSION IN STEEL BALANCE STAFF. × 50

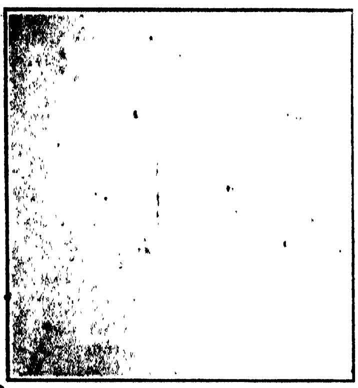
Electric Pig Iron in Brazil

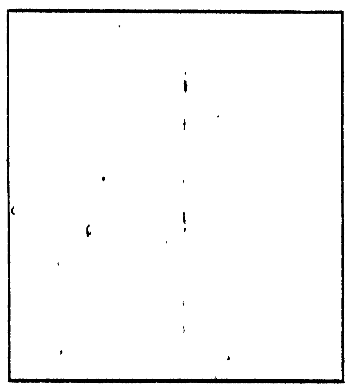
To the Editor of Chem. & Met.:

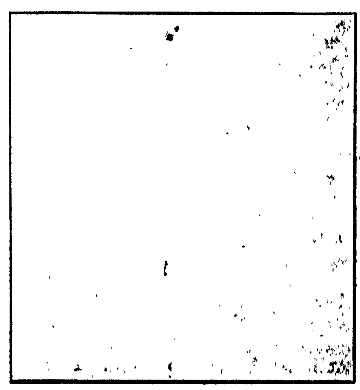
SIR—It might be of interest to your readers to learn that the first Electro Metal pig-iron furnace in America has been successfully put into operation in Ribeirao Preto, State of Sao Paulo, Brazil.

On April 1 the first tap was made and since then the furnace has been working steadily without troubles of any kind, producing 25 to 30 tons per day. From the description of our plant appearing in *Chem. & Met.* of Dec. 7, 1921, you will find that we have two furnaces, exactly alike, but only one can be operated until a new power station is completed. The furnace is of the size rated at 3,000 kw., but is provided with three G. E. transformers, each with a capacity of 1,550 kva., thus making it possible to run the furnace at a high rate, if so desired. As a matter of fact I believe that an output of 35 tons per day will be easy to attain, the limiting factor of course being the electrodes and their current-carrying capacity. Unfortunately the power supply is also at the present time a limiting factor, and we have to run the furnace very slowly. I might mention here that the smooth curve G. E. regulators, used for varying the low tension voltage from 60 to 120 volts, have proved very satisfactory, making possible a very close regulation of the power input.

When designing the furnaces we did not digress to any great extent from the standard design; only in a few details did we have to make some small changes on account of local conditions. We thought it advisable to decrease the diameter and height of the shaft on account of the higher density of the Brazilian charcoals compared with Swedish charcoals (15 lb. per cu.ft. compared with 9 lb.). The cubical contents of our shaft is only 70 per cent of the standard shaft, and the result has shown itself very satisfactory. As the gases escaping from the furnace top have a temperature seldom exceeding 100 deg. C., it is evident that the height of the shaft could be decreased even more without detrimental effects, but to do so would have meant a radical departure from the usual arrangement, as a certain distance is required between the charging floor and the floor where the electrodes are handled and joined together. For this reason the height of the shaft was hardly changed at all, but on the other hand the diameter at the bosh was quite considerably decreased. This gives the shaft a more cylindrical shape, facilitating the descent of the charge and bringing about a more effective gas circulation which







FIGS. 2, 3, 4—CLEAN STEEL. UNETCHED. × 100

Fig. 2—Only inclusion in 1901 steel

Fig. 3—Only inclusion in 1907 steel

Fig. 4—1922 steel polished in relief

at this type of furnace is of such great importance.

Another slight difference is that the electrodes enter the furnace nearer its center line than is usually the case. By this arrangement relatively cold material will always descend on the electrodes and no semi-fused mass will be formed in front of the electrodes that would prevent the descending charge from arriving in the reaction zones formed round each electrode. In spite of the small change it has proved highly beneficial, improving the regularity of the operation to a marked degree.

By this arrangement the brickwork back of the electrodes, which used to be the weakest point of the furnace, is less exposed to the heat, and the roof consequently stands up better.

The electrical connections on furnaces of the Electro Metal type have been the subject of much study and discussion. On the early furnaces diametrically opposite electrodes were always connected to the same transformer, it being taken for granted that the currents in each phase would pass diametrically across the crucible, thereby providing the greatest possible resistance to the current and making possible to operate the furnace at a higher voltage for a given power input. Investigations, however, have shown not only that such crossings of the currents are impossible, but also that the greatest voltage drop takes place just at the electrodes, the resistance of the actual charge therefore being of small importance. Hence there is no very good reason for connecting diametrically opposite electrodes to the same transformer and consequently adjacent electrodes should be connected, a method that has been followed here in Ribeirao Preto. This arrangement makes possible a very effective interlacing of the busbars, thereby cutting down the induction losses and improving the power factor.

Of course it is much too early to tell anything about the operating results. It will suffice to say that from all indications the power, electrode and charcoal consumption appears to be normal. During the last week, for instance, the furnace produced 178.2 metric tons with a power consumption of 354,000 kw.-hr., or 1,986 kw.-hr. per ton. The average load for the week was only 2,107 kw.

As to the rest of the plant, I might say that the 6-ton Ludlum furnace was put in operation last July and has been working ever since on purchased scrap, producing ingots that have been rolled into bars.

N. A. V. PAULSSON.
Companhia Electro Metallurgica Brasileira,
Ribeirao Preto,
Estado de Sao Paulo,
Brazil

Review of Recent Patents

Treatment of Gases From Gas Producers—This invention has for its object such a treatment of the gases produced from the gasification of fuel in a gas producer that it becomes possible to obtain the most advantageous operation of the plant from a calorific standpoint and to obtain a complete and continuous conversion of the ammonia in the gas into ammonium sulphate.

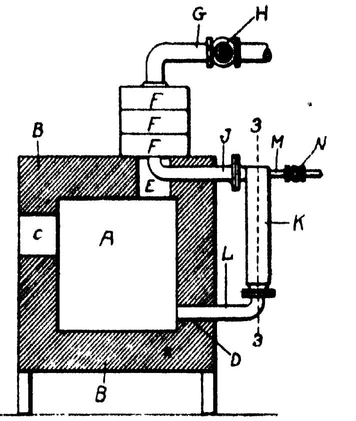
The principal point in this process consists in causing the air that is to be sent in under the grate of the gas producer to pass through the water that has served to cool the gases by spraying. The water is thus cooled and can be used again and the air is heated and at the same time charged with moisture that is useful for the production of water gas in the producer. The circulation of water and its temperature should be adjusted in such a manner that the water will condense the ammoniacal salts only—that is, such salts as do not distill in an aqueous solution—and that this water shall become richer and richer in ammoniacal salts by successive passages in the apparatus for spraying the gases. After the condensation of the fixed salts has taken place, the gases are sent into a closed saturator in which the sulphatation of the ammonia contained in the gases takes place and crystallized ammonia sulphate is produced.

In order to supply the saturator with heat necessary for dilution of the bath and for insuring crystallization of the sulphate, the saturator should be provided with a heating device fed with steam. This steam may be taken from the jacket of the gas producer or from the discharge of an engine, and afterward the steam is fed into the circuit of the air that is fed under the grate of the gas producer. The water of condensation contained in the fixed ammoniacal salts, concentrated by their successive passages through the gases, is used for diluting the sulphuric acid in a receptacle placed in line before the saturator, and in this receptacle a first formation of ammonium sulphate takes place with the elimination of harmful acids, which escape directly from the said receptacle without entering into the gas circuit at all. (1,450,562. Oliver Piette, Brussels, Belgium. April 3, 1923.)

Varnish Composition—Cheaper gums than are ordinarily used in oil varnishes may be employed in compounding if an aryl ester of an inorganic acid is added in compounding. Triphenyl phosphate is especially recommended as a suitable substance to use. Not only is it possible to use cheaper materials by employing this substance but also superior qualities are imparted to the resulting product, it is claimed by the inventors, P. Rothberg and A. P. Sachs, of Summit, N. J., and Manhattan, N. Y. (1,448,869. March 20, 1923.)

Producing Gaseous Fuel—In high-temperature furnaces such as are employed for metallurgical purposes, in order to maintain the requisite temperature, the fuel oil must be introduced into the combustion chamber in the form of a gas premixed with the proper proportion of air to effect the complete combustion. The temperature of the furnace is dependent upon the temperature of the combustion of the fuel supplied to it.

This invention is concerned with a method for preheating the air, premixing it with the fuel and introducing the fuel in the form of a vapor or gas with the correct proportion of air so that the highest possible temperature and complete combustion may be obtained in the furnace. The means for effecting this consists of a counter-flow preheater in which the air is preheated by the exhaust fumes from the furnace, a vaporizing chamber in which the oil is injected and thoroughly intermixed with the air and control valves on the air and oil supply, so that the proportion may be definitely regulated, all as shown in the accompanying cross-section of a furnace to which this type of burning equipment has been applied. In the illustration, the preheater is shown at *F*, the control valves at *H* and *N*, and the vaporizing chamber at *K*, while the gas for combustion is introduced into the combustion chamber *A* at *D*. (1,450,338. M. Sklovsky, assignor to Deere & Co., of Moline, Ill. April 3, 1923.)



Paper Pulp Process—If a small amount of hydrosulphurous acid, a powerful reducing agent, is introduced into the cooking acid used in the sulphite process, an increased and improved yield is obtained. The bisulphite liquor is made up in the usual manner and the hydrosulphurous acid, which may be made specially from such a source as sodium hydrosulphite, is added. Another recommended method of producing the hydrosulphurous acid in the liquor is that of addition of zinc

to the cook, in which case, by reaction with the sulphurous acid present, hydrosulphurous acid results. Ordinarily the addition of from 1 to 2 lb. of zinc dust to a ton of charge in the digester is sufficient to bring about the desired condition. This process has been patented by B. S. Summers, of Port Huron, Mich. (1,451,125. April 10, 1923.)

Sulphur Burner—In the manufacture of sulphuric acid by burning crude sulphur to form sulphur dioxide, there is a necessity in certain cases to use a sulphur high in ash. The purpose of the present invention is to provide a continuous burner for such a sulphur.

This burner comprises a stationary cylindrical shell forming the combustion chamber or burner proper and inclined to the horizontal at a slope of about 1 in. per foot of length. The ends of the shell are closed at each end of the cylinder, making it practically a closed combustion chamber. At the top and near the lower end is the sulphur inlet. This inlet is of the screw conveyor type and makes a positive feed. In this same end of the chamber, somewhat above the bottom, is a port which serves for admitting air for combustion and for overflow of excess sulphur. At the upper end of the drum is the ash outlet connected tangentially to the drum. This ash outlet is located somewhat above the line of sulphur in the burner, thus preventing loss of sulphur with the ashes. The outlet for sulphur dioxide is also at this upper end of the drum and is provided with a suction fan for drawing air into the burner from the other end and for removing the sulphur dioxide at this end. Within the burner is a water-cooled shaft upon which are mounted numerous paddles set at an angle, so that when the shaft rotates the ashes are conveyed to the upper end of the burner. These blades are of a comparatively narrow and ribbon-like structure, so that they will not interfere with the passage of the gases through the burner. However, in order to provide proper conveyance of the ash to the ash outlet, the blades are set in sufficient numbers on the rotating shaft so that their ends overlap. (1,450,677. Horace G. Chickering, assignor to E. I. du Pont de Nemours & Co., Wilmington, Del. April 3, 1923.)

American Patents Issued May 8, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,454,113—Oil Filter. C. A. Hamilton and B. F. Noyes, Bayonne, N. J.

1,454,112—Means for Cracking Hydrocarbons. H. A. Wier and S. A. Wier, Dallas, Tex.

1,454,153—Process of Preparing Sugar. J. Carr, Esher, and A. B. Bradley, Fulham Park, England.

1,454,211—Gas-Pressure Regulator. W. P. Capps, Shreveport, La.

1,454,214—Fused Salt Bath for Heating Steel in Hardening. R. S. Dean, Cicero, Ill., assignor to the Western Electric Co., New York City.

1,454,248—Filtering Apparatus for Air and the Like. S. J. Marx, Cleveland, Ohio, assignor to the Cleveland Air Engineering Corp., Cleveland, Ohio.

1,454,255—Apparatus for Electrical Precipitation of Suspended Particles From Gases. C. H. Weiskopf, Santa Monica, Calif., assignor to International Precipitation Co., Los Angeles, Calif.

1,454,291—Cast Metal Container. J. G. Lehman, Bethlehem, Pa., assignor to Bethlehem Foundry & Machine Co., Bethlehem, Pa.

1,454,300—Combination Agitator and Sampler. L. Sturges, Chicago, Ill., assignor to Solar-Sturges Manufacturing Co., Chicago, Ill.

1,454,301—Fluid Meter. L. E. Van Hise, Los Angeles, Calif., assignor of one-third to J. V. Baldwin, one-third to G. E. McCreery and one-third to P. F. Howell, all of Los Angeles, Calif.

1,454,338—Furnace Retort. C. E. Richardson, Newark, N. J., assignor to International Coal Products Corp., Richmond, Va.

1,454,339—Method of Treating Cellulose Pulp to Remove Odors Therefrom. G. A. Richter, Berlin, N. H., assignor to the Brown Co., Portland, Me.

1,454,341—Safety Control for Automatic Gas Appliances. G. F. Schwartz, St. Louis, Mo.

1,454,341—Solidifying Molten Sulphur. R. H. Stewart, Vancouver, Canada, assignor to Texas Gulf Sulphur Co., Bay City, Tex.

1,454,377—Process of Elevating Liquids. J. C. Grant, London, England.

1,454,411—Progressive Nitrocellulose Powder Containing Nitroguanidine. J. M. Skilling, Wilmington, Del., assignor to E. I. du Pont de Nemours & Co., Wilmington, Del.

1,454,419—Apparatus for Continuous Extraction, Particularly of Oil. M. Wilbuschewitsch, Zurich, Switzerland.

1,454,462-3—Process of Esterification and Process of Producing High-Grade Esters. A. A. Backhases, Baltimore, Md., assignor to United States Industrial Alcohol Co.

1,454,485—Process of and Apparatus for Treating Hydrocarbon Oils. J. P. Persch, Houston, Tex., assignor of one-fifth to B. Tolles, Hohokus, N. J.

1,454,491—Tube Mill. E. C. Soper, Chattanooga, Tenn.

1,454,521—Process of Making Ethyl Alcohol From Galactose. E. C. Sherrard, Madison, Wis., dedicated to the people of the United States.

1,454,564—Process of Producing Zirconium Dioxide. Otto Ruff, Breslau, Germany.

1,454,567—Method and Apparatus for Producing a Chemical Union Between Hydrocarbon Gases and Hydrocarbon Oils. H. B. Snyder, Fullerton, Calif.

1,454,581—Process of Treating Vegetable Fiber. H. C. Fueller, Jacksonville, Fla.

1,454,583—Process of Producing Magnesium Nitrate. V. M. Goldschmidt, Christiania, Norway, assignor to A/S De Norske Saltverker, Bergen, Norway.

1,454,591—Method of Treating Gases. A. Naglevoort, Providence, R. I., assignor to the Nitrogen Corporation, Providence, R. I.

1,454,593—Method of Purifying Mineral Oils. E. E. Arnold, Coventry, R. I., assignor to the Nitrogen Corporation, Providence, R. I.

1,454,599—Process of Ammonia Synthesis and Catalyst Therefor. J. C. Clancy, Providence, R. I., assignor to the Nitrogen Corporation, Providence, R. I.

1,454,604—Process of Making Glycol. W. H. Rodebush, Baltimore, Md., assignor to U. S. Industrial Alcohol Co.

1,454,606—Paper-Making Machine. J. D. Tompkins, Valatie, N. Y.

1,454,609—Apparatus for Use in the Manufacture of Aldehydes. E. J. Winter, Baltimore, Md., assignor to the United States Industrial Alcohol Co.

1,454,610—Bleaching Pulp and Apparatus Therefor. R. B. Wolf, New York City.

1,454,612—Carburizing Material and Process of Making Same. L. Aeby, East Chicago, Ind., assignor to Chicago Flexible Shaft Co., Chicago.

1,454,616-7—Process for Resolving and for Preventing the Formation of Emulsions. E. E. Ayres, Jr., Chester, Pa., assignor to the Sharples Specialty Co., Philadelphia, Pa.

1,454,687—Method of Making Acid-Proof Containers. J. E. Perrault, Watertown, Mass., assignor to Hood Rubber Co., Watertown, Mass.

1,454,694—Leather Drier. W. M. Schwartz and E. B. Ayres, Philadelphia, Pa., assignors to Proctor & Schwartz, Philadelphia, Pa.

1,454,705—Method of Extracting Oil. F. P. Croft, Philadelphia, Pa.

1,454,708—Manufacture of Carbon Bisulphide. A. E. Delph, Workingham, England, assignor to Courtaulds, Ltd., London, England.

1,454,747—Apparatus for Manufacturing Flowers of Sulphur. E. Knapp and J. K. Dickerson, Middleport, N. Y., and F. L. Begtrup, Louisville, Ky., assignor to Niagara Sprayer Co., Middleport, N. Y.

1,454,838—Concentration of Minerals. W. O. Borcherdt, Austinville, Va., assignor to the New Jersey Zinc Co., New York City.

1,454,839—Fire Extinguishing Apparatus for Oil Tanks. W. D. Witter, Roselle Park, N. J., assignor to the Foamite Firefoam Co., New York City.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

British Patents

For complete specifications of any British patent apply to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Cellulose From Wood—In a process for obtaining cellulose from wood and the like by treatment with chlorine peroxide and subsequently with alkaline lye, the chlorine peroxide is used in solvents, such as dilute acetic acid, which dissolve the liquor after it has been transformed by the chlorine peroxide. (Br. Pat. 191,357; not yet accepted. E. Schmidt, Berlin, Germany. Feb. 28, 1923.)

Dioxyperylene—If dioxydinaphthyl is heated with ring-closing condensing agents, such as aluminum chloride, dioxyperylene is obtained. Basic substances, such as the oxides, hydroxides or carbonates of alkali and alkaline earth metals, are preferably added to the mixture. Specifications 165,770 and 165,771 are referred to. (Br. Pat. 191,363; not yet accepted. H. Pereira, Vienna, Austria. Feb. 28, 1923.)

Paper — A further development in utilizing rubber latex efficiently in paper making is obtained by adding a small quantity of soluble alkaline sulphide to the same before it is diluted and mixed with paper pulp in the process described in the parent specification. On addition of acid to coagulate the rubber, etc., sulphur is deposited for the subsequent vulcanization. With acid fibers, or paper sized with resin and alum, the addition of acid may be unnecessary. Sufficient sulphide to produce 1 to 2 per cent sulphur calculated on the rubber content is usually enough, but quantities to produce 10 per cent may be added. (Br. Pat. 191,446. F. Kaye, Ashton-on-Mersey. Feb. 28, 1923.)

Synopsis of Recent Literature

Utilization of Waste Lime Rock

Most of the lime manufactured in the United States is burned in various types of shaft kilns. The fuel and limestone may be added in alternating layers, as in pot kilns, or the fuel may be burned beneath the stone, the flames and hot gases passing up through the spaces between the rock fragments. The necessary draft is maintained either by a tall stack, a power fan, or in certain cases by natural currents.

The necessity of a good draft is a great detriment to the utilization of small-sized fragments of stone, for if large quantities of the finer materials are mixed with the larger masses the draft is greatly retarded and imperfect calcination results. For this reason rock below 4 in. in diameter is usually either discarded or diverted to other uses. In this way, in many cases, a large waste is entailed.

With the growing tendency toward underground operations in lime quarries the problem of utilization of small rock is becoming more urgent, since a much larger part of the rock comes out in the finely divided form.

Of the possible means of burning the smaller fragments either a rotary or a Mount kiln is most commonly used. Since either one of these types of apparatus is rather expensive, neither can be used economically unless the output of the plant is quite large. For plant operating twenty to twenty-four shaft kilns the addition of one Mount kiln for small fragments, and one rotary kiln for fine, is regarded by some as an ideal equipment which will utilize practically the entire quarry output. The Interior Department, Bureau of Mines, from whose publication this information comes, is at the present time working upon the problem of burning small-size rock in the ordinary shaft kiln.

However, as alternate means of disposing of fragments from 2 to 7 in. in diameter several possible outlets may be developed. Open-hearth steel furnaces usually demand stone not less than 4 or 5 in. in diameter, but for blast furnaces smaller stone may be used. This use, however, is limited not only by the demand, but by transportation, for it is too low priced to warrant a heavy haulage charge. Fragments unsuited for lime manufacture are used extensively for road building, and also as ballast and riprap for railway construction. However, these last two applications are of local significance only. Still further uses for small fragments are for use in terrazo floors, for facing concrete blocks, or as a substitute for sand in mortar and wall plaster.

There is also a growing tendency to use pulverized limestone as liming for land. When this means of outlet is resorted to, large storage space for the product between seasons is necessary, because the demand for agricultural limestone is seasonal. Limestone pulverized to a much finer grade than for agricultural use is finding wide application in various products. Small quantities may be added to stock food as a bone builder. A dust—approximately 80 per cent of which will pass a 200-mesh screen—is the most widely used filler in road asphalt surface mixture, although slate flour, portland cement and hydrate of lime are used to some extent. Ground limestone is used, to a limited extent, as a fertilizer filler. Very finely pulverized stone may be used successfully as a whiting substitute in certain classes of rubber, paint and other products. It is essential for such uses that it be very finely ground and uniform in size so as to exclude all comparatively large-size grains. In general the limestone flour that will successfully meet the requirements of fillers such as whiting or china clay should approximate 300-mesh size.

Seaboard Liquid Purification Process

Enough has been written of the Seaboard process of liquid purification of gas so that by this time engineers are thoroughly familiar with the theory. The process has now been in use for some time and reports of its success over a varying length of time are beginning to come to hand. In *Gas Age-Record* for April 21, 1923, H. R. Broker reports the various advantages and disadvantages of the method as they have worked out in the plant at Racine, Wis.

The apparent advantages were:

First—Low cost of installation. A wet process plant designed to obtain 90 per cent sulphur removal for 3,500,000 cu.ft. send-out costs approximately $11,000. One additional oxide box would cost approximately this amount and would not remove 30 per cent of the sulphur.

Second—Low cost of operation. As near as could be determined the cost of operation would not exceed 0.7 cent per thousand cubic feet of gas purified, including royalty, labor and materials, as against 1½ to 2 cents for the oxide method.

Third—Labor is practically eliminated. No additional men are required; the only labor connected with the process is in adding soda ash daily and in oiling pumps and fans. In any plant not sufficiently large or not adapted entirely to mechanical handling of oxide, there is a labor charge, as every operator knows, that does not show on the books. There is a tendency to carry some men on the payroll primarily to have them available when a box is to be emptied.

Fourth—By varying the strength of solution and rate of circulation, the Seaboard process is apparently capable of removing 90 per cent of the sulphur whether a 400-grain gas or 1,000-grain

Important Articles in Current Literature

More than fifty industrial technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem. & Met.* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. Those that are of unusual interest will be published later in abstract in this department; but since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage. The magazines reviewed have all been received within a fortnight of our publication date.

RUBBER SOFTENERS. Paul M. Aultman and C O North *Rubber Age*, May 10, 1923, pp 100-101

SUGAR CANE BAGASSE AS PAPER STOCK. Dr. H. Kumagawa and Dr. K. Shemomura. *Paper*, May 2, 1923, pp. 7-10.

OPERATING CONTROL IN PULP MAKING. R. Sieber. *Paper*, April 25, 1923; pp. 11-14

SOLVENT RECOVERY, FIRE HAZARDS IN. W D. Milne. *Quarterly of National Fire Protective Assn.*, April, 1923, pp. 346-57.

PRINCIPLES OF HEAT TRANSFERENCE. Geoffrey J. Greenfield. (Concluding chapter). *Chem. and Ind*, April 27, 1923, pp. 417-9.

MECHANICAL METHODS FOR THE PROPULSION OF GASES. E. F. Hooper and B. B. Waller. *J. Soc. Chem. Ind.*, April 27, 1923, pp. 180T-184T.

DESIGN OF HOT-AIR DRYING PLANT. George H. Gill. *Engineering* (London), First Part, April 27, 1923, pp. 511-512.

SUGGESTIONS FOR SAVING HEAT IN MANUFACTURING PLANTS. Charles L. Hubbard *Power*, May 8, 1923, pp. 704-708.

THE USE OF PULVERIZED COAL (IN CEMENT KILNS). H. A. Schaffer *Power*, May 8, 1923, pp 718-719.

IMPROVED METHOD OF UTILIZING OLD FIREBRICK. James A Faulkner. *Power*, May 15, 1923, pp. 754-756.

RESTORING USED STEEL BARRELS. *Oxy-Acetylene Tips*, May, 1923, pp. 7-8.

BRITISH STEEL WORKS GAS PRODUCER PRACTICE. Fred Clements. Paper for May, 1923, meeting, *Iron and Steel Institute* (England).

MODERN THEORIES OF DETERGENT ACTION. T. Hedley Barry. *Chemical Age* (London), April 28, pp. 446-448.

INDUSTRIAL USES OF HYDROGENATED OILS. W. W. Middleton. *Chemical Age* (London), April 28, pp. 448-450.

MANUFACTURE OF OLIVE OIL. *Chemical Age* (London), April 28, pp. 452-453

EFFECT OF SOME SUBSTITUTES FOR TIN OXIDE ON THE OPACITY OF WHITE ENAMELS FOR SHEET STEEL R. R. Danielson and M. K Frehafer. *Journal American Ceramic Society*, May, 1923, pp. 634-644.

REVERSIBLE THERMAL EXPANSION OF REFRACTORY MATERIALS. H S. Houldsworth and J. W Cobb. *Journal American Ceramic Society*, May, 1923, pp. 644-662.

REFRACTORY POSSIBILITIES OF SOME GEORGIA CLAYS. R. T. Stull and G. A. Bole. *Journal American Ceramic Society*, May, 1923, pp. 663-673.

GLASS WOOL HEAT INSULATION IN EUROPE. A. D. Saborsky. *Journal American Ceramic Society*, May, 1923, pp. 674-684.

WEEKLY SUMMARY—GRAINS H_2S

Week Ending	Gas Make for Week, M Cu. Ft	Average Make per Day, M. Cu. ft.	Average Inlet	Average Outlet	Per Cent Removal	Lb. H_2S Removed	Lb. Soda Consumed	Lb. Soda per M Cu Ft Gas	Lb. H_2S Removed per Lb. Soda Consumed
Jan. 14	17,001	2,429	690	190	72.5	12,120	1,830	0.108	6.63
Jan. 21	18,873	2,696	660	245	63.0	11,180	1,469	0.078	7.61
Jan 28	18,390	2,627	720	295	59.0	11,170	1,350	0.073	8.26
Feb. 4	19,520	2,789	670	240	64.2	12,000	1,300	0.067	9.23
Feb. 11	19,140	2,734	670	220	67.1	12,310	1,550	0.097	7.94
Feb. 18	16,809	2,401	625	200	67.9	10,200	1,200	0.072	8.50
Feb. 25	21,037	2,964	595	175	70.6	12,820	825	0.040	15.1
Mar 4	20,580	2,940	590	175	70.3	12,200	525	0.025	23.2
Average	18,919	2,698	652	217	67.8	11,750	1,256	0.070	10.8

Solution: Rate 60 gal per M., temp 60 deg F. Actifier air 40 cu ft per gal temp 60-100 deg F.

gas is being treated. This is, of course, not true of oxide purifiers.

Fifth — Possible elimination of stopped services and ruined meters from hydrocyanic acid.

It has been known for many years that a large part of the hydrocyanic acid in the gas has been going through the oxide boxes and into the mains. During recent years a large part of the so-called rust troubles and meter troubles have been traced to this compound. The Seaboard process removes a large part of the cyanides (80 to 90 per cent), sufficient so that the oxide boxes can handle the residue.

The design and operation of the apparatus are more technical than it may first appear from the simplicity of the process, as we soon learned after putting the plant into operation. There are several factors which have a very material effect on the efficiency of operation, most noteworthy of which are the size of coke, depth of packing, rate of circulation, and type of sprays or efficiency of distribution of liquor.

The plant was started in cold weather and we immediately found that we were chilling the gas with the resultant deposit of naphthalene in the actifier. It will be noted that the actifier is quite an efficient cooler when cold air is used. We were blowing 5,000 cu.ft. of air per minute (sometimes at a temperature around zero) through the actifier and absorbing heat from the liquor; this cold liquor again coming in contact with the gas in the absorber. It was found necessary to either heat the liquor entering the absorber or to heat the actifier air.

About 2 weeks after starting the plant we got into trouble from a strong odor of hydrogen sulphide around town. This was noticeable within an area of a mile from the plant. We immediately conferred with Koppers engineers, who recommended dilution of the actifier air as it left the stack. We had two old fans at hand having a combined rated capacity of about 25,000 cu.ft. of air per minute, which were connected to the outlet of the actifier temporarily.

At the same time Prof. O. L. Kowalke was called to give us some information regarding the amount of hydrogen sulphide air would carry without detection. He advised that 1 part in 10,000 was noticeable. The actifier air contained approximately 1 part in 300, so that it would be necessary to use 35 cu.ft. of dilution air per cu-ft. of actifier air discharged, or 175,000 cu.ft. of dilution air per minute. The diluted air would need to be very thoroughly mixed and discharged above the surrounding buildings. The cost of suitable fans, stack and necessary power made this scheme prohibitive. The only remaining positive solution was to burn the actifier air.

During the time we were discharging the air into the atmosphere we had complaints of sickness that were undoubtedly in part psychological. Silverware and copper in restaurants near by turned black over night.

Up to the time of writing, the apparatus has not come up to the contemplated efficiency, but we have sufficient reason to believe that when smaller coke is put in and the sprays properly adjusted, we shall be able to get at least 90 per cent removal of hydrogen sulphide.

The accompanying table of operating data is a summary of results for 8 weeks, which time the plant was in continuous operation. From the data sheet a striking difference in soda consumed is noticeable for the last week and a half. Steam had been admitted at the bottom of the actifier to saturate the air and prevent loss of water from the soda solution, and at the same time utilize the heat in this waste steam. The difference in soda requirements when the steam was shut off shows the fallacy in its use. The results for the last week represent very good efficiency in soda requirements.

Due to the short time, and the numerous difficulties encountered, it is impossible to give a just estimate of the cost of operation.

The conclusions drawn are:

First—We have not lost faith in the process and believe it will work out satisfactorily.

Second—We feel justified in believing the process not feasible near business or dwelling houses without burning the actifier air; as our experiments with dilution, although not complete, indicate that the people controlling the process have no ground to justify their recommending dilution.

Third—The sizes of shells, fans, pumps and all engineering data will stand considerable investigation before the most efficient plant can be specified to be used under any given set of conditions.

Book Reviews

TABLES ANNUELLES DE CONSTANTES ET DONNÉES NUMÉRIQUES DE CHIMIE, DE PHYSIQUE ET DE TECHNOLOGIE. Vol. IV, 2nd Part, 1913-1916. By *Ch. Marie*, secrétaire général du Comité International. Gauthier-Villars et Cie. (Paris). University of Chicago Press (Chicago). 1922. 627-1377 pp. 22x27 cm. Price, $13.25 net.

An international committee was organized at the Eighth Congress of Applied Chemistry in London, June, 1909, for the purpose of collecting and publishing annual tables of physical constants and other numerical data. This committee published Vols. I, II and III, containing, respectively, data for the years 1910, 1911 and 1912. The preparation of the succeeding volumes was interrupted by the war. The work has now been resumed under the patronage of the International Research Council and the International Union of Pure and Applied Chemistry. The original secretary of the committee, Professor Marie, has continued in charge of the work, and Vol. IV contains data for the 3-year period 1913-1916. Work on Vol. V, containing data for the years 1917-1922, is about completed and it is hoped that Vol. VI will contain data for 1923 and 1924 and thereafter the publication again become annual.

The present volume embraces data on electricity, magnetism, atomistic properties, radioactivity, cosmic physics, atomic weights, molecular weights, transition temperatures, diffusion, osmotic pressure, solubility, calorimetry and thermochemistry, chemical equilibrium, velocity of reaction, electrolytic conductivity, electrochemical equivalents, electromotive forces, colloids, crystallography and mineralogy, organic chemistry, essential oils, fats and waxes, biology, vegetable physiology and chemistry; engineering data classified under (1) mechanical constants, (2) electrical constants, (3) physical and chemical properties of fuels; metallurgical data classified under (1) metals and alloys, (2) mechanical constants, (3) electrical constants; supplement.

The data are concisely and systematically arranged, and complete literature references are given. The manner in which the compilation is made is designed to promote completeness and accuracy. The information in all cases was collected by collaborators residing in the various countries and then forwarded to the central office in Paris. From there it was distributed to specialists who undertook the compilation of each separate section.

The total represents an expenditure of considerable effort, which is, for the most part, contributed by zealous individuals impelled by their interest in science who received either no pay or very inadequate pay. The value expressed as effort put into the compilation is certainly many times the sum

of money received for its support as grants and from the sale of the publication. A purchaser may accordingly be assured that he is not only buying a volume that is an invaluable aid to research in every laboratory, but he is supporting an undertaking designed for the general advancement of science and industry.

Furthermore, generous support is especially needed at the present time on account of the increasing difficulties of publishing the tables with the funds so far available. When one considers the very small sums that have been collected, the amount accomplished is remarkable. The undertaking is certainly one that should receive more liberal and regular support than it has in the past. ATHERTON SEIDELL.

BRIQUETTING. By *Albert L. Stillman*, E.M., M.Sc. The Chemical Publishing Co., Easton, Pa. 6¼x9 in., xl + 466 pp., with 160 illustrations. Price, $6.

The author states in the preface: "Although thousands of tons of briquets are manufactured each year, from all classes of raw materials, the only textbook to date published on the subject is the very comprehensive work 'Handbook of Briquetting,' by Prof. G. Franke, translated from the German by Prof. F. Lantsberry. It is, therefore, thought that a book on the subject, presenting it from the American standpoint, will be of interest."

The author has prepared a text on briquetting that is interesting and valuable to American engineers, in describing machinery, binders and methods for briquetting various materials with special reference to American practice. A brief introductory chapter on raw materials is followed by 71 pages describing the various types and classes of briquet presses of both American and foreign makes. Manufacturers' names are given and installations are described with comments on the commercial success or failure of the press.

Chapters III to V inclusive describe the briquetting of steel swarf and turnings, cast-iron boring and non-ferrous metals swarf and scrap. Particular attention is called to the various types of gas and electric furnaces for melting metal briquets and to the reduction of melting losses by the use of briquets rather than loose scrap.

Chapter VI, on "A Discussion of Binders," and Chapter X, on "Principles of Briquetting With Binders; The Briquetting of Coals; Combustion of Fuel Briquets," are full of valuable and practical information based on the author's extended experience in briquet engineering. He does not stop with a mere description of different types of binders, but discusses their advantages and disadvantages and the extent to which the binders and processes have proved commercially successful.

Chapter XI, on "A Chronology of Coal Briquetting in the United States and Canada," discusses the reasons for failures in fuel briquetting and points out the difficulties to be avoided in future construction. Briquetting plants are described from the first one at Port Richmond piers, Philadelphia, Pa., in 1872 to the Nukol plant at Port Stanley, Ontario, built in 1921.

Other chapters in the book cover the briquetting of sawdust, wood wastes and charcoal; the winning, drying, distillation and briquetting of peat and peat char; the carbonization and briquetting of lignite, *braun kohle* and lignite chars; the briquetting of coke braize, low-temperature cokes and petroleum carbon; briquetting of flue dust and ores; and laboratory research in briquetting. Comprehensive bibliographies and lists of patents are given at the end of each chapter.

There are a few minor errors. On page 9 it is stated that "The United States Government Bureau of Mines is at present engaged in investigating the distillation of waste straw and kindred products." It was the U. S. Department of Agriculture that made this investigation and not the Bureau of Mines.

Also on page 236 reference is made to a contract between the Bureau of Mines, John B. Adams and Fred Bremier for the erection of a commercial lignite carbonizing and briquetting plant in Dakota. This contract was not completely signed and the construction of the plant was never started. On page 237, "Grand Forge" should be "Grand Forks," North Dakota. Most of the subject matter is selected with excellent judgment that reflects the author's experience in briquetting.

A. C. FIELDNER.

THE WORKING OF STEEL. ANNEALING, HEAT-TREATING AND HARDENING OF CARBON AND ALLOY STEEL. By *Fred H. Colvin* and *K. A. Juthe*. McGraw-Hill Book Co., New York. 250 pp. Price, $3.

This is a revision of what is probably the best and most handy volume on heat-treatment so far printed. The first forty-five pages of the book, containing chapters on Steel Making, Composition and Properties of Steel, Alloys and Their Effect on Steel, cover the subject in as complete a manner as is necessary. The authors are to be commended for getting into this short space a mass of pertinent information that usually occupies far too great a volume in most text books. Much of the reading matter has been rewritten with improvement. The classification of steels appearing on page 11, and the matter on the physical testing of steels, are useful additions which did not appear in the first printing. Chapter VIII is on Heat-Treatment, and is greatly altered, especially the part that discusses the principles of the art. It is markedly improved and actually is the "heart of the book." It appears to the reviewer that this chapter should replace Chapter IV, and if it were so the authors would have condensed the subject of heat-treatment into less than 100 pages, which is truly a remarkable performance. Chapter IV at present contains some remarks on the application of Liberty engine materials to the automotive industry. In the reviewer's opinion, this is out of place. A serious crticism might be leveled that while Liberty engines might have been a war-time commodity, there is some question as to whether peace-time articles can be manufactured with the same precision.

Chapters V, VI and VII, on Forging, Annealing and Case-Hardening, contain many corrections. Annealing deserves more space than the four pages the authors have given it; the subject of normalizing—an annealing operation—is conspicuously absent. While the general treatment of case-hardening is excellent, it is probably dangerous to advocate mixing carburizers in the shop when much more uniform materials for this purpose are purchasable from a number of sources which have command of the raw materials required. Cyanide hardening is not discussed, which is a strange omission. The balance of the book, on Hardening Carbon Steels, High-Speed Steels, Construction of Furnaces, and Pyrometry, are the same as in the first edition. It is to be regretted that the authors have not inserted some more advanced tables at the end of the book, in addition to the simple ones which are now found.

Those practicing the art of heat-treatment will find that "Working of Steel" is a book containing practically everything required in a technical way for the execution of their art, which naturally employs the method of trial and error quite extensively. It is a book that should be owned by all heat-treaters, and it is believed by the reviewer that it is written in such a way as to be understandable to any intelligent person. SIDNEY CORNELL.

New Publications

BOOKS

NATIONAL SAFETY CODE FOR THE PROTECTION OF THE HEADS AND EYES OF INDUSTRIAL WORKERS. Bureau of Standards Handbook Series, No. 2. Price 10c.

"INDEX TO PROCEEDINGS" American Society for Testing Materials, Vols. 13 to 20 (1918 to 1920). Published by the society, 1315 Spruce St., Philadelphia, Pa. Price in cloth $2.50. 189 pages. Both subject matter and authors are indexed.

PAMPHLETS

"OPTICAL METHODS IN CONTROL AND RESEARCH LABORATORIES," by J. N. Goldsmith, S. Judd Lewis and F. Twyman, has been published by Adam Hilger, Ltd., 75A Camden Road, London, N. W. 1, England. This second edition is greatly enlarged, and forms a guide to applications and to the selection of apparatus. Price 1s. 8d.

RICHARDS & GEIER, patent and trademark attorneys, 277 Broadway, New York City, have recently published a third edition of their booklet on trademarks, which contains the salient features of the trademark law and practice. Copies of this booklet are available for gratuitous distribution to interested readers.

NEW U. S. GEOLOGICAL SURVEY PUBLICATIONS: I: 24, Gold, Silver, Copper, Lead and Zinc in Nevada in 1921, by V. C. Heikes (Mineral Resources of the U. S., 1921, Part I), published Feb. 10, 1923; I: 28, Gold, Silver, Copper, Lead and Zinc in Colorado in 1921, by Charles W. Henderson (Mineral Resources of the U. S., 1921, Part I), published March 16, 1923; I: 30, Iron Ore, Pig Iron and Steel, in 1921, by Ernest F. Burchard and Hubert W. Davis (Mineral Resources of the U. S., 1921, Part I), published April 23, 1923; II: 26, Sulphur and Pyrites in 1921, by H. A. C. Jenison and H. M. Meyer (Mineral Resources of the U. S., 1921, Part II), published Dec. 29, 1922; II: 27, Stone in 1921, by G. F. Lough-

lin and A. T. Coons (Mineral Resources of the U. S., 1921, Part II), published Jan. 22, 1923; II: 28, Cement in 1921, by Belle W. Bagley (Mineral Resources of the U. S., 1921, Part II), published Jan. 8, 1923; II: 29, Mineral Waters in 1921, by W. D. Collins (Mineral Resources of the U. S., 1921, Part II), published Feb. 5, 1923; II: 30, Natural-Gas Gasoline in 1921, by E. G. Sievers (Mineral Resources of the U. S., 1921, Part II), published Jan 25, 1923.

NEW BUREAU OF STANDARDS PUBLICATIONS: Circ. 46, Testing of Barometers and Altimeters; Circ. 62, Soap; Circ. 73, Copper; Circ. 78, Solders for Aluminum; Circ. 81, Bibliography of Scientific Literature Relating to Helium; Circ. 98, U. S. Government Specification of Volatile Mineral Spirits for Thinning Paints; Sci. Paper 458, Apparatus for the Determination of the Magnetic Properties of Short Bars, by M. F. Fischer. Sci. Paper 463, Preparation and Properties of Pure Iron Alloys—II. Magnetic Properties of Iron-Carbon Alloys as Affected by Heat-Treatment and Carbon Content, by W. L. Cheney, No. 464 Preparation and Properties of Pure Iron Alloys—III. Effect of Manganese on the Structure of Alloys of the Iron-Carbon System, by Henry S. Rawdon and Frederick Sillers, Jr.; Sci. Paper 465, Composition, Purification, and Certain Constants of Ammonia, by E. C. McKelvy and C. S. Taylor, Sci Paper 466, Wave Length Measurements in the Arc Spectra of Gadolinium and Dysprosium, by C. C. Kiess; Tech. Paper 227, American and English Ball Clays, by H. H. Sortwell; Tech Paper 228, Lathe Breakdown Tests of Some Modern High-Speed Tool Steels, by H. J. French and Jerome Strauss; Tech Paper 230, A Recording Chronograph for the Inverse Rate Method of Thermal Analysis, by H. J. French; Tech Paper 231, Tentative Standard Test Methods and Percentages of Oil and Moisture in Hair Press Cloths, by F. R. McGowan and C. W. Schoffstall; Tech. Paper 232, Shellac, by Percy H. Walker and Lawrence L. Steele, Tech Paper 234, Methods of Measuring the Plasticity of Clays, by F. P. Hall; Miscellaneous Publications, No 2, The International Metric System of Weights and Measures.

ilar capacity with the recently organized Cajon Lime Products Co., San Bernardino, Calif. He will also act as superintendent at the proposed plant of the new company.

R. C. TOLMAN, professor of physical chemistry and mathematical physics at the California Institute of Technology, has been elected a member of the National Academy of Sciences.

A. S. WALTER, professor of chemistry at the New Mexico School of Mines at Socorro, N. M., has been recently appointed professor of mining and metallurgy. Professor Walter has been identified with mining, milling and smelting in the West since 1907. He is the junior member of the firm R. J. Walter & A. S. Walter, consulting mining and metallurgical engineers, of Denver.

Men in the Profession

Prof. HORACE G. BYERS, head of the department of chemistry, Cooper Union, N. Y., and president of the American Institute of Chemistry, sailed May 8 on the Mauretania for a 3 to 4 months trip to Belgium, France and Germany. The greater part of Dr. Byers' time will be spent on investigating the status of the chemical industry in Belgium and France.

G. W. CLAMER of the Ajax Metal Co., Philadelphia, has been elected president of the American Foundrymen's Association. H. B. SWAN of the Cadillac Motor Co. is the new vice-president.

H. C. DICKINSON, who has been for some time on leave of absence from the Bureau of Standards to serve as director of research of the Society of Automotive Engineers, has returned to the bureau. He resumes his work as physicist and has been designated chief of the heat division. Work of this division includes thermometry, pyrometry, automotive engine investigations and the various branches of research on thermal physics.

E. H. DIX, JR., who for the past few years has had charge of the metals branch of the engineering division, U. S. Army Air Service, at McCook Field, has resigned to take charge of the new metallurgical laboratory of the Research Bureau of the Aluminum Company of America, New Kensington, Pa. Mr. Dix has been working on the production of light alloys since his graduation. During the war he was in charge of the testing department of the general laboratories of the Bureau of Aircraft Production. At McCook Field he organized a most interesting foundry which operates under strict technical control, where is worked out the correct manufacturing practice for new and old alloys.

ECKARDT V. ESKESEN, head of the New Jersey Terra Cotta Co., New York, has been elected president of the National Terra Cotta Society, rather than vice-president as previously noted in these columns. O. W. KETCHEM of Philadelphia has been elected first vice-president and ADOLPH HOTTINGER second vice-president. WALTER GEER, JR., is treasurer and F. S. LAURENCE has been elected executive secretary.

Dr. E. C. FRANKLIN was guest of honor at a luncheon given by the Chicago Chemists Club, May 7.

CHARLES HINCHMAN has been elected vice-president of the Keystone Tire & Rubber Co., New York.

A. E. MARSHALL, chemical engineer, of Baltimore, Md., delivered a series of three lectures on chemical engineering to the department of chemical engineering, Columbia University, May 8, 9 and 10.

Prof. HARRY MCCORMACK of Armour Institute of Technology and Dr. GUSTAV EGLOFF of the Universal Oil Products Co. are in Washington, testifying in the patent interference case of Dubbs vs. Isom (Sinclair Refining Co.) in connection with oil cracking. Dr. Walter F. Rittman of the Carnegie Institute of Technology and Prof. Frank Wagner of Rose Polytechnic Institute have testified for the Sinclair Refining Co.

ROBERT A. MILLIKAN, foreign secretary of the National Academy of Sciences, returned to Pasadena, Calif., recently after having delivered several addresses before scientific organizations in the Eastern states.

HERBERT FISHER MOORE, first professor of engineering materials at the University of Illinois, gave an interesting illustrated address before the members of the Engineers' Club of the Lehigh Valley, Allentown, Pa., May 7, on the subject of the failure of materials caused by fatigue stresses.

Prof. A. A. NOYES recently underwent an operation at Johns Hopkins Hospital, Baltimore, to combat an infection in his larynx. He is reported to be convalescing satisfactorily.

FRANK REITH, formerly chief chemist at the plant of the Golden State Portland Cement Co., Oro Grande, Calif., has become connected in a sim-

Society Calendar

AMERICAN ASSOCIATION OF CEREAL CHEMISTS will hold its ninth annual convention at Hotel Sherman, Chicago, June 4 to 9.

AMERICAN CHEMICAL SOCIETY will hold its fall meeting in Milwaukee, Wis., Sept. 10 to 14.

AMERICAN ELECTROPLATERS SOCIETY will hold its eleventh annual meeting at Providence, R. I., July 2 to 5.

AMERICAN GAS ASSOCIATION will hold its annual convention the week of Oct. 15 at Atlantic City. An elaborate exhibition of gas-making and gas-utilization equipment is planned.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its summer meeting June 20-23 at Wilmington, Del.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W. Va., June 7, 8 and 9.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold its spring meeting May 28 to 31 in Montreal, Canada.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

CANADIAN INSTITUTE OF CHEMISTRY will hold its annual meeting in Toronto, May 29 to 31.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (NINTH) will be held in New York Sept. 17-22.

NATIONAL FERTILIZER ASSOCIATION will hold its thirtieth annual convention at White Sulphur Springs, W. Va., the week of June 11.

NATIONAL LIME ASSOCIATION will hold its fifth annual convention at the Hotel Commodore, New York City, June 13 to 15.

NATIONAL SYMPOSIUM ON COLLOID CHEMISTRY will be held at the University of Wisconsin, June 12 to 15.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

PACIFIC DIVISION, American Association for the advancement of Science, will hold its seventh annual meeting at the University of Southern California, Los Angeles, Sept. 17 to 20, in conjunction with the summer session of the national association and a meeting of the Southwestern Division of the National Association.

SOCIETY OF CHEMICAL INDUSTRY, Canadian Section, will meet in Toronto, May 29 to 31.

SOCIETY FOR STEEL TREATING — Eastern sectional meeting will be held June 14 and 15, in Bethlehem, Pa.

TAYLOR SOCIETY will hold a meeting June 7, 8 and 9 at the Hotel Onondaga, Syracuse, N. Y.

The following meeting is scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: June 8—American Chemical Society, regular meeting.

Industry and Trade

Current News and Market Developments

News Section

May 21, 1923
CHEMICAL & METALLURGICAL ENGINEERING
Tenth Avenue at 36th Street, New York
H. C. PARMELEE, *Editor*

Market Section

The Summary of the Week

Four dye plants, backbone of German chemical trust, seized by French.

Harry A. Curtis to head Yale's chemical engineering department.

Richard B. Moore succeeded by Samuel C. Lind as chief chemist of Bureau of Mines.

Reports to Department of Commerce, from different foreign countries, say American exporters are neglecting the trade of markets abroad, because domestic markets are more attractive.

State Department announces method of procedure to be followed by importers who desire export licenses for shipping goods from the Ruhr.

Spanish decree of April 30 extends preferential import rates to commodities entering Spain from different American republics, but the decree does not extend to United States goods.

Collectors of customs have received instructions to exact penalties on importers who release goods from custody on bond in lieu of required shipping documents, whenever the missing papers are not presented within prescribed time limits.

Demand for calcium arsenate has quieted down following uncertainty in arsenic market, and prices are easier.

Recent advances in acetic acid have been followed by an advance of one-half cent per lb. in quotations for acetate of lead.

A sale of 700 tons of coconut oil in bulk at 8c. per lb. c.i.f. Pacific Coast, was reported. This is a new low price for the movement.

Lower prices have been announced for salicylates, but all producers have not met the decline and offerings do not appear free at the lower price levels.

Manufacturers Report on Business Conditions

AT the convention of the National Association of Manufacturers, held last week in New York, a very interesting report on general industrial conditions was submitted. This report deserves more than passing mention, including, as it does, production and consumption of basic materials in the representative industries of the country. The conclusions reached are in harmony with those which have been current in trade circles. The manner in which information has been sought and obtained is strikingly different from the ordinary and gives to the report of the association an authority that is beyond dispute. The report is based on a survey of the manufacturing trades in the leading industrial centers. This survey took the form of a questionnaire to which more than 42,000 answers were received, and from this abundance of first-hand information the conclusions of the report were drawn. While the questionnaire covered a wide range of industries, the information was grouped under key industries.

According to the survey, conditions in general throughout the country are very healthy and wholesome. A large number of replies from manufacturers characterized business as excellent and further stated that prospects for the fall trade were equally bright. Those who reported business as poor formed only a small fraction of 1 per cent of the number who answered in that way in the year preceding.

Production, as compared with last year, is showing an increase of something like 40 per cent in all lines of manufacture, with excellent prospects for fall. Stocks on hand are reported generally as low or normal, indicating that sales are keeping ahead of or abreast with production, another most healthy symptom. In New York, Massachusetts, Pennsylvania, Ohio, Illinois and Indiana, the reports of "excellent to fair" for present business and fall prospects in all lines rarely fall below an average of 99 per cent, while stocks are reported low to normal by about the same percentage f. manufacturers.

Under the plan of grouping key industries, reports on activities in chemicals are joined with those for drugs, oils and paints. It is possible that unusual activity in some of these trades may bring up the average for the group, but at least an approximate idea of conditions existing in those industries may be gathered from the survey, which states that 95 per cent report present trade excellent to fair and fall prospects excellent to fair. Ninety-four per cent report business as better than last year and stocks on hand are normal or low in 88 per cent. Employment has increased in 93 per cent of the factories, while there is a labor shortage felt by 66 per cent. Wages have been increased in 75 per cent of the cases, while almost the same percentage report a production increase of about 37 per cent. Sales quantities have increased about 20 per cent in 70 per cent of the reporting factories, while their values have increased on the average of 14 per cent over the values of last year.

Important Changes in Personnel at Bureau of Mines

R. B. Moore Resigns as Chief Chemist and Chief Mineral Technologist to Be Succeeded by Samuel C. Lind

RICHARD B. MOORE, well known for his work as chief chemist of the United States Bureau of Mines, is resigning his post to take effect on June 1. He is to go into commercial work with the Dorr Co., engineers, of New York, where he is to be in charge of that company's development work and is to act as consulting engineer in certain of the company's projects. His resignation follows 11 years of service at the bureau. Dr. Samuel C. Lind is to be his successor.

Dr. Moore is 58 years old. His education has included work at University College, London, under Sir William Ramsay, a B.S. degree at Chicago University, from which institution he went to the University of Missouri as an instructor. In 1905 he became professor of chemistry at Butler College, Indianapolis, where he remained until 1911. In 1916 the University of Colorado bestowed on him the honorary degree of Doctor of Science. Perhaps his most notable work at the bureau has been in connection with the production and purification of the rare gases, especially helium.


Photo by Harris & Ewing
SAMUEL C. LIND

Dr. Lind, who succeeds him, has also had very thorough training in scientific work and extensive experience in the work of the bureau. His education included study at Washington and Lee University, a degree at M.I.T., a Ph.D. from Leipzig, after which he worked at the University of Paris and the Radium Institute of Vienna. When he entered the Bureau of Mines as physical chemist, he was acting as assistant professor of chemistry at the University of Michigan. This was in 1912. Dr. Lind, at present, is in charge of the bureau's rare and precious metals experiment station, at Reno, Nev. His chief work has been on radio activity, radium extraction and measurements; the influence of radiation on chemical action; kinetics of chemical reaction; and the relations of gaseous ionization to chemical action. He is likewise the inventor of the well-known interchangeable electroscope which bears his name.

A.C.S. Invited to Washington

The Washington Chemical Society voted on May 10 to invite the American Chemical Society to hold its 1924 spring meeting in Washington. It is hoped that this session of the society can be made unusually successful because of the expected large attendance at so favorable a location. Since the society has received no other invitations for that meeting, it is expected by Washington chemists that this invitation will be accepted.

Anti-Dumping Order Issued

The Treasury Department has issued an anti-dumping order against calcium carbide imported from the province of Quebec, Canada, having received information that this product is being sold or is likely to be sold at less than its fair value, to the detriment of domestic producers. The duty on calcium carbide is 1 cent a pound. In accordance with the order under the 1921 anti-dumping law, collectors will assess additional duty on importations from Quebec sufficient to bring the total cost to a fair value.

Michigan to Have New Chemical Engineering Laboratory

With the opening of the fall term at the University of Michigan, that institution is to be equipped with its new engineering building, which will include one of the finest chemical engineering laboratories in the country. The equipment includes adequate experimental apparatus for work on evaporation, distillation, gas absorption, filtration, drying and cystallizing, as well as on stirring and mixing.

With its new facilities, the school is much better fitted for graduate work than it has been in the past. As a result several specialized groups of graduate courses are to be given, including gas engineering, metallurgy, organic industries, pulp and paper and general manufacturing.

Ford Buys Garnet Quarry

Henry Ford's latest purchase is a New Hampshire plant for the quarrying and finishing of garnet for use in the automobile manufacturing industry as a polishing agent.

Calendar

The following important technical meetings are scheduled for the immediate future:

AMER SOCIETY MECHANICAL ENGRS.
Montreal, May 28-31

CANADIAN INSTITUTE OF CHEMISTRY
Toronto, May 29-31

SOCIETY OF CHEMICAL INDUSTRY
Canadian Section
Toronto, May 29-31

AMER. ASSN CEREAL CHEMISTS
Chicago, June 4-9

AMER LEATHER CHEMISTS ASSN.
White Sulphur Springs, W. Va.,
June 7-9

NAT'L FERTILIZER ASSOCIATION
White Sulphur Springs, W. Va.,
June 11-16

NATIONAL LIME ASSOCIATION
New York City, June 13-15

SOCIETY FOR STEEL TREATING
Eastern Sectional Meeting
Bethlehem, Pa., June 14-15

AMER. INST CHEMICAL ENGRS.
Wilmington, Del., June 20-23

AMER. SOC FOR TESTING MATERIALS
Atlantic City, June 25-29

France Seizes Four German Dye Plants

Outcome of Latest Move May Have Great Significance—I. G. Now Under French Control

France has taken a big bite into the "Interessengemeinshaft" (I. G.), or German chemical trust. Four of Germany's largest dye plants have been seized. These are said to represent from 50 to 90 per cent of the entire dye output of the trust. The numerous dispatches received from the Ruhr are somewhat conflicting in detail. It is not clear what disposition is to be made of the plants seized. One report states that the time of occupation will be only long enough to seize and remove available dyestuffs which are due France and Belgium. The New York *Tribune* states, however, that "the seized factories, in accordance with the terms of the treaty, will not be turned back to Germany until the default on dye payments has been cleared up through future negotiations—a development which by no means appears imminent."

The four plants that have been seized are the Badische Anilin und Soda Fabrik, near Ludwigshafen, said to employ 40,000 workers; the Kalle Chemical Works at Biberich-on-the-Rhine; the Hochster Farbwerke, formerly the Meister Lucius & Brüning concern; and the Weiler-ter-Meer works at Urdinge, near Duisberg. The laborers on duty at the plants were allowed to leave but none was allowed to enter.

Since Germany's attitude has been disclosed on the réparation settlements question, through the note of May 2, the French and Belgians are gradually tightening their grip on the occupied areas. If German labor is unavailable in the Ruhr, France hopes to make up the shortage by imported workmen. For several days past Italians have been entering the area in large numbers.

Production of Carbon Black Becomes Political Issue in Louisiana

At Present Production Is Permitted Under Certain Regulations—Change in Administration May Ban Industry From the State

A GUBERNATORIAL CAMPAIGN is opening in Louisiana. One of the issues apparently is to be the attitude of the state toward the carbon black industry. The Monroe gas field in that state, described by the Bureau of Mines as the most extensive ever discovered in the country, now is the principal source of carbon black in the United States. The Monroe field is so isolated that no use has been found for this great gas supply other than the manufacture of carbon black, with its incidental recovery of gasoline and some small use for local fuel purposes. There has been much discussion of proposals to pipe this gas to New Orleans, but as the distance is in excess of 300 miles and the crossing of the Mississippi River is involved, the feasibility of the project has remained in sufficient doubt to prevent the financing of the project.

The present state administration in Louisiana instigated careful studies of the situation, to which the U. S. Geological Survey and the Bureau of Mines contributed importantly. As a result of those studies it was deemed best to permit the manufacture of carbon black under certain regulations. This policy now is being assailed and one of the candidates for Governor is expected to advocate that the industry be banned from the state.

It is declared that the fifteen carbon plants in the Monroe field are using 1,380,000,000 cu.ft. of gas a day. It is contended that the profits of these fifteen factories aggregate $3,000,000 a year, practically all of which goes out of the state. It is argued that the benefit to Louisiana from this industry is practically negligible and that on the other hand the extinction of the gas field is threatened.

The opposition to the manufacture of carbon black insists on basing its claims of inefficiency and waste on a quantitative standard. Sight is lost of the fact that carbon black is a complex and highly essential pigment, contributing perhaps as much to the pleasure and needs of the people in Louisiana through its use in the rubber, printing and other industries as it would were it made available to them in the form of fuel. Since the losses of long transmission would be great, the efficiency of Monroe field gas at the burner in New Orleans probably would not be much greater than that at the carbon black factories. Since the pipe line to New Orleans or other centers of population is still a vision and very likely never will be realized, the friends of the carbon black industry in Louisiana are pointing out that to ban that utilization of this resource would mean that no use whatever would be made of the gas. As the presence of gas is regarded as the best clue to the occurrence of oil, it is certain that active drilling in the field will continue. Under such conditions it never has been found practicable in any gas field to attempt to conserve the supply under ground awaiting the development of the so-called higher uses.

Strength in Paper Markets

Very firm conditions exist in the paper and pulp industry. A review of the industry by the American Paper and Pulp Association says that the paper manufacturers, in the face of the heaviest demand ever known in some branches of the industry, are not taking advantage of the increasing cost of raw materials and of labor to increase prices. In one important branch of the industry, for example, prices are 98 per cent higher than in 1914, but costs are 101 per cent higher.

The basic strength of the paper markets in general is indicated by the fact that there seems to be no speculative demand. The orders being received are strictly to meet pending requirements. Boxboard mills are sold ahead for three months, newsprint is in unprecedented demand, with prospects of still greater demand, orders for wrapping are in excess of production, and in such food-protective specialties as parchment and waxed paper deliveries are from three weeks to two months behind.

Increased Output of Acetate of Lime and Methanol

Production of acetate of lime in March was 15,569,000 lb., as compared with 13,894,000 lb. in February. For the first quarter of the year production was 46,007,000 lb., which compares with 44,171,000 lb. for the last quarter of 1922. These figures were compiled by the Department of Commerce, through the Bureau of the Census, in co-operation with the National Wood Chemical Association. Methanol production in March is placed at 91,273 gal., as against 85,105 gal. in February. For the first 3 months of the year the output of methanol reached a total of 2,498,134 gal., which represents an increase of 55,506 gal. over the production for the last quarter of 1922.

Final Program of A.I.C.E.

Local Committee of American Institute of Chemical Engineers Announces Technical Program and Social Features of Wilmington Meeting

THE fifteenth semi-annual meeting of the Institute will convene at the Hotel du Pont, Wilmington, Del., on June 20. Registration will begin at 8 a.m. and the technical program will follow closely. Four sessions of technical papers will include the following:

"Activated Carbon, Its Evaluation and Uses," Frederick Bonnet, Jr.

"The Properties of Activated Carbon Which Determine Its Industrial Applications," N. K. Chaney, A. B. Ray and Ancel St. John.

"The Abatement of Industrial Stenches by Activated Carbon," N. K. Chaney and A. B. Ray.

"The Capillary Theory of Adsorption From Solution With Silica Gel," W. A. Patrick.

"The Refining and Recovery of Petroleum Products by Silica Gel," E. B. Miller.

"Hydro-Electric Development in the Pacific Northwest," C. A. Newhall.

"Synthetic Ammonia From Byproduct Hydrogen," Charles O. Brown.

"Oxidation of NO to NO_2," W. A. Patrick.

"The Sulphur Industry," C. A. Newhall.

"Laboratory Corrosion Tests," W. S. Calcott and J. C. Whetzel.

"Materials of Construction for Chemical Apparatus," Harold F. Whittaker.

"Acid- and Abrasion-Resisting Metals and Materials," W. E. Piper.

"Modern Methods of Metal Protection and Finishing," L. E. Eckelmann.

"The Literature of Chemical Corrosion," A. E. Marshall.

"Action of Fullers Earth on Vegetable Oils," David Wesson.

"Automatic Fractionating Columns," W. A. Peters, Jr.

"The Rate of Absorption of Hydrochloric Acid Gas in the Tyler Vitreosil System," H. E. Fritz and James R. Withrow.

"The Theory of the Design and Testing of Gas Absorption Apparatus," E. M. Baker.

"Calculation of Vapor Recompression Evaporators," L. A. Pridgeon.

"Economic Value of Chemistry in Industry—A Study of the Census of Manufactures, 1919, and of Foreign Trade, 1921," R. K. Strong.

The members and guests of the Institute will be entertained at a reception given by Mr. and Mrs. C. L. Reese on Wednesday afternoon and at the theater in the evening. An opportunity for inspecting the conservatories of P. S. du Pont and a supper at the home of Irenee du Pont will be among the courtesies extended to the visitors.

Trips through the famous Jackson laboratories of the du Pont Co., the Jessup & Morse Paper Co., the Bond Corporation cork plant and the Joseph Bancroft cotton-finishing plant will be features of the technical program.

Washington News

Spain Excludes U. S. From Favored Import Rates

Cable advices from Commercial Attaché Cunningham at Madrid state that a Spanish decree of April 30 grants the benefit of preferential rates of the import tariff to Honduras, Hayti, Dominican Republic and Panama, thereby according them the same treatment as is given other American republics by previous legislation. The favored rates are not extended to include the United States, Canada and Brazil. According to unofficial advices from Spain, all goods from the United States imported into Spain after Nov. 5 will be subject to materially higher duties than are now in effect. Efforts are being made to procure an agreement whereby materials and manufactured goods from this country will be admitted into Spain on a more favorable basis, but the higher import duties on many materials originating in Spain, as put into effect by the new tariff act of this country, makes it improbable that our goods will be favored by Spanish import regulations.

United States Largest Buyer of Haitien Logwood

A report from Consul Damon C. Woods, covering the logwood industry in the Cape Haitien consular district, states that logwood held second place among the commodities exported from that district in 1922. In commenting on market conditions, the report states that logwood recovered appreciably from the depression of 1921, when the price fell to $15 per ton f.o.b. Cape Haitien, as contrasted with $40 in the summer of 1920. Of the total amount shipped in 1922, at least 90 per cent went to Newport News and Chester, Pa., for reduction into extract at the plants of large American dyewood concerns. This proportion amounted to 13,571 tons, of the declared value of $277,194.79, or an average of $17.42 per ton after deduction of the export duty of $3 per ton. Due to the lower freight rate nearly all of this logwood was carried on sailing vessels.

The logwood extract plant at Grand Riviere du Nord, in the Cape Haitien district, increased its output and exportation from 306,199 lb. of liquid extract in 1921 to 1,552,889 lb. in 1922. The declared value of the product for the latter year was $59,592. In addition the factory shipped 30,260 lb. of extract in crystallized form. The entire quantity went to the United States.

Declared exports from the three ports of the district to the United States, exclusive of returned American goods, for the years 1921 and 1922 were:

	1921		1922	
	Quality	Value	Quantity	Value
Logwood....	10,047 tons	$238,148	13,571 tons	$277,194
Logwood extr. crystals	....	....	30,260 lb.	2,092
Logwood extr. liquid	306,198 lb.	17,836	1,552,889 lb.	59,592

Thomas W. Delahanty Joins Chemical Division

Thomas W. Delahanty, a chemical engineer of New York, who recently was appointed a member of the staff of the Chemical Division of the Department of Commerce, assumed his new duties May 14. The appointment is in line with plans to increase the staff of the division under C. C. Concannon, acting chief, to meet the demands of expanding work.

Mr. Delahanty is a Cornell graduate and a member of the American Chemical Society and of the American Society of Mechanical Engineers. During the war he was inspector of powder and explosives in the ordnance department of the army and later became Lieutenant in the navy air service in charge of hydrogen gas production at Rockaway Beach, N. Y. He has had considerable experience in manufacture, import and export of drugs, chemicals and dyes through his connection with Dicks David Co., Inc., and the American Chemical Co. He came to the Chemical Division from the Ajax Rubber Co., where he had been systematizing production, control and marketing of products.

Specific Penalties for Loss of Shipping Documents

Of interest to importers was the announcement of Assistant Secretary of the Treasury Moss, made last Wednesday, to the effect that new regulations would become effective with reference to the cancellation of bonds. This refers to bonds given by importers in cases where goods reach domestic markets and where shipping documents are missing or are incomplete. In such cases the consignee obtains possession by furnishing a bond to the collector of customs, in order to guarantee the later presentaton of the necessary documents. According to the new instructions, collectors of customs are advised, in treating bonds for the production of missing documents as satisfied, to demand and collect $20 for each missing invoice not produced within 6 months, and $10 for each missing declaration of the owner or ultimate consignee not produced within 90 days from the date of entry.

Also an amount equal to the invoice value plus the duty will be collected for failure to return to the collector on demand packages subject to redelivery.

Collectors may in their discretion waive demands for the payment of liquidated damages upon the non-production of other documents governing the importation and admission of merchandise into the commerce of the United States, but when demand is made in such cases no greater amount will be collected than $20 upon any one default of the bond, without specific authority of the department.

Unfavorable Outlook for Lower Freight Rates

Senators and Representatives who have been planning to make a drive at the next session of Congress for reduced freight rates are perturbed by the prospect that such agitation will not arouse any popular enthusiasm. When prices are good, the average shipper is more interested in service than he is in the rate. On most commodities the freight rate really represents a small percentage of the selling price. When prices are hovering around the cost of production, the freight charge looks big. For that reason the agitation of railroad legislation in 1921 and early in 1922 struck a popular chord. It is believed, however, that in prosperous times there will be no general support for any legislation that would instruct the Interstate Commerce Commission to regard an amount less than 6 per cent as a fair return or to take into account other factors which would have the effect of lowering rates.

Transportation specialists in Washington agree that more efficient service is being rendered by the railroads at this time than ever before has been the case. The proportion of unfilled car orders to the total loadings is very small. This has been made possible through closer co-operation and more friendly relationships with the shippers; through the reduction to the minimum of bad-order equipment, and through the placing in service of increasing numbers of new cars.

Personals

Leon Rigole, vice-president of the Société Co-operative Graines & Huiles, Antwerp, was in New York last week.

C. A. Mace, formerly with the Butterworth-Judson Corporation, is now associated with the Tower Manufacturing Co.

Colonel Charles B. Wing, prominent paper manufacturer, died at his home in Cincinnati on May 13.

J. W. Daniels, president of the new linseed oil combine, the Archer-Daniels-Midland Linseed Co., Minneapolis, was in New York last week. According to G. H. Tomlinson, who is in charge of the New York office of the old Midland Linseed Products Co., the sales policy will not be altered in any way, and the production of "Midland" brand oil will be marketed through his office as heretofore.

F. C. Ryan, Eastern sales manager of the Shasta Zinc Co., left New York last week on a business trip, to include points in the Middle West.

American Exporters Urged to Retain Trade of Foreign Markets

Business With Markets Abroad Being Neglected, According to Reports Received by Department of Commerce

After having captured a considerable foreign trade, American manufacturers are allowing it to get away from them while they cater to the domestic market, which for the nonce is more attractive. Reports to the Department of Commerce from a large number of countries indicate that American exporters are neglecting their foreign business. Since the war upset the world's trade, the American exporter has been playing the flirt with foreign markets, as one official described it. For a time every attention will be given a foreign buyer and then without warning he will be jilted. It is feared that many markets will be lost irretrievably to the United States if the present tendency continues.

Largely as a result of fortuitous circumstance, the United States has built up an important foreign business. While favorable conditions were responsible for inducing American manufacturers to go into foreign markets, their activities in that connection represent a large investment. Not only is this investment being jeopardized by the present business policies of many exporters, but it is sealing the way against any retracing of steps when the domestic demand begins to fall off.

Officials of the Department of Commerce are urging that a fair distribution of available stocks be made among all customers. If there is to be any favoritism shown, it should be in favor of the foreign market. American consumers, once that they understand the situation, would be willing to make some sacrifice in order that foreign trade may be retained.

American manufacturers and exporters, it is pointed out, would be well advised in taking a leaf from the German book. Germany, and to a less extent England, fill foreign orders first. They are in a position to satisfy later their domestic customers if they should be displeased in securing delivery. Concrete information is at hand from a hundred sources to indicate that foreign markets are being neglected. It applies to all lines and is not confined to the chemical trade. The situation is regarded at the Department of Commerce as being of sufficient seriousness to require the most energetic efforts to remedy the situation while there still is time.

Curtis to Direct Chemical Engineering at Yale

Harry A. Curtis, now in charge of the Department of Commerce's nitrate investigation, has been appointed professor of chemical engineering at Yale University. He will undertake his new work at New Haven early in the fall, taking charge of the course in chemical engineering which was established by Yale about 3 years ago.

The work in chemical engineering at this institution is to be developed in close co-operation with both the chemistry and the engineering departments. Details of the plans for the department and the course of study will be prepared during the next few months to permit their application during the next college year. As head of the department Curtis will be active in both the scientific and technical faculties.

The nitrate study on which he is now engaged will be actively prosecuted by Dr. Curtis during the summer and probably will continue to receive his attention in a consulting capacity until this part of the government's raw materials survey has been completed.

Photo by Harris & Ewing

HARRY A. CURTIS

Dr. Curtis was graduated from the University of Colorado in chemical engineering and taught there for several years prior to 1917. He received the Ph.D. degree in chemistry at the University of Wisconsin and somewhat later was for a short time professor of chemistry at Northwestern University. For 2 years he was in government work, first as a Captain in the Ordnance Department and later as executive officer of the Fixed Nitrogen Research Laboratory, Washington. In this War Department work he was active in the design and operation of the small-scale ammonia-oxidation plant at Sheffield, Ala. More recently he has been chief chemist of the International Coal Products Co., first being in charge of research and development work at Irvington, N. J., and subsequently serving as general manager of the Clinchfield Carbocoal Corporation, South Clinchfield, Va., an International subsidiary.

News Notes

The California Section of the A.C.S. continues to provide excellent addresses at its monthly meetings. On May 11 Prof. James Kendall of Columbia gave an illustrated talk on "The Separation of Isotopes."

"The Andrew Carnegie Chair of Biochemistry" is the name assigned to the chair of biochemistry at the University of Cincinnati, according to an announcement made by Judge Rufus B. Smith, chairman of the board of trustees. With the expansion of the biochemistry department at the University of Cincinnati it is expected that Cincinnati will become the center for the study of various branches of chemistry.

A new chemical laboratory at Tufts College, Mass., comprising a large three-story and basement building, is practically completed, and arrangements are being made to dedicate the structure with appropriate ceremonies on alumni day, June 16.

Oats won't produce alcohol, although sugar can be obtained in large quantities by hydrolysis of hulls. The Forest Products Laboratory has made this finding as a result of special experiment. It is thought that this conclusion confirms the belief that many cellulosic substances which have been considered as possible sources of alcohol are actually not suitable for its production.

The second annual fertilizer conference to be held by the Connecticut Agricultural College is planned for July 11 and 12. This conference is intended primarily for manufacturers and dealers. However, several papers of interest to the consumer as well as to these groups are included in the program.

Cleveland and Akron chemists are planning a big day for May 23, when the Cleveland Chapter of the A.C.S. holds its spring meeting. During the day several Cleveland plants are to be visited and in the evening Charles L. Parsons, H. E. Howe and H. H. Dow, president of the Dow Chemical Co., are to address the society.

Non-Shellac phonograph records of simple materials and inexpensive fabrication have been developed by European manufacturers. The new process, using paper, cloth or leather as a base instead of requiring molding, makes use of rotary presses capable of turning out 50,000 per unit per day. The unit mold's capacity has been about 600 per day. Production of the new records is to begin here in the near future.

Liquid oxygen can be used to advantage in lessening blasting costs in iron, salt and other mineral mines and quarries. This explosive also has several further advantages, according to the Pittsburgh experiment station of the Bureau of Mines and $15,000 for further investigation of this use of oxygen has been appropriated for use during the coming fiscal year.

American Buyers of Goods in the Ruhr May Obtain Export License

New Regulations Define How Applications Must Be Made—German Firms Authorized to Make Deliveries on Sales Made Prior to Feb. 20

LAST Wednesday the Department of State issued a statement, in which was outlined the method to be followed by American importers, in securing deliveries of goods which they had purchased from the Ruhr section of Germany. The statement sets forth that the method of procedure in securing export licenses is not as simple as it is desired, but represents such concessions as have been granted to date on the part of the German authorities and from the occupying forces. It is held that American buyers will receive considerable relief by observing these regulations and directions.

"American buyers intending to apply for export licenses for goods in occupied Germany must address their applications to the Rhineland High Commission at Coblenz, stating the date of contract, quantity and character of goods, the value of order, name of German supplier and submit evidence showing that contract was made prior to Feb. 1 and that payment has been made either in whole or in part. A copy of the contract should accompany the application.

"However, the authorities in occupation stipulate that applications must be accompanied by a statement covering the American interest in the shipment. Accordingly, until further notice, American buyers should first submit the application direct to the American Embassy in Paris or Brussels, which will issue the statement required and forward it with the application to the American Consul at Coblenz, who in turn will present the application to the High Commission for approval. When the application is returned, the Consul will, upon request, turn it over to the American buyer's agent or representative, who should then make all arrangements with appropriate licensing office for delivery of the license and payment of export tax, to the authorities in occupation.

"The department is informed that the authorities in occupation on May 1 put into force an export tariff based on the German export tariff of 1921 instead of the 10 per cent ad valorem tax which has been temporarily collected and, furthermore, that the time for receiving applications from American buyers for contracts made previously to Feb. 1 has been extended for an indefinite period. However, American buyers are urged to expedite their applications as much as possible. The department also understands that German firms are now authorized by their government to deliver goods involved in commercial transactions made prior to Feb. 20, provided they have first obtained a German export license.

"In negotiating, on behalf of American commerce, with the various governments concerned in this matter, it has been the aim of the Department of State to endeavor to obtain for American traders the same facilities granted to traders of other countries and at the same time to find a way out of the present deadlock of commerce, whereby, through the modification of conflicting regulations and the elimination as far as possible of official interference, the movement of American-owned goods for export out of occupied Germany could actually be accomplished."

Federal Specification Board Officials Named

Dr. George K. Burgess, new director of the Bureau of Standards, has been named by the President as chairman of the Federal Specification Board. In this office he succeeds S. W. Stratton, formerly director of the bureau.

N. F. Harriman, who has been acting chairman during the interim, is named as vice-chairman and technical secretary of the board, in charge of all administrative and routine matters and supervision of technical committee work. Mr. Harriman is located at the Bureau of Standards.

Manganese Exports From Brazil

Total exports of manganese from Brazil in 1922 were 340,706 tons, an increase in quantity over 1921 exports and a decrease as compared with 1920, according to a report from Commercial Attaché W. L. Schurz at Rio de Janeiro. Heavy exports were made to the United States, the message states.

Figures on total manganese exports for 5 years, in gross tons, with the average price per ton are given as follows:

1922, 340,706 tons, $65; 1921, 275,694 tons, $83; 1920, 453,737 tons, $88; 1919, 205,725 tons, $82; 1913, 122,300 tons, $22.

Quiet Market for Fertilizers in France

The French fertilizer market is calm, according to a cable from Commercial Attaché Jones to the Department of Commerce dated May 13. April deliveries of nitrate of soda were 53,000 tons, imports were 37,000 tons and stocks on hand 20,000 tons. Little business is being done in other fertilizers. The price of turpentine fell to 600 francs, the market being unsettled. Raw materials of naval stores are being gathered.

Trade Notes

Stocks of flaxseed at Minneapolis on May 12 were placed at 10,263 bu., which compares with 6,885 bu. the week previous and 69,829 bu. on the corresponding date a year ago.

The Department of Commerce announces that the value of products of establishments engaged primarily in the distillation of common or ethyl alcohol and other liquors, whether sold as such for industrial or medicinal use, or in a denatured form, amounted to $28,789,000 in 1921, as compared with $31,854,000 in 1919, a decrease of about 10 per cent.

The Endicott-Johnson Corporation officials have been in St. Louis inspecting various properties with a view to locating a large warehouse there.

The M. S. Chemical & Drug Co. of Brooklyn, N. Y., has increased its capital stock from $5,000 to $250,000.

The Archer-Daniels Linseed Co., 29th Ave., Minneapolis, Minn., manufacturer of oil products, has been reorganized as the Archer-Daniels-Midland Co. A charter has been taken out under Delaware laws with capital of $10,625,000, and plans are in progress for general expansion in plant facilities for the production of vegetable oils.

Governor Gifford Pinchot of Pennsylvania has signed a bill recently passed by the Legislature, regulating the sale of caustic acid, alkali and chemical or mineral preparations designed for domestic or agricultural service. The bill requires that all containers used for such materials be labeled with the name and address of the manufacturer, and the word "poison."

The Rubber Controller for Ceylon has announced that a maximum of 36,020 long tons of Ceylon-produced rubber may be exported from Ceylon during the year Nov. 1, 1922, to Oct. 31, 1923.

The steamship "West Prospect" arrived at San Francisco on May 14, from Manila, with a cargo of 2.259 tons of copra.

E. Bright Wilson has been appointed equity receiver for the Druggists' Commercial Alliance, Inc., 250 Hudson St., New York, in an action filed by the Mifflin Chemical Corporation.

Officials of the International Paper Co. have denied reports that the company is involved in negotiations for a merger with Canadian interests which would combine a half dozen plants operating on the St. Maurice River near Quebec.

Bush, Beache & Gent, Ltd., of London, announces that the company is now entirely British owned. It is removing shortly to larger offices at 24 Monument St., London, E. C. 3.

White Arsenic Makes Gold Mining Profitable

New Plant Treating Gold-Bearing Concentrate at Montana Mine Yields 100 Tons of As_2O_3 Per Month—Sold at 14½c. Per Lb., f.o.b. New Jersey

ON APRIL 15 the Jardine Mining Co. removed 75 tons of crude oxide of arsenic from the kitchens of its newly built plant at Jardine, Mont. This was the first product from the plant, which had been in operation for about 30 days. The mines of the Jardine company are on the edge of Yellowstone National Park, 6 miles from Gardiner, the nearest railroad point. They have been worked for gold for many years. The ore is low grade, however, and the recent demand for arsenic offered a welcome opportunity to realize a profit from the large content of arsenopyrite in the gold ores.

The special correspondent of *Engineering and Mining Journal-Press* in that vicinity reports that as a consequence of the high price of arsenic, plans were made in December, 1922, to treat the concentrate and recover the arsenic at the mill. Fortunately, the large mill building formerly used as a cyanide plant was in good condition. A few tanks were removed, the building was remodeled, and the new equipment was rapidly installed. A reverberatory furnace, connected with a dust chamber, and a series of kitchens 6x8 ft. in section and 180 ft. long, were built. These were connected to a large stack, the top of which is 250 ft. higher than the furnace. Construction work was finished and the plant was operating on March 17, just 2 months from time it was started. The cost of plant, including building alteration and equipment, was $12,000.

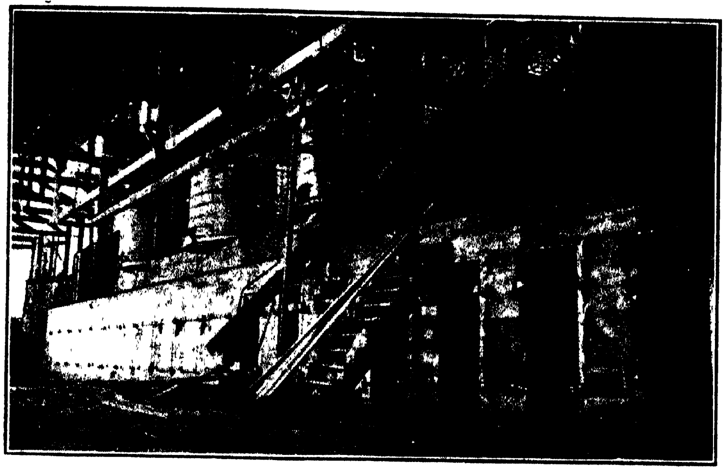
The first time the concentrates are treated the reverberatory furnace is fired with ordinary mine-run coal. The arsenic volatilizes and the fume is conducted through the dust chamber and thence to the baffled kitchens, where the arsenious oxide is deposited. This product is not white; accordingly it is stored until enough has been accumulated for refining. It is then put through the same process except that a coke fire is used in the reverberatory instead of a coal fire.

The concentrate as received from the mill averages 38 per cent arsenic and contains from 2 to 3 oz. in gold per ton. At the present time the capacity of the arsenic plant is limited to 100 tons of oxide per month.

Shipped to New Jersey

The first car of calcined concentrates was shipped from Gardiner on March 29 to the East Helena smelter. The first shipment of refined white arsenic was contracted for by W. F. B. Berger, representing the Chipman Chemical Engineering Co. The price agreed upon was reported to have been 14½c. per lb. f.o.b. Bound Brook, N. J.

The large smelting companies have been producing white arsenic as a by-product for years, but this is probably the first venture at producing it as on a commercial scale by an independent mining company.



ARSENIC KITCHENS BUILT IN THE OLD CYANIDE PLANT AT THE JARDINE MINE

Leather Chemists to Meet at White Sulphur, W. Va.

The convention of the American Leather Chemists which is to be held at White Sulphur, W. Va., June 7-9 is to include features which will be of great interest. These embrace a wide field, including among others two papers on chrome tanning, one on tannin and several on the use of oil in leather fabrication. Dr. Allan Rogers will give a unique talk, illustrated by moving pictures, on leathers of marine origin. F. M. Moffat, president of the Tanners' Council, plans to be present to address the association.

Advisory Committee Expanded for 1923 Exposition

Chemical Exposition plans are being formulated for the 1923 show, which is to be held at Grand Central Palace, New York, during the week of Sept. 17 to 22, inclusive.

The advisory committee which aided in conducting last year's exposition has been expanded, and in addition to the former twenty executives and technical men now includes the following members from the sales and production departments of the chemical and chemical equipment manufacturers: John W. Boyer, of the Mathieson Alkali Works; Dr. Charles L. Reese, of E. I. du Pont de Nemours & Co.; Percy D. Schenk, of the Duriron Co.; Milton Kutz, of the Roessler & Hasslacher Chemical Co.; W. E. Moore, of the New Jersey Zinc Co.; T. C. Oliver, of the Chemical Construction Co.; R. Gordon Walker, of the Oliver Continuous Filter Co.; Williams Haynes, of *Drug and Chemical Markets*; H. J. Schnell, of the *Oil, Paint and Drug Reporter*.

Alabama Exporting Large Amounts of Pitch

According to advices coming from Birmingham, Ala., a number of plants in that section are selling pitch in large quantities to European governments and private firms. One company at Ensley is reported to have closed.

The Semet-Solvay Co. of Ensley has just closed a deal with the Italian Government for 5,113 tons of pitch for $60,000. This is but a small part of a movement of pitch that has been going to Europe during the past few months. In all it is estimated that from 40,000 to 50,000 tons has been shipped to Europe since Jan. 1, 1923.

About 35,000 tons of pitch had been accumulated by another company. All of this has been shipped to France, Italy and other countries, having been sold mostly in 5,000-ton lots.

Before the world war much pitch was shipped from the Birmingham district to European countries. During the war the shipments ceased. It has only been since Jan. 1 of the present year that these shipments have been revived. During the war piles of pitch at a number of plants at Bessemer and Fairfield grew very large, and it is out of these piles that many shipments have been made.

European manufacturers are using this pitch in making briquets, which are burned as fuel and are very valuable where coal is scarce or high.

One large producer has recently perfected a high-grade coke, which is manufactured out of this pitch by putting it through a beehive coke oven. This gives a coke of 98 per cent pure carbon, and sells for several dollars more per ton than ordinary coke.

It is estimated that from now on Birmingham pitch will continue to move to Europe at the rate of from 6,000 to 8,000 tons per month, even after the present accumulation is exhausted.

Facts and Figures That Influence Trade in Chemical Products

Market Conditions

Current Prices
Imports and Exports
The Trend of Business

Prices for Chemicals Continue to Show Downward Tendency

Arsenic and Calcium Arsenate Sell at Lower Levels—Imported Copper Sulphate Weak—Prussiates Inactive and Decline in Price—Permanganate of Potash Lower—Denatured Alcohol Advanced in Price—Acetate of Lead Higher

THE market for chemicals was easier during the week. A few items, notably acetate of lead and alcohol, were marked up in price, and many of the important chemicals held a steady position, yet the general tone as a whole was easier. Imported materials have led the way in the downward movement and are relatively weaker than chemicals of domestic origin. In part this is due to lack of confidence in the position of foreign and in part to arrivals from abroad at a time when buyers were not prominent with the consequent result that prices were lowered to move stocks and thus avoid carrying charges. There seems to be a hesitancy on the part of consumers to take on fresh commitments and the market is not in a position to encourage speculative buying from non-consumers. Basically many selections are in a firm position but the influence of foreign markets and the attitude of buyers is expected to be a prominent factor in regulating values.

Arsenic holds a very prominent place in the present market. Views regarding prices for the next three months vary with well posted members of the trade holding that declines will be maintained only if imported makes come on the market in large volume. Estimates on domestic production of arsenic have been lowered but this has very little bearing on the market for nearby positions. It is evident, however, that demand has fallen off with the coming of lower prices and the same holds true for calcium arsenate.

Buying of caustic soda for export has ceased to be active and reports are heard that prices would have to be lowered materially to meet the views of foreign markets. As a result prices f.a.s. New York are easy and concessions could be obtained if actual business was in sight. On the other hand bichromates are firmly held and production has been reduced due to scarcity of labor. Most of the acids likewise are firm with some selections sold ahead and very little to be had in the open market.

The prospect of securing chemicals from the Ruhr, that is on purchases made prior to Feb. 1 and possibly to Feb. 20, were brighter as the result of an announcement from the Department of State that arrangements had been made with the authorities in Germany and with the authorities of the occupying forces, whereby shipments would be made, if a prescribed method of procedure were followed in securing export licenses.

Acids

Acetic Acid—Consuming demand is variously reported but in general new business appears to be along quiet lines, with export slowed up by the high prices in effect. Some of the largest consumers are covered by contracts placed at prices below those now quoted in the open market. Current quotations are on a basis of 3.38c. per lb. for 28 per cent and 6.75c. per lb. for 56 per cent. On glacial prices vary according to seller with round lots quoted at 12c. to 12.78c. per lb.

Boric Acid—Sellers are reported to be competing keenly for business and values have not reacted from the recent decline. Increased output also is credited as being a factor. Offerings are available at 10½c. per lb., in bbl. and 11½c. per lb., in kegs.

Chromic Acid—Steadiness in price has been the outstanding feature to this acid for a long time. Consuming interest is sufficient to prevent accumulations, without causing any upset to values. The technical grade is held at 39c. per lb., in drums and 98 per cent at 40c. per lb.

Citric Acid—Reports from foreign markets still indicate firm prices abroad and this has a steadying influence on the market in general. Spot holdings, however, have been subject to some fluctuations according to seller with offerings heard at 51½c. to 52½c. per lb. Domestic goods holds at 49@50c. per lb. with offerings fairly ample.

Lactic Acid—Imported offerings are said to be in fair demand with prices largely nominal. Home makes are finding a good outlet in consuming trades with prices on a steady basis of [illegible]@6c. per lb. for 22 per cent light and [illegible]@5c. per lb. for 22 per cent dark.

Muriatic Acid—Producers are still well sold ahead and the scarcity of stocks gives a strong tone to the market. Good call is reported for contract deliveries and this leaves but little to be had on new accounts. Quotations are given at 90c. to $1 per 100 lb. for 18 deg. and $1.75@$2 per 100 lb. for 22 deg.

Oxalic Acid—Prices for domestic remain firm at 13½c. per lb., f.o.b. works with smaller lots commanding higher prices. Demand, while not active, has been fairly good. Imported is not in large supply but prices do not appear steady and sellers are open to bids with 13½c. per lb. given as representing the market.

Tartaric Acid—Imported was easier in tone and 36¾@37c. per lb. was quoted for prompt. Trading was not active. Domestic grades are moving regularly against contracts with very little offered in the open market. Prices for the latter hold at 37½c. per lb.

Potash

Bichromate of Potash—The general asking price of producers is 11½c. per lb., f.o.b. works, although some makers are willing to deliver at that price in places near by works. There has been a fair call for moderate sized lots and with an absence of competitive selling, values are well maintained.

Caustic Potash—Sales of domestic have been made at 9c. per lb., works, and this is the inside price heard for such offerings. Imported sold at 7½c. per lb. early last week, and eagerness of holders to move stocks gave a weak appearance to the market. As low priced stocks were reduced, prices recovered slightly and 7¾c. per lb. was asked for spot and shipment. In fact shipment was quoted up to 8c. per lb. and prices depended on seller.

Carbonate of Potash—Stocks of 90-95 per cent are still held in the local market, with prices low in comparison with quotations for lower grade material. It was possible to do 6½c. per lb. For 80-85 per cent asking prices were 7c. per lb., with a possibility that 6¾c. per lb. could be done. Hydrated was in fair demand at 7½@7¾c. per lb.

"Chem. & Met." Weighted Index of Chemical Prices

Base — 100 for 1913-14

This week	177.66
Last week	177.69
May, 1918	270.00
May, 1919	248.00
May, 1920 (high)	280.00
May, 1921 (low)	143.00
May, 1922	159.00

An easier situation in spot barium chloride brought down the week's index number 3 points. The major items in the list scarcely moved so far as prices were concerned.

Chlorate of Potash—Offerings of imported chlorate could be picked up at 7¾c. per lb. and attempts to advance prices resulted in withdrawal of buyers. There is a steady movement of domestic with the price holding steady at an inside figure of 8½c. per lb., works, for powdered or crystal.

Permanganate of Potash — Lower prices have prevailed in this market and the impression is gaining that still lower prices are to follow. The general asking price for spot material was 19c. per lb. Consumers are slow to take hold and prices for shipment are purely nominal, as no interest was taken in forward positions. Some consumers say that a 14c. per lb. level will be reached before the decline will be checked.

Prussiate of Potash—While 70c. per lb. was asked for red prussiate, it was difficult to interest buyers at that figure and on firm bids it was reported that 68c. per lb. would find sellers. Yellow prussiate likewise was easier and 36c. per lb. was given as the price at which sales were made.

Sodas

Soda Ash—The market is quiet as far as new business is concerned but contract withdrawals are holding up well and this is absorbing a large part of production. Prices are holding on a steady basis with quotations for light ash at $1.20 per 100 lb. in bags, carlots at works and $1.40 per 100 lb. in bbl. These are contract prices and on new orders for prompt shipment a slight advance is asked. Dealers have quoted as low as $1.75 per 100 lb., with a range upward on a quantity basis.

Bichromate of Soda—Underlying conditions have not changed for the better, and prominent producers are holding out for 8½c. per lb. at works. The spot market is quiet but 8½c. per lb. is asked, and while reports are still heard to the effect that odd lots can be picked up at 8¼c. per lb., this is by no means an open quotation.

Caustic Soda—The falling off in export buying has had a dampening effect on prices, in spite of attempts of producers to maintain values. Shipments to foreign markets are noted against old orders, but demand for June forward is very dull and according to reports $3.25c. per lb. could be done on some makes, although prices are generally quoted at 3.30@3.35c. per lb., according to brand and seller. Domestic consumption is fairly large, based on the movement from producing points. Quotations for domestic use are 2½c. per lb., basis 60 per cent, carlots, f.o.b. works. Spot offerings are held at an inside price of 3½c. per lb., with the usual range for smaller amounts.

Fluoride of Soda — The advance in price of a short time ago served to restrict trading, and values have eased off both on the part of imported and domestic grades. Freight rates play an important part in dividing demand for the two grades, with imported cheaper along Atlantic coast points. Prices for imported are 9@9½c. per lb., while domestic is held at 10½c. per lb. and upward on a quantity basis.

Nitrate of Soda—The announcement of a new schedule of prices for shipments from Chile, as reported last week, has had no influence as a market factor. In the spot market $2.60 per 100 lb. is given as the asking price, but resale offerings are rather numerous, especially at southern points and this causes some shading. Interest is not keen either for spot or shipment. The new prices are on a basis of $2.45 per 100 lb. for July, August and September; $2.47½ per 100 lb. for October; $2.50 per 100 lb. for November; $2.52½ per 100 lb. for December; $2.55 per 100 lb. for January; $2.60 per 100 lb. for February; $2.62½ per 100 lb. for March to June inclusive. Estimates on consumption of nitrate for the year, to end June 30, place the total in excess of 2,100,000 tons and the visible supply is placed at 1,150,000 tons.

Prussiate of Soda—A buyers' market has prevailed with prices weak. Spot holdings have shown wide fluctuations, according to seller. Some reports credit sales at 16½c. per lb. and up to 17½c. per lb. is asked. Buyers are interested only when concessions are granted and slow consuming demand is largely responsible for the present weakness. Imported for shipment is quoted at 16½@17c. per lb., with prominent domestic producers not yet ready to quote on anything but May deliveries.

Miscellaneous Chemicals

Acetate of Lime—Reports on production show that the domestic output for the first quarter of the year was larger than for the last quarter of 1922. The position of raw materials, however, is firm and the higher selling price recently inaugurated is being adhered to. Asking prices are 4@4.05c. per lb.

Arsenic—Demand for white arsenic is none too active. The fact that some domestic producers are supplying consumers at prices under those quoted in the open market is taking away interest in imported grades. It is generally held however that prices will hold fairly steady for the present unless imports become larger than is now expected. Some producers have offered prompt shipment at 13½c. per lb., but there were offerings of prompt from Canada at 13c. per lb. with June shipment at the same price. For June, domestic material is offered at 12½c. per lb. In the spot market prices ranged from 14¾c. to 15c. per lb., but it was difficult to arouse interest at those levels. Some reports say that sales for delivery into 1924 have been made at 9c. per lb., but other reports say there is no interest in distant positions.

Calcium Arsenate — Buying interest has become less active and consumers evidently are influenced by the lower prices which have come out recently for arsenic. Sales of calcium arsenate are reported to have gone through at 16c. per lb. although 17c. per lb. is the figure asked in many quarters. A considerable quantity of arsenate was damaged by fire last week but this had nothing more than a passing effect on the market.

Copper Oxide—Demand has been active throughout the season and stocks have been held at low levels. Some producers are using their entire output to take care of contract deliveries and are unable to quote for nearby shipment. With offerings difficult to locate, prices are little better than nominal. with prices of 20@21c. per lb. heard as representing sellers views.

Copper Sulphate — Domestic makes are offered at 6c. per lb. for large crystals and 5.90c. per lb. for small crystals. Demand is reported to be fair but not active. Imported grades were very weak and sales are said to have been made at 5½c. per lb. The lower prices have not succeeded in stimulating business to any marked degree and the trend of values is uncertain, depending on the volume of imports.

Cream of Tartar—Domestic makers held out for 26½c. per lb., while on the imported there were sellers down to 25½c. Demand showed no improvement, and, despite the recent uplift in the acid, prices were rather unsettled in some directions.

Lead Acetate—With the seasonable demand about to come in producers of lead acetate advanced the market ½c. per lb. The revised trading basis follows: White crystals, bbl., 14@14½c.; white, broken, 13½@14c.; white granular, 13¾@14¼c.; brown, broken, 13@13½c. per lb. Less than a fortnight ago there was much talk of a higher market, but the weakness in the metal held prices in check. The higher cost of acetic acid was one of the reasons given out for the uplift in prices.

Tin Oxide—The market for tin suffered another decline, but late in the week the metal developed a firmer tendency and producers of tin oxide saw no good reason for lowering prices. Up to the close 50c. represented the general asking price.

Denatured Alcohol Up

Leading producers of denatured alcohol announced an advance of 2c. per gal. on all grades. Demand was described as fair, but with competition not so keen, the market presented a better feeling from the seller's point of view. The No. 1 special closed at 35c. per gal. in drums, and 41c. per gal. in barrels, carload lots. Completely denatured, 188 proof, formular No. 1, was raised to 43c. per gal. in drums, and 49c. per gal. in barrels. Ethyl spirits closed unchanged on the basis of $4.70 per gal. for the 190 proof, U. S. P. Methanol also was unchanged, first-hands quoting on the basis of $1.18 on the 95 per cent. Production of methanol in March was placed at 831,784 gal., against 733,179 gal. in February and 933,171 gal. in January.

Coal-Tar Products

Competition in Salicylates Unsettles Prices—Spot Phenol Quiet—Flake Naphthalene Sells at 9c. on Spot; Crude Easier

AT THE close of the week prices named for the salicylates showed a wide range. The decline in the market was not general, several large factors refusing to meet the cut announced early last week and, according to some traders, it was not possible to purchase round lots at the lower levels in all instances. Talk in the trade had it that a "price war" was the cause of the sudden shift in the position of certain makers. With no important change in the market for phenol, traders seemed to be at a loss for any other reason for the decline. Of course, there is a possibility that, with demand less active and prospects for cheaper phenol in sight, producers who led in the decline saw no good reason for maintaining prices any longer.

The reported seizure by the French of several large German coal-tar products plants attracted attention in trade circles here, but in the absence of more definite information operators suspended judgment. With sufficient tariff protection manufacturers in this country are no longer so anxious about developments abroad. It is pointed out that the American coal-tar products industry has made rapid strides toward recovery from the severe slump witnessed about 2 years ago.

Importations of naphthalene continue, but virtually all of the crude arriving is moving into manufacturing channels. New prices on domestic ball and flake naphthalene have not yet been named. Spot flake was barely steady. Phenol settled at 54@55c. on spot, with trading quiet all week. Benzene in other than motor grades appeared in largest supply, but prices showed no quotable change.

Benzene—Reports on the state of trade were rather conflicting last week. Several handlers took the stand that business was not so good as at this time last year, yet prices pointed to a fairly steady market. Sales of the 90 per cent grade, for prompt shipment, went through at 30c. per gal., carload lots, in drums. Leading factors say that there is no accumulation in stocks of motor benzene and that indications point toward a steady market for some time to come.

Creosote—Another bulk shipment of creosote oil arrived from abroad consigned to wood preservative plants. What really interested traders was the receipt of several shipments of creosote oil fit for disinfectant manufacture. The market for the 25 per cent grade held at 30c. per gal. in tanks and 35c. per gal. in drums.

Cresylic Acid—The demand was inactive and prices were unsettled, imported 97 per cent, pale, being available at $1.25@$1.30 per gal., in drums, while on the 95 per cent, dark, there were sellers at $1.15 per gal. Domestic production has been augmented, but actual offerings remain light owing to the sold-up condition of leading makers.

Naphthalene—During the past week 1,440 bags of crude naphthalene arrived at New York, mostly from German ports. The market for crude was easier and nominal quotations on fair quality goods ranged from 3¼@3½c. per lb. c.i.f. New York. Flake on spot sold at 9c. per lb. On ball naphthalene the "outside" market held at 9½@9¾c. per lb. There was no buying interest in futures.

Phenol—Scattered lots of U.S.P. phenol sold on spot at 54@55c. per lb. The demand was slow all week and the undertone was barely steady. With the trade talking increased production, buyers were disposed to hold off. Leading makers quote around 27@28c. on contract.

Salicylic Acid—A quotation of 40c. per lb. was named in more than one direction, but this failed to bring out a general downward revision in prices. In fact the largest producer refused to shade 50c. per lb. The keen competition among certain producers of salicylates, which has unsettled the market in all directions, had also curtailed buying. The revised list of prices, announced by several factors within the past week, follows: Sodium salicylate, U.S.P., 47c.; acid salicylic, U.S.P., 40c.; acid acetylsalicylic, U.S.P., 95c.; salol, U.S.P., 85c. Methyl salicylate was unchanged at 62c. per lb.

Beta Naphthol—Producers continue to quote the market on the 23c. per lb. basis, but in outside channels price cutting is being resorted to.

Aniline Oil—The market was steady at the close at 16c. per lb., round-lot basis, prompt shipment.

Xylene—First hands were sellers on contract at 75c. per gal. for the pure, but had little to offer. Second hands continue to quote around $1 per gal., spot.

Financial Notes

The annual report of the Anton Jurgens' United Margarine Works of Holland shows net income in 1922 of $f,931,723, leaving a balance of $1,446,223 after payment of all interest and full dividends on preference shares.

The Beech-Nut Packing Co. for the first 3 months of 1923 reports net earnings of $595,787 after all charges, but before providing for Federal taxes. This compares with net earnings of $392,291 in the same period last year.

A readjustment of capital of the St. Louis Coke & Chemical Co. of St. Louis has been completed. The reorganized company will be called the St. Louis Coke & Iron Co.

The Vacuum Oil Co. has declared a semi-annual dividend of $1 a share on the new $25 par stock, payable June 20 to stock of record May 31. This is equal to 32 per cent on the old stock of $100 par. Last year 16 per cent was declared on $100 par stock.

An addition of $75,000,000 to its authorized capital stock, increasing it from $225,000,000 to $300,000,000, has been proposed by the Standard Oil Co. of New York.

Income account of Devoe & Raynolds Co., Inc., for the year ended Dec. 31, shows net profits of $704,995, after charges, depreciation, and taxes. Consolidated income account for the year shows net sales of $10,077,924; cost of sales, $6,147,393; operating profit, $3,930,531, and total income, $4,007,134.

The Kennecott Copper Corporation for the first quarter of 1923 reports total income of $4,963,453 and net income of $4,395,203 after allowing for interest obligations totaling $568,250. Net income for the first quarter of the year was equal to $1.56 a share on the outstanding capital stock, against 28 cents a share earned in the last quarter of 1922.

Latest Quotations on Industrial Stocks

	Last Week	This Week
Air Reduction	67	64⅝
Allied Chem. & Dye	69½	67
Allied Chem & Dye, pfd.	110½	110
Am. Ag. Chem.	25	18
Am. Ag. Chem., pfd.	46⅜	43
American Cotton Oil	12½	9½
American Cotton Oil, pfd.	25½	19⅝
Am Drug Synd	5⅝	5⅛
Am Linseed Co.	28⅝	27⅛
Am. Linseed Co., pfd.	48	46½
Am. Smelting & Refining	60⅜	56
Am. Smelting & Refining, pfd.	98⅞	96⅛
Archer-Daniels Mid. Co., w.i.	39	38⅛
Atlas Powder	175	172
Atlas Powder, pfd.	87⅛	90
Casein Co. of Am.	*60	*60
Certain-Teed Products	39	38½
Commercial Solvents A	28	28
Corn Products	131⅛	131
Corn Products, pfd	117½	116½
Davison Chem	27⅞	27
Dow Chem	40⅛	..
Du Pont de Nemours	140	131
Du Pont de Nemours, db.	87⅛	86
Freeport-Texas Sulphur	15⅝	15
Glidden Co	9	9
Grasselli Chem.	130	130
Grasselli Chem., pfd.	102	*103
Hercules Powder	*107	105
Hercules Powder, pfd.	*102⅛	103
Heyden Chem.	1⅞	1⅞
Int'l Ag. Chem. Co.	7	8
Int'l Ag. Chem Co., pfd.	29	25
Int'l Nickel	14⅛	14⅛
Int'l Nickel, pfd.	78	78
Int'l Salt	*90	*90
Mathieson Alkali	49½	48
Merck & Co	86	85
National Lead	122⅛	118⅞
National Lead, pfd.	112⅛	112⅛
New Jersey Zinc	165	163
Parke, Davis & Co.	79⅛	81
Pennsylvania Salt	92⅛	89
Procter & Gamble	*140	*140
Sherwin-Williams	*29⅝	*29⅛
Sherwin-Williams, pfd.	*101	*101
Tenn. Copper & Chem.	10⅛	10½
Union Carbide	61	61
United Drug.	80⅛	80
U. S. Ind. Alcohol	58⅛	56⅛
Va.-Car. Chem. Co.	13½	11⅞
Va.-Car. Chem. Co., pfd.	89½	87

*Nominal. Other quotations based on last sale.

Vegetable Oils and Fats

Coconut Weak on Selling Pressure—Linseed Futures Unsettled—Cottonseed Steadies—China Wood Lower—Tallow 7½c.

INQUIRY for vegetable oils in the edible group showed moderate improvement, but this could not be said of the technical descriptions. Prices were unsettled and declines were registered in coconut, corn, china wood and palm oils. Cottonseed, both crude and refined, steadied on smaller offerings, reflecting a tight statistical position on old crop oil. The break in tallow prices was a feature in the week's developments. Linseed oil was dull and sentiment favored buyers. Soya bean oil was barely steady. Olive oil foots was unsettled on lack of demand.

Linseed—Spot oil sold at $1.14 per gal., carlots, cooperage included, indicating that crushers were not in a hurry to lower prices. On June deliveries, however, business was booked at $1.09 per gal., cooperage terms, while on July oil nominal prices ranged from $1.03@$1.05 per gal. The forward positions were unsettled throughout the week, and some consumers, who have lost confidence in the market, resold contracts at sharp concessions. Crushers admitted that July-August-September oil might have been obtained at less than $1 per gal. on a firm bid. Demand, taken as a whole, was quiet. Foreign oil was offered freely on spot and sales went through at prices ranging from $1@$1.06 per gal., duty paid. The cost of import was high towards the close and May shipment from abroad settled around $1.06@$1.08 per gal., duty paid, landed weights, New York. Importations of flaxseed from the Argantine have been heavy. Crushers have virtually caught up on contract deliveries, but have not yet had an opportunity to accumulate a surplus in either seed or oil. Foreign crushers believe that the future of the market hinges upon the state of trade in America. Continued heavy absorption of oil by consumers in this country would tend to steady the seed situation. The acreage planted to flaxseed in the United States will have some bearing on the market, and from latest reports a fair increase in the plantings may be expected. The Argentine seed movement continues large, while Indian shipments have been in excess of 500,000 bu. weekly for some time now. Linseed cake for export was dull and prices nominal at $34.50@$35.50 per ton, f.a.s. New York.

Cottonseed—Prices did not move much one way or the other, but a steadier undertone was in evidence, reflecting apprehension over the tight statistical position and the improvement in lard and other speculative markets. Shorts were the buyers of May oil in the option market on the Produce Exchange and business went through at higher than 11¼c. per lb., in prime summer yellow. The December option settled around 8⅞c. per lb., but interest in the distant months was of a desultory character. Refiners' brokers were credited with buying July and September oil, at least part of which represented covering. Cotton prices did better on unfavorable weather news from the south, which also exerted some influence on oil. The Chicago lard stocks on May 15 were estimated at 30,455,152 lb., against 34,212,572 lb. on the first of the month, the shrinkage causing considerable surprise in the oil trade. Crude oil held at 9⅞@10c. per lb., f.o.b mills, with offerings scanty. Bleachable oil was offered at 10¾c. per lb., f.o.b. Texas points. Lard compound held at 13@13¼c., f.o.b. New York. Oleo stearine was dull at 10c. nominal.

China Wood Oil—The market was weak, May delivery at New York selling at 25c. per lb., while June-July brought 23c. per lb. Demand was quiet and prices easy, even at the decline.

Coconut Oil—The sale of 700 tons of Manila oil at 8c. coast, bulk basis, was reported last week. Selling pressure was in evidence on the coast and on tank car offerings, nearby oil, prices ranged 8⅛@8¼c. In New York the feeling was not so bearish and the price on Ceylon type oil in sellers' tanks settled at 8⅝@8⅞c., according to position. Copra was offered at 5⅛@5⅝c., c.i.f. New York.

Corn Oil—Crude was lowered to 9⅛@9⅜c., sellers' tanks, f.o.b. point of production.

Olive Oil — Denatured closed unchanged at $1.10@$1.15 per gal., in barrels, spot. Prime green sulphur oil (foots) closed barely steady at 9⅛@9⅜c. per lb., spot New York, with demand quiet.

Palm Oil—The decline in tallow restricted buying in palm oils to a minimum and prices at the close were more or less nominal. Lagos was offered at 7⅞c., spot, one parcel of 200 tons being available at this figure.

Soya Bean Oil—Crude soya was offered at 10¼c., coast, and 10½c. New York, sellers' tanks, duty paid, nearby positions. Demand was dull. One car of spot oil was offered at 10⅞c., Atlantic port.

Fish Oils—No sales went through in crude menhaden oil. The nominal quotation on forward material held at 50c. per gal., tanks, f.o.b. factory. Newfoundland cod oil held at 70@72c. per gal., f.o.b. New York.

Tallow and Greases—The sales of several hundred drums of extra tallow went through at 7½c. per lb., f.o.b. plant, a decline of ½c. for the week. At the weekly London auction prices were unchanged. House grease was offered at 6⅞@7c. per lb., according to acidity.

London Tallow Auction

At the weekly tallow auction, held in London, May 16, 731 casks were offered and 644 casks sold. Prices realized were unchanged.

Miscellaneous materials

Casein—Arrivals from foreign sources were heavy, amounting to 4,870 bags. Offerings increased and the market presented an unsettled appearance. Prices named on the ordinary grades ranged from 20@25c. per lb., depending upon the quantity and seller.

Glycerine— While refiners did not alter prices for the c.p. grade, holding out for 17½c. asked, in drums, it was intimated that certain operators took on business at 17c., drums included. Trading was inactive. Chicago quoted 17c. as the market for c.p. Dynamite glycerine sold late in the week at 16c. per lb., carload lots, drums included, a decline of ½c. from the nominal price of a week ago. Demand for dynamite glycerine was quiet. Crude soap lye, basis 80 per cent, loose, held at 11¼c. asked, eastern territory, while in the Middle West 11c. represented the nominal asking price. On saponification, 88 per cent, loose, 12½c. was asked, with no transactions to report.

Turpentine—Inquiry from foreign as well as domestic buyers sent prices sharply higher and late in the week the nominal quotation stood at $1.22½ per gal., which compares with $1.08, the recent low. Southern markets developed strength and this stimulated buying interest. However, after the rise the demand met with a setback.

Shellac—Cables were about unchanged and importers continued to offer T. N. on spot at 64@66c. per lb. Bleached, bonedry, held at 76@78c. per lb. Superfine orange was available at 68@70c. per lb. Trading was inactive.

White Lead— Corroders considered changing prices, but at the last minute it was decided upon to maintain the list on the basis of 9⅜c. per lb. for the standard dry, in cask, round-lots. The pig lead market seemed to steady and this checked the easier undertone for the time being. Pig lead was unchanged at 7¼c., New York.

Zinc Oxide—New business was routine only, but deliveries against existing contracts absorbed the bulk of the production and leading producers reported a steady situation. Production of tires has not yet been restricted to the point where zinc oxide business is likely to suffer. American process, lead free, held at 8@8¼c. per lb. French process, red seal, closed unchanged at 9⅜c. per lb.

Argentine Linseed Exports

Shipments of linseed from the Argentine from Jan. 1, 1923, to May 12, 1923, by countries, were:

	Bushels
United Kingdom	2,120,000
Continent	8,920,000
United States	13,128,000
To order	4,868,000
Total	29,036,000

The visible supply at the Argentine ports on May 12 was estimated at 4,000,000 bushels. The shipments to-date exceed all previous shipments for a like period.

Imports at the Port of New York

May 11 to May 17.

ACIDS—240 bbl. tartaric, Genoa, L. Appula Soc. Ind. Chimica Ital, 120 bbl. tartaric, Bremen, Warren Products Co., 25 dr. cresylic, Rotterdam, Shipping & Coal Co., 30 dr. cresylic, Rotterdam, Order, 15 bbl. oxalic, R. W. Greeff & Co., 20 csk tartaric, Liverpool, Order, 91 dr cresylic, Liverpool, Order, 400 bbl. tartaric, Genoa, L. Oppula Soc. An.

ALCOHOL—28 bbl. denatured, Arecibo, M. Feigel & Bros., 174 bbl do, Arecibo, C. Esteves; 32 bbl., Piraeus, Order, 103 csk. butyl, Bordeaux, Commercial Solvents Corp., 52 bbl. denatured, Arecibo, C Estevas; 28 bbl. do., Arecibo, M. Feigel

ALIZARINE—5 csk, Liverpool, A Klipstein & Co, 7 csk., Hamburg, Kuttroff, Pickhardt & Co.; 4 csk., Hamburg, Regal Color & Chem. Co., 4 pkg., Hamburg, Grasselli Chem. Co.; 3 csk, Hamburg, Guaranty Trust Co.

ANTIMONY OXIDE—50 pkg., Changsha, Order.

ARCHIL LIQUOR—19 csk, Liverpool, H. Kohnstamm & Co.

ARGOLS—352 bg, Lisbon, C. Pfizer & Co; 142 csk., Messina, Tartar Chem Wks, 275 bg., Rotterdam, C. Pfizer & Co, 115 csk., Naples, Tartar Chem. Works

ARSENIC—396 cs., Kobe, P. E Falkingham, 160 cs., Kobe, China-Am Tobacco & Trading Co, 250 cs., Kobe, Mitsui & Co, 115 cs., Kobe, Frazer & Co., 200 csk., Hamburg, A. Klipstein & Co, 50 csk., Hamburg, Ore & Chemical Corp., 150 cs, Hamburg, Order; 25 csk, Genoa, Guaranty Trust Co., 87 csk., Antwerp, Chem Nat'l Bank; 159 csk, Antwerp, Order, 44 csk, Bordeaux, Order

AMMONIUM—10 csk carbonate, Liverpool, Order; 8 csk sulphocyanide, Liverpool, Order, 1183 csk nitrate, Hamburg Kuttroff, Pickhardt & Co

ASBESTOS—950 bg., Southampton, W D. Crumpton & Co

BARIUM HYDRATE—21 csk, Hamburg, E Suter & Co

BARIUM SUPEROXIDE—68 bbl. Hamburg, F. Boehm

BARIUM PEROXIDE—99 csk., Hamburg., W. A. Brown & Co., 62 dr., Havre, Mallinckrodt Chem. Wks., 124 dr., Havre, Gulf Merc. Corp

BARYTES 600 bg, Bremen, N. Y. Trust Co., 599 bg, Bremen, Order; 17 csk., Hamburg, Order.

BARIUM CHLORIDE 52 csk, Antwerp, Order.

CAMPHOR—100 cs., Kobe, Nat'l Park Bank; 200 cs., Kobe, Mitsui & Co.; 56 cs., Shanghai, Eastman Kodak Co.; 100 cs., Hamburg, A. Ochse Co.

CASEIN—667 bg, Buenos Aires, Equitable Trust Co.; 84 bg., Buenos Aires, Nat'l City Bank, 417 bg., Buenos Aires, Williamson Trading Co.; 2002 bg., Buenos Aires Kalbfleisch Corp.; 100 bg., London, A. Hurst & Co., 250 bg., Bordeaux, N. Y. Trust Co, 100 bg., Bordeaux, Nat'l City Bank, 833 bg., Buenos Aires, Equitable Trust Co.; 417 bg, Buenos Aires, Irving Bank-Col. Trust Co.

CREOSOTE—6015 tons, Antwerp, American Creosoting Co.; 60 dr., Leith, Order

CHEMICALS—46 csk., Hamburg Roessler & Hasslacher Chem. Co, 93 pkg., Bremen, Pfaltz & Bauer, 7 cs., Antwerp Ciba Co.; 157 pkg, Rotterdam, Order, 149 pkg., Antwerp, Order, 63 bbl Hamburg, Roessler & Hasslacher Chem. Co.; 242 pkg, Hamburg, Jungmann & Co.

CHALK—500 tons, London, Baring Bros. & Co.; 3,000 bg., Antwerp Bankers Trust Co.; 2,200 bg., Antwerp, Irving Bank-Col. Trust Co., 2,000 bg., Antwerp, Order; 1,828 tons (bulk), Dunkirk, Taintor Trading Co.; 500 tons (bulk), Dunkirk, J. Higman

COLORS—68 csk., Havre, Ciba Co; 58 csk. aniline Havre, Sandoz Chem. Works; 2 csk do., Havre, Order; 24 pkg, Hamburg, Kuttroff, Pickhardt & Co; 20 pkg., Hamburg, Grasselli Chem Co.; 19 cs dry, Bremen, M G. Lange & Co.; 5 keg aniline, Antwerp, Am. Ex Nat'l Bank; 16 pkg., aniline, Antwerp, Irving Bank-Col Trust Co.; 4 csk., Antwerp, Order; 8 csk. dry, Southampton, Order; 14 pkg. aniline, Havre, Sandoz Chem. Wks., 1 pkg., aniline, Rotterdam, Am. Aniline Products, Inc.; 11 csk. and 1 cs., Rotterdam, B. Mernard; 8 pkg., Rotterdam, F. Donders; 3 csk. Rotterdam, Order; 162 pkg. earth, Leghorn, Reichard-Coulston, Inc.; 65 csk. ochre, Marseilles, Gledhill & Co.; 6 dr. aniline, Liverpool, Am. Exchange Nat'l Bank; 12 csk. earth, Hamburg, E. M. & F. Waldo; 26 csk. earth, Hamburg, J. H. Furman Co.; 50 csk. do., Hamburg, C. J. Osborn & Co.; 37 csk. ochre, Bordeaux, Butcher & Co.; 10 csk. aniline, Hamburg, Guaranty Trust Co.; 13 csk., Hamburg, H. A. Metz & Co.; 7 cs. aniline, Hamburg, Carbic Color & Chem. Co.

COPPER SULPHATE—156 csk., Hamburg, A. Klipstein & Co.

COPRA—21,444 bg., Cebu, Order.

CREAM TARTAR—40 bbl., Genoa, Order, 40 csk., Bordeaux, National City Bank.

DIVI-DIVI—769 bg., Monte Cristi, M. J. Petit.

EPSOM SALT — 500 bbl., Hamburg, Hansa Co.

FERTILIZER—2,500 bg. bonemeal, Karachi, Ralli Bros

FLUORSPAR—975 bg., Hamburg, H. Sundheimer, 400 bg., Hamburg, A. Klipstein & Co.

FULLERS EARTH—950 bg., London, L. A. Salomon & Bros.

FUSEL OIL 12 csk., Antwerp, Guaranty Trust Co., 8 csk., Hamburg, A. Klipstein & Co., 6 dr., Hamburg, Order, 68 bbl. and 13 dr, Hamburg, Order, 9 csk., Genet, Maas & Waldstein, 5 dr., Dunkirk, Maas & Waldstein, 10 dr., Dunkirk, Guaranty Trust Co.; 3 dr., Dunkirk, Order.

GAMBIER—198 cs, Singapore, Order.

GLAUBERS SALT—278 bg., Hamburg, Roessler & Hasslacher Chem Co.

GLYCERINE 6 dr., Liverpool, Br. Am. Tobacco Co., 20 csk., Marseilles, Order; 41 dr., Antwerp, N. Y. Trust Co, 10 csk., Nazaire, Marx & Rawolle.

GUMS—100 cs. damar, Padang, Order, 270 pkg. copal, Macassar, Brown Bros & Co., 1,200 pkg. do., Macassar, Kidder, Peabody & Co., 3,855 pkg. do., Macassar, Order, 250 bg arabic, Port Sudan, Thurston & Braidich, 250 bg. arabic, Port Sudan, T M Duche & Sons; 500 bg. arabic, Port Sudan, Caraconda Bros., 250 bg. arabic, Port Sudan, W. Tappenbeck; 200 pkg. damar, Batavia, W. H. Muller & Co.; 155 pkg copal, Singapore, Irving Bank-Col. Trust Co, 350 bg. damar, Singapore, Kidder, Peabody & Co; 255 bg do, Singapore, Baring Bros. & Co., 140 bg damar, Singapore, Order, 901 pkg. copal, Macassar, Nat'l City Bank, 553 pkg. copal, Macassar, Order, 810 pkg. copal, Brown Bros & Co, 72 pkg. copal, Macassar, Irving Bank-Col. Trust Co, 5,191 pkg. copal, Macassar, Order, 3,103 pkg. copal, Antwerp, Order, 30 bg. copal, Antwerp, Order, 125 bg. copal, London, Chem. Nat'l Bank.

IRON OXIDE—100 bbl Malaga, Scott, Libby & Co., 95 bbl., Malaga, J. L. Smith & Co., 91 bbl., Malaga, Reichard-Coulston, Inc, 81 bbl., Malaga, Order, 86 bbl., Malaga, S C. Goldberg, 298 bbl. Malaga, C K. Williams & Co., 111 bbl., Malaga, Reichard-Coulston, Inc.; 125 bbl., Malaga, E M. & F. Waldo; 303 bbl., Malaga, C. J. Osborne & Co.; 114 bbl., Malaga, Hummel & Robinson Co.; 17 csk., Liverpool, E. M. & F. Waldo, 39 csk., Hull, J. L Smith & Co, 40 csk, Liverpool, J. A. McNulty; 15 csk, Liverpool, Order; 25 csk, Manchester, Order; 25 csk., Leith, Reichard-Coulston, Inc.

IRON SULPHATE—88 csk., Antwerp, E. M Sergeant & Co.

LITHOPONE — 200 csk., Antwerp, A. Klipstein & Co.; 999 csk., Antwerp, Benj. Moore & Co.; 80 csk., Antwerp, E. M. & F. Waldo.

MAGNESITE—250 bg. calcined, Rotterdam, H. J. Baker & Bro.; 105 bg. do., Rotterdam, Spelden.

MAGNESIUM—40 cs. carbonate, Hull, Van Oppen & Co.; 61 dr. chloride, Hamburg, Innis, Spelden & Co.; 345 bbl. chloride Hamburg, Hansa Co.; 182 dr. chloride, Hamburg, Innis, Spelden & Co.

MANGROVE BARK—1,500 bg. extract, Singapore, Order

MYROBALANS—1,824 pkts. Calcutta, Nat'l City Bank, 10,263 pkts., Calcutta Order.

NAPHTHALENE—328 bg., Hamburg, Irving Nat'l Bank; 218 bg., Hamburg, Irving Bank-Col. Trust Co.; 894 bg., Hamburg, Calco Chem. Co.; 500 bg., London; Order

OILS — Castor — 55 bbl, Hull, Brown Bros & Co.; 200 bbl., Hull, Order **Cod**—160 bbl., Hull, Order; 100 bbl., Hamburg, Order. **China Wood**—152 bbl, Hankow, Int'l Banking Corp, 109 csk., Hamburg, Order **Linseed**—146 bbl., London, Order; 146 bbl., London, Irving Bank-Col. Trust Co; 120 bbl, Rotterdam, I. R Boody & Co.; 1157 bbl., Rotterdam, L. & E Frankel; 291 bbl., Rotterdam, J. C Francesconi Co.; 146 bbl, Rotterdam W. Benkert Co.; 144 bbl, Rotterdam, Bur-Mac Chem. Corp; 371 bbl Rotterdam, Order; 1019 bbl, Hull, Nat'l City Bank; 800 tons in bulk, Hull, Am. Linseed Co.; 450 bbl., Hull, Order; 725 bbl., Copenhagen, Order; 770 tons, Leith Midland Linseed Products Co. **Olive Oil Foots**—(sulphur oil)—500 bbl., Naples, Brewer & Co.; 200 bbl., Messina, Bank of the Manhattan Co.; 200 bbl., Messina, First Nat'l Bank of Phila.; 100 bbl., Palermo, Banca Comm. Ital., 100 bbl., Malaga, Elbert & Co.; 400 bbl., Syracuse, Order; 200 bbl., Catania, Mech. & Metals Nat'l Bank; 200 bbl., Catania, Order; 200 bbl., Milazzo, Order. **Palm**—499 csk., Seccondee, Order; 48 pkg., Liverpool, D. Bacon; 474 csk., Liverpool, African & Eastern Trading Corp, 69 csk, Liverpool, Order. **Rapeseed**—1144 bbl., Liverpool, Vacuum Oil Co.; 200 bbl., Hull, Nat'l City Bank; 335 bbl., Hull, Order; 75 bbl., Leith, Order. **Sesame**—144 csk., Rotterdam, Order.

OIL SEEDS—Castor—1844 bg., Santos, F. Matarazzo & Co.; 373 bg., Santos, Bank of N. Y & Trust Co.; 4400 bg., Santos, F. Matarazzo & Co. **Linseed**—87,350 bg., Rosario, Spencer Kellogg & Sons; 17,676 bg., Buenos Aires, Spencer Kellogg & Sons, 60,957 bg., Diamante, Order; 8,502 bg., Bajada Grande, Order; 26,407 bg., Buenos Aires, Order; 8,827 bg., Buenos Aires, L. Dreyfus & Co.; 6,088 bg., Buenos Aires, Order; 17,858 bg., Buenos Aires, L. Dreyfus & Co., 24,090 bg., Buenos Aires, Am. Linseed Co., 51,014 bg., Buenos Aires, Order.

POTASSIUM SALTS — 100 bbl., bicarbonate, Hamburg, Brown Bros & Co.; 449 csk., nitrate, Hamburg, Kuttroff, Pickhardt & Co., 34 dr, caustic, Bremen, Brown Bros. & Co., 14 csk., carbonate, Bremen, P. H. Petry & Co.; 2,000 bg., sulphate, Bremen, A. Vogel; 30 dr., permanganate, Hamburg, E. E Reifenberg, 581 dr., caustic, Hamburg, A. Klipstein & Co., 37 dr., caustic, Hamburg, Order; 424 dr., permanganate, Hamburg, Order; 2,625 bg., muriate, Antwerp, Societe Comm. des Potasses D'Alsace, A quantity of Kainit, Antwerp, Societe Comm. des Potasses D'Alsace, 62 csk., carbonate, Hamburg, Innis, Spelden & Co., 400 pkg., salts, Hamburg, Roessler & Hasslacher Chem. Co.; 21 csk, carbohydrate, Hamburg, Globe Shipping Co.; 200 bbl., bicarbonate, Hamburg, Mallinckrodt Chem Works, 100 cs alum, Hamburg, Order.

PITCH—767 bbl., Hull, Order.

QUEBRACHO—2,017 bg., Buenos Aires, Guaranty Trust Co; 6,128 bg, Buenos Aires, Nat'l Bank of Commerce, 6,955 bg., Buenos Aires, Order, 937 bg., Buenos Aires, Nat'l Bank of Comm.; 21,025 pcs, Santa Fe, Tannin Corp.; 6,000 bg., extract, Buenos Aires, Tannin Corp.; 10,075 bg, extract, Buenos Aires, Tannin Corp, 4 100 bg., Buenos Aires, Fourth Atl. Nat'l Bank of Boston.

QUICKSILVER—100 flasks, London, A. Pickering & Co

SHELLAC — 40 cs, London, Mech. & Metals Nat'l Bk; 100 bg., London, Order, 300 bg., Calcutta, Brown Bros. & Co., 520 bg., Calcutta, Bank of Br. West Africa, 350 pkg, Calcutta, Irving Bank-Col. Trust Co.; 200 bg., Calcutta, Br. Bank of South America, 150 bg., Calcutta, Chase Nat'l Bank; 600 bg., refuse lac, Calcutta, Bank of the Manhattan Co.; 50 cs., Calcutta, First Fed. For. B'k'g Corp.; 10 bg., Calcutta. Phil. Nat'l Bank; 3,429 bg., 200 chests, 338 pkg, button, 200 pkg., garnet, 75 cs., seed, and 40 bg., refuse, Calcutta Order; 13 chests button, Hamburg, A. Holmrath.

SODIUM SALTS — 1845 bg. nitrate, Mejillones, Wessel, Duval & Co.; 9,857 bg. nitrate, Iquique, Wessel, Duval & Co.; 15 csk. carbonate, Liverpool, J. Turner & Co; 119 csk. sulphide, Hamburg, A. Klipstein & Co.; 109 dr. sulphide, Hamburg, Order; 10 csk. hyposulphite, Hamburg, Kuttroff, Pickhardt & Co.; 268 dr. sulphohydrate, Hamburg, C S. Grant & Co.

SUMAC—700 bg., Palermo, Order.

STRONTIUM NITRATE—38 csk., Hamburg, Meteor Products Co.

TALC—700 bg., Genoa, C. Mathieu; 200 bg., Genoa, Kountze Bros.; 450 bg., Genoa, Parfume de Luxe Co.; 200 bg., Genoa, Order; 1,000 bg., Genoa, Ital. Discount & Trust Co.

TANNIN—12 csk., Antwerp, Geigy Co

TARTAR—58 bg, Malaga, Tartar Chem. Works

TALLOW—414 csk., Buenos Aires, Nat'l City Bank; 162 csk., Buenos Aires, Swift & Co.; 286 tcs., Buenos Aires, Nat'l City Bank.

WATTLE BARK—1,824 bg., Durban, E J. Haley, Inc.; 11,659 bg, Durban, Tannin Corp.; 2,592 bg., Durban, Order.

WAXES — 113 bg. bees, San Antonio, Equitable Trust Co.; 86 bg. do, Valparaiso, W. R. Grace & Co.; 175 bg. do, Valparaiso, Banco Anglo Sud. Am; 51 bg. bees, San Antonio Guaranty Trust Co.; 314 bg. bees, Lisbon Order; 36 bg. bees, Valparaiso, Guaranty Trust Co.; 332 bg. carnauba, Santos, F. Matarazzo & Co.; 26 bg. bees, Rio de Janeiro, Order.

ZINC CHLORIDE — 37 dr., Hamburg, Innis, Spelden & Co.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available. In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb	$0 38 -	
Acetone, drums	lb	.25 -	25½
Acid, acetic, 28%, bbl	100 lb	3 38 -	3 50
Acetic, 56%, bbl	100 lb	6 75 -	7 00
Glacial, 99½%, bbl	100 lb	12 00 -	12 50
Boric, bbl	lb	10½ -	
Citric, kegs	lb	49 -	52
Formic, 85%	lb	14 -	16
Gallic, tech	lb	45 -	50
Hydrofluoric, 52%, carboys	lb	12 -	12½
Lactic, 44%, tech, light, bbl	lb	.11½-	12
22% tech, light, bbl	lb	05½-	06
Muriatic, 18° tanks	100 lb	90 -	1 00
Muriatic, 20°, tanks	100 lb	1 00 -	1 10
Nitric, 36°, carboys	lb	04½-	.05
Nitric, 42°, carboys	lb	06 -	06½
Oleum, 20%, tanks	ton	18 50 -	19 00
Oxalic, crystals, bbl	lb	.13½-	.13¾
Phosphoric, 50% carboys	lb	07½-	.08½
Pyrogallic, resublimed	lb	1.50 -	1 60
Sulphuric, 60°, tanks	ton	9 50 -	11 00
Sulphuric, 60°, drums	ton	13.00 -	14 00
Sulphuric, 66°, tanks	ton	16.00 -	16 50
Sulphuric, 66° drums	ton	20 00 -	21 00
Tannic, U S P, bbl	lb	65 -	70
Tannic, tech, bbl	lb	45 -	.50
Tartaric, imp crys, bbl	lb	.36½-	
Tartaric, imp, powd, bbl	lb	.36½-	
Tartaric, domestic, bbl	lb	37½-	
Tungstic, per lb	lb	1 10 -	1 20
Alcohol, butyl, drums, f o b works	lb	.26 -	.28
Alcohol ethyl (Cologne spirit), bbl	gal	4 75 -	4.95
Ethyl, 190 p'f U S P, bbl	gal	4 70 -	
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 190 proof			
No 1, special bbl	gal	41 -	
No. 1, 190 proof, special, dr	gal	35 -	
No 1, 188 proof, bbl	gal	42 -	
No 1, 188 proof, dr	gal	36 -	
No 5, 188 proof, bbl	gal	40 -	
No. 5, 188 proof, dr	gal	.34 -	
Alum, ammonia, lump, bbl	lb	03½-	03¾
Potash, lump, bbl	lb	02¾-	03¼
Chrome, lump, potash, bbl	lb	05¼-	05½
Aluminum sulphate, com, bags	100 lb	1 50 -	1 65
Iron free bags	lb	.02½-	02¾
Aqua ammonia, 26°, drums	lb	06½-	07½
Ammonia, anhydrous, cyl	lb	.30 -	30½
Ammonium carbonate, powd casks, imported	lb	.09½-	.10
Ammonium carbonate, powd, domestic, bbl	lb	.13 -	.14
Ammonium nitrate, tech, casks	lb	10 -	.11
Amyl acetate tech, drums	gal	3 50 -	3 75
Arsenic, white, powd, bbl	lb	.14½-	15
Arsenic, red, powd, kegs	lb	14½-	14½
Barium carbonate, bbl	ton	78 00 -	80 00
Barium chloride, bbl	ton	85.00 -	90 00
Barium dioxide, drums	lb	.18 -	18½
Barium nitrate, casks		.08 -	08½
Barium sulphate, bbl	lb	.04 -	04½
Blanc fixe, dry, bbl	lb	.04 -	.04½
Bleaching powder, f o b wks, drums	100 lb	1 90 -	
Spot N Y drums	100 lb	2 40 -	
Borax, bbl	lb	05½-	05½
Bromine, cases	lb	28 -	30
Calcium acetate, bags	100 lb	4 00	4 05
Calcium arsenate, dr	lb	17 —	18
Calcium carbide, drums	lb	05½	05½
Calcium chloride, fused, drums	ton	22 00 -	23 00
Gran drums	ton	28 00 -	30 00
Calcium phosphate, mono, bbl	lb	06½-	07
Camphor, cases	lb	86 -	.88
Carbon bisulphide, drums	lb	07 -	07½
Carbon tetrachloride, drums	lb	09½-	10
Chalk, precip.—domestic, light, bbl	lb	04½-	.04½
Domestic, heavy, bbl	lb	03½-	03¾
Imported, light, bbl	lb	.04½-	05
Chlorine, liquid, cylinders	lb	06 -	06½
Chloroform, tech, drums	lb	35 -	38
Cobalt oxide, bbl	lb	2 10 -	2 25
Copperas, bulk, f o b wks	ton	19 00 -	20 00
Copper carbonate, bbl	lb	19 -	20
Copper cyanide, drums	lb	.47 -	50
Coppersulphate, dom., bbl	100 lb	6 00 -	6 25
Cream of tartar, bbl	lb	.25½-	26½
Epsom salt, dom., tech, bbl	100 lb	1.90 -	2 15
Epsom salt, imp, tech, bags	100 lb	1.00 -	1 15
Epsom salt, U.S.P., dom., bbl	100 lb	2.50 -	2 60
Ether, U.S.P., drums	lb	.13 -	15
Ethyl acetate, com., 85%, drums	gal	.80 -	.85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal	.95 -	1.00
Formaldehyde, 40%, bbl	lb	$0 14½-	$0 15¼
Fullers earth—imp, powd, net	ton	30 00 -	32 00
Fusel oil, ref, drums	gal	3 55 -	4 05
Fusel oil, crude, drums	gal	2 50 -	2 60
Glaubers salt, wks, bags	100 lb	1.20 -	1 40
Glaubers salt, imp, bags	100 lb	90 -	95
Glycerine, c p, drums extra	lb	.17½-	
Glycerine, dynamite, drums	lb	16 -	
Glycerine, crude 80%, loose	lb	11	11½
Iodine, resublimed	lb	4 55 -	4 65
Iron oxide, red, casks	lb.	12 -	.18
Lead			
White, basic carbonate, dry, casks	lb.	.09¾-	.10
White, basic sulphate, casks	lb	.09½-	
White, in oil, kegs	lb	12½-	14
Red, dry, casks	lb	11¾-	12
Red, in oil, kegs	lb	13½-	.15
Lead acetate, white crys, bbl.	lb	14 -	14½
Brown, broken, casks	lb	13 -	13½
Lead arsenate, powd, bbl	lb	23 -	24
Lime-Hydrated, bbl	per ton	16 80 -	17 00
Lime, Lump, bbl	280 lb	3 63 -	3 65
Litharge, comm, casks	lb	10¾-	11
Lithophone, bags	lb	07 -	07½
in bbl	lb	07	07¾
Magnesium carb, tech, bags	lb	08 -	08½
Methanol, 95%, bbl	gal	1 18 -	1 20
Methanol, 97%, bbl	gal	1 20 -	1 22
Nickel salt, double, bbl	lb	10½-	
Nickel salts, single, bbl	lb	11½-	
Phosgene		60 -	75
Phosphorus, red, cases	lb	35 -	.40
Phosphorus, yellow, cases	lb	30 -	35
Potassium bichromate, casks	lb	11¼-	11½
Potassium bromide, gran, bbl	lb.	19 -	20
Potassium carbonate, 80-85%, calcined, casks	lb	.06¾-	07¼
Potassium chlorate, powd	lb	07½-	08
Potassium cyanide, drums	lb	45 -	50
Potassium, first sorts, cask	lb.	08¼	09
Potassium hydroxide (caustic potash) drums	lb	07¾-	09
Potassium iodide, cases	lb	3 65 -	3 75
Potassium nitrate, bbl	lb	.06¾-	07¼
Potassium permanganate, drums	lb.	19 -	20
Potassium prussiate, red, casks	lb	70 -	72
Potassium prussiate, yellow, casks	lb	36½-	37
Salammoniac, white, gran, casks, imported	lb.	.07 -	07¼
Salammoniac, white, gran, bbl, domestic	lb	.07¾-	.08
Gray, gran, casks	lb.	.08 -	.09
Salsoda, bbl	100 lb	1 20	1 40
Salt cake (bulk)	ton	26 00 -	28 00
Soda ash, light, 58% flat, bags, contract	100 lb	1 60 -	1 67
Soda ash, light, basis, 48%, bags, contract, f o b wks	100 lb	1 20 -	1 30
Soda ash, light, 58%, flat, bags, resale	100 lb.	1.75 -	1.80
Soda ash, dense, bags, contract, basis 48%	100 lb	1.17½-	1 20
Soda ash, dense, in bags, resale	100 lb	1.85 -	1.90
Soda, caustic, 76%, solid, drums, f a s	100 lb.	3.30 -	3 40
Soda, caustic, basis 60%, wks, contract	100 lb.	2.50 -	2.60
Soda, caustic, ground and flake, contracts	100 lb.	3 80 -	3.90
Soda, caustic, ground and flake, resale	100 lb.	3.72½-	..
Sodium acetate, works, bags	lb.	.05½-	.06½
Sodium bicarbonate, bbl	100 lb.	2.00 -	2 50
Sodium bichromate, casks	lb.	.08½-	08½
Sodium bisulphate (niter cake)	ton	6.00 -	7.00
Sodium bisulphite, powd., U.S.P., bbl	lb	.04½-	.04½
Sodium chlorate, kegs	lb.	.06½-	.07
Sodium chloride	long ton	12.00 -	13.00
Sodium cyanide, cases	lb.	.20 -	.23
Sodium fluoride, bbl	lb.	$0.09 -	$0 10½
Sodium hyposulphite, bbl	lb.	.02½-	.03
Sodium nitrite, casks	lb.	.08 -	.08½
Sodium peroxide, powd, cases	lb.	.28 -	.30
Sodium phosphate, dibasic, bbl	lb.	.03½-	.04
Sodium prussiate, yel drums	lb.	.16½-	.17½
Sodium salicylic, drums	lb	.47 -	57
Sodium silicate (40°, drums)	100 lb.	.80 -	1.25
Sodium silicate (60°, drums)	100 lb.	2.00 -	2.25
Sodium sulphide, fused, 60-62%, drums	lb.	.04½-	.04½
Sodium sulphite, crys, bbl	lb.	.03½-	.03½
Strontium nitrate, powd, bbl.	lb.	.12½-	.13
Sulphur chloride, yel drums.	lb.	.04½-	.05
Sulphur, crude	ton	18.00 -	20.00
At mine, bulk	ton	16.00 -	18.00
Sulphur, flour, bag	100 lb	2.25 -	2.35
Sulphur, roll, bag	100 lb.	2 00 -	2.10
Sulphur dioxide, liquid, cyl	lb.	.08 -	.08½
Talc—imported, bags	ton	30 00 -	40.00
Talc—domestic powd, bags.	ton	18 00 -	25.00
Tin bichloride, bbl	lb.	.12½-	.13¾
Tin oxide, bbl	lb.	.50 -	
Tin crystals, bbl	lb.	.35½-	.36
Zinc carbonate, bags	lb.	.14 -	.14½
Zinc chloride, gran, bbl.	lb.	.06 -	.07
Zinc cyanide, drums	lb.	.37 -	.38
Zinc oxide, lead free, bbl.	lb.	.08 -	.08½
5% lead sulphate, bags	lb.	.07½-	......
10 to 35% lead sulphate, bags	lb.	.07 -	.....
French, red seal, bags	lb.	.09¾-	.....
French, green seal, bags	lb.	.10¾-	......
French, white seal, bbl	lb.	.12 -	.....
Zinc sulphate, bbl.	100 lb.	2.50 -	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl	lb.	$0.65 -	$0.80
Alpha-naphthol, ref, bbl	lb.	.75 -	.90
Alpha-naphthylamine, bbl.	lb.	.35 -	.37
Aniline oil, drums	lb.	.16 -	.16½
Aniline salts, bbl	lb	.24 -	.25
Anthracene, 80%, drums	lb.	.75 -	1.00
Anthracene, 80%, imp, drums, duty paid	lb.	.70 -	.75
Anthraquinone, 25%, paste, drums	lb.	.70 -	.75
Benzaldehyde U S P, carboys	lb.	1.40 -	1.45
tech, drums	lb	75	80
Benzene, pure, water-white, tanks and drums	gal.	.30 -	.32
Benzene, 90%, tanks & drums	gal.	.27 -	.30
Benzene, 90%, drums, resale	gal.	.30 -	.33
Benzidine base, bbl	lb.	.85 -	.90
Benzidine sulphate, bbl	lb.	.70 -	.75
Benzoic acid, U S P, kegs	lb.	.72 -	75
Benzoate of soda, U S P, bbl.	lb.	.57 -	65
Benzyl chloride, 95-97%, ref., drums	lb.	.45 -	
Benzyl chloride, tech, drums	lb.	.30 -	.35
Beta-naphthol, subl, bbl	lb	.55 -	.60
Beta-naphthol, tech, bbl	lb.	.22 -	.23
Beta-naphthylamine, tech	lb.	.80 -	.90
Cresol, U S P, drums	lb.	.25 -	.29
Ortho-cresol, drums	lb.	.28 -	.30
Cresylic acid, 97%, resale, drums	gal.	1.25 -	....
95-97%, drums, resale	gal.	1.15 -	1.25
Dichlorbenzene, drums	lb.	.07 -	.09
Diethylaniline, drums	lb.	.50 -	.60
Dimethylaniline, drums	lb.	.42 -	.43
Dinitrobenzene, bbl,	lb.	.19 -	.20
Dinitroclorbenzene bbl.	lb.	.22 -	.23
Dinitronaphthalen, bbl	lb.	.30 -	.32
Dinitrophenol, bbl	lb.	.35 -	.40
Dinitrotoluene, bbl	lb.	.20 -	.22
Dip oil, 25%, drums	gal.	.25 -	.30
Diphenylamine, bbl	lb.	.50 -	.52
H-acid, bbl	lb.	.80 -	.85
Meta-phenylenediamine, bbl.	lb.	1.00 -	1.05
Michlers ketone, bbl	lb.	3.00 -	3.50
Monochlorbenzene, drums	lb.	.08 -	.10
Monoethylaniline, drums	lb.	.95 -	1.10
Naphthalene, flake, bbl	lb.	.09 -	.09½
Naphthalene, balls, bbl.	lb.	.09½-	.10½
Naphthionate of soda, bbl	lb.	.58 -	.65
Naphthionic acid, crude, bbl.	lb.	.55 -	.60
Nitrobenzene, drums	lb.	.10 -	.12
Nitro-naphthalene, bbl.	lb.	.30 -	.35
Nitro-toluene, drums.	lb.	.15 -	.17
N-W acid, bbl	lb.	1.25 -	1.30
Ortho-amidophenol, kegs	lb.	2.30 -	2.35
Ortho-dichlorbenzene, drums	lb.	.17 -	.20
Ortho-nitrophenol, bbl	lb.	.90 -	.92
Ortho-nitrotoluene, drums	lb.	.10 -	.12
Ortho-toluidine, bbl	lb.	.14 -	.15
Para-amidophenol, base, kegs	lb.	1.20 -	1.30
Para-amidophenol, HCl, kegs	lb.	1.25 -	1.35
Para-dichlorbenzene, bbl	lb.	.17 -	.20
Paranitraniline, bbl.	lb.	.74 -	.75
Para-nitrotoluene, bbl	lb.	.60 -	.65
Para-phenylenediamine, bbl.	lb.	1.45 -	1.50
Para-toluidine, bbl	lb.	.95 -	.98
Phthalic anhydride, bbl	lb.	.35 -	.38
Phenol, U.S.P., drums	lb.	.54 -	.55
Picric acid, bbl.	lb.	.20 -	.22
Pyridine, dom., drums	gal.	nominal	

Pyridine, imp., drums	gal.	$2.50 - $2.75
Resorcinol, tech., kegs	lb.	1.40 - 1.50
Resorcinol, pure, kegs	lb.	2.00 - 2.25
R-salt, bbl.	lb.	.55 - .60
Salicylic acid, tech., bbl.	lb.	.47 - 48
Salicylic acid, U.S.P., bbl.	lb	40 - 50
Solvent naphtha, water-white, drums	gal.	37 - 40
Crude, drums	gal.	24 -
Sulphanilic acid, crude, bbl	lb	18 - 20
Thiocarbanilide, kegs	lb.	35 - 38
Toluidine, kegs	lb.	1.20 - 1 30
Toluidine, mixed, kegs	lb.	.30 - 35
Toluene, tank cars	gal.	.30 - 35
Toluene, drums	gal.	.35 - 40
Xylidines drums	lb.	47 - 49
Xylene, pure, drums	gal.	75 - 1 00
Xylene, com., drums	gal.	.37 -
Xylene, com., tanks	gal.	.32 -

Naval Stores

Rosin B-D, bbl.	280 lb.	$6 10 -
Rosin E-I, bbl.	280 lb.	6 10 -
Rosin K-N, bbl	280 lb	6 15 -
Rosin W G-W W., bbl	280 lb	6 50 - 7 50
Wood rosin, bbl	280 lb	6 00 - 6 10
Turpentine, spirits of, bbl.	gal.	1 22½ -
Wood, steam dist, bbl.	gal	1 00 -
Wood, dest dist, bbl.	gal.	75 -
Pine tar pitch, bbl	200 lb	- 6 00
Tar, kiln burned, bbl.	500 lb.	- 13 00
Retort tar, bbl.	500 lb.	- 12 00
Rosin oil, first run, bbl	gal	45 -
Rosin oil, second run, bbl.	gal	48 -
Rosin oil, third run, bbl	gal	.52 -
Pine oil, steam dist	gal.	75 -
Pine oil, pure, dest dist.	gal	70 -
Pine tar oil, ref.	gal.	48 -
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal.	32 - 32½
Pine tar oil, double ref, bbl.	gal.	- 75
Pine tar, ref, thin, bbl	gal.	- 25
Pinewood creosote, ref, bbl	gal.	- 52

Animal Oils and Fats

Degras, bbl	lb	$0 03¾ - $0 04¼
Grease, yellow, bbl	lb	07 - 07¼
Lard oil, Extra No 1, bbl	gal	90 - 92
Neatsfoot oil 20 deg bbl.	gal	1 30 -
No 1, bbl.	gal	92 - 94
Oleo Stearine		10 -
Red oil, distilled, d p bbl	lb	11 - 11½
Saponified, bbl	lb	11 - 11¼
Tallow, extra, loose	lb	07½ -
Tallow oil, acidless, bbl	gal.	.94 - .96

Vegetable Oils

Castor oil, No 3, bbl	lb	$0 14 -
Castor oil, No 1, bbl.	lb	14½ -
Chinawood oil, bbl	lb.	25 - 27
Coconut oil, Ceylon, bbl	lb	09¾
Ceylon, tanks, N Y	lb	08¾ - 08¾
Coconut oil, Cochin, bbl.	lb.	10 - 10¼
Corn oil, crude, bbl	lb	.12½
Crude, tanks, (f o b mill)	lb.	.09½ - 09¾
Cottonseed oil, crude (f.o.b. mill), tanks	lb	09¾
Summer yellow, bbl.	lb	12 -
Winter yellow, bbl.	lb.	13 - .13½
Linseed oil, raw, car lots, bbl.	gal.	1 14 -
Raw, tank cars (dom)	gal.	1 09 -
Boiled, cars, bbl. (dom).	gal.	1 16 -
Olive oil, denatured, bbl.	gal.	1 10 -
Sulphur, (foots) bbl	lb.	.09½ - 09¾
Palm, Lagos, casks	lb.	07½ - .07¾
Niger, casks	lb	07½ - .07¾
Palm kernel, bbl	lb	.08¾ - .09
Peanut oil, crude, tanks (mill)	lb	13½ -
Peanut oil, refined, bbl.	lb.	17 -
Perilla, bbl	lb	16½ - 16¾
Rapeseed oil, refined, bbl.	gal.	83 - 84
Rapeseed oil, blown, bbl	gal	88 - 89
Sesame, bbl	lb	11½ - 12½
Soya bean (Manchurian), bbl.	lb.	.12¾ - 13
Tank, f o.b. Pacific coast	lb	10½ - 10¾
Tank, (f o b. N Y.)	lb	10½ - 10¾

Fish Oils

Cod, Newfoundland, bbl	gal	$0 70 - $0 72
Menhaden, light pressed, bbl	gal	76 -
White bleached, bbl.	gal.	78 -
Blown, bbl.	gal	82 -
Crude, tanks (f o b factory)	gal.	50 -
Whale No. 1 crude, tanks, coast	lb	07¾ - 08
Winter, natural, bbl	gal	76 - 78
Winter, bleached, bbl	gal	79 - 80

Oil Cake and Meal

Coconut cake, bags	ton	$30 00 - $31 00
Copra, sun dried, bags (c i f)	lb	05¼ - 05½
Sun dried Pacific coast	lb	05¼ - 05½
Cottonseed meal, f o b mills	ton	38 00 -
Linseed cake, bags	ton	34 50 -
Linseed meal, bags	ton	36 50 -

Dye & Tanning Materials

Albumen, blood, bbl	lb.	$0 45 - $0 50
Albumen, egg, tech, kegs.	lb.	.80 - 85
Cochineal, bags	lb	35 - 36
Cutch, Borneo, bales	lb.	04½ - .05
Cutch, Rangoon, bales	lb.	13 - 13½
Dextrine, corn, bags	100 lb.	3 64 - 3 69
Dextrine gum, bags	100 lb.	3 99 - 4 09
Divi-divi, bags	ton	38 00 - 39 00
Fustic, sticks	ton	30 00 - 35.00
Fustic, chips, bags	lb.	.04 - .05
Logwood, sticks	ton	28.00 - 30 00
Logwood, chips, bags	lb	02½ - .03
Sumac, leaves, Sicily, bags	ton	70 00 - 72.00
Sumac, ground, bags	ton	$65 00 - $67 00
Sumac, domestic, bags	ton	40 00 - 42.00
Starch, corn, bags	100 lb	2.97 - 3 07
Tapioca flour, bags	lb	.05½ - 06¼

Extracts

Archil, conc, bbl	lb.	$0.17 - $0 18
Chestnut, 25% tannin, tanks.	lb	02 - 03
Divi-divi, 25% tannin, bbl	lb	04 - 05
Fustic, crystals, bbl	lb	20 - 22
Fustic, liquid, 42°, bbl	lb	08 - 09
Gambier, liq, 25% tannin, bbl.	lb	08 - 09
Hematine crys, bbl	lb	14 - 18
Hemlock, 25% tannin, bbl	lb	04 - 05
Hypernic, solid, drums	lb	24 - 26
Hypernic, liquid, 51°, bbl	lb	.14 - 17
Logwood, crys, bbl	lb.	19 - 20
Logwood, liq, 51°, bbl	lb.	.09 - 10
Quebracho, solid, 65% tannin, bbl	lb.	04½ - 05
Sumac, dom., 51°, bbl.	lb.	06½ - 07

Dry Colors

Blacks Carbongas, bags, f o b works	lb	$0 20 - $0 24
Lampblack, bbl	lb	12 - 40
Mineral, bulk	ton	35 00 - 45 00
Blues Bronze, bbl	lb	55 - 60
Prussian, bbl	lb	55 - 60
Ultramarine, bbl	lb	08 - 35
Browns, Sienna, Ital, bbl	lb	06 - 14
Sienna Domestic, bbl	lb	03½ - 04
Umber, Turkey, bbl	lb	04 - 04½
Greens Chrome, C P Light, bbl	lb	32 - 34
Chrome commercial, bbl	lb	12 - 12½
Paris, bulk	lb	30 - 35
Reds, Carmine No 40, tins	lb	4 50 - 4 70
Oxide red, casks	lb.	10 - 14
Para toner, kegs	lb	1 00 - 1 10
Vermilion, English, bbl.	lb.	1 30 - 1 32
Yellow, Chrome, C P bbls	lb	20 - 21
Ocher, French, casks	lb.	.02½ - 03

Waxes

Bayberry, bbl	lb.	$0 28 - $0 30
Beeswax, crude, bags	lb.	.20 - 21
Beeswax, refined, light, bags	lb	32 - 34
Beeswax, pure white, cases	lb.	40 - 41
Candelilla, bags	lb.	23 - .24
Carnauba, No 1, bags	lb	42 - .43
No. 2, North Country, bags	lb	23 - .23½
No. 3, North Country, bags	lb	19 - 19½
Japan, cases	lb.	16½ - 16¾
Montan, crude, bags	lb	.04½ - .04¾
Paraffine, crude, match, 105-110 m p	lb.	.04 - .04¼
Crude, scale 124-126 m p., bags	lb	02¾ - 03
Ref., 118-120 m p, bags	lb.	03½ - 03¾
Ref, 125 m p, bags	lb.	03½ - .03¾
Ref, 128-130 m p, bags	lb.	.04 - .04¼
Ref., 133-135 m p, bags	lb.	.04½ - .04¾
Ref, 135-137 m p, bags	lb.	.05 - .05¼
Stearic acid, sgle pressed, bags	lb.	.13½ -
Double pressed, bags	lb.	.14½ -
Triple pressed, bags	lb.	.15½ - .16

Fertilizers

Ammonium sulphate, bulk, f o b works	100 lb	$3 25 - $3 30
F.a.s double bags	100 lb.	3 85 - 3 90
Blood, dried, bulk	unit	4 25 -
Bone, raw, 3 and 50, ground	ton	27 00 - 30 00
Fish scrap, dom, dried, wks	unit	4 00 -
Nitrate of soda, bags	100 lb	2.60 - 2 65
Tankage, high grade, f.o.b. Chicago	unit	3.25 - 3 50
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$4 00 - $4.50
Tennessee, 78-80%	ton	8 00 - 8 25
Potassium muriate, 80%, bags	ton	34 55 -
Potassium sulphate, bags basis 90%	ton	43 67 -
Double manure salt	ton	25 72 —
Kainit	ton	7 22 —

Crude Rubber

Para—Upriver fine	lb.	$0 27½ -
Upriver coarse	lb.	22 -
Upriver caucho ball.	lb	.25 -
Plantation First latex crepe	lb.	27½ - 27¾
Ribbed smoked sheets	lb.	.27½ - 27¾
Brown crepe, thin, clean	lb.	.26½ - 26¾
Amber crepe No 1	lb.	26½ - 27

Gums

Copal, Congo, amber, bags	lb.	$0 12 - $0 13
East Indian, bold, bags	lb.	23 - 23½
Manila, pale, bags	lb.	.20 - 20½
Pontinak, No 1 bags	lb.	20 - 20½
Damar, Batavia, cases	lb.	.28 - .29
Singapore, No 1, cases	lb	34 - 35
Singapore, No 2, cases	lb.	23 - 24
Kauri, No 1, cases	lb.	64 - 65
Ordinary chips, cases	lb.	18 - 20
Manjak, Barbados, bags	lb.	09 - 09½

Shellac

Shellac, orange fine, bags	lb.	$0 68 -
Orange superfine, bags	lb.	.70 - .71
A. C. garnet, bags	lb.	nominal
Bleached, bonedry	lb.	.76 - .78
Bleached, fresh	lb.	64 - .65
T. N., bags	lb.	62 - 64

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh ton	$500.00 -
Asbestos, shingle, f.o.b., Quebec	sh. ton	$65.00 - $85.00
Asbestos, cement, f.o.b., Quebec	sh. ton	20.00 - 25.00
Barytes, grd., white, f.o.b. mills, bbl	net ton	16.00 - 20.00
Barytes, grd., off-color, f o b. mills bulk	net ton	13.00 - 15.00
Barytes, floated, f.o b. St Louis, bbl	net ton	28 00 -
Barytes, crude f o b. mines, bulk	net ton	10.00 - 11 00
Casein, bbl, tech	lb.	21 - .25
China clay (kaolin) crude, f.o.b Ga	net ton	7 00 - 9 00
Washed, f o b Ga.	net ton	8 00 - 9.00
Powd, f o b Ga	net ton	14 00 - 20 00
Crude f o b Va	net ton	8 00 - 12 00
Ground, f o b Va.	net ton	14 00 - 20 00
Imp, lump, bulk	net ton	15 00 - 20 00
Imp, powd	net ton	45 00 - 50 00
Feldspar, No 1 pottery	long ton	6 00 - 7 00
No 2 pottery	long ton	4 00 - 5 50
No. 1 soap	long ton	7 00 - 7 50
No 1 Canadian, f o.b. mill	long ton	20 00 - 22 00
Graphite, Ceylon, lump, first quality, bbl	lb	06½ -
Ceylon, chip, bbl	lb.	05½ -
High grade amorphous crude	ton	15.00 - 35.00
Gum arabic, amber, sorts, bags	lb.	.15 - 16
Gum tragacanth, sorts, bags	lb	.50 - .60
No 1, bags	lb	1.50 - 1.60
Kieselguhr, f o b Cal	ton	40 00 - 42.00
F o b N Y	ton	50 00 - 55.00
Magnesite, crude, f o.b Cal.	ton	14 00 - 15 00
Pumice stone, imp, casks.	lb	03 - .05½
Dom, lump, bbl.	lb	05 - 05½
Dom, ground, bbl.	lb	06 - 07
Silica, glass sand, f o b Ind	ton	2 00 - 2 50
Silica, sand blast, f o b Ind.	ton	2 50 - 5 00
Silica, amorphous, 250-mesh, f.o b Ill	ton	17 00 - 17 50
Silica, bldg sand, f o b Pa	ton	2 00 - 2 75
Soapstone, coarse, f o.b Vt, bags	ton	7 00 - 8 00
Talc, 200 mesh, f o b., Vt, bags	ton	6 50 - 9.00
Talc, 200 mesh, f o b Ga., bags	ton	7 00 - 9 00
Talc, 200 mesh, f o b Los Angeles, bags	ton	16 00 - 20.00

Mineral Oils

Crude, at Wells

Pennsylvania	bbl	$3 25 - $3 50
Corning	bbl	1 85 -
Cabell	bbl	1 91 -
Somerset	bbl.	1 75 -
Illinois	bbl	1 97 -
Indiana	bbl	1 98 -
Kansas and Oklahoma, 28 deg	bbl	1 20 -
California, 35 deg and up	bbl	1 04 -

Gasoline, Etc.

Motor gasoline, steel bbls	gal	$0 22½ -
Naphtha, V M & P deod, steel bbls	gal	21½ -
Kerosene, ref tank wagon	gal	14 -
Bulk, W W export	gal.	07 -
Lubricating oils:		
Cylinder, Penn, dark	gal.	25 - 27
Bloomless, 30@31 grav	gal.	.20 - .22
Paraffin, pale	gal	28 - .30
Spindle, 200, pale	gal.	.25 - .26
Petrolatum, amber, bbls	lb	.05 - .05¼
Paraffine wax (see waxes)		

Refractories

Bauxite brick, 56% Al_2O_3, f o.b. Pittsburgh	ton	$45-50
Chrome brick, f o.b Eastern shipping points	ton	50-52
Chrome cement, 40-50% Cr_2O_3	ton	23-27
40-45% Cr_2O_3, sacks, f o b. Eastern shipping points	ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f o b Ky wks.	1,000	40-46
2nd quality, 9-in shapes, f.o.b. wks.	1,000	36-41
Magnesite brick, 9-in straight (f o b wks)	ton	65-68
9-in. arches, wedges and keys	ton	80-85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48-50
Silica brick, 9-in sizes, f o b. Birmingham district	1,000	48-50
F.o b. Mt Union, Pa	1,000	42-44
Silicon carbide refract brick, 9-in.	1,000	1,100 00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N.Y.	ton	$200.00 - $225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11½ - .11¾
4-6% C	lb.	.12 - .13
Ferromanganese, 78-82% Mn, Atlantic seabd., duty paid	gr. ton	120.00 -
Spiegeleisen, 19-21% Mn.	gr. ton	40.00 -
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb.	2.00 - 2.50
Ferrosilicon, 10-15%	gr. ton	48.00 - 50.00
50%	gr. ton	95.00 -
75%	gr. ton	150.00 - 160.00

Ferrotungsten, 70-80%, per lb. of W	lb.	$0.90 –	$0.95
Ferro-uranium, 35-50% of U. per lb of U	lb.	6.00 –	....
Ferrovanadium, 30-40%, per lb. of V	lb.	3.50 –	3.75

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$6 00 –	$9.00
Chrome ore Calif. concentrates, 50% min Cr_2O_3	ton	22 00 –	23.00
C i f Atlantic seaboard	ton	20 50 –	24 00
Coke, fdry, f o.b. ovens	ton	7 00 –	7 50
Coke, furnace, f o b. ovens	ton	6 00	6.50
Fluorspar, gravel, f.o.b. mines' Illinois	ton	20.00 –	21 50
Ilmenite, 52% TiO_2	lb.	01½–	.01¾
Manganese ore, 50% Mn, c i f. Atlantic seaport	unit	.33 –	....
Manganese ore, chemical (MnO_2)	ton	75.00 –	80.00
Molybdenite, 85% MoS_2, per lb MoS_2, N Y	lb.	.65 –	.70
Monazite, per unit of ThO_2, c i f, Atl. seaport	lb.	.06 –	.08
Pyrites, Span, fines, c i f Atl seaport	unit	.11½–	.12
Pyrites, Span, furnace size, c i f Atl seaport	unit	.11½–	.12
Pyrites, dom fines, f.o b. mines, Ga	unit	.12	
Rutile, 95% TiO_2	lb.	.12 –	......
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8 50 –	8.75
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	8.00 –	8.25
Uranium ore (carnotite) per lb of U_3O_8	lb.	3.50 –	3.75
Uranium oxide, 96%, per lb U_3O_8	lb	2 25 –	2.50
Vanadium pentoxide, 99%	lb	12 00 –	14 00
Vanadium ore, per lb V_2O_5	lb.	1 00 –	......
Zircon, washed, iron free, f o b. Pablo, Fla.	lb.	04½–	.13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	15 – 15¼
Aluminum, 98 to 99%	26–27
Antimony, wholesale, Chinese and Japanese	7¾– 8¼
Nickel, virgin metal	28–30
Nickel, ingot and shot	30–
Monel metal, shot and blocks	32.00
Monel metal, ingots	38.00
Monel metal, sheet bars	45 00
Tin, 5-ton lots, Straits	41 37½
Lead, New York, spot	7.25
Lead, E. St Louis, spot	7.00
Zinc, spot, New York	6 85
Zinc, spot, E. St. Louis	6.50

Other Metals

Silver (commercial)	oz	$0 66½
Cadmium	lb.	1.00
Bismuth (500 lb lots)	lb.	2 55
Cobalt	lb.	2 65@2.85
Magnesium, ingots, 99%	lb.	1 25–
Platinum	oz	116 00
Iridium	oz.	260.00@275.00
Palladium	oz.	81 00
Mercury	75 lb.	68 00

Finished Metal Products

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	25 50
Copper bottoms	30 75
Copper rods	25.25
High brass wire	19 37½
High brass rods	17 00
Low brass wire	21.10
Low brass rods	22 00
Brazed brass tubing	24 25
Brazed bronze tubing	29.00
Seamless copper tubing	25 25
Seamless high brass tubing	23 50

OLD METALS—The following are the dealers' purchasing prices in cents per pound.

Copper, heavy and crucible	11 60@11.80
Copper, heavy and wire	11 50@11.60
Copper, light and bottoms	10 00@10.10
Lead, heavy	5 75@ 6 00
Lead, tea	3 50@ 3 75
Brass, heavy	6 50@ 6 75
Brass, light	5.75@ 6 00
No. 1 yellow brass turnings	6.75@ .700
Zinc	3.75@ 4.25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.29	$3.14
Soft steel bars	3.19	3.04
Soft steel bar shapes	3.19	3.04
Soft steel bands	3.29	3.19
Plates, ¼ to 1 in. thick	3.29	3.14

Industrial

Financial, Construction and Manufacturing News

Construction and Operation

Arkansas

FORT SMITH—The Fort Smith Fertilizer Co., recently organized, has plans under way for the erection of a new 1-story plant for commercial fertilizer production Grinding, mixing, drying and other machinery will be installed Walter Knight is president

California

EXETER—John F Hamburg, an official of the Engels Copper Mining Co., Mills bldg., San Francisco, is at the head of a new company now being organized to construct and operate a cement manufacturing plant on site selected near Exeter It will consist of a number of buildings and is estimated to cost more than $2,000,000, with machinery William F. Humphrey, attorney, Mills Bldg., San Francisco, represents the new company.

REDDING—The Swayne Creosoting Co., plans for extensions and improvements in its plant, including the installation of additional equipment

MERCED—The Yosemite Cement Co., recently organized, is having plans prepared by the Hunt Engineering Co., Kansas City, Mo., for the erection of a new mill on 1,500-acre site acquired on the Merced River, near Merced. It will cost approximately $1,000,000, with machinery The Agricultural Lime & Composite Co., American National Bank Bldg., San Francisco, is interested in the project J E Monroe is an official of the company.

SOUTH SAN FRANCISCO—The Metal & Thermit Corp., Swift St., is taking bids for the erection of the initial units of its proposed new plant on site recently acquired, and will commence work at an early date. It will cost in excess of $1,500,000, with machinery. Headquarters are at 120 Broadway, New York The engineering department, 1127-29 Western Ave., Pittsburgh, Pa., Frank I Ellis, is in charge

Connecticut

MANCHESTER—The Oxford Soap Co has work in progress on a 3-story addition, 60x150 ft, to be equipped as a feldspar-grinding mill and will commence the machinery installation at an early date Complete pulverizing equipment will be installed Other extensions and improvements are contemplated for considerable increase in output.

Florida

TAMPA—The Tampa Bay Fertilizer Co., recently organized with a capital of $1,000,000, is perfecting plans for the operation of a local plant. S W Allen is president.

Illinois

DE PUE—The Mineral Point Zinc Co., Room 1111, 140 South Dearborn St., Chicago, has plans under way for a new smelting plant and general works on local site, to cost in excess of $1,000,000, with equipment. The Leonard Engineering Co., 37 South Wabash Ave., Chicago, is engineer William Scott is president

CHICAGO—The Chicago Bearing Metal Co., 2234 West 43rd St, will immediately commence erection of a new 1-story building at its plant, 35x100 ft, to cost $19,000.

Kansas

WICHITA—The Billings Paint Co. has leased a portion of the new building to be erected at Lulu and Douglas Sts., 80x120 ft., for a new works.

Maryland

HAVRE DE GRACE—The Tiger Tire Co., Toronto, Ont., is completing negotiations with the local Board of Trade for the acquisition of a site for the erection of a new branch plant for the manufacture of ties and rubber goods Property has been donated to secure the plant, which is estimated to cost approximately $200,000, with machinery Plans will soon be drawn.

HAGERSTOWN—The Tanners' Hide & Tallow Co has commenced the rebuilding of its local plant, destroyed by fire a number of months ago, and plans for the installation of machinery at the earliest date, to include melting equipment, presses, grinders, etc.

BALTIMORE—The Standard Sanitary Mfg. Co., Bessemer Bldg., Pittsburgh, Pa., has authorized the immediate preparation of plans for the initial unit of its proposed new enameled products plant on site lately acquired on 5th Ave. It will consist of a number of buildings, estimated to cost in excess of $1,000,000 with machinery.

Michigan

PETOSKEY—The Northwestern Pulp & Paper Co has tentative plans under consideration for the rebuilding of the portion of its local pulp mill destroyed by fire, May 7, with loss estimated at $100,000, including equipment.

Minnesota

ST PAUL—The Waldorf Paper Products Co has awarded a contract to the Steenberg Construction Co, Endicott Bldg., for the erection of its proposed new plant at 2230 Myrtle St., to be 4-story, 84x110 ft., estimated to cost $125,000, with machinery.

Missouri

ST. LOUIS—The Anheuser-Busch Brewing Association, 9th and Pestalozzi Sts., will remodel its malt house and a portion of its stock houses for a plant for the manufacture of glucose and kindred products. The improvement with equipment is estimated to cost $300,000 Work will be commenced at once

CAPE GIRARDEAU—The Marquette Cement Mfg Co, 140 South Dearborn St., Chicago, Ill., has purchased the local plant of the Cape Girardeau Portland Cement Co., for a consideration said to be $2,000,000. The new owner will take immediate possession and will develop plans for extensions and improvements to increase the present capacity.

ST LOUIS—The A. Leschen & Sons Rope Co, 5909 Kennerly Ave., has awarded a contract to James Stewart & Co., Boatmen Bank Bldg., for the erection of a new building at its wire rope manufacturing plant to cost $100,000, to be equipped in part as a testing laboratory

New Hampshire

DANBURY—The Ford Motor Co., Highland Park, Mich, is planning for the construction of a mill on garnet properties on the Wilmot highway, recently acquired from the Garnet Grit Co., for material for the polishing of plate glass. Pulverizing, grinding and refining machinery will be installed The output will be used at the company glass plant at Glassmere, Pa., comprising the former plant of the Allegheny Glass Co, lately purchased.

New Jersey

NEWARK—The Flood & Conklin Co., 182 Chestnut St., manufacturer of varnishes, etc., has filed plans for the immediate erection of an addition to its plant to cost about $40,000

PERTH AMBOY—The manual training committee of the Board of Education has been authorized to arrange for the purchase of a gas furnace for installation at the local school, to be used in connection with metal casting instruction.

PERTH AMBOY—A company is being organized by Emil Stremlau, Room 209, 217 Smith St., to construct and operate a local oil plant for the manufacture of a gasoline substitute. The initial works will cost about $50,000.

TRENTON—The Mercer Pottery Co., Muirhead Ave., manufacturer of general ware, will commence the erection of a 1-story

addition to cost about $15,000, exclusive of equipment

NEWARK—The Celluloid Co, 209 Ferry St, has completed plans for the construction of a new plant addition for general increase in capacity, estimated to cost $130,000, with equipment

METUCHEN—The Empire Floor & Wall Tile Co, Middlesex Ave, has been secured by new interests and plans are being arranged for the immediate reopening of the plant, which has been inactive for some time past Alterations and improvements will be made in the building and machinery with the installation of necessary operating equipment Roy Schweiker is plant superintendent

CARTERET—The Mexican Petroleum Co will make extensions and improvements in its local oil works, including the erection of new buildings

New York

FORT MILLER—Fire May 6, destroyed a portion of the plant of the Fort Miller Pulp & Paper Co, with loss estimated at $100,000, including equipment. It is planned to rebuild.

GENEVA—The General Glass Co, Inc, recently organized by Rochester, N Y, interests, has acquired the plant of the Geneva Glass Products Co, and will take immediate possession. The new company will expand the factory and purposes to install additional equipment for the production of glass under a recently developed process The company is headed by Henry J. and Earl H Crowder Louis E Fuller Rochester, attorney, is representative

North Carolina

CHARLOTTE—The Ornamental Stone Co, 129 Brevard Court, will commence the erection of a new plant, 75x300 ft, for the manufacture of precast stone products Mixing and grinding machinery, molding apparatus and other equipment will be installed W F McCanless is president, and C J Helms, secretary and treasurer in charge

BEAUFORT—M L Wright, Beaufort, has plans under consideration for the establishment of a local plant for the manufacture of fertilizer products Inquiries are being made for equipment

Ohio

COSHOCTON—The Columbia Tire & Rubber Co, Mansfield O has acquired the local plant of the Midland Tire & Rubber Co, and will use the property as a branch works Extensions and improvements are planned The company will also continue its branch factory at Columbiana, O

LISBON—The American Vitrified Products Co has broken ground for a new 1-story plant to replace its works destroyed by fire early in March with loss of about $100,000 New machinery will be installed The plant is estimated to cost close to $130,000 with equipment

NEWTON FALLS—The Newton Falls Rubber Co, lately organized, has extension and improvement work in progress at the former local plant of the Trumbull Rubber Co, acquired from the receiver, and purposes to have the mill ready for service early in June Equipment will be provided for the employment of about 250 men Irvin Jordan is vice president and general manager

Oklahoma

BARNSDALL—The Barnsdall Refining Co has commenced enlargements in its local oil-refining plant to increase the handling capacity to about 5,000 bbl per day A number of new plant units will be equipped

PONCA CITY—The Marland Refining Co will rebuild the portion of its local oil plant destroyed by fire recently with loss approximating $25,000

Pennsylvania

WARREN—The Conewango Refining Co has tentative plans under consideration for the rebuilding of the portion of its Plant No 1, destroyed by fire, May 7, with loss estimated at $750,000, including machinery The company is operated by the Fred G Clark Co., 1081 West 11th St Cleveland Ohio

PITTSBURGH—The Vitro Mfg Co, 60 Oliffe St, manufacturer of enamels, oxides etc., has filed plans for the erection of a 1-story plant addition, estimated to cost $14,000, exclusive of equipment.

FRANKLIN—Fire, May 7, destroyed a portion of the No. 3 Eclipse refining plant of the Atlantic Refining Co, with loss estimated at $33,000 It is planned to rebuild Headquarters are at 3144 Passyunk Ave, Philadelphia, Pa

PITTSBURGH—The National Tube Co, Frick Bldg has taken title to property on Forbes St, 150x223 ft, to be used as a site for a new research laboratory Plans will be drawn at an early date

PHILADELPHIA—The Phil-Fiber Boxboard Mills, Inc, Delaware and Tasker Sts, has filed plans for the erection of a new 1-story building at its plant to cost about $14,000

ROULETTE—The Roulette Glass Co, Corning, N Y, recently organized with a capital of $1,200,000, is considering plans for the erection of a new plant at Roulette, on site now being selected Dr George S Goff heads the company

Texas

BRECKENRIDGE—The Magnolia Petroleum Co Dallas, is planning for the construction of a new plant on local site for the production of carbon black, estimated to cost close to $200,000, with machinery Application has been made for permission

FORT WORTH—The Transcontinental Oil Co Pittsburgh, Pa, has plans nearing completion for the erection of an addition to its local refinery, to include the installation of a new unit for gasoline manufacture stills and other equipment, estimated to cost $500,000 O D Robinson is vice president

FORT WORTH—The Texhoma Oil & Refining Co, Wichita Falls, Tex, is planning for the erection of a new local plant for gasoline refining It will consist of 4 units each with capacity of 500 bbl a day, estimated to cost close to $500,000, with machinery W B Hamilton is president

TEXAS CITY—The Marland Refining Co, operating a local oil storage and distributing works, has preliminary plans under consideration for the erection of an oil refinery in the vicinity of its present works, estimated to cost in excess of $250,000, with machinery

EL PASO—Wells, Stillwell & Spears, Inc, has plans nearing completion for the construction of a cotton oil mill, to cost approximately $90,000 The equipment will be electrically operated

West Virginia

MORGANTOWN—The United States Window Glass Co has plans for the installation of additional machinery at its local plant including gas producers and other equipment Extensions will be built A portion of a bond issue of $350,000 now being sold will be used for the expansion Walter A Jones is president

New Companies

LAUBEC CHEMICAL PRODUCTS CO, New York, N Y, chemicals and chemical byproducts, $25,000 Incorporators H Laub, C Heckelman and H Becker Representative Herman Gottlieb, 299 Broadway

CAPE OIL CO, Boston, Mass, refined oils, $3,750,000 Henry L F Kreger, president and Robert Cutler, treasurer, both of Boston

J M BOOTH CHEMICAL CO El Paso Tex, chemicals and chemical byproducts, $10,000 Incorporators J M Booth, and W H Pryor, both of El Paso

JOHNSON-CARTER CORP, Newark, N J.; celluloid and composition products, $500,000 Incorporators Peter and Charles Johnson, George Y Carter Representative Porter, Link & Lafferty 31 Clinton St Newark.

ELECTROLYTIC ZINC PROCESS CO, Butte, Mont, chemical and metallurgical operations, $10,000. C. F Kelley, Butte, heads the company.

NEWMAN PRODUCTS CORP, 526 West 18th St, Chicago, Ill, chemicals and chemical byproducts, $10,000 Incorporators: John Newman, G Arthur Buhl and George S Pines

GOOD RUBBER CO, Akron, O; rubber products, $10,000 Incorporators W D and E K Good, both of Akron

McCALL OIL CO, Oakland, Calif, petroleum products, $125,000 Incorporators: B B McCall Sr and Jr, and H. E Peterson. Representative: Roscoe D. Jones, Bank of Italy Bldg., San Francisco

NORRIS FERTILIZER CO, Wilmington, Del; fertilizers: $40,000. Representative. Corporation Service Co, Equitable Bldg., Wilmington.

MOKAN CHEMICAL CO, Kansas City, Mo, chemicals and chemical byproducts; $10,000. Incorporators F I and Searcy Ridge, both of Kansas City.

ETTINGER-SMITH CHEMICAL CO, 3763 Wabash Ave, Chicago Ill, organized; chemicals and chemical byproducts. Bernard and Michael Holtzman are heads,

LEMA TANNING CO, Salem, Mass.; operate a leather tannery, $25,000 Paul Harsfald is president, and Morris H Levins, Dorchester, Mass, treasurer and representative.

ATLAS ROCK SALT CO, Wilmington, Del, salt and derivatives, $100,000 Representative: Corporation Trust Co of America, du Pont Bldg., Wilmington.

SEABOARD CRYSTAL CO., Newark, N J; chemicals and chemical byproducts, $100,000 Incorporators: James F. McKenna John M. Williams and John F. Burrell, 67 Stockton St, Newark. The last noted is representative

UNIVERSAL GYPSUM CO., Rotan, Tex., gypsum products; $100,000. Incorporators C E Williams, L Ford and J. B Gray, all of Rotan

NORTHEASTERN CONCRETE TILE CO, Worcester, Mass, concrete and cement products, 500 shares of stock, no par value Isaac M. Freedman is president, and N A Fieldstad, Worcester, treasurer and representative

TRIBOROUGH CHEMICAL CORP., Wilmington, Del., chemicals and chemical byproducts, $20,000 Representative: Corporation Service Co, Equitable Bldg., Wilmington

ALPINE OIL CO, San Francisco, Calif, refined petroleum products, $50,000. Incorporators S Herbert Lanyon, W. S. Boggs and C L. Froding Representative Thomas J Straub, 445 Sutter St, San Francisco.

RALEIGH ASBESTOS & SHINGLE CO., 217 Pullen Bank Bldg, Raleigh, N C.; asbestos and composition products, $100,000 Incorporators Perrin Busbee, D H. Winslow and C. F. Koonce

NAKLO CO, Rumford, Me, chemicals and chemical byproducts, $200,000. William J Leader is president, and J Abbott Nile, treasurer, both of Rumford Representative: Ralph T Parker, Rumford

REILLY-WHITEMAN CO, Philadelphia, Pa., being organized to manufacture chemicals and chemical compounds Application for a state charter will be made May 28 Representative: Frank A Moorshead, Commonwealth Bldg, Philadelphia

SUPERIOR OIL CO, Sandusky, O, refined oils; $100,000 Incorporators Martin J Monahon and Albert J Sanders, both of Sandusky

NEW ENGLAND PORCELAIN CO, Boston Mass; porcelain products, $100,000 Horatio C Rohrman, president, and H Wray Rohrman, Winchester, Mass, treasurer and representative

BLEKRE TIRE & RUBBER CO, St Paul, Minn., rubber products, $475,000 E O Blekre, 5025 Colfax Ave South, Minneapolis, Minn, heads the company

Opportunities in the Foreign Trade

Parties interested in any of the following opportunities may obtain all available information from the Bureau of Foreign and Domestic Commerce at Washington or from any district office of the bureau The number placed after the opportunity must be given for the purpose of identification.

OILS, TECHNICAL AND EDIBLE; fats, greases, tallows (raw materials and manufactured products thereof) Rotterdam, Netherlands Agency.—6340

OIL CAKES, FOODSTUFFS, etc, of the best quality. Malmo Sweden Agency.—6345.

CHEMICALS, PERFUMERY, HARDWARE, etc Capetown, South Africa. Agency.—6346

ROSIN AND TURPENTINE Genoa, Italy. Agency — 6400.

BLACK DECOLORANT FOR BLEACHING PURPOSES Turin, Italy. Agency —6401

DRUGS, CHEMICALS AND TOILET ARTICLES Winnipeg, Canada Purchase and agency —6402.

FERTILIZERS AND CHILEAN NITRATE Mannheim, Germany. Purchase —6403

CHEMICALS, DRUGS AND DRUGGISTS' SUNDRIES. Winnipeg, Canada Purchase.—6405.

CRUDE SULPHUR, 99 per cent and copper sheets, 4x4 ft., of various thicknesses and weights. Karachi, India. Purchase —6406.

PAINTS. Johannesburg. South Africa. Exclusive agencies.—6420.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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Christening a New Technology

APPROXIMATELY a billion dollars is expended annually by industry for products of mine or quarry in which the metal content is of little or no significance. Fluorspar, talc, feldspar, mica, gypsum, salt, graphite, sulphur and scores of other mineral products are attaining constantly increasing industrial importance and the consuming industries are requiring that more and more skill and care be used in their preparation. For many of these products this refining process goes far beyond those limits of milling or concentration that for non-metallic minerals would correspond to the ore dressing of metal-bearing ore. And this further preparation, which demands close control of chemical as well as physical properties of the product, calls for a new type of supervision and research. In the field of the metallic minerals this is the sort of service that is rendered by metallurgy. But obviously the metallurgist of orthodox training and common experience is not suited to supervise this work in the case of the non-metallics. The mining engineer is almost never enough of a chemical engineer to do the job with thorough satisfaction. It can scarcely be questioned, therefore, that there is real need here for a new group of technologists skilled in the science and engineering of the non-metallics.

The Bureau of Mines in the establishment of its new experiment station at Rutgers College, New Jersey, very properly recognizes these facts, for the new station will specialize in problems of producing and utilizing the non-metallic minerals. Dr. OLIVER BOWLES, who has been designated to head this new station, is eminently fitted for the task to which he has been appointed. He has studied many of these problems and has offered valuable guidance to numerous non-metallic industries. He represents precisely the type of specialist that must grow up in all of these lines if we are to have the maximum efficiency in the utilization of these valuable natural raw materials.

There is a wealth of these resources in the United States and in most cases we have been prone to look upon the supplies as inexhaustible. But, however abundant the supply may seem to be, the maximum skill used in the preparation of these raw materials for the chemical engineering industries will be well worth while. The direct saving in production cost per unit of quantity may not be great, but the usefulness and real value of the product will inevitably be increased. The production wastes which are eliminated and the by-products which are developed will doubtless more than pay the producing industries for their increased investment in supervision and research.

A Little Homily on The Man in the Works

AN AMERICAN ENGINEER resident in England has invented a mechanical system of treating numbers algebraically that is almost uncanny in what it accomplishes. It bids fair to throw a large number of clerks out of employment. At first glance that seems a pity, but in the end it may be a good thing for the clerks. Except in the light of tradition, is there really any distinction in a white collar job? Suppose it leads to a post of administration, how many men are competent in administration? They are very rare. And what kind of a life is more miserable than a position which the incumbent is not equipped to fill? Most of the young men in the office settle down later to posting letters or copying off figures or operating an adding machine—a class of work that is but little above the rank of unskilled labor.

We think the young man has a better chance if he goes into the works. There he can find himself. If he has mechanical skill, he has, under intelligent industrial administration, the opportunity to develop it. If he has the art of getting along with men, that, too, will soon come to the fore. If he has the mental equipment to be a good salesman, he is learning what other salesmen never learn: the strategems of manufacture and what the works can turn out with ease as well as the things that will cause trouble in production. In other words, he learns which are the most profitable wares to sell. And in the long run he is better paid.

Suppose he wants to improve his mind and to develop the graces of life. His work is over when the whistle blows, and all that is best in literature and art is his for the asking. Scarcely any private library or gallery is equal in scope at least to the public libraries and municipal galleries. There is nothing to hinder him from being a gentleman in appearance, in speech and in habit of mind.

Let's hark back to the medieval days when the guilds of craftsmen, of men who worked with their hands, were flourishing. The greatest treasures in art today are the work of those very men. There is nothing to prevent the craftsman of today from advancing, unless it be his native inhibitions or some unfortunate family connections.

The president, the secretary, the treasurer, the chief engineer and the general superintendent have no rest. Theirs is the worry about credits, about getting in materials, about making shipments, getting cars for loading, and finding new markets. Some of them may get around a bit later in the mornings, but their work is never done. Not one competent executive in a thousand can really shed his cares when he leaves the office.

His leisure is a respite from worry and he needs a frivolous musical comedy or a game of golf for his diversion. But the man in the works who takes off his jumper and washes up when the whistle blows can find a grassy spot under a greenwood tree and read to his heart's content in warm weather, or he can hear concerts, see the best plays, rejoice that PINERO has come back and admire JANE COWL in *Juliet*—in short, the beautiful things of life are his in response to his resolution to avail himself of them. There is no occasion for him to tie himself down to the movies or to literature for lazy minds or to hang around the drug store. He can leave that to the white collar boys in the office. Most of them are booked for the Vale of Discontent.

Why Not Make Our Own Synthetic "Valuables"?

OPPORTUNITY for the expansion of a domestic industry, in the face of foreign competition, depends largely on the difference between the foreign value of imported merchandise and the price at which it is sold to the American consumer. Last year the Treasury Department and the Senate Finance Committee undertook a joint investigation. The appraiser of merchandise at the port of New York was instructed to report the facts in regard to the country of origin, foreign value, transportation and other charges, duty paid and total landed cost of sundry articles purchased in New York City by representatives of the Finance Committee.

The investigation was carried out in a businesslike manner. The itemized data of the landed cost were prepared from invoices and entries on file at the Customs Office. The articles, after purchase by a customer unknown to the retailer, were inspected at the appraiser's office and identified by the examiners who usually pass on such merchandise. The results, as set forth in a Senate committee print, offer convincing proof in these particular instances of the vast "spread" between foreign value and American retail price, between the total landed cost and the amount paid by the consumer.

The articles purchased included necessaries and luxuries. In the latter class we note the cost in the United States of what was presumably a string of imitation amber beads, made in Germany and valued there at 62 cents. Charges, including transportation, insurance and freight, amounted to 1.6 cents; duty, 12.4 cents—making a total landed cost in the United States of 76 cents. The necklace was purchased from Gimbel Bros., of New York, on June 6, 1922, the price being \$12.50. This shows an increase in retail cost over landed price of 1,544 per cent!

The profits made by New York retailers on "pearls" are much more modest, to judge from statistics. A necklace of these was valued in France, the country of origin, at \$12.25. Charges, including transportation, insurance and freight, aggregated 98 cents; duty, \$4.28—making a total landed cost in the United States, including 75 cents for an American-made clasp, of \$18.26. The article was purchased from B. Altman & Co., of New York, on May 31, 1922, the price being \$150. In this instance the percentage of retail price to landed cost was a paltry 757 per cent!

These facts should spur the efforts of American inventors and technicians who realize that a demand exists here for imitation gewgaws of all types. The labor cost to make beads and artificial jewelry is not great. The problem is one rather of the application of the science of glassmaking and the mechanics of production. At present the only persons in the United States who seem to be benefiting from the demand are the retailers.

White Tiles In Black Places

CLEANLINESS may be next to godliness—yet someone has said that in the average chemical plant it is often "next to impossible." We were inclined to that view ourselves until the other day we had the pleasure of going through the byproduct house of a modern coke-oven plant in a large Middle Western city. The things that impressed us most were that the walls were tiled in white and both the floors and the walls were actually clean. Now a byproduct house is generally far from inviting, for the manufacture of ammonium sulphate is ordinarily accompanied by rather dirty conditions. But things were different in this case. The white tiles not only improved lighting conditions tremendously but they seemed to establish a high standard of cleanliness—and the management had lived up to this standard.

But, you may ask, is it not an added burden rather than a help to management to be compelled to maintain this state of affairs? If you think so, perhaps you have not taken into account the psychological effect of such surroundings. Is it not a fact that men when forced to be clean about their work will also be careful? And we should not forget that particularly in the chemical plant the careful operator is the jewel of greatest price.

There is a thought here that all of us might well keep in mind: Make the men clean up the drip or sludge under the machines and wash the splatters off the walls. Their self respect and consequently the quality of their work will be improved in the process, and you, Mr. Manager, will realize dividends in an easier and more profitably operated plant.

Opportunities for The Inventive Mind

ON BEHALF of the British Institute of Patentees Sir WILLIAM BELL has recently made public a list of suggestions embracing the major inventions most needed by the world. A glance through this comprehensive compilation brings home with fresh emphasis the important rôle of the chemical engineer. Of a dozen problems which one reviewer has selected at random from this list, more than half may be said to lie within the fields of chemistry and engineering. Nor could any one of them be approached intelligently without a fair appreciation of the principles of these sciences. A bendable glass, a flannel fabric that will not shrink, a road-surfacing material that will not be slippery even when wet, an efficient heating furnace—these are but a few of the problems awaiting solution.

It is not our purpose to glorify the chemical engineer unduly or to magnify the importance of his work as it relates to his fellow men. His responsibilities to progress are admittedly large; the present list is but a confirmation of this fact. It merely catalogs a few of the opportunities awaiting evolution into reality by the creative minds of our profession.

The Significance of Industrial Hydrogen

AN EDITORIAL INTERVIEW WITH DR. H. S. TAYLOR OF PRINCETON UNIVERSITY

THREE great fields for industrial hydrogen are aëronautics, hydrogenation processes and nitrogen fixation—i.e., synthetic ammonia.

If dirigible airships come into general use, it is scarcely likely that they will be lifted by helium except in war time. They may be partly lifted by it by inclosing an inner bag of hydrogen in an envelope of helium, but the principal lifting medium will probably be hydrogen. A modern dirigible airship requires two and three quarter million cubic feet of gas, which is the contents of a very large municipal gasometer. Hydrogen becomes explosive in a mixture with helium when the concentration reaches 15 per cent.

Hydrogenation processes also call for large volumes of the gas. Professor TAYLOR has spoken of a single factory that daily consumes over 800,000 cubic feet of hydrogen.

Fixation of nitrogen bids fair to demand the largest supply when once the synthesis of ammonia is properly mastered. To produce one short ton of ammonia requires 80,000 cubic feet of hydrogen. To multiply the entire number of tons of ammonia needed for fertilizer by 80,000 gives one a notion of the tremendous volume of hydrogen needed for this purpose alone.

The processes available for producing hydrogen are five: (1) The steam-iron contact process. (2) Water-gas catalytic process, in which water gas—i.e., hydrogen and CO—pass with steam over a catalyst at 500 deg. C., giving hydrogen and carbon dioxide. (3) Liquefaction, in which the CO of water gas is liquefied, freeing the hydrogen. (4) Electrolytic decomposition of water. (5) Thermal decomposition of hydrocarbons.

We cannot say that any one process is the best. In water-gas catalysis, for instance, there is a remnant of about 4 per cent of nitrogen that persists as a mixture and cannot be economically removed in the present state of the art. This is of no consequence in ammonia synthesis, because nitrogen is one of the reacting substances and more must be added. But in the hydrogenation of oils it is a diluent, and a very troublesome one at that. So the cheapness of water-gas catalysis hydrogen must be discounted in hydrogenation.

Electrolysis of water gives us the purest hydrogen, but it is also expensive unless the producer has a good market for the oxygen that is made with it. One large hydrogenating works began with the steam-iron catalytic process, but, finding a market for oxygen, has gone over very profitably to the purer hydrogen from electrolysis of water.

The thermal decomposition of hydrocarbons, the process described in the three articles by E. R. WEAVER of the Bureau of Standards which are now appearing in *Chem. & Met.*, has not been employed to a large extent thus far in the hydrogen industry. Among the principal difficulties has been the high temperature required for the complete decomposition of the more stable compounds such as CH_4 which are always produced in cracking and which unless removed become troublesome inerts or diluents. Mr. WEAVER'S work promises to solve the problem. Another difficulty, mentioned in the paper, is the production of carbon monoxide due to oxidation-reduction reactions which occur in the cycle. This is minimized by attention to the purity of materials used in construction of the equipment, the absence of iron and the elimination of moisture and oxygen from the oils used. Mr. WEAVER'S contribution is pioneer work of leading importance, but it may be said that all the other hydrogen processes need the same kind of intensive study. Each of the other systems should yield improvements under such research, and until this is done it is scarcely fair to make comparisons. It is the opinion of Professor TAYLOR that the steam-iron contact process is a very promising field for such investigation and that it could be improved materially in output of hydrogen per unit of raw material (coke and steam) and in the engineering features of the layout. There has been little improvement over the original unit built by HOWARD LANE in England early in this century. The German modification of the Lane process which substitutes one retort for thirty-six has been introduced, and economies are claimed for it, but putting thirty-six retorts into one is scarcely a radical change, and the economic difference between the two types cannot be great. What is needed in this case is fundamental study and then the creation of new designs.

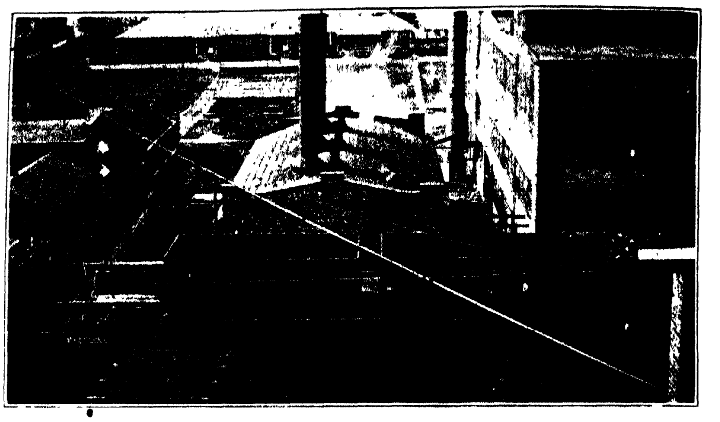
It is encouraging, however, to be able to record the results of fundamental study in at least one of the five important processes for hydrogen production. Only when similar data are available for each of the other systems will it be possible to show which of the methods will be of the greatest significance in the large-scale production of this gas so essential to war- and peace-time industry.

Dr. Hugh Stott Taylor, whose views on the industrial significance of hydrogen are reflected in this interview, is professor of physical chemistry at Princeton University. He is an Englishman, born in Lancashire in 1890, and a former student of Arrhenius at the Nobel Institute, Stockholm. Later he studied at the Technische Institut at Hanover and at the University of Liverpool. In 1914 he came to Princeton, where, except during his war activities, he has been ever since. Of late he has been addressing himself in research to catalysis and more particularly to the adsorption of gases by catalytic agents. All cases of contact catalysis, he believes, are preceded by an association of the reacting substances with the contact catalyst. This adsorption is just as specific as catalysis. Dr. Benton of Princeton has shown, for example, that CO can be oxidized in a mixture of 1 part in 99 of H_2. The reason is that while the relation of H_2 to CO is as 99:1, the concentration of gases on the surface of the catalyst is almost wholly CO, with no H. "The CO oxidizes first because the H_2 doesn't get a look-in," says Professor Taylor.

Route Your Materials Via Air Line

By F. L. Jorgensen
President, Dust Recovery & Conveying Co.
Cleveland, Ohio

A short study of the art of pneumatic conveying. Classification of the various systems in use Examples of successful installations. How abrasives are handled



AN AIR LINE LIME CONVEYOR

PNEUMATIC material conveying has been in use for a considerable time. Although until recently only a few materials have been successfully handled, engineering progress in the last few years has increased the field of this method and made it an important factor in the material-handling world. In this article, brief mention will be made of the various systems of pneumatic conveying in use and many examples will be given of installations in various fields, installations that have solved labor difficulties, cut costs and improved conditions generally.

Pneumatic conveying systems naturally fall into two main classifications—the pressure or blowing system and the vacuum or suction system. In recent years the vacuum system, into which classification most of the examples cited here fall, has taken the lead.

The two main classifications mentioned above have three subdivisions each, depending on the pressure under which the system operates. Thus the completed classification is: Vacuum systems—low, medium and high; pressure systems—low, medium and high.

Of the above, the low-pressure or the low vacuum system is, with few exceptions, exclusively used in dust-collecting work and is mentioned here only to make the outline complete. These systems are in some cases used for conveying sawdust, shavings, wool, feathers and similar lightweight materials. The systems work generally with a pressure or vacuum of 6 to 10 in. of water. A comparatively large air volume is required, ranging from 30 to 70 cu.ft. of air per pound of material handled, depending on the nature and weight of the material and the distance over which it must be conveyed. Fans are used for this work.

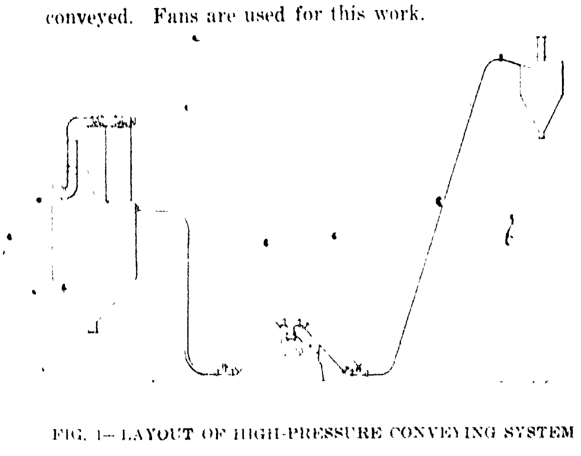


FIG. 1—LAYOUT OF HIGH-PRESSURE CONVEYING SYSTEM

The medium-pressure and medium-vacuum systems have been used extensively for many years, especially for handling grain and similar materials. These systems have successfully solved many handling problems of this nature. Rotary blowers or vacuum pumps supply the energy and 4 to 10 in. of mercury is the pressure or vacuum used. In general design these systems resemble the high-pressure and high-vacuum systems. However, as they use a larger volume of air, they also use larger pipe lines and collecting stations than do the high systems. From 3 to 10 cu.ft. of air per pound of material handled is required, depending on the nature and weight of material handled and the distance which the material is conveyed. They will handle, however, the same materials as the high systems, subject to certain disadvantages which will be pointed out later.

The High-Pressure System

As stated above, pneumatic conveying has been used for years for handling materials that had little or no dust in them, such as grain, and where it was immaterial if part of the dust were discharged with the air. This was because there had been no efficient dust-collecting plant as yet developed. Now such equipment has been perfected and the field of pneumatic conveying has thus been enormously enlarged.

In so far as equipment is concerned, this high-pressure system is the simplest of all. It consists of a high-pressure blower, a pipe line and a collector. The material can be fed into the pipe line either through a specially designed feeder or through an ejector. When materials containing little or no dust such as grain, wood chips, whole pepper or the like are handled, the material can simply be blown through the pipe line into a cyclone or directly into a bin or warehouse. This is illustrated on the right-hand side of Fig. 1.

Where, however, dusty materials such as soda ash, plaster of paris, cement, etc., are conveyed, the equipment must include in addition an air filter to prevent the dust being carried away with the escaping air, thus eliminating waste and nuisance. This is shown on the left side of Fig. 1.

The use of this pressure system is in practice generally limited to problems where the material to be conveyed can be fed into fixed receiving stations at stationary points, and the rapidly increasing use of pneumatic conveying in late years has mainly been due to the suction system. With this system, because a flexible feeding hose can be used and pipe lines can be

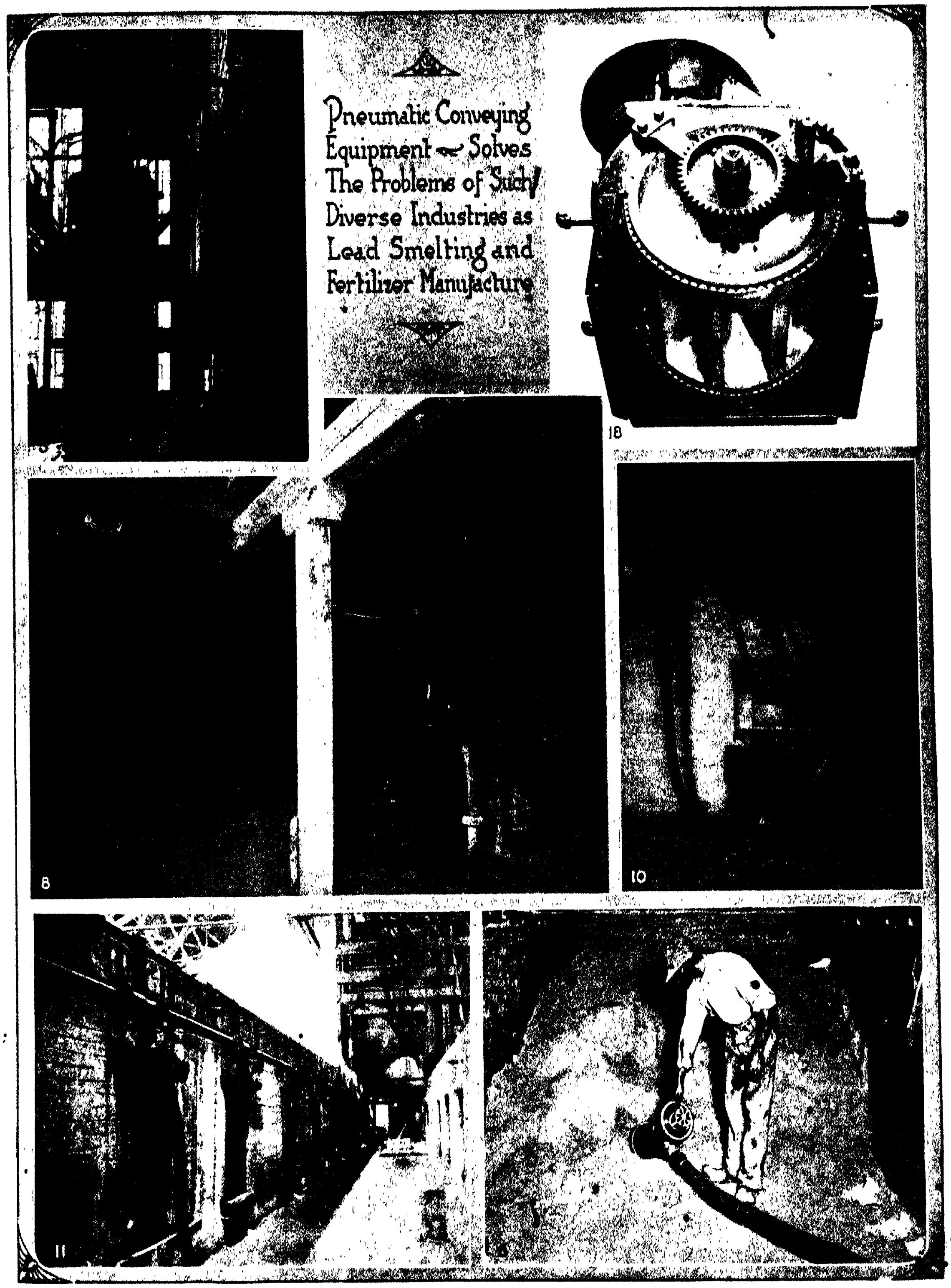


Fig. 3—View of equipment for handling lead. Fig. 18—Rotary discharge lock. Fig. 8—Collecting station. Lithopone-conveying equipment. Fig. 10—Intake at lithopone crusher. Fig. 11—System for handling dust from settling chambers. Fig. 6—Unloading a car of fertilizer. (Note the relatively clean conditions and absence of dust.)

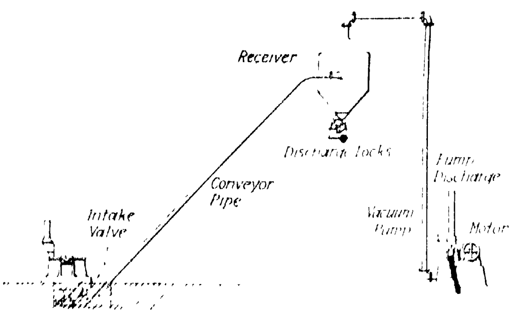


FIG. 2—LAYOUT OF HIGH VACUUM CONVEYING SYSTEM

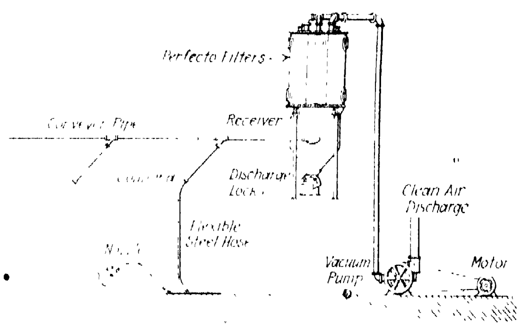


FIG. 3—LAYOUT OF SYSTEM WITH DUST FILTRATION

run from the same collecting station to various points, a greater flexibility and hence adaptability is attained.

During the war it became extremely difficult to get material for sacks. For this reason such materials as cement, soda ash, gypsum, lime, etc., very often had to be shipped in bulk in box cars. This practice has developed from an emergency measure to a common method of shipment because of the economy which it effects. But shipping in this manner does make it hard to unload the cars by the methods formerly in use. The need for an economical unloading device is met, however, by the pneumatic conveying system and today this use of the equipment is the field in which it is most employed.

When mentioning the subject of car unloading, we at the same time strike the essential difference in the adaptability of the medium-vacuum system in comparison with the high-vacuum system. With the medium-vacuum system an air volume of from 3 to 10 cu.ft. per pound of material is required with vacuum at 4 to 10 in. Hg. This necessitates (to make a concrete illustration) using a 10-in. pipe and suction hose for unloading 20 tons per hour from a car conveying material a distance of, say, 150 ft., using an air volume of 4,000 cu.ft. per minute and with a vacuum of 8 to 10 in. Hg; while under the same conditions and with the same capacity and distance, the high-vacuum system would require only 1,600 cu.ft. of air per minute at 16 to 17 in. Hg vacuum and only a 4-in. conveying pipe and hose. It will be very easy for everybody to understand the difference between handling a 10-in. heavy suction hose in a car in comparison with a 4-in. hose; the difference being that the one is nearly impossible and the other is practical. This and the dust-collecting efficiency explain the success of pneumatic conveying in late years.

What applies to hose, of course, also applies to pipe lines and size of collecting station and dust collectors; and it will be apparent that a small pipe line is easier to put up almost anywhere than a large cumbersome line. The high velocity and vacuum used have made it feasible to convey the heaviest known materials as well as the lightest; and this system is actually handling such materials as metallic lead from atomizers, which weigh from 450 to 500 lb. per cu.ft.; and such materials as talcum powder, carbon black and powdered coal.

Fig. 2 shows the outlines of a typical pneumatic conveying installation of the simplest form and will illustrate the system as this has been used for many years. It consists simply of a vacuum pump, pipe line and receiver in which the material is precipitated. This equipment in modern practice would be used only on materials free from dust, as dust will not all settle in the receiver, but pass on and be discharged through the pump. This equipment as well as the following

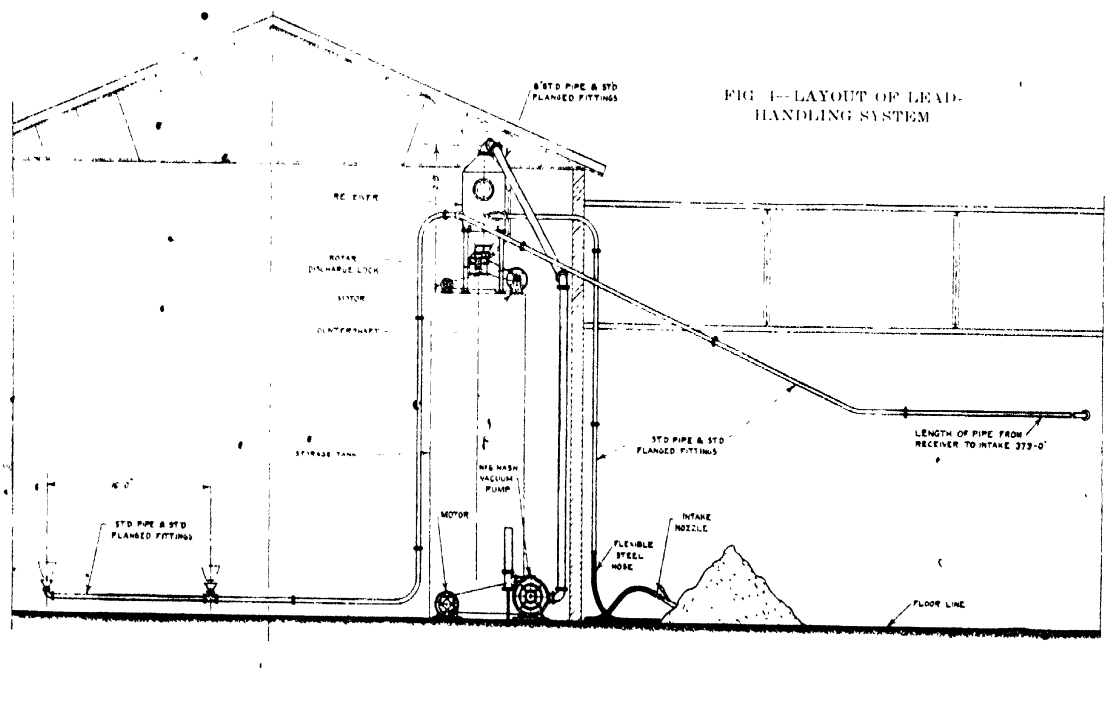


FIG. 4—LAYOUT OF LEAD-HANDLING SYSTEM

Fig. 13—Conveyor for dust from precipitators. Fig. 14—Unloading bauxite. Fig. 12—System for recovery of flue dust. Fig. 16—Unloading pebble phosphate. Fig. 17—Three-valve discharge lock.

described installation can of course be used as well with the medium- as the high-vacuum system. It is only to be borne in mind that the comparative size, for same capacities, will be different, as the high-vacuum system will allow all parts to be considerably smaller.

A typical installation on this order is shown in Figs. 3 and 4. This installation was designed for high-vacuum and conveyed 10 tons per hour of atomized metallic lead from atomizers to storage bins through a 2½-in. pipe. This type of equipment, however, has its widest field in grain handling and when the large elevators or dock legs get to the bottom of the present large tonnage steamers, a 3- to 4-in. flexible suction hose for cleaning up at the rate of 10 to 20 tons per hour saves time and labor. Fig. 4 also serves to illustrate how much space is saved by such an installation in comparison with the corresponding equipment of belt or other mechanical conveyors. This type of application is also ideal for handling material from small boats or for transferring from barges to steamers and *vice versa*. When this method is once fully understood in the shipping world, the demand for such pneumatic conveying equipment will be enormous.

We have previously indicated the quickly increasing demand for equipment for handling dusty materials, either from one place to another in a factory where conditions will not allow any other means, for unloading cars, and for handling poisonous or for other irritating materials. It has been the development of the high-vacuum system with the required small air volume and the perfected dust-collecting equipment which has made it possible to satisfy this demand. In Fig. 5 is shown the general outline of such a system. It is the same in every way as the equipment described immediately above, but automatic self-cleaning dust filters are placed on the top of the receiver and the air when leaving the receiver is filtered in the filter compartments shown. The dust is retained by the filters and periodically and automatically is shaken back into the receiver and discharged with the material through the discharge lock, while the air that now is clean passes on to the pump.

One of the most difficult labor problems, in the fertilizer industry and also in other places, consists in handling disagreeable and dusty materials. Men do not generally care for such work and the resulting labor turnover often assumes serious proportions. Among materials the handling of which is attended by such difficulties, we might mention fertilizer materials like tankage, phosphate, dried blood and bone meal. Materials in other industries include lime, cement, calcium arsenate, salt cake, etc.

In handling this type of material pneumatically the labor problem is mostly solved, for the method does away with the dust problem and its consequences in disagreeable working conditions. In Fig. 6 we see a worker unloading a car of such material. Note how clear the atmosphere is of dust in comparison with the results obtained by hand methods.

In Fig. 7 the layout of such an installation is given, the design being arranged for the unloading of three cars at once. By a multiplication of the 3-in. pipe lines shown, even more cars can be unloaded at once and switching is eliminated. In this particular layout the material from the cars is discharged into an industrial railway for distribution throughout the plant, as the elevation at the right of Fig. 7 shows.

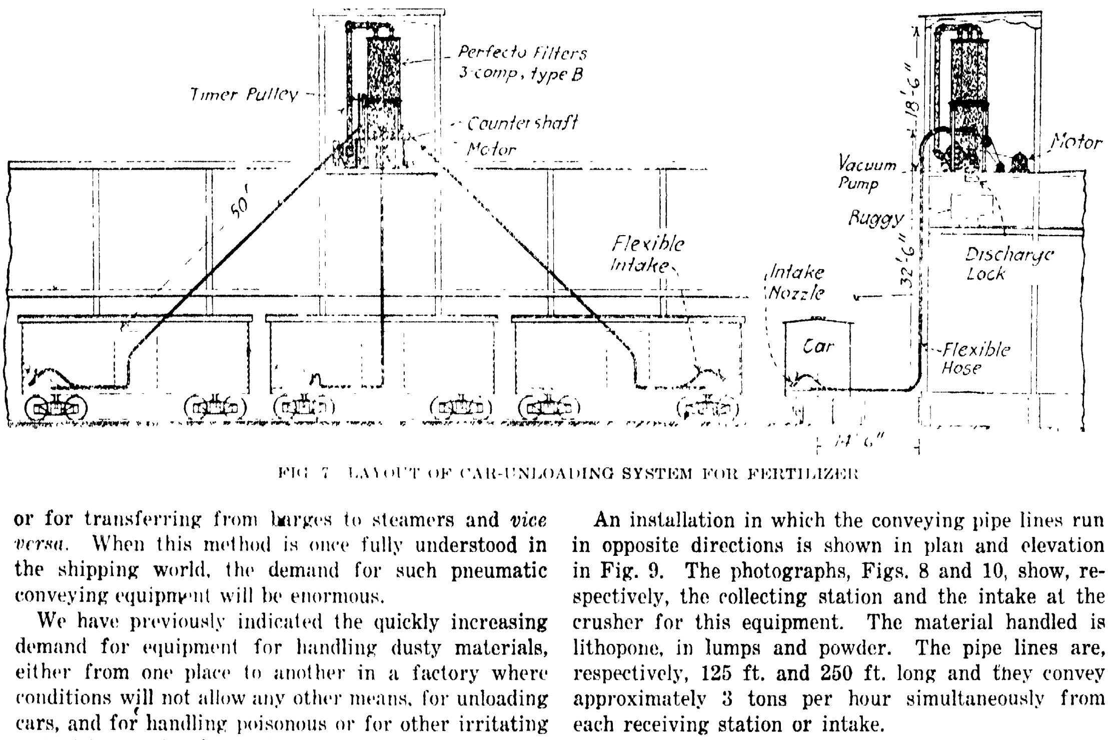


FIG. 7. LAYOUT OF CAR-UNLOADING SYSTEM FOR FERTILIZER

An installation in which the conveying pipe lines run in opposite directions is shown in plan and elevation in Fig. 9. The photographs, Figs. 8 and 10, show, respectively, the collecting station and the intake at the crusher for this equipment. The material handled is lithopone, in lumps and powder. The pipe lines are, respectively, 125 ft. and 250 ft. long and they convey approximately 3 tons per hour simultaneously from each receiving station or intake.

AIR TRANSPORTATION IN METALLURGY

There has recently developed a great interest in pneumatic conveying in many branches of metallurgical industry. This has been accelerated by the pronounced labor shortage in this field. Several installations along this line are now being made for handling arsenic recovered from smelters, dust from powdered coal in annealing furnaces, dust from checkerwork in steel plants and other uses.

Fig. 11 shows one of these installations. Here a suction line runs along in front of the settling chambers of a smelter, over the doors. At each door is a Y connection. To these connections a flexible hose with suction nozzle can be attached wherever desired, and the settled material from within the chamber recovered.

Figs. 12 and 13 give us two views of an installation at a smelter used for similar purposes. Fig. 12 shows the main run for recovering dust from the flue and the

pipe lines to the tower in which are the collecting station and the bin. Fig. 13 shows the method of conveying the recovered material from the dust filters.

Figs. 14 and 15 show a photograph and the layout of an installation for unloading aluminum ore. In the photograph two men are seen unloading a car with two 3-in. flexible suction lines. The installation has a capacity of 20 tons per hour. This quantity, drawn out of the cars through two 3-in. hose, is elevated a little over 70 ft., with a horizontal conveying distance of about 50 ft. Each 3-in. hose pulls a little over 10 tons per hour; and, while one 4-in. hose would do this work, it is found easier to handle the two 3-in. hose than the one 4-in. hose. To make clear where a hose larger than 3 in. can be used to advantage, Fig. 16 is shown. Here a 4-in. hose is operating in the hold of a boat and the weight is so carried from above that the difficulty of manipulation is reduced. On the installation shown in this picture 30 tons of pebble phosphate per hour is discharged from the boat into cars on the wharf.

Many times objections have been raised to pneumatic conveying because of the high horsepower it requires when compared with such equipment as belt conveyors, screw conveyors and bucket elevators. It is not the writer's object even to suggest that pneumatic conveying will ever replace other conveying means where it is possible to operate these. However, there are to be found an unlimited number of places and conditions or applications where no other conveying system but the pneumatic can be used. For instance, one of these is shown in the headpiece. This photograph shows a $2\frac{1}{2}$-in. pipe line hanging on a wire rope and passing clear over a manufacturing plant of large proportions, said pipe line being 450 ft. long. Through this pipe line is conveyed night and day more than 3 tons of lime per hour which has to be passed on from one manufacturing process to another in a steady stream.

New problems are constantly coming up and are being solved; and the writer is of the firm opinion that, from month to month, considerable material can be added to the short outline given above. There is one more point to be mentioned before we close. Within the past 6 months a development has been made which opens the field of abrasive handling wide to the pneumatic conveyor, a thing which many past attempts have failed to accomplish. The reason why abrasive materials could not be handled before by pneumatic conveying was the excessive wear on the discharge locks rather than the wear on the pipe lines and hose. Six months ago, however, a new discharge lock was invented which

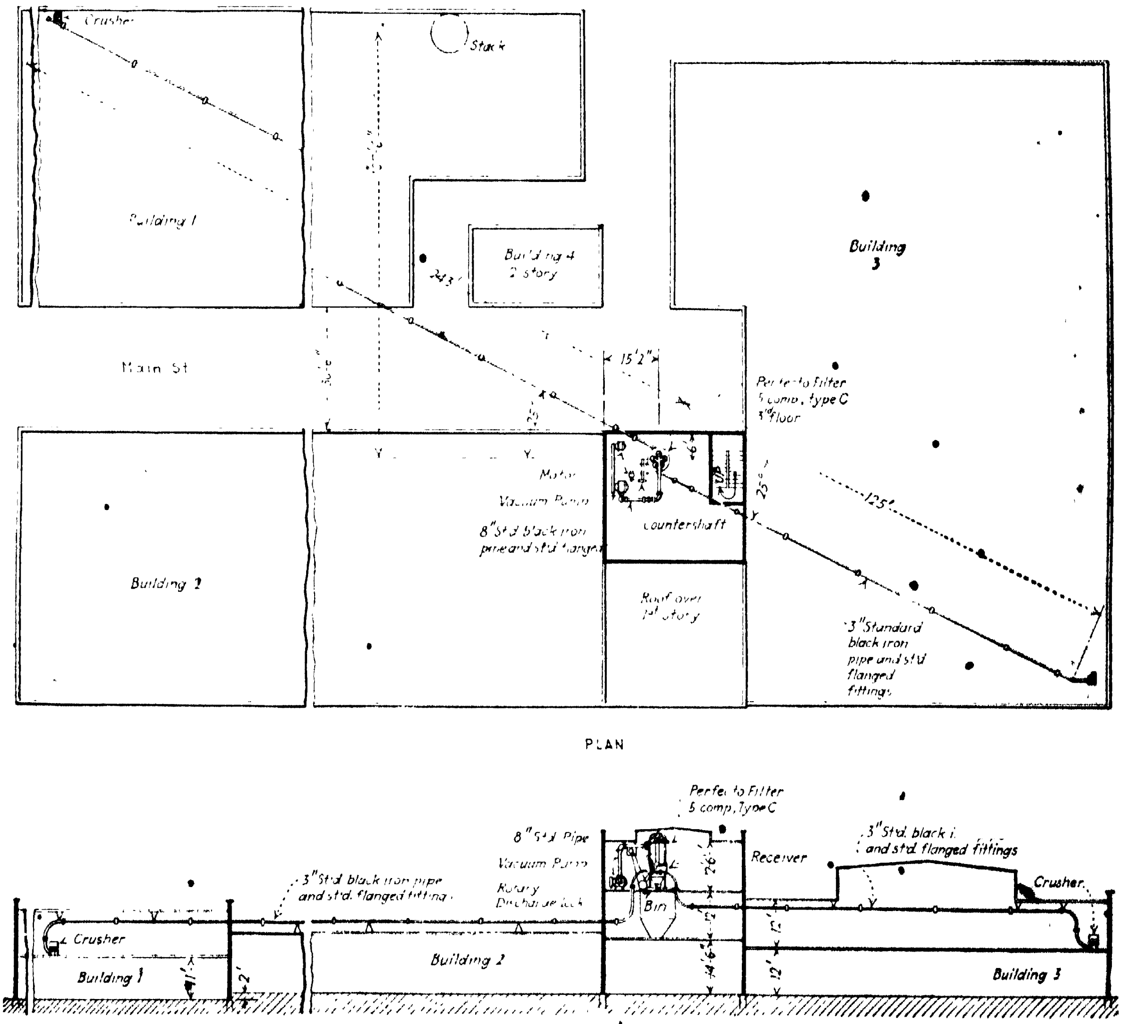


FIG. 9—LAYOUT OF LITHOPONE-HANDLING SYSTEM

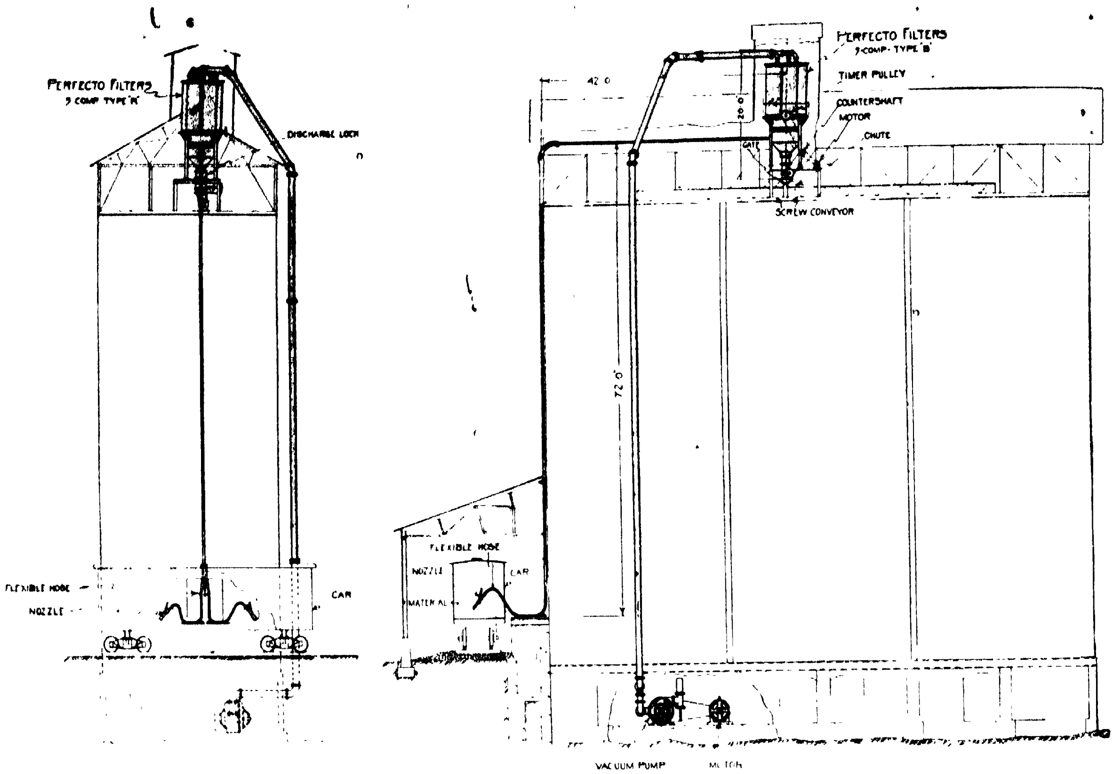


FIG. [illegible]. BAUXITE HANDLING SYSTEM LAYOUT

without any trace of wear is handling the most abrasive materials known. Fig. 17 shows this lock, which is called a three-valve discharge lock; while Fig 18 shows the rotary lock, which has been the standard unloading lock in the past and which is successfully handling all non-abrasive materials.

The installation shown in Figs. 14 and 15 has handled many hundred tons of bauxite concentrates, a material of an extremely abrasive nature, through this so-called three-valve lock; and, while the said material will wear out a screw conveyor in 3 weeks' time and a rotary discharge lock in less time than that, a three-valve lock has now been running for months on this material without any wear whatever. Great progress has also been made in the materials used for suction hose, and on this same installation the conveying hose and pipe lines show only insignificant wear; it, of course, being a fact that material at a high velocity travels at the center of the pipe lines and only strikes the pipe when the bends are sharp.

Chloridizing Silver Ores

Tests conducted at Western stations of the Bureau of Mines have shown that the roasting of silver minerals tends to produce metallic silver. Chloridizing roasting of silver minerals, therefore, is essentially a problem of chloridizing metalic silver and subsequent volatilization of silver chloride. In the furnace, conditions must be maintained that prevent the silver from being hydrolyzed and from reverting to the metallic state before passing from the ore as silver chloride.

Silver is not easily chloridized and volatilized, and has so far offered greater difficulty than any of the common metals. It seems extremely sensitive to atmospheric conditions in the furnace.

Silver minerals occur in many low-grade and complex ores of lead, zinc and copper, silver sometimes being of major importance, especially in economic value. A high percentage extraction is required to make any process for such ores commercially feasible.

In many ores the silver has minor value. When silver is present with rather high percentages of lead and copper, it may not seem economical to provide the conditions for making high extractions.

Salvages in the Oil Industry

A study is to be made by the Interior Department of salvages in the petroleum industry, with particular reference to production activities. The investigative work will be performed by C. P. Bowie, petroleum engineer, of the Bureau of Mines. Large sums of money are spent annually by oil companies in the purchase of new equipment such as casing, sucker rods, drilling and fishing tools, engines and the hundreds of other essentials that go to make up equipment for oil field work. This new material often replaces used or partly damaged equipment that many times is consigned to the scrap heap without proper thought as to the possibility of it being worked over or repaired and put back into service or made to serve some other useful purpose in the industry. Some of the larger companies have been doing a considerable amount of salvage work for a number of years and a few have departments whose particular object is the care and repair of salvaged materials. Careful study of the subject by the Bureau of Mines and dissemination of the information obtained should, it is believed, result in a very material saving to the many smaller oil-producing companies.

Production of Hydrogen By the Thermal Decomposition of Oil

Discussion of the Purity of the Gas Obtained in the Experimental Manufacture of Hydrogen for Government Air Services—Carbon Monoxide the Principal Impurity—Suggested Means for Eliminating It—Thermal Balance of Process

BY E. R. WEAVER,
Chemist, Bureau of Standards

IT IS the purpose of the present article to give only the more interesting data showing the variations in the composition of the gas obtained during the various runs of the plant. In Table I data are shown for each of the runs for which purity curves have been prepared. The table is self-explanatory with the exception of the temperature data, which represent temperatures observed shortly before the beginning of the corresponding runs.[1] A blank under generator-temperature indicates that no reliable temperature reading was obtained in the generator before the beginning of the run because of the presence of smoke. There can be no doubt that the maximum temperatures existing in the plant were higher than those observed; just how much higher it is difficult to estimate. The condition of the refractories in the vaporizer after the experiments indicated that the temperature at the bottom of the checker-brick column had been at least 100 deg. C. hotter than the maximum observed at the lowest sight cock.

PURITY OF HYDROGEN

Characteristic curves representing the variation of purity of the hydrogen produced during any run in which the rate of production remained approximately constant are shown in Figs. 4 and 5. All the purity curves obtained were similar in form to these; it can be readily seen that each of the more complex curves of Figs. 6 to 13 is composed of segments of the general shape of the curves in Figs. 4 and 5. Each such segment represents a period during which the conditions of production were not materially changed.

The three curves of Fig. 4 are typical of production at a low and fairly uniform rate. Although the maximum observed temperatures were rather high, especially in run 24, they were probably not well distributed and the poor yields and low purity are to be ascribed to temperatures too low to decompose methane successfully.

The various impurities are separated in Fig. 5, which represents a run made at high temperature with an oil feed of 1 gal. per minute. The impurities were determined in this case by volumetric analysis, and the irregularities were caused by the unavoidable variations in oil flow resulting from irregular air pressure in the supply tank. It is noteworthy that the carbon monoxide, always greatly in excess of the nitrogen, approaches a constant quantity, while the methane, which is negligible during the first half hour, increases rapidly toward the end of the run.

ELIMINATION OF METHANE

At the beginning of the investigation it was expected that the troublesome problem would be the elimination of methane. Such did not prove to be the case, however. The dominant impurity in all experiments was carbon monoxide. Nevertheless carbon monoxide is to be regarded as a more or less accidental impurity, the source and elimination of which will be discussed in the next section.

Figs. 6 and 7 show the results of a variation from the usual practice of vaporizing the oil on the checker

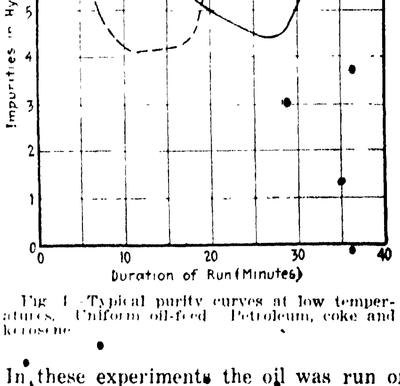


Fig. 4—Typical purity curves at low temperatures. Uniform oil-feed. Petroleum, coke and kerosene

brick. In these experiments the oil was run onto the coke and the vapors were passed from the generator through the checker-brick tower. It was hoped that this procedure would result in economy of time and fuel, because the carbon deposited in the coke bed could be burned more rapidly and efficiently than that deposited on the checkerwork.

During portions of both runs the oil vapor was passed directly from the top of the coke bed to the

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*EDITOR'S NOTE: This is second in a series of three articles describing experiments carried out with the modified water-gas plant of the Gas Engineering Co., Trenton, N. J., for the purpose of obtaining a complete study of the process.

[1]Unless otherwise stated the oil was vaporized in the checker brick and passed through both the checker brick and the coke bed in all the experiments described.

checker-brick tower without passing through the body of the coke. This was done in order to determine the efficiency of the checker brick alone in producing hydrogen, with special reference to the possibility of dispensing with a coke fire and using an oil or gas fire as a source of heat. The results definitely prove that gas passed through the checker-brick tower alone contains several times as much methane as that passed through the hot coke. This was found to be the case in spite of the fact that the observed temperature of the checker brick was higher in run 26 than in any other experiment except runs 34 and 45.

No apparent advantage of any kind resulted from vaporization in the coke bed; and the latter was so clogged up by the deposited carbon that only short runs could be made. This factor more than offset any advantage which might have resulted from the more efficient utilization of the carbon produced during blasting.

The very poor results obtained when the checker brick

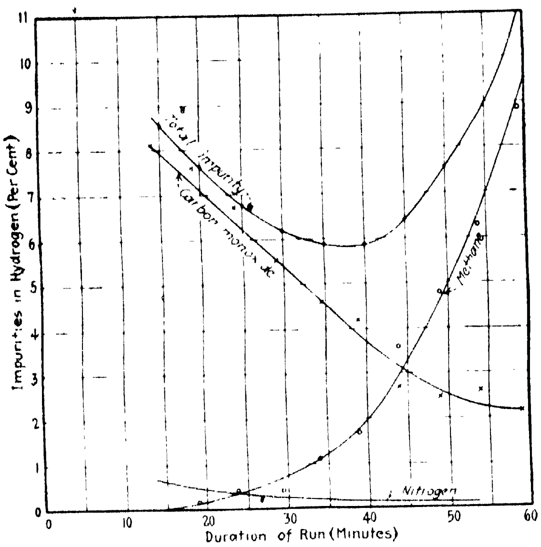


Fig. 5—Composition of gas produced in run 34 as determined by volumetric analysis

alone was used as a heating surface were probably due as much to the lower temperature of the brick as to the smaller surface of contact. The effect of temperature is well shown by comparison between runs 35 and 36 (Fig. 8). The difference in the results obtained is to be ascribed entirely to the formation of methane at the lower temperatures of run 36. A still more instructive comparison may be made between runs 41, 42, 43 and 45. (Figs. 9 and 13.) Runs 41 and 42 were purposely made at low temperatures in order to study the effect of temperature. In run 43 the temperature of the checkerwork was about 200 deg. higher, and the effect on yield and purity is at once apparent. In run 45 a further increase in the temperature of the checkerwork gave still better results, although the apparent temperature of the coke was less than that in run 43. This and other similar observations show that the temperature of the checker brick is a much more important factor than might be assumed from the fact that the final elimination of methane must be accomplished in the coke bed. Indeed checker-brick temperature appears to be quite as important as coke temperature. It is probable that most of the endothemic reaction takes place in the

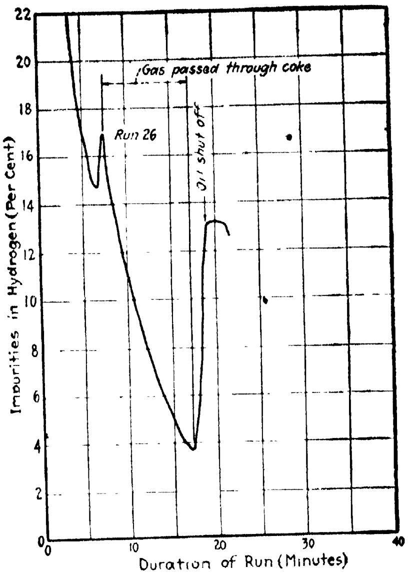


Fig. 6—Effect upon passage through coke upon removal of impurities. Rate, 1 gal of oil per min

TABLE I—GENERAL DATA REGARDING THE PRODUCING RUNS REPRESENTED BY FIGS. 4 TO 13

Run No.	Duration, Min.	Oil Used: Kind	Oil Used: Quantity, Gal.	Solid Fuel	Highest Observed Temp.: Vaporizer, Deg. C.	Highest Observed Temp.: Generator, Deg. C.	Hydrogen Produced, Cu.Ft.
23	35	Kerosene	19.8	Petroleum coke	1,440	1,460	2,864
24	14	Kerosene	16.4	Petroleum coke	1,380	1,565	2,279
25	23	Kerosene	20.2	Petroleum coke	1,360		2,957
26	19	Kerosene	21.2	Petroleum coke	1,450		3,318
27	27	Kerosene	14.6	Petroleum coke	1,285		2,034
34	60	Kerosene	62.8	Petroleum coke	1,525	1,590	10,876
35	40	Fuel oil	48.8	Petroleum coke	1,400	1,565	8,137
36	15	Fuel oil	14.4	Petroleum coke	1,110	1,460	2,480
37	48	Fuel oil	80.0	Retort carbon	1,380		12,119
38	46	Fuel oil	67.8	Retort carbon	1,370		11,227
41	22	Fuel oil	33.2	Retort carbon	1,130	1,625	5,629
42	17	Fuel oil	25.2	Retort carbon	1,130	1,450	4,073
43	29	Fuel oil	51.8	Retort carbon	1,325	1,590	9,726
44	60	Kerosene	71.2	Retort carbon			11,717
45	45	Kerosene	73.0	Retort carbon	1,470	1,540	13,680

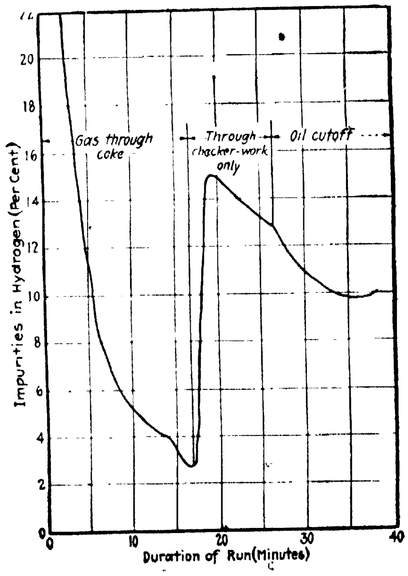


Fig. 7—Effect of passage through coke upon removal of impurities. Rate: 0.5 gal. oil per min.

checkerwork and that a relatively small decrease in efficiency there puts a much greater load on the coke. If, for example, 90 per cent of the endothermic reaction takes place in the checker brick, a decrease of 10 per cent in their efficiency would about double the amount of heat taken from the coke to complete the reaction. This relation is substantiated by the facts that the first hydrogen produced, even in the runs made at the lowest temperatures, was found to be nearly free from methane and that the initial temperature was observed to affect principally the amount of oil which can be used before an appreciable amount of methane appears.

The Source of Carbon Monoxide

The plant would have produced hydrogen of quite satisfactory purity from the start had it not been for the occurrence of considerable amounts of carbon monoxide. It is evident that any free oxygen in the system

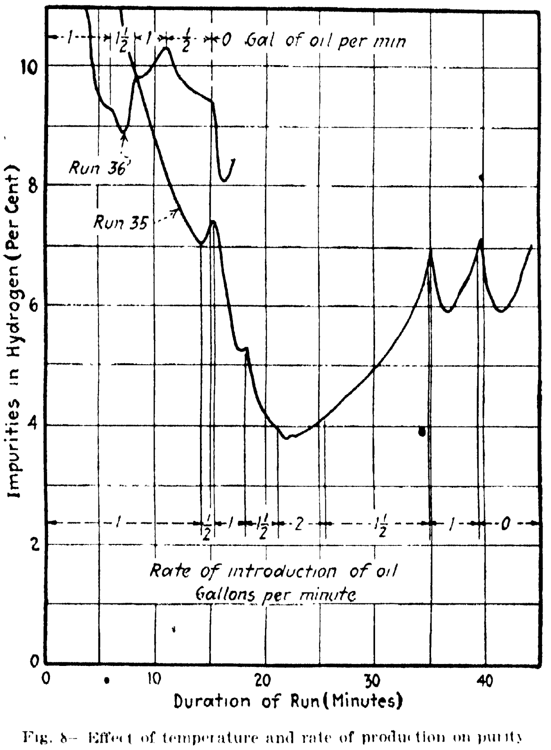


Fig. 8— Effect of temperature and rate of production on purity

or oxygen in any compound which can be reduced by hydrogen or carbon at temperatures up to 1,600 deg. C will appear in the gas as carbon monoxide. The sources of the oxygen were ultimately determined with some certainty to be: (1) water vapor from the Silocel lining of the generator, and (2) oxides of iron present in the machine.

The source of this principal impurity (carbon monoxide) in the hydrogen is of so much importance that the reasons for the conclusions given will be stated in detail.

The principal possible sources of oxygen appear to be as follows: (1) Air remaining from the blast or included in coke or linings. (2) Water or organic compounds containing oxygen in the oil. (3) Water or organic compounds containing oxygen in the coke. (4) Any materials, notably iron, or iron oxides, which remain in any heated portion of the system and can be oxidized during blasting and reduced by hydrogen or

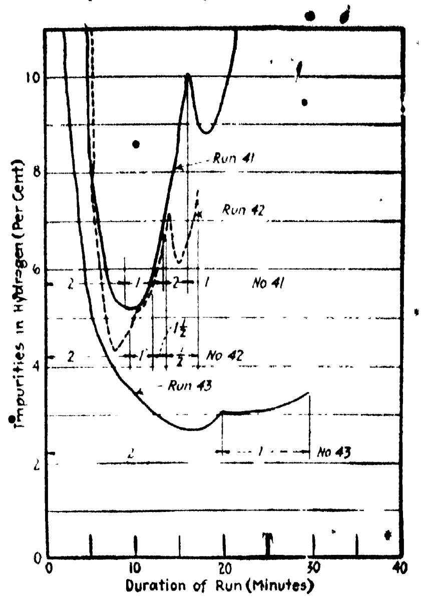


Fig 9—Effect of temperature on production.

carbon during hydrogen production. (5) Water from a leak in the water-cooled valve between generator and checker-brick tower. (6) Water from the linings of the generator.

If the oxygen had come from air, each volume of carbon monoxide would have been accompanied by approximately twice its volume of nitrogen. On the contrary, the amount of nitrogen found was always very small after the first minute or two of the run, seldom amounting to more than 10 per cent of the carbon monoxide in the samples taken for volumetric analysis.

The rate was computed at which carbon monoxide was being produced at the time each volumetric analysis was made. It was assumed that the nitrogen present was

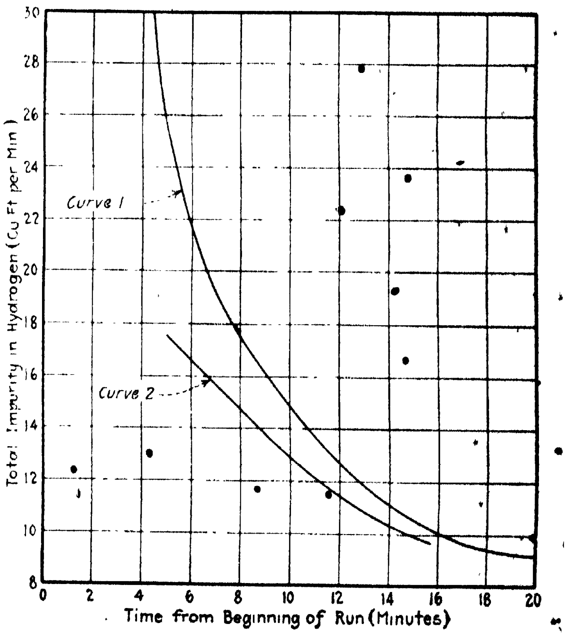


FIG. 10—TOTAL IMPURITY IN HYDROGEN

Curve 1—Graphic average of six runs at 2 gal. per minute.
Curve 2—Graphic average of six runs at 1 gal. per minute.

residual blast gas and that an amount of carbon monoxide equal to one-half the volume of nitrogen should be ascribed to the same source. Half the percentage of nitrogen was therefore subtracted from the percentage of carbon monoxide found by analysis, and the remainder was multiplied by the rate of hydrogen production. This gave the volume in cubic feet per minute of carbon monoxide produced, presumably from some source other than residual blast gas. The figures so obtained throw much more light on the question of the source of the carbon monoxide than do the analyses alone and will be frequently referred to.

Eliminating Oil and Coke

No considerable part of the oxygen could have come from the oil, since the amount of carbon monoxide produced per unit time was almost, if not quite, independent of the rate at which the oil was introduced. (See Fig 10.) Consequently, a sudden increase in the rate of hydrogen production was always accompanied by a corresponding decrease in the percentage of carbon monoxide in the gas. A change in rate of production was also, of course, accompanied by a change in the percentage of methane present, the effects upon the concentration of methane and carbon monoxide being in opposite directions. Consequently, an increase in rate of production near the beginning of a run, when carbon monoxide was the dominant impurity, always resulted in an increase of purity of the hydrogen; near the end of a run, when methane was in excess, a change of rate had the opposite effect upon the purity of the hydrogen; and at an intermediate stage of production the effects upon carbon monoxide and methane balance each other and a change of rate has no noticeable effect upon the percentage of impurity present. These effects are clearly shown by all the later runs, notably Nos. 35 and 38, Figs. 8 and 11.

That the oxygen did not come from the oil is also indicated by the fact that the amount of carbon monoxide produced was the same whether kerosene or fuel oil was used. The amount of carbon monoxide observed in some of the runs would have required as much as 12 to 15 per cent of any oxygen-containing organic compound; the occurrence of such a compound in such amounts in each of two refined petroleum oils is in itself so improbable as to eliminate the oil from further consideration as a source of oxygen. Water itself in any such quantity must have occurred as a visible emulsion.

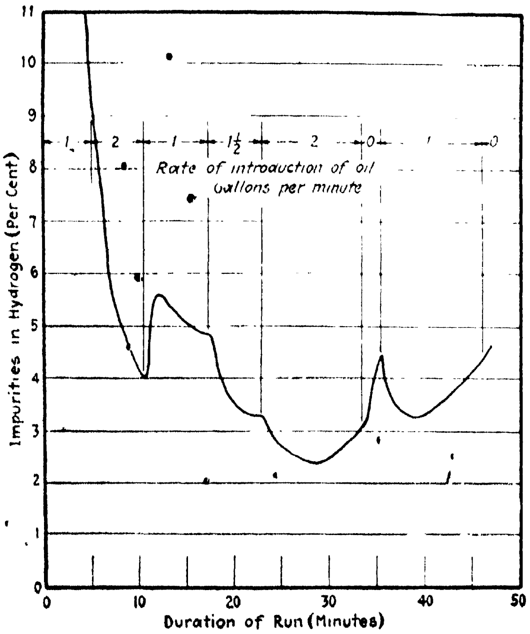


Fig. 11—Effect of rate of production on purity at different stages (run 38).

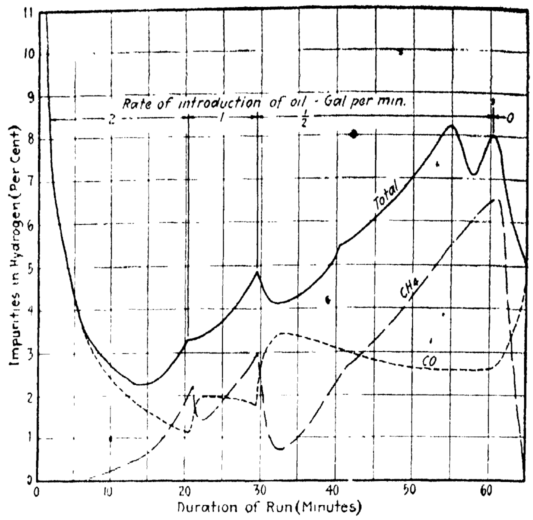


Fig. 12—Effect of rate of production on purity at different stages (run 11).

The coke probably did contain enough water at all times to drive out included air and fill the interstices of the solid with steam, but water or any organic compound of oxygen would have reacted with the carbon to form carbon monoxide at temperatures far below those actually employed, and all but a small part of the gas would have escaped during blasting. During one period for which computations were made, the carbon monoxide produced during the runs, if confined in the total volume occupied by the loosely piled coke, would have exerted, at the operating temperature, a pressure of at least 300 atmospheres.

The possibility of water leaking into the generator was one of the first considered, but there was no evidence of such a leak at the only point at which it could have occurred.

The Remaining Sources of Hydrogen

Water from the linings, and iron oxide or other materials which can be alternately reduced and oxidized, alone remain as sources of oxygen. There is abundant evidence that each of these played some part in the actual formation of carbon monoxide.

The reactions involved are very simple Water vapor will react with carbon to produce carbon monoxide and hydrogen, while iron oxide will react with hydrogen to produce water, which will immediately give carbon monoxide. The reduced iron remains in the generator until the next blast, when it is again oxidized by air or even by carbon dioxide and so carries oxygen over into the next run.

A considerable part of the impurity can unquestionably be ascribed to water in the linings of the generator and checker-brick tower, which consisted of firebrick backed by Silocel powder. The latter material was packed into position in the form of a paste, and the water in the paste could escape only by evaporation. It may even have been partly renewed in some cases

where wet coke was put into the machine, and the steam produced may have entered the colder parts of the lining and there condensed.

The source of the reactive iron is not so easily ascertained. Some parts of the shell and connections were exposed to relatively high temperatures, especially valve stems and the metal not covered by the lining around the secondary air inlets, the charging and stack valves, and the sight holes. Some iron, no doubt, came from scale from various metal parts during erection and use, some from pyrometer tubes, some from lintels and old grate bars,[2] some from ash of the fuel, and some from iron oxide in the refractories. Some iron rust may even have been carried in suspension by the oil from the storage tank and connections.

The iron oxide in the refractories was probably the greatest single source of oxygen. The dust produced by rubbing together two of the checker brick took up 0.1 per cent of its weight of oxygen when heated to redness in an oxidizing atmosphere and lost the same amount in an atmosphere of hydrogen. This test was repeated two or three times consistently. The brick were porous enough to account for an enormous effective surface exposed to the action of the gases.

The Case Against the Lining

The following facts point to water from the lining as a source of a considerable part, at least, of the carbon monoxide:

(1) There is a tendency for the amount of carbon monoxide produced per minute to increase during the period of experimentation. This, no doubt, corresponds to a drying out of the Silocel.

(2) No direct connection can be traced between the rate of carbon monoxide formation in the different runs and the temperature at the beginning of the run, but there was a decided tendency for the carbon monoxide production to increase during the first two or three runs following a shut-down. This was to be expected, since the rate of escape of water vapor from the wet outer layer of the lining was no doubt proportional to the amount of heat conducted through firebrick and dry inner Silocel.

(3) That some water still remained to be evaporated was proved when the lining of the generator was torn down after the experiments. A sample of the Silocel from near the top of the generator was found still to contain over 5 per cent of water, enough to condense in the top of a test tube when a few grams of the powder was heated in the bottom.

(4) At various times, but especially when running oil directly onto the coke, the generator became clogged with carbon to such an extent that the pressure of hydrogen would force open the stack valve. Every time this occurred a sharp increase of carbon monoxide was shown just before the valve opened. It even became possible to predict with some accuracy when the valve would open by watching the purity recorder. The sudden increase of impurity was, no doubt, caused by the hydrogen being forced through the porous lining, carrying with it an unusual amount of steam. This explanation was verified by broad streaks of lampblack found in the Silocel when the lining of the generator was torn out.

[2]The lintels which support the lining above the ash pit and fire doors were found to be fused about three-fourths of the way through the lining after the experiments.

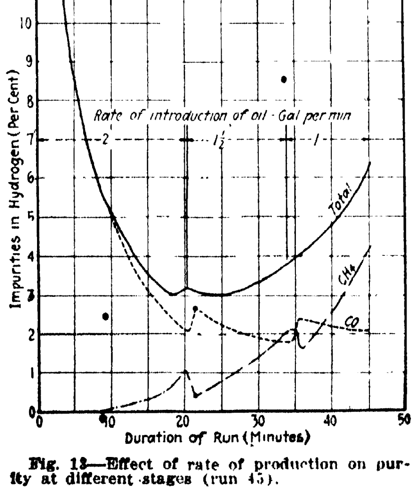


Fig. 12—Effect of rate of production on purity at different stages (run 45).

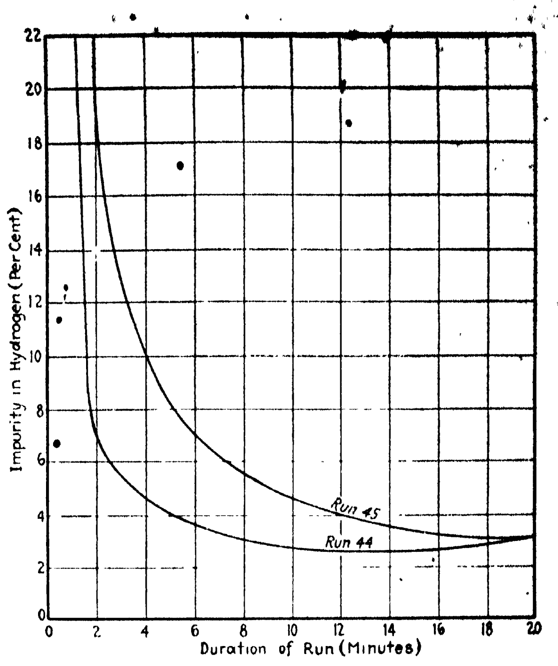


Fig. 11—First 20 min of runs 44 and 45, showing effect of preliminary reduction on purity of hydrogen. 2 gal. of oil introduced into machine 10 min before beginning run 44

The Case Against the Iron Oxide

That iron oxide caused the formation of a large quantity of carbon monoxide is indicated by the following facts:

(1) It is impossible to account for the variation in the rate of formation of carbon monoxide during a single run by assuming that it all comes from water in the lining. The lag involved in the conduction of heat through firebrick and dry Silocel is such that no rapid variation in the rate of vaporization of the water in the wet Silocel can be credited. Even if there were no lag, but the amount of heat transmitted through the lining was always exactly proportional to the difference in temperature, no variation greater than about 20 per cent could be accounted for in the rate of formation of carbon monoxide between the beginning and the end of the run; while the observed variation usually amounted to several hundred per cent.

(2) The amount of carbon monoxide formed was

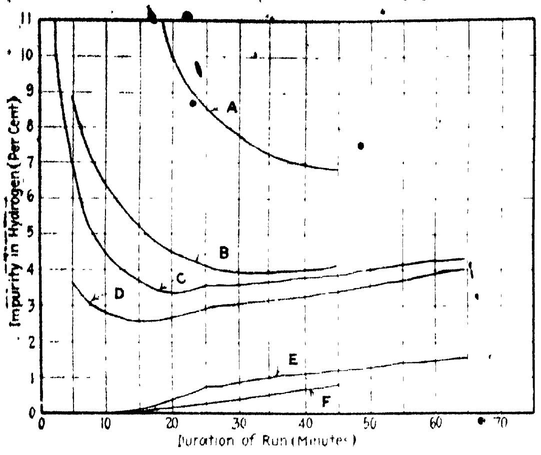


FIG. 15—COMPOSITION OF HYDROGEN IN HOLDER FROM RUNS 44 AND 45

Curve *A*—Run 45 Total impurity, all gas saved
Curve *B*—Run 45 Total impurity, gas wasted during first 5 min.
Curve *C*—Run 44 Total impurity, all gas saved
Curve *D*—Run 44 Total impurity, gas wasted during first 5 min.
Curve *E*—Run 44 Methane
Curve *F*—Run 45. Methane.

greatly diminished by introducing a little oil several minutes before beginning to run and permitting it largely to reduce the iron oxide present. This is clearly shown by a comparison between runs 44 and 45, of which the complete purity curves are given in Figs. 12 and 13. These runs were made under conditions very similar in all respects except that in the case of run 44 about 2 gal. of oil was introduced into the generator 10 minutes before beginning continuous operation. Fig. 14 shows the first portion of the same purity curves on an enlarged time scale and a reduced purity scale. These curves are continued to represent the course of the runs only so long as oil was introduced at the initial rate. The practical effect of the preliminary reduction is strikingly illustrated in Fig. 15, which shows the percentage of impurity in all the gas delivered to the holder in the case of the two runs. In these and all other runs an amount of hydrogen equal to at least the volume of the shells was wasted through

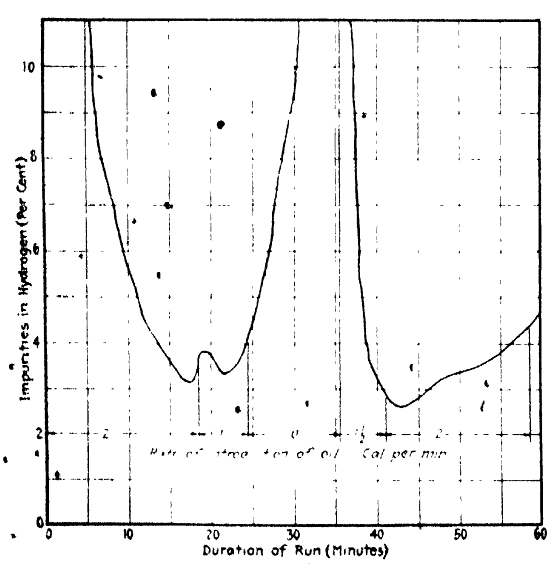


Fig. 16—Showing improvement in purity of hydrogen following a temporary shut-down (run 37).

a purge valve before the gas was turned through the meter and the figures represent only the gas actually metered. It is apparent that the use of 10 gal. of oil during a period of 5 minutes is less effective in eliminating impurities than is the use of 2 gal. 10 minutes before the run.

Fig. 16 also illustrates in a striking manner the result of a long period of reduction upon the impurities in the gas. In this case the introduction of oil was interrupted for 11 minutes after a 25-minute run. When production was again started, gas of higher purity was produced in greater quantity than during the first portion of the run in spite of the heat lost during 25 minutes of operation and 10 minutes of idleness.

(3) The smallest rate of production of impurities occurring in any of the experiments was in run 26 (Fig. 6). In this run the oil was vaporized in the upper part of the coke bed, and during the first 7 minutes was passed through the checker-brick tower only. When the gas was then directed through the coke, the remarkably low rate of 1.2 cu.ft. of impurity per minute was observed both from the record of the automatic recorder

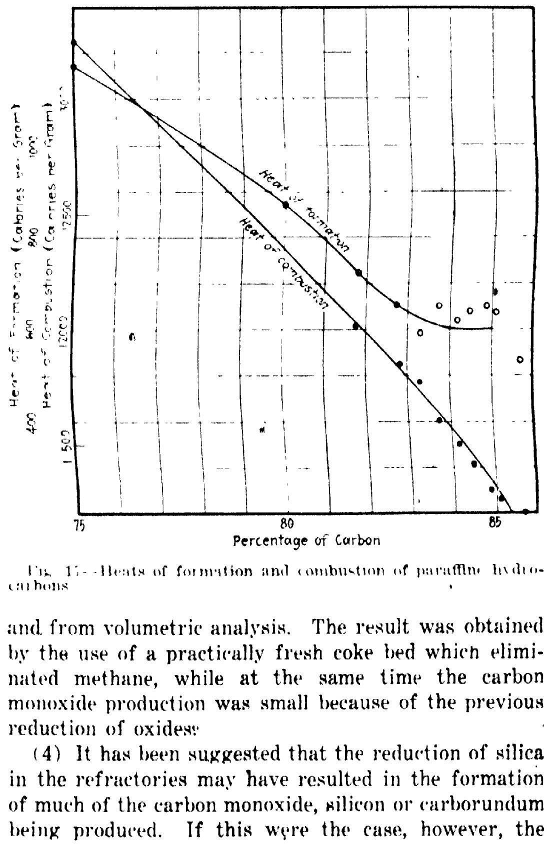


Fig. 17—Heats of formation and combustion of paraffin hydrocarbons

and from volumetric analysis. The result was obtained by the use of a practically fresh coke bed which eliminated methane, while at the same time the carbon monoxide production was small because of the previous reduction of oxides.

(4) It has been suggested that the reduction of silica in the refractories may have resulted in the formation of much of the carbon monoxide, silicon or carborundum being produced. If this were the case, however, the rate of formation of the gas in the presence of a large excess of the solid should be a rapidly changing function of the temperature. No increase in the rate of formation with increase of temperature was noted, however. On the contrary, the results indicate the reverse, but this apparent reversal is no doubt due to the fact that the highest temperatures were employed after the lining was pretty well dried out. The independence of temperature shown by the rate of formation of carbon monoxide and the rapid decline of the rate during a run can be explained only by a chemical reaction which would take place at a much lower temperature

but which is limited by the small amount of the reacting substance present. The evidence again points to iron oxide, although it is possible that some other oxide present in small quantity may have had some part.

Thermal Balance of the Process

The heats of combustion of various saturated hydrocarbons of the paraffine series, taken from the Landolt-Börnstein Tables, are shown in Fig. 17, together with their heats of formation obtained by subtracting the observed heat of combustion from the heat of combustion of the component carbon and hydrogen. Since the observations on heat of combustion were mostly made with bomb calorimeters, it is evident that the "heat of formation" here given includes the heat of vaporization and represents the total amount of heat which must be supplied by the checker brick and coke to vaporize and decompose the oil.

All of the paraffine hydrocarbons that are liquid at ordinary temperatures contain between 88.33 and 85.75 per cent of carbon. It is apparent, therefore, that it makes little difference what oil is used, either as to yield of hydrogen, fuel value of the deposited carbon, or heat required to decompose the oil. Provided the checker brick is sufficiently hot to vaporize the heavier oil, practically the same results should be secured from the use of the same weight of a heavy lubricating oil, or even solid paraffine, as from gasoline or kerosene.

It is assumed, for the purpose of drawing an approximate thermal balance, that an oil of specific gravity, 0.80, containing 85 per cent carbon, is used under the operating conditions of run 45, which are believed to represent about the most favorable operating conditions for this plant. (The question of preliminary reduction of the iron oxide in order to avoid the formation of carbon monoxide has practically nothing to do with the thermal balance.) It is also assumed that 75 per cent of the carbon of the oil was deposited on the checker brick and that this was burned to CO only, the carbon in the generator being all burned to CO_2.

Table II then represents roughly the thermal balance indicated by the observations made on run 45, in which 13,680 cu.ft. of hydrogen was produced.

TABLE II APPROXIMATE THERMAL BALANCE OF EXPERIMENTAL PLANT

	Total Kg Cal	Btu Per Cu Ft of Hydrogen
Potential heat of fuels used		
247 kg. oil	2,790,000	718
159 kg. coke	1,280,000	329
Total fuel used	4,070,000	1,046
Heat accounted for		
Potential heat of 37 kg hydrogen	1,260,000	324
Heat required to vaporize and decompose 247 kg oil	160,000	41
Sensible heat in 37 kg. hydrogen at 1,200 deg C	160,000	41
Sensible heat in products of combustion of carbon at 1,000 deg. C.	885,000	228
Potential heat of 370 kg CO	900,000	231
Miscellaneous losses, including radiation, carbon suspended in hydrogen, purges and leakage	705,000	181
Total	4,070,000	1,046

The figures in Table II are very rough approximations only. In particular the temperatures at which hydrogen and blast gas leave the plant are mere estimates. The balance is sufficiently near the truth, however, to show the very poor thermal efficiency of the process and to indicate the direction in which to work for improvement.

The concluding article in this series, which will discuss the arrangement and operation of the plant for thermal efficiency, will be published in a subsequent issue.

Plan for Critical Tables of Constants

The International Critical Tables of Physical and Chemical Constants have been outlined to some extent by the editorial board. The very general interest aroused by this work is due to the wide application of constants involved, bearing as they do upon a very broad range of industries. The scope of the tables is indicated by the following topics: Chemical kinetics, kinetics of physical processes, diffusion, molecular kinetics, chemical equilibrium, pressure-volume-temperature relations in homogeneous systems (does not include H_2O, CO_2, SO_2, Na., Hg, air, N, H, Si), phase relations in heterogeneous systems, volume change accompanying change in phase where directly determined, properties of surfaces, electrochemistry, thermochemistry, photochemistry, mechanics, sound, heat, radiometry (including spectrophotometry, electricity, magnetism, electronics, ionization of gases, X-rays, miscellaneous tables of useful information, certain biological data, assembled properties of selected materials, conversion tables, tables of units and standards, standardization tables, and computational tables.

Among the industrial materials on which data are to be included are the following: Minerals; alloys, amalgams and commercial metals; abrasives, ceramic cements and cementing materials, exclusive of refractory cements; clays; heavy clay products; natural building materials of mineral origin; refractory materials, including refractory cements; white wares, including laboratory porcelain, electrical porcelain, etc.; commercial glasses; vitreous enamels; thermal insulating materials for high temperature; low-temperature insulating materials; woods; rubber and artificial plastics; carbon for electrical purposes; mica; transformer oils and other liquid electrical insulating materials; asphalts, bitumens, tars, pitches, mineral waxes and creosotes; lubricants; liquid fuels; solid fuels; animal and vegetable oils, fats and waxes, including hydrogenated oils but excluding essential oils and processed oils; essential oils; natural and artificial resins, gums and balsams; odoriferous materials; solid secretions of animal origin, such as bone, ivory, shell, horn, coral, etc., and some artificial substitutes; skins, leather and leather substitutes; cat gut and allied substances; textile fibers, including animal, vegetable, mineral and artificial; sponges, mosses, sea grasses, etc.; explosives; tannins; dyes, pigments and coloring materials; sweetening agents; foodstuffs; adhesives; paper; paints, varnishes, airplane dopes and raw materials; refrigerating brines; nitrating acids; molding sands.

Jersey Sand as a Water Softener

Green sand marl is suitable for direct use as a water-softening agent, says the geology division of the Department of Conservation of Development of the State of New Jersey. Large quantities of this green sand occur in southern Jersey. The state bulletin says:

"After certain preliminary treatment, which charges it with exchangeable sodium, the marl is placed in the water softener and the water allowed to flow through it in a manner somewhat resembling the ordinary filter. The exchangeable sodium of the treated marl combines with the calcium and magnesium, the presence of which causes the hard water. The marl in turn gives up a proportionate quantity of sodium to the water. To restore it to complete efficiency it is necessary only to pass a solution of brine through the apparatus."

Principles of Chemical Engineering*

A Symposium Review of an Outstanding Work on Chemical Engineering of Value Alike to the Student in College and to the Seasoned Engineer

The Book: Its Significance

The Older Engineer Will Welcome This Volume as Enthusiastically as the Student

BY HENRY HOWARD
President, American Institute of Chemical Engineers

THIS BOOK will be found useful to every chemical engineer as a part of his working library. When Davis in 1901 brought out his "Hand Book of Chemical Engineering" in England, he was striking into what was then an almost untouched field. I do not know of anything that will impress one more as to the progress made in the "science" of chemical engineering than a comparison of these two books.

Another point that cannot fail to impress anyone who is not familiar with chemical engineering is the wide range of technical knowledge that is required by the well-trained chemical engineer of today. The authors should be particularly commended for the way in which they present the fundamental theoretical conceptions, both physical and chemical, which underlie or at least give useful explanations of the various subjects covered. The chapter on combustion deserves special mention, because of the suggestive way in which the subject is discussed.

The book is particularly valuable to older engineers who have not had the benefit of modern systems of instruction, in that the mathematical and chemical calculations are so carefully and logically developed that the older engineer will find their study most stimulating.

It is to be hoped that the prevent volume is merely the forerunner of amplified editions that the same authors will bring out from time to time, as was the habit of Dr. George Lunge in his various editions of "Sulphuric Acid and Alkali," which have performed such a wonderful service for the chemical industry of the world.

This criticism would not be complete without pointing out what seem to me to be shortcomings in the book. The space given to heating by powdered fuel and oil firing seems inadequate. Both of these methods are being widely adopted in chemical processes, especially where uniform conditions of temperature and oxidizing or reducing atmospheres are required. Inexpensive and satisfactory powdered coal equipment that requires no preliminary coal drier and which presents no explosion hazard is now available—for instance, the Aero pulverizer. The chapter on crushing and grinding gives some excellent information and data, but principally describes apparatus useful for very large-scale operations that are more commonly met with in mining.

Many more criticisms could be made, but the fact remains that the book presents much new material and is a very real contribution to the literature on this subject. It should be in every chemical engineer's library.

*"Principles of Chemical Engineering," by William H. Walker, Warren K. Lewis and William H. McAdams. New York: McGraw-Hill Book Co., 1923. 637 pages, $5 net.

Industrial Stoichiometry

A Difficult But Necessary Subject for the Chemical Engineer Presented in a Common-Sense, Usable Way

BY JOHN MORRIS WEISS
Consulting Chemical Engineer, New York City

THE chapter on the elements of industrial stoichiometry might well have been entitled the elements of mathematical common-sense. The author has taken the attitude that figures should be our servant and not a bogy. The simplification of the methods of calculation from one system of units to another by placing all figures on a molecular or atomic basis, though not new, is presented in a very clear and thorough fashion.

This chapter also brings to the attention of the reader a few of the more useful approximations of physical chemistry such as Trouton's formula for latent heats of vaporization. These are indeed extremely useful and will often serve for the sufficiently approximate solution of a problem in cases where exact data are unavailable in the literature and where the determination of the exact data would entail a burden out of proportion to the resulting extra exactitude of results.

The section entitled "Efficiency" would, in the writer's opinion, be advantageously susceptible of enlargement. There are many types of industrial processes in which the way the yield figures are stated is often puzzling and not co-ordinated. In the single example given, the author should have been more explicit in his definition of "recoverable salt." If he meant recoverable in the same state of purity as the original crude salt, his mathematical interpretation is the correct one. Some factor, however, should be introduced to distinguish two processes which by the author's method might show the same mathematical efficiency and yet the output *in one cycle* per unit of crude might make one process immeasurably more efficient commercially than the other.

The sections on "Choice of Data" and "Sampling" are to be highly commended. There is no doubt that in many instances chemists and engineers collect many useless data at great expense while neglecting obvious data readily obtained with little or no effort. In the discussion of the boiler tests and in the sample calculations given it would seem rather dangerous to base extensive calculations on the results ordinarily obtained with an Orsat gas apparatus, and it would seem desirable, where such calculations are to be made, to suggest the use of a more accurate analytical method than the one used. The section on "Sampling" is very pertinent and too much emphasis cannot be placed on its importance. The writer feels that similar emphasis might well have

been placed on the selection of accurate analytical methods and care in the application of these methods to the materials of the process.

On the whole, the chapter is stimulating and suggestive and represents a real contribution to chemical engineering thought. The principles are sound and, I believe, most useful to the practical experienced man. In fact, I feel that in the hands of the inexperienced the chapter may prove a dangerous tool. In Illustration I, if there is soot from either incomplete combustion or a leakage of air in the setting of the boiler, the calculations of the various results might be seriously in error. No doubt such matters are considered in later chapters, which at the time of this review I have not seen.

To the seasoned engineer, however, such matters are obvious, and to him the work is extremely useful, replete as it is with helpful suggestion and simplification of the mathematical problems with which we all have to deal in our daily work.

The Physical Basis for Chemical Engineering

The Chapters on Fluid Films, Flow of Fluids and Flow of Heat Form an Engineering Background to the More Restricted Consideration of Special Equipment

By George L. Mitchill, M.E.
New York City

Valuable technical books are being published continually; but it is only at rare intervals that a book is issued of such outstanding interest that it marks an epoch for its field. Such a book, to our mind, is "Principles of Chemical Engineering," by Professors Walker, Lewis and McAdams of M.I.T. It is the first successful attempt to place the study of chemical engineering on a basis of rational fundamentals. As a contribution to the text-book literature of this subject it marks the beginning of a new attitude toward chemical engineering.

THAT part of this work dealing with "Fluid Films" is descriptive, merely defining and declaring the existence of such films, and explaining their general effect on the flow of liquids and the transfer of heat. Incidentally the existence of such films is shown to explain the difficulty with which liquids commonly dissolve or absorb minute particles suspended in the air or other gas with which they are in contact. A clear conception of the nature of such films and their bearing on engineering problems can be drawn from this part of the work.

The treatment of the "Flow of Fluids" thoroughly covers the broad field indicated by the title. Introducing the conception of potential pressure and velocity head early, the authors show the manner in which these are connected with the action of various types of devices used for measuring pressure and flow. After a discussion of the mechanism of flow through conduits, these devices are considered with reference to the effect of changes in volume, temperature, viscosity, etc., on the indications read on various types and the energy loss incidental to their use.

In that part of the work devoted to the flow of heat, the authors define and thoroughly consider the mechanisms of conduction, convection and radiation of heat. Proper consideration is given to the effect of various complicating factors which so often intrude themselves in practice.

In scope, these chapters are not as broad as the titles, though they are in exact conformity with the title of the book. True engineering is the application of these "principles."

The scope and treatment are as applicable to mechanical or any other form of engineering as they are to chemical engineering, which is as it should be. The chemical engineer is expected to apply the principles of the science of chemistry; but to produce commercially successful results he must have recourse to the application of the science of mechanisms. He would hardly be expected to design heavy machines; but he would surely be expected to outline the piping system he required to handle his liquids or gases—that seems such a simple matter. However, the general design of an economical piping layout involves many factors and considerations quite foreign to chemistry, but these will also be controlled to a considerable extent by the chemical engineering. For example, piping a liquid at a certain temperature may so decrease its viscosity as to result in a distinct saving in power, offset perhaps by the cost of insulating the piping. There may be a technical as well as an economical limit to this temperature. The chemical engineer must possess the knowledge to control both factors to be truly successful.

Perhaps the above is a poor example, but it illustrates the point. A text book of chemical engineering should include the basic principles of mechanical engineering, with particular stress on such matters as flow of liquids and heat. This one does.

As to general scope and viewpoint, then, this book is what it sets out to be. Now, is it a good engineering textbook as to the line drawn where principles end and specific commercial methods begin? It is. It is no condensed catalog of flow meters, oil heaters, or pyrometers, notwithstanding that the principles of these and many other devices are considered.

Does it lean too far the other way? Does it dwell on the discovery of this or that natural law or detail of experimental methods by which physical constants were discovered? It does not. The laws are stated and formulated, the constants tabulated, and then the application is shown— which in the writer's opinion constitutes engineering.

Good engineering must be not only sound in its application of natural laws and physical constants, but must be reasonable. The formulas mathematically derived therefrom should be simplified by appropriate assumptions and approximations consistent with the degree of reliability necessary to commercial results. This book does so. The simplifications generally permissible or permissible in special cases are quite usually indicated.

Much more might be said along these lines, in general quite favorable to the book, as judged from the part here reviewed. But there is a different point to be considered. A text for students should be readable and interesting, consistent with brevity and complete mathematical

demonstration, if it is to be of much use in connection with American methods of teaching. For my part, I found this text interesting reading. References are well placed and easily found and the general arrangement is such as to avoid defeating the end of the work by breaking the student's train of thought.

All the above might be said without justifying the existence of the book as a text, especially if it is new. There are many such already. One might collect matter from this one and that one, arrange it differently perhaps, and evolve a new book satisfying most of the requirements of an engineering text. But such a book might not be at all justified. A new book should contain something new—not only as to arrangement but if possible as to material and information. I am impressed with the references to up-to-date literature and experiments and also such matters as the close consideration of fluid films in most problems in both flow of fluids and of heat. Also the discarding of empirical friction coefficients and the general solution of flow of liquid problems by a formula and curves which take into consideration all the many factors involved.

The authors should polish up some of their text, slightly change the form of a few formulas, stress some points differently and make a few typographical corrections. But I feel that the general arrangement and mode of presentation will stand the test.

The Art of Drying

A Subject Which Has Labored Under a Burden of Empiricism Is Brought by the Authors to the Dignity of a Science

By A. W. Lissauer
W. L. Fleisher & Co., Engineers, New York City

THE art of drying deserves recognition as a science, and a helping hand to aid its ascent from among the rule-of-thumb trades to its rightful place with others deemed worthy of academic study. It is not difficult to see why this has been a subject relegated to the tender mercies of the plant mechanic for solution; the removal of water by evaporation seems so simple—only a few trays, a box, some pipe coils and perhaps a fan, and presto! another drier is created. And at the same time is created one of two mental attitudes: if the mechanic by chance happens to guess right, "drying problems are too simple to bother with scientifically"; but if he happens to guess wrong, some one else, perhaps the office boy, is given an opportunity to outguess Nature! In either event, no attempt is made to discover the whys and wherefores, no data are collected, no progress is made. It is true that manufacturers of drying equipment have made valiant attempts to find out why their apparatus functions—or otherwise; but such data, all too often unfortunately, are crystallized into a "one grain per cubic foot absorption" philosopher's stone, or a collection of "designs of driers that have worked."

It is a great step forward in the right direction, then, to have the authors of this work on chemical engineering devote so large a part of it to this subject. One cannot help being impressed with the fact that they, among the leaders in their field, are convinced that sure, efficient and economical drying is one of the essential processes in modern industrial engineering. So also the reader is convinced of the inclusive background of properly and scientifically carried out experimental work, without which the most erudite analysis is merely scientific guesswork.

Everyone will acknowledge that the drying field is large; perhaps two-thirds of our industries require or use some type of such apparatus. It is, therefore, unfortunate that only a chapter has been allotted to contain within its bounds all that has been deemed worthy. Such concentration inevitably means generalization, with consequent danger of misleading the inexperienced who are unable to guide themselves concretely with only the general direction pointed out. The interest which this book will create will, it is hoped, encourage the authors to enlarge on the subject and to include a résumé of their experimental work, the results of which, as is so clearly pointed out, are so necessary for the solution of specific problems.

This chapter on drying is welcomed as an earnest effort to place the subject in its deserved place among the other chemical engineering processes; that those who refer to the book will be convinced that this has been accomplished is a foregone conclusion.

Evaporation and Evaporators

The Mechanism of Vaporization and Its Application in Various Processes of Evaporation and Types of Equipment

By E. J. Winter
Consulting Chemical Engineer, New York City

PAGES 375 to 435 deal with evaporation and evaporators. The mechanism of vaporization is explained, the factors controlling it are enumerated; and all evaporation processes are subdivided into four classes, according to heat supply and vapor removal. Steam-heated evaporators have been given the prominence they deserve. The true importance of vacuum and multiple effect evaporators is explained, and the various considerations which govern proper design are carefully evolved.

The evaporators themselves are subdivided into eight groups, according to design and method of operation. Some of these groups are never met with in practice, although they are of real theoretical interest.

The authors discourage the use of exhaust steam, basing their conclusions on prime movers of the highest class. Nothing is said about the auxiliaries. This question must be decided, in each case, by a heat balance of the entire plant, and not by a general rule. Where exhaust steam is used for evaporation and the feed water enters the boilers cold, the use of exhaust steam is very costly.

The usual difficulties encountered during operation are taken up one by one and suggestions are made, in each case, for the diagnosis of the trouble and the remedy. The method of calculation for evaporator design is very carefully set forth, and two examples have been solved. The equations for multiple effect evaporation have been included, but in the examples shown the "trial and error" method is used, as is always done in practice.

Basic Principles of Distillation

The Separation of Liquids From Liquids Placed on a Rational Basis and Illustrated by Examples From Practice

BY E. J. WINTER
Consulting Chemical Engineer, New York City

THE concluding pages of the book are devoted to a careful and authoritative exposition of the various distillation processes. The underlying principles in the separation of immiscible, partly miscible, and mutually soluble liquids are explained; the limitations of Râoult's and Henry's laws are shown; and the correct method of procedure is deduced and applied in several examples. The minimum reflux and the effect of various reflux ratios have been determined by calculation, and are shown graphically; and the number of plates required deduced therefrom.

On page 602 a novel and very ingenious method is offered for calculating the point at which the feed should enter the column. It is based on equal "enrichment rates" of the plates, keeping the rate of rectification constant throughout the column.

The authors remark: "It would seem that in commercial practice the feed is often introduced too high up the column." In a number of cases this is merely apparent and well justified. Sorel and Mariller tested a mixture of pure ethyl alcohol and pure water, and the authors based their calculations on these results. The distiller's high-wines, however, contain a number of troublesome compounds, among others the fusel oils. These are high boiling, very sparingly miscible in water, but completely soluble in ethyl alcohol. The "exhausting" plates of the rectifying column—i.e., those under the feed plate—are poor in alcohol; fusel oil forms constant boiling mixtures with water, evaporating at a lower temperature than ethyl alcohol. In other words, the water in the immiscible mixture evaporates before the alcohol, and it becomes impossible to exhaust the waste on the number of exhaust plates calculated by the authors.

The two expressions for the free energy of separation of liquid mixtures are no better than the assumptions they were based upon, but the conclusions drawn therefrom are undoubtedly true. Compared with the minimum work of separation, distillation-rectification is a very inefficient process.

Usually the chemical engineer has no other means at his disposal for the separation of liquid mixture. Occasionally, however, other (chemical) means are available as well; and the surprising inefficiency of the method becomes evident by comparison. This in nowise detracts from the basic importance of distillation.

Gas Producers—Their Design and Operation

The Industrial Use of Producer Gas Is Increasing and Its Generation Is of Much Importance to the Engineer

BY G. L. MONTGOMERY
Assistant Editor, *Chem. & Met.*

THE use of various types of fuel gas is of ever-increasing importance, as the authors have pointed out in earlier chapters. As this use increases, the equipment for manufacturing the gas must also increase in importance. Thus it seems to me extremely fitting that the subject of gas producers should be given a fairly thorough treatment in any work written primarily as a text for chemical engineering students.

The subject is treated from the standpoint of description of an ideal producer, having reference to the governing factors in the design and operation of the various elements; the application of these principles in various commercially successful producers; and the methods by which the production and efficiency of a producer may be figured for varying conditions of operation.

In the compass of an extremely small space, sufficient information is clearly and correctly brought forward to satisfy the needs of all except the engineer who specializes in producer design or control. In accordance with the general scheme of the book, the chemical engineer is here presented with the basic facts which he needs to know about gas producers.

Of particular interest is the development of the production computation. The authors have here applied their special type of equation, which is of value in that it shows at all points what the unit is and provides an extremely easy expression to check in case of error. So many cases of confusion in figuring the production of gas-making equipment have come to the writer's attention that a grounding of the student in such a clear method seems the noteworthy point in this part of the book.

Fuels—Their Combustion and Apparatus

Since Fuel Is Basic to the Production of Heat, Its Use Is of Primary Importance to the Chemical Engineer

BY JOSEPH A. DOYLE
Vice-President W. S. Rockwell Co., New York City

THE chapters on fuels and power, combustion and furnaces and kilns present a constructive, definite and conservative analysis of the subjects in question. It is pleasing to note that the authors have definitely expressed their views without the usual qualifications that leave the reader in doubt.

The orthodox method of treatment in the usual considerations of fuels, power, furnaces, methods of heating, etc., is not as broad as it should be; perhaps we should be more concerned with the use made of heat than with the process of making it. After all, the chemical industry is, like the metallurgical industry, more concerned with the quality and the cost of the product than with an abstract consideration of fuels, combustion and equipment.

For these reasons, the chapters of this work such as that on furnaces and kilns, which deal with the equipment for utilizing heat, were of most

interest to me and afford an opportunity for future expansion promising much good for the art. While in many details my experience does not run exactly parallel to that of the authors, the book gives a good picture of the fundamentals and as a text for the beginner in the art of chemical engineering should prove a work of real value.

Humidity, Thermometry and Related Equipment

The Design and Use of Much Equipment of Great Importance to the Chemical Engineer Is Properly Founded on a Consideration of the Amount of Water Vapor Present in Some Gas

By C. H Kimberly
Binks Spray Equipment Co., New York City

The general plan of this part of the book is excellently worked out and indicates that it can be well adapted to use for a text where the details are explained by a person thoroughly familiar with the physics and mathematics of the subject. However, for use by a student or practical engineer handling the entire field of chemical engineering, the very thoroughness and length to which the authors have gone in dealing with this phase of the work have a great tendency to cloud the understanding of one searching for information.

The definitions are well worded and as complete as is required and give a clear knowledge of their subjects. The use of problems to explain the principles and operation of the practical side is admirable. The charts are, however, not sufficiently explained, or their lines defined, to allow of their being put to practical use without a detailed study of the authors' intention.

The illustrations are excellent and cover the distinctive types correctly; but a few others showing the application of spray cooling ponds, evaporators, etc., would be of great help if the volume is used outside the class room. The authors apparently have a thorough knowledge of the subject and have given it a deep and excellent treatment, and the book, if used under direction of a competent instructor and as a text book, should meet a decided need and be of much value.

Crushing, Grinding and Separation

A Subject of Growing Importance to the Chemical Engineer Is Well Covered in This Book

By Edward H. Robie
Assistant Editor Engineering and Mining Journal-Press

Crushing and grinding and the mechanical separation of materials form an important part of many chemical processes. The authors are well advised in devoting sixty-seven pages of the book to these subjects. After discussing briefly the theoretical side of crushing and grinding, the factors on which the selection of machines is based are outlined. Apparatus is logically classified in four divisions: preliminary breakers, intermediate crushers, fine crushers, and fine pulverizers. For breaking the largest pieces, jaw or gyratory crushers are ordinarily used, three forms of the former and one of the latter being described briefly. The Symons disk machine (incorrectly spelled "Symonds") is the only form of apparatus mentioned under the head of intermediate crushers, though the use of gyratories and rolls is somewhat more common for the size of feed included in this designation—i.e., 1½ to 2 in. Rolls, however, are described under the heading of fine crushers, along with rotary crushers, stamps and the Chilean mill.

The section on fine pulverizers includes descriptions of cylindrical and conical ball mills, tube mills, centrifugal roll mills, burr mills and disintegrators. Ball mills are extremely popular, particularly in the mining field, the Marcy and Hardinge types being described briefly. The ways in which the fineness of the product of a ball mill may be regulated are well stated, though exception might be taken to the statement, "There is a certain amount of grinding or shearing action taking place in the mill, due to rolling of the balls, but its importance is small compared with the action of the falling balls." I am inclined to think that attrition is the chief way that grinding is accomplished in a ball mill, particularly when the smaller sizes of balls are used.

Speaking generally of the chapters under review, the treatment may be said to be good though brief. For more complete data, such a book as Allen's "Handbook of Ore Dressing" or Truscott's "A Text-book of Ore Dressing" should be consulted.

Filtration—Theoretical and Practical

The Subject Is Covered From the Standpoint of Design, Operation and Utility

By Arthur Wright, M. E.
Filtration Engineers, Inc., New York City

Upon opening this chapter and thumbing over its pages the reader is confronted by a formidable array of mathematical formulas; differential and integral calculus that may well make him fumble back for facility to the math of his sophomore year. The chief interest of the chapter lies in its treatment of "filter calculations" and derivations of formulas.

In contrast to the skimpiness of some parts of this chapter, the paragraphs on "Filter Calculations" are not stinted. We must respect the mass of experimental work undertaken and the thoroughness with which it has been done. This is indeed most important in its endeavor to point the way from loose rule-of-thumb methods by reducing filtration principles to mathematical equations. The authors have made a considerable advance and their work can well be commended.

To sum up, the value of this book is academic, not practical, but it is none the less important for that. It is a real contribution to the art of filtration and should give rise to increased efforts to reduce to mathematical terms the varied performance of our present-day filtering apparatus

Machinery and Appliances for Production and Control

Equipment News

From Maker and User

Materials and Accessories for Chemical Industries

High Temperature Refractory

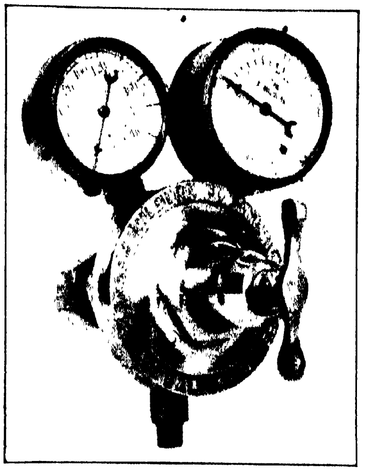
The Celite Products Co. for a number of years has had an insulating brick on the market known as "Sil-O-Cel," which has been used for the insulation of various types of furnaces, boilers, ovens, kilns, etc.

Quite recently this company has developed a calcined brick known as Sil-O-Cel C-22 brick, which is used for severe conditions where the unburned brick might be subjected to a temperature high enough to cause shrinkage. These C-22 brick are recommended for use where the insulation will be subjected to temperatures in excess of 1,650 deg. F. and can be successfully used without any danger of shrinkage at temperatures in excess of 2,000 deg. F. They are composed entirely of Sil-O-Cel and for this reason have a high insulating value. They also have an unusually high crushing strength for an insulating brick.

These brick are for service at extreme operating temperatures and are especially well adapted for use in the combustion zones of power boilers, in furnaces, kilns, etc., which operate at temperatures in excess of 2,500 deg. F.

Pressure Regulator

This is a new regulator for the purpose of regulating the control and delivery of acetylene, oxygen, hydrogen and other high-pressure gases. It is designed to maintain a constant predetermined pressure regardless of fluctuations in the initial pressure line and variations in consumption. This regulator is simple in design. The front cap contains an adjusting key, a top spring button and a tension spring. The body contains in front a flexible metal diaphragm, soldered on. Over this diaphragm is screwed a bronze diaphragm plate or spring button to hold the tension spring. Inside this body is a fixed nozzle containing a loose operating pin. Over the nozzle is loosely assembled the valve sleeve, which has a roll of gas ports drilled through its circumference and carries the valve seat. The seat closes against the nozzle by initial gas pressure on the valve sleeve and pressure of a compensating spring resting in the recessed tank coupling. The loose operating pin inside of the nozzle is actuated at one end by the deflection of the diaphragm and at the other by pressure of the valve sleeve.



MILBURN GAS REGULATOR

It will be noticed from the above description that the regulator closes with the gas pressure and not against it. This enables the sealing to be effected by pressure of several pounds instead of hundreds of pounds, as would be the case if the sleeve were yoked to the diaphragm. In this design the sleeve is entirely independent of the diaphragm. An equilibrium is maintained in the regulator at all times, throttling the supply when the desired pressure is built up and opening instantly when the consumption lowers the pressure and an increased supply is needed.

This regulator has been simplified in all particulars from the old design and has been reduced in size and weight. The valve seat is now subjected to much less wear and, being held in perfect alignment, it works with accuracy for many months longer than the seat of the old-style regulator.

Neither volume of gas nor accuracy of regulation has been sacrificed in simplifying the construction. On the contrary, the manufacturer claims for this regulator that it will act with more directness and regulate within closer limits, in addition to maintaining its efficiency of regulation for a longer and harder period of service.

The regulator is adapted for use with various gases by a change of the gages shown in the illustration. The rear connection is also changeable so that the regulator can be attached to various types of containers. This regulator is the invention of A. F. Jenkins, who has long been associated with the acetylene industry. It is manufactured and sold by the Alexander Milburn Co. of Baltimore, Md.

Catalogs Received

STEERE ENGINEERING CO., Detroit, Mich.—Pamphlet 246. Leaflet pointing out further information relative to this company's bulletin 39.

OXWELD ACETYLENE CO., Chicago, Ill.—How Welded Joints Solved Pipe Line Troubles. A book made up of reprints describing the use of oxy acetylene welding equipment as used in the petroleum industry, the city gas plant, long-distance high-pressure gas transmission, and industrial piping.

THE FOXBORO CO., Foxboro, Mass.—A new issue of the Foxboro Co.'s general catalog, including many recent bulletins of this company, issued under date of April, 1923. The subjects include all types of Foxboro recording and indicating instruments.

KNAPP METAL BARREL & PACKAGE CO. OF NEVADA, San Francisco, Calif.—Leaflet describing the Knapp knock-down metal barrel with locking head.

BROWN HOISTING MACHINERY CO., Cleveland, Ohio—Catalog F. A catalog describing the new Brownhoist single roll coal crusher. Catalog M. A catalog describing the new Brownhoist belt conveyor idler.

LINK-BELT CO., Chicago, Ill.—Book 480. A new Link-Belt catalog describing the company's line of electric hoists and overhead traveling cranes. This book is well illustrated with many suggestive applications of Link-Belt hoists and cranes.

CONTINENTAL PIPE MFG. CO., Seattle, Wash.—Catalog 18. A new and very complete catalog on various types of wood pipe and flumes manufactured by this company. The book is well illustrated and contains many tables of value to the engineer.

THE ESTERLINE-ANGUS CO., Indianapolis, Ind.—Bulletin 223. A bulletin describing various new uses for the Esterline type of graphic instruments.

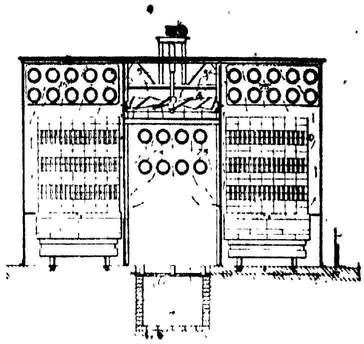
PENNSYLVANIA FLEXIBLE METALLIC TUBING CO., Philadelphia, Pa.—Bulletin 55-B. A new bulletin describing the "Penflex" type of all-metal heavy-duty hose and couplings for tank car unloading.

THE ROTO CO., Hartford, Conn.—A new catalog describing the Roto line of tube cleaners for boilers, economizers, condensers, evaporators, feed water heaters and other tubular equipment.

Review of Recent Patents

Developments of Interest to the Chemical Engineer

Drying, Catalysis and Crystallization Among Fundamental Processes Stressed in Recent Patent Specifications



A NEW WASTE HEAT DRIER

FEW UNIT PROCESSES in chemical engineering have been more intensively studied or more extensively developed than drying. Driers have been used for many years, but until quite recently their development has been empirical. Perhaps within the last decade modern drying has come into its own. It is, therefore, with rather unusual interest that patents on drying equipment are studied. W. M. Schwartz and E. B. Ayers, of Philadelphia, have patented a tunnel drier for drying bricks and other pottery materials before they are baked in a kiln. Among other interesting features, it utilizes the waste heat from the firing kiln to dry the pottery or brick.

The principle of the drier is illustrated in the accompanying diagram. It consists essentially of three longitudinal chambers, two drying chambers on either side and an intermediate circulating chamber in the center. The drier is heated in two ways. In the first place, hot air from the cooling zone of the kiln comes into direct contact with the bricks as they are dried, and again the flue gases from the kiln itself are led through the drying chamber in pipes, over which circulates the air that comes in contact with the bricks and dries them. The gases from the cooling part of the kiln enter from the

American Patents Issued May 15, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.*'s staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,454,870-871—Nitration Apparatus and Process for Nitrating Cellulose. H. V. Walker, Newark, N. J.

1,454,873—Method of Handling Gases and Product Containing Dissolved Gas. H. C. P. Weber, Pittsburgh, Pa., assignor to Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

1,454,874—Fractionating Column. H. C. P. Weber, Pittsburgh, Pa., assignor to Westinghouse Company.

1,454,916—Means for Separating the Liquid and Solid Components of Mixtures of Liquids and Solids. A. J. Arbuckle, Johannesburg, Transvaal, South Africa.

1,454,945—Acid Receiver. P. L. Pfannenschmidt, Jena, Germany.

1,454,959-961—Cellulose Ether, Cellulose-Aralkyl-Ether and Composition Containing Cellulosic Derivatives. Henry Dreyfus, London, England.

1,455,005—Process of Producing Anhydrous Metallic Chloride. B. S. Kirkpatrick, San Pablo, and F. S. Morgan, Berkeley, Calif., assignors to Standard Oil Co. of California.

1,455,015—Soap. F. C. Atkinson, Indianapolis, Ind., assignor to American Hominy Co., Indianapolis.

1,455,016—Process of Preserving Cotton Seed. F. C. Atkinson, Indianapolis, Ind.

1,455,059—Cooling Means for Exhaust Mains. J. Van Ackeren, Pittsburgh, Pa., assignor to the Koppers Co., Pittsburgh, Pa.

1,455,060—Process of Recovering Iron Oxide and Other Products From Spent Iron Sludge. C. V. Bacon, Mahwah, N. J.

1,455,072—Dehydration of Alcohol. H. E. Bue, Roselle, N. J., assignor to the Standard Development Co.

1,455,088—Electrically Operating Treating Chamber for Hydrocarbon Vapors and Gases. J. L. McCabe, Wichita, Kan.

1,455,139—Electric Dehydrator. F. W. Harris, Los Angeles, Calif., assignor to the Petroleum Rectifying Co., San Francisco.

1,455,156—Apparatus for Refrigeration. R. A. Willson, Spokane, Wash., assignor of one-half to F. N. Martin, Spokane.

1,455,181—Furnace Gas Producer. C. E. Wentzel, Dayton, Ohio, assignor to International Clay Machinery Co., Dayton.

1,455,200—Insulating Composition for Electrical Apparatus. F. J. Groten, Jr., Meriden, Conn., assignor to Conn. Tel. & Elec. Co., Meriden.

1,455,238—Drying Appliance. H. J. Bosch, New York.

1,455,254—Utilization of Edible Fats. M. Kahn, New York, assignor to Intraven Co., New York.

1,455,263—Method and Apparatus for Testing Gaseous Mixtures. G. Oberfell, Tulsa, Okla.

1,455,264—Easily and Neutrally Soluble Double Compounds of 1-Allyl-3.7-Dimethyl Xanthine. E. Preiswerk, Basel, Switzerland, assignor to the Hoffman-La Roche Chemical Works, New York City.

1,455,284—Burning Sulphur. H. S. Davis, Pittsburgh, Pa., assignor to Texas Gulf Sulphur Co., New York City.

1,455,299—Method of Evaporating Ammonia Liquor. F. F. Marquard, Clairton, and C. W. Littler, Swissvale, Pa.

1,455,309—Propulsive Blasting Explosive. A. J. Strane, St. Paul, Minn., assignor to the Atlas Powder Co., Wilmington, Del.

1,455,376-7—Process of Converting Oils and Apparatus Therefor. J. H. Adams, Flatbush, N. Y., assignor to the Texas Co., Houston, Tex.

1,455,392—Apparatus for Drying Charges for Shaft Furnaces. E. Diepschlag, Breslau, Germany.

1,455,414—Absorbing and Purifying Composition. J. C. Tate, Oakland, Calif.

1,455,436—Art of Filtration. G. H. Field, Culver, Ind., assignor to Standard Oil Co., Whiting, Ind.

1,455,437—Petroleum-Distillation Process. V. T. Gilchrist, San Francisco, Calif., assignor to Superior Process Refining Co., San Francisco.

1,455,448—Process of Manufacture of Diphenylenediketones From Anthracene Compounds. G. Peters, Worms, Germany.

1,455,456—Ball Mill. L. L. Sweet and M. Morley, Wallace, Idaho.

1,455,469—Method of and Apparatus for Separating Coal and Like Substances and Impurities Mingled Therewith. W. D. Althouse, Philadelphia, Pa.

1,455,471—Method of Preparing Pulp. C. Bache-Weig, Portland, Me.

1,455,486-7-8—Dyes of the Acridine Series and Their Manufacture (2 patents). Dyes of the Benzene-Napthalene-Acridine Series and Their Manufacture. H. Grünhagen, Berlin, Germany, assignor to the Chemical Foundation, New York City.

1,455,495—Mercury Derivatives of Aromatic Compounds and Process of Making Same. A. Klages, Magdeburg-Sudost, Germany, assignor to the Chemical Foundation, New York City.

1,455,505—Filtering Apparatus. W. Paterson, London, England.

1,455,508—Process of Making the Chlorinated Products of Methane. E. H. Riesenfeld, Freiberg, Germany, assignor to the Chemical Foundation, New York City.

1,455,509—Method of Refining Mixtures of Chlorides of Napthalenes Serving as Substitutes for Rosin. K. Rucker, Berlin, Germany, assignor to the Chemical Foundation, New York City.

1,455,527—Coke Oven. P. Gottart, Brussels, Belgium, assignor to the Belgian-American Coke Ovens Corp., Wilmington, Del.

1,455,544—Rubber or Rubber-Coated Article. L. Minton, Manchester, England.

1,455,546—Process of Treating Bitumen or Cellulose-Containing Substances. I. Moscicki, Lwow, Poland.

1,455,591—Process of Treating Paper Stock. F. P. Miller, Downington, Pa.

1,455,598—Aromatic Hydrocarbon Cement. W. S. Barrie and L. Chadwick, Selwyn, Queensland, Australia.

1,455,630 and 679—Preparation of Starch and Sulphuric Acid. J. A. Lloyd, Coventry, England, assignor to Courtaulds, Ltd., London.

1,455,642—Still. J. M. Mahoney, Houston, Tex.

1,455,655—Process of and Means for Tanning Hides. V. Peradotto, Gallenca, Turin, Italy.

1,455,707—Recovery of Ether. J. H. Brégeat, Paris, France, assignor to Brégeat Corporation of America, Wilmington, Del.

1,455,728—Process for the Removal of Water From Colloidally Dissolved Substances Such as Crude Peat, Coal Sludge and the Like. H. Horst, Uerdingen, Germany, assignor to Gesellschaft für Maschinelle Druckentwasserung mitbeschränkter Haftung, Uerdingen, Germany.

1,455,762—Process of Recovering Cork and Other Products From Bark. G. C. Howard, Seattle, Wash.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

floor of the circulating chamber by means of dampers, which can be regulated, and mix with the air that is being circulated by means of fans at the top of the circulating chamber. The accompanying diagram illustrates a cross-section of the kiln and shows the flue underneath the floor of the circulating chamber, through which the air is admitted to the drier. It also shows the pipes 23 and 25 which contain the flue gases from the kiln.

Bricks are loaded on cars that are pushed through the tunnel drier by means of a hydraulic ram, both sides being operated at the same time. The diagram does not show deflectors which control the flow of gases nor the stacks and headers by which the flue gases are led from the kiln through the drying chamber in pipes and on to the stacks. This is described in Patent 1,451,589, issued April 10, 1923, and assigned to Proctor & Schwartz of Philadelphia.

A Useful Idea in Producing Halogen Acids

When silicon tetrachloride is treated with water, silicic acid and hydrochloric acid are formed. This, however, does very little good in the manufacture of hydrochloric acid, because the silicic acid comes down as a gelatinous precipitate, which is practically impossible to handle on a commercial scale. On the other hand, this reaction might be useful if it took place at a temperature above the dehydrating point of silicic acid. Then the material would come down in a dry state and the hydrochloric acid would be evolved as a gas. This is substantially the process patented by F. S. Low of Niagara Falls and assigned to the Weaver Co. of Madison, Wis. In carrying it out, he suggests vaporizing the silicon tetrachloride with a blast of steam. The reaction then takes place in a chamber in which the temperature is kept well above the dehydrating point of silicic acid. The silica drops to the bottom and may be removed by means of a hopper, whereas the hydrochloric acid vapor is evolved through a system in which appropriate absorption can take place. (1,451,399, issued April 10, 1922.)

A Continuous Crystallizer

Another patent is interesting, as it involves a principle that is coming to the fore more and more—that of continuous crystallization of particles having a definite size. The crystallizer of Truman E. Stevens of Omaha, Neb., contains scrapers made of large wire or heavy bristle brushes. The fine crystals are thus formed on the surface of the tank, which is cylindrical, and are immediately brushed off by the brushes. This keeps the tank free from an insulating layer, allows rapid cooling, and feeds the whole tank with fine crystals which grow to larger crystals as they travel to the bottom of the crystallizer, where they may be removed through an appropriate chute. (1,450,992, issued April 10, 1923, and assigned to Potash Reduction Co., Hoffland, Neb.)

Catalysts Improved by Grinding

Metallic nickel used as a catalyst in the hydrogenation of fatty acids and their esters and glycerides can be produced by treating a nickel salt with metallic zinc, but the resulting nickel is only weakly catalytic. If, however, the zinc is used in granular form and the reaction takes place under grinding conditions, as for example in a ball mill, the resulting nickel powder has a very much higher catalytic activity. This process was patented by George A. Richter, and assigned to the Brown Co. of Berlin, N. H. (1,451,113, issued April 10, 1923.) It is further noted in this patent that nickel which is produced from nickel sulphate has a higher activity than that produced from nickel chloride. The precipitated nickel is settled out and is washed free from zinc salt solution, after which it is dried in an inert atmosphere or under vacuum.

Trend of Invention in the Paint and Varnish Industries

Byproduct Recovery and Special Paints and Enameling Compositions Are the Subject of Late Patent Developments

AT LEAST six of the many patents issued during the month of March and April are of interest to the paint and varnish industries. Paul W. Webster, of Perry & Webster, New York, has described an oxidizable oil that can be recovered from the fume-collectors over paint and varnish heating kettles. The product he obtains is useful as a froth-producing material to be used in the flotation process. A non-corrosive paint consisting essentially of ferric oxide, zinc oxide and copper oxide is the subject of a patent by A. C. Tutt and Levi F. Snelson. A pure white paint "of a lasting, permanent nature which will be proof against the action of fire, acid, sun, water and rust" is specified in a similar patent by John T. Lawrence. Two of the patents refer to varnish gums. James McIntosh has patented a synthetic gum made by the condensation of a phenolic body with a ketone. Carleton Ellis' patent relates to a paint the vehicle of which contains cumaron resin. This paint dries to a flat or dull surface in contrast with the glossiness of ordinary paint. Herman F. Willkie, of the U. S. Industrial Alcohol Co., has obtained a novel enameling composition containing pyroxylin, which, although applied as a single coat, dries to form a dense opaque surface, very much like the highly glossed surface obtained with varnish.

Recovering a Marketable Byproduct

In paint and varnish manufacture various types of drying oils, such as linseed, tung, china wood and soya bean oils, are boiled together with the resins, gums and pigments in kettles, which are usually provided with fume-collection equipment. These fumes given off consist of various vapors and volatile oils, together with some comparatively permanent gases. Examination of these fumes has shown that they contain an oil distillate that may be separated by condensation. The condensers consist of tubes cooled by means of air or various liquid refrigerants. By drawing air into the condensing tubes the distillate is oxidized during the time it is condensing. The stable liquid obtained from these condensers is an air-drying fatty oil, with a condensing point below 75 deg. F. (1,447,954, issued March 6, 1923.)

Non-Corrosive and Special Paints

An example of the non-corrosive paints obtained by Tutt and Snelson is made by mixing 70 parts of dry ferric oxide, 10 parts of dry zinc oxide and 10 parts of copper oxide and thoroughly incorporating them with about 60 parts of raw linseed oil. Small quantities of either waste or reclaimed rubber and of raw amber are also incorporated with the oil and form a part of the paint. The rubber gives an adhesive quality, while the amber supplies the gloss. (1,448,284, issued March 13, 1923.)

The formula for the paint made by Lawrence is as follows: Poppy seed oil 80 parts, barium sulphate 12 parts, sodium carbonate 12 parts, prepared white zinc oxide 24 parts, white lead 12 parts, zinc sulphate 16 parts, silica 12 parts, ground white antimony 6 parts, commercial yellow rosin 6 parts, and water-white rosin 6 parts. All of the ingredients except the rosin are mixed together at approximately 600 deg. F. for about half an hour. The non-corrosive properties of this paint are claimed to apply for both wood and metal surfaces. (1,450,688, issued April 3, 1923.)

Synthetic Gum and Cumaron

The patent on synthetic gum, which is assigned to the Diamond State Fibre Co., provides for the condensation of phenol, or a phenolic body, with a ketone such as acetone or methylethylketone, in the presence of sulphuric acid, bromine, sulphur, pyridine, or any other suitable catalytic agent. The resulting gum after it has condensed to a solid form is placed on an oven and subjected to a temperature of from 120 to 130 deg. C. for from 10 to 12 hours. A yellow or orange gum having a melting point of about 80 deg. C. and a high luster is obtained which is especially valuable as a shellac substitute. It is soluble in alcohol, benzol, acetone and most other organic solvents, although it is insoluble in water. (1,448,566, issued March 13, 1923.)

The patent by Carleton Ellis provides

for the use of a 33 to 45 per cent solution of hard cumaron resin (m.p. 90 deg. C.), which is mixed with 5 lb. lithopone and put through a paint grinder. This paint thus obtained when applied to a wooden or other surface dries to a flat finish. For a red color, iron oxide may be used instead of lithopone, the following proportions being necessary: 225 lb. mineral red, 57 lb. cumaron resin and 80 lb. heavy benzine. The use of various other pigments, such as ocher, umber and brunswick green, may be desirable in order to obtain a variety of colors. (1,451,092, issued April 10, 1923.)

Pyroxylin Enameling Composition

The object of the patent by Willkie was to provide a composition that would give an enameled surface, similar to varnish, by the application of a single coat. The enameled coating obtained by this composition, although it is applied as a single coating, is in reality made up of a lower layer of a dense opaque character and an upper varnish-like layer that gives the coated surface a high gloss. A cellulose ester such as pyroxylin is dissolved in a solvent mixture made up of 75 per cent by volume of ethyl alcohol having a strength of approximately 90 per cent, 23.75 per cent of anhydrous ethyl acetate and 1.25 per cent of diethyl phthalate. The last named is the so-called high-boiling solvent and it remains in the upper part of the hardened film as a latent solvent of the cellulose ester, thus cementing together the particles of precipitated ester, which form the lower layer of the coating.

It is pointed out that other cellulose esters, such as cellulose acetate, may be used and that the ethyl acetate and alcohol may be replaced by various solvents such as acetone, methyl acetate, etc. Furthermore, the diethyl phthalate may be replaced by various other compounds, such as ethyl aceto acetate, triacetin, etc. (1,449,157, issued March 20, 1923, and assigned to U. S. Industrial Alcohol Co.)

Synopsis of Recent Literature

Foundations and Floors

The subjects of foundations, floors and ceilings is a highly important one to the executive who contemplates industrial building. G. L. H. Arnold, in his series on "Buildings From the Manager's Viewpoint," in *Management Engineering* for May, 1923, points out that good foundations properly supported, floors of ample strength and ceilings free from obstructions are prime requisites of the good factory building.

Foundations — The foundation must first be strong enough to bear the building load. It must be supported in such a way that settlement is reduced to a minimum and cracking prevented. To attain this latter point bearing surfaces must be ample and, if the soil is poor in bearing qualities, piling must be used. Finally, foundations must be properly waterproofed to a point well above the water line.

Floors — The points to consider in flooring, after the prime one of adapting the floor material to the type of manufacture to be conducted in the building, are:

1. It should be smooth, and free from nails, bolts and other projections; also from holes and splinters.

2. It should be dry, of low heat conductivity, durable, and easily cleaned.

3. It should be constructed strongly enough to bear at least four times the static load, and six times the moving load which may be placed upon it.

4. It should be as nearly noiseless as possible. Noisy floors may wear well, but the noise of the feet, truck wheels and machinery irritates the workmen.

5. It should not be slippery, nor made of material which will wear slippery.

6. Regular inspection of floors should be made and defects repaired promptly.

Ceilings— Lighting and the probable requirements for pipes, shafting and belts will be the important factors to be considered in connection with the ceilings. For lighting purposes the flat slab ceiling is best, while if much piping and shafting is to be run the beamed type with its smaller column heads is better. In general, a proper compromise must be made to suit the particular industry.

Seaboard Liquid Purification Process

An answer to the paper of R. H. Broker, recently published by *Gas Age-Record* and synopsized in these pages, from the pen of F. W. Sperr, Jr., of the Koppers Co., appears in *Gas Age-Record* for May 19. Mr. Sperr says in part:

The paper by Mr. Broker is to be welcomed as a frank statement of the difficulties likely to be encountered by a gasworks management which undertakes to design and build its own liquid purification plant. It should perhaps have been stated plainly in the paper that, at the request of the Racine management, the design and construction of the plant were done by themselves locally; but doubtless Mr. Broker intended that this should be brought out in the discussion. In fairness to the "Seaboard process," it should be emphasized that there are five other plants in operation using the process under all sorts of conditions, and that these are all operating with a high degree of efficiency and to the satisfaction of their owners.

From the local conditions at Racine,

Important Articles In Current Literature

More than fifty industrial technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem. & Met.* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. Those that are of unusual interest will be published later in abstract in this department; but since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage. The magazines reviewed have all been received within a fortnight of our publication date.

MITSCHERLICH PULP. Arthur S. M. Klein. *Paper Trade Journal*, May 17, 1923, Technical Section, pp. 180-184.

FINDING STEAM LOSSES FROM STEAM COSTS. S. H. Childs. *Paper Trade Journal*, May 17, 1923, Cost Section, pp. 52-53.

DENATURED ALCOHOL IN CANADA. Ross E. Gilmore. *Canadian Chemistry and Metallurgy*, May, 1923, pp. 116-118.

CANADA'S CHEMICAL TRADE. S. J. Cook. *Canadian Chemistry and Metallurgy*, May, 1923, pp. 135-138.

TURPENTINE. G. H. Pickard. *American Paint Journal*, May 14, 1923, pp. 18-22.

THE ELECTRON IN CHEMISTRY. Sir J. J. Thomson. *Journal of the Franklin Institute*, May, 1923, pp. 593-620.

HIGH TEMPERATURE INVESTIGATION. E. F. Northrup. *Journal of the Franklin Institute*, May, 1923, pp. 665-686.

STAINLESS STEEL. *Engineering*, May 4, 1923, p. 550.

SOME EFFECTS OF ZIRCONIUM IN STEEL. F. M. Becket. *Iron Age*, May 10, 1923, p. 1321.

SURFACE COMBUSTION. W. A. BONE. *Engineering*, May 11, 1923, p. 594.

THE DESIGN OF HOT-AIR DRYING PLANT. George H. Gill. *Engineering* (London), May 4, 1923, pp. 541-542.

SEABOARD LIQUID PURIFICATION PROCESS. F. W. Sperr, Jr. *Gas Age-Record*, May 19, 1923, pp. 639-640.

RINCKER COMPLETE GASIFICATION PLANT. *Gas Age-Record*, May 19, 1923, pp. 637-638.

LES APPLICATIONS INDUSTRIELLES DE LA CATALYSE EN CHIMIE ORGANIQUE. A. Mailhe. *La Technique Moderne*, May 1, 1923, pp. 257-264.

inferences are drawn by Mr. Broker against the efficiency of the process. At present writing, one of the five other plants is removing 82 per cent of the hydrogen sulphide in the gas; the others are removing from 90 to 95 per cent of the hydrogen sulphide. All of these plants are removing 90 per cent or more of the hydrocyanic acid in the gas. In the case of the single plant with 82 per cent efficiency of H_2S removal, changes will be made which will increase this to 90 per cent. For plants which it designs and builds the Koppers Co. is willing to guarantee an efficiency of at least 85 per cent.

The only other important point raised by Mr. Broker is the question of the odor of the actifier air. There has been no disposition on the part of the Koppers Co. to minimize this.

The expedient of burning the actifier air, as practiced at Battle Creek, is undoubtedly the surest way of avoiding complaint; but in certain cases the Koppers Co. has recommended dilution, and with ample ground, in spite of Mr. Broker's statement. One plant located in the midst of an important business district and close to offices and dwellings has employed dilution for nearly a year as the sole method of disposal of the actifier air, and has had no complaint and no indication of objectionable odor. Three other plants located farther away from business or residence district discharge the actifier air directly into the atmosphere and have had no complaint.

The height of the point of discharge above the ground is undoubtedly important; and with a sufficiently high stack, dilution may in many cases be the most satisfactory means of getting rid of the actifier air. It should be brought out in this connection that when the Racine plant was first started they had a wooden stack only 30 to 35 ft. high—in fact, not so high as the purification tower. It was during this period that practically all of the odor trouble occurred.

Men in the Profession

R. F. BOWER, a statistical expert in fertilizers and fertilizer materials, has been appointed to assist in the nitrate studies of the Department of Commerce. Mr. Bower will give particular attention to the agricultural demands for nitrogen.

C. G. DARWIN, grandson of Charles Darwin, recently addressed the Southern California Section of the American Chemical Society, at Los Angeles, on "The Periodic System." Mr. Darwin has been appointed to the new Tait chair of natural philosophy at Edinburgh University.

J. WALTER DRAKE, an automobile manufacturer of Detroit and a native of Sturgis, Mich., has been selected to fill the vacancy in the office of the Assistant Secretary of Commerce created by the resignation of Claudius H. Huston.

A. C. FIELDNER, supervising chemist and superintendent of the Bureau of Mines Experiment Station, Pittsburgh, Pa., gave a lecture before the Mining Society of Pennsylvania State College, State College, Pa., May 4, on "The Constitution of Coal."

L. W. HIMMLER has resigned as assistant chemist in the Dairy Division, Bureau of Animal Industry, at Washington, D. C., to join the research staff of the Cudahy Packing Co., at Omaha, Neb.

S. P. HOWELL has been assigned to work in connection with the field investigation of liquid oxygen explosives for the Bureau of Mines.

RAYMOND B. LADOO, mineral technologist of the Bureau of Mines, has resigned that position to go with the Southern Mineral Co., Washington, D. C. He will devote his attention to the development work in connection with the non-metallic minerals in the Southern states.

ERIC A. LOF, who since 1909 has been connected with the power and mining engineering department of the General Electric Co. as industrial engineer and specialist, has resigned to take up work with the American Cyanamid Co., with headquarters in New York City. He will assume his new duties June 1.

RONIER D. OILAR, chemical engineer, returned recently from a trip to South America, having spent a little over a year in development and investigational work on vegetable oil, soap and packing-house industries in Peru and several other countries.

BRADLEY STOUGHTON, formerly secretary of the American Institute of Mining and Metallurgical Engineers and more recently consulting engineer, will, beginning next fall, be professor of metallurgy at Lehigh University, Bethlehem, Pa.

Obituary

HENRY WOODLAND, secretary and treasurer of the Allis-Chalmers Manufacturing Co., died suddenly at his home in Milwaukee, May 14. Born in Utica, N. Y., Mr. Woodland at an early age became connected with the New York Air Brake Co. of Chicago. When in 1901 this company was taken over in the consolidation which formed the Allis-Chalmers company, he became assistant treasurer of the new organization and afterward its treasurer. In 1916 he was elected secretary and treasurer. At the time of his death he was also vice-president and a director of the Hanna Engineering Co. of Chicago.

New Publications

NEW BUREAU OF STANDARDS PUBLICATIONS. Circ 42, Tables of Thermodynamic Properties of Ammonia; Tech. Paper 285, Thermal Stresses in Steel Car Wheels, by George K. Burgess and G. Willard Quick.

UNIV OF ILLINOIS BULLETIN 136, "An Investigation of the Fatigue of Metals, by H. F. Moore and T. M. Jasper.

A COMPARISON OF BRITISH AND AMERICAN FOUNDRY PRACTICE, with special reference to the use of refractory sands, by P. G. H. Boswell Published by the University Press of Liverpool, Ltd, Liverpool, England. Price 4s. 6d

CENTENARY OF THE ALKALI INDUSTRY A well-illustrated volume recording a century of progress in the British alkali industry.

NEW BUREAU OF MINES PUBLICATIONS: Bull 201, Prospecting and Testing for Oil and Gas, by R E Collom, Bull. 202, Electric Brass Furnace Practice, by H. W. Gillett and E L Mack, Bull 211, The Chloride Volatilization Process of Ore Treatment, by Thomas Varley, E P Barrett, C C Stevenson and Robert H Bradford, with an introductory chapter by Stuart Croasdale; Bull. 213 Talc and Soapstone, Their Mining, Milling, Products and Uses, by Raymond B Ladoo, Bull 218, The Technology of Slate, by Oliver Bowles; Tech Paper 279, Economic Combustion of Waste Fuels, by David Moffat Myers; Tech. Paper 287, Preparation of Light Aluminum-Copper Casting Alloys, by R. J. Anderson; Tech. Paper 300, The Universal and the Fireman's Gas Masks, by S H Katz, J. J. Bloomfield and A C Fieldner, Tech. Paper 301 Proposed Method for Reducing Mineral Waste in the Wisconsin Zinc District, Wisconsin, by Will H Coghill and C O Anderson; Tech Paper 323, Specifications for Petroleum Products and Methods for Testing; Tech Paper 325, Natural-Gas Manual for the Home, by R A Cattell; Bull 210 (issued from Bureau of Mines, Denver Colo) Oil-Shale a Historical, Technical and Economic Study by Martin J Gavin.

Calendar

AMERICAN ASSOCIATION OF CEREAL CHEMISTS, ninth annual convention, Hotel Sherman, Chicago, June 1 to 9.

AMERICAN CHEMICAL SOCIETY, fall meeting, Milwaukee, Wis., Sept. 10 to 14.

AMERICAN CHEMICAL SOCIETY, New York Section, regular meeting, Rumford Hall, Chemists' Club, June 8.

AMERICAN ELECTROPLATERS SOCIETY, eleventh annual meeting, Providence, R. I., July 2 to 5.

AMERICAN GAS ASSOCIATION, annual convention, Atlantic City, Oct. 15 to 20.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, summer meeting, Wilmington, Del., June 20 to 23.

AMERICAN LEATHER CHEMISTS ASSOCIATION, twentieth annual convention, Greenbrier, White Sulphur Springs, W. Va., June 7, 8 and 9.

AMERICAN PULP AND PAPER MILL SUPERINTENDENTS ASSOCIATION, annual meeting, Springfield, Mass., May 31 to June 2.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, spring meeting, Montreal, Canada, May 28 to 31.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS, iron and steel exposition, Buffalo, N. Y, Sept. 24 to 28.

AMERICAN SOCIETY FOR TESTING MATERIALS, twenty-sixth annual meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, June 25 to 30

CANADIAN INSTITUTE OF CHEMISTRY, annual meeting, Toronto, May 29 to 31.

INSTITUTE OF MARGARIN MANUFACTURERS, fourth annual convention, Hotel Traymore, Atlantic City, June 14 and 15.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (NINTH), New York, Sept. 17-22.

NATIONAL FERTILIZER ASSOCIATION, thirtieth annual convention, White Sulphur Springs, W. Va., June 11 to 16.

NATIONAL LIME ASSOCIATION, fifth annual convention, Hotel Commodore, New York City, June 13 to 15.

SOCIETY OF CHEMICAL INDUSTRY, Canadian Section, Toronto, May 29 to 31.

SOCIETY FOR STEEL TREATING, Eastern sectional meeting, Bethlehem, Pa., June 14 and 15.

TAYLOR SOCIETY, Hotel Onondaga, Syracuse, N. Y., June 7 to 9.

Industry and Trade

Current News and Market Developments

Summary of the Week

Oliver Bowles, mineral technologist, appointed to head new non-metals experiment station of Bureau of Mines at Rutgers College.

Brief course in chemical engineering planned for benefit of students attending Ninth Annual Chemical Industries Exposition.

Lehigh engages Bradley Stoughton as professor of metallurgy.

Importers are carrying heavy stocks of chemicals and are finding it difficult to maintain prices.

Report from Washington states that annual coal-tar census will soon be ready for publication.

Official import figures for February show that arrivals of chemicals for that month suffer in comparison with totals for corresponding period last year.

Tariff Commission is considering establishment of a permanent staff in foreign countries.

Report from Germany casts doubt on belief that importers of coal-tar products will secure regular shipments from that country.

Imported caustic potash offered freely with prices gradually working lower.

Lower prices for tin have resulted in a 2c. per lb. decline in tin oxide.

Bureau of Census figures on cottonseed products brought about higher prices for cottonseed oil.

C. P. glycerine unsettled on freer offerings from midwest producer.

Turpentine lowered in price as result of large receipts at southern terminals.

Phenol offered in a larger way by second hands and at reduced prices.

Heavy arrivals of crude naphthaline from abroad and lower cables from foreign centers created easier feeling.

Yellow prussiate of soda offered at reduced prices for June delivery with spot market also easier.

German Coal-Tar Industry Affected by Lack of Fuel and Raw Materials

Majority of Producing Plants Located in Occupied Territory—Coal Shortage Closing Works

"THE statement of leaders of the German coal-tar dyes industry that, by reason of stocks on hand either at the works or with dealers in that country or abroad, Germany is probably able to supply demands for the next 6 months should be taken with reserve," declares William T. Daugherty, assistant trade commissioner of the United States at Berlin, in a report to the Department of Commerce dated April 5, 1923.

It is estimated that 80 per cent of the total production of coal-tar dyes, considered alone, is located in occupied territory, the report states, and plants have had difficulty in securing fuel and raw materials owing to refusal to pay the tax imposed by the occupational authorities. The main seats of five of the eight concerns in the "Interessengemeinschaft" of the German coal-tar dyes industry, which pool is practically a monopoly of that industry in Germany, are in occupied territory. Four of the large plants have been seized by the French and Belgians since the trade commissioner's report was prepared.

It has also been estimated, the report states, that 50 per cent of Germany's total production of pharmaceuticals, considered alone, is likewise located in occupied territory.

When the report was prepared, it was reported that the works on the upper Rhine belonging to the Badische were having difficulties in getting fuel. The Badische plant at Ludwigshafen was said to be virtually closed, while its other plants were embarrassed by a coal shortage. Fresh supplies were said not be forthcoming on account of the operators refusing to pay the French export tax. The Hoechster works were reported to be operating in very limited measure; while the same applied to the works of Bayer, at least in its works at Elberfeld, although its Leverkusen plant, in the English zone, was reported in a more favorable position. The Leverkusen works was said to be using brown coal, mined within English-occupied territory.

The report gives figures showing the decline in exports of German coal-tar dyestuffs, largely due, it is said, to development of the industry in the United States. In metric tons, these figures show that in 1913 exports from Germany of anilin and other tar dyes were 64,288; in 1920, 17,899; in 1921 (8 months only), 14,308; in 1922, 36,011. In 1913 exports of alizarin dyes from anthracene were 11,040 metric tons; in 1920, 3,325; in 1921 (8 months only), 1,570 and in 1922, 1,777 metric tons. In 1913, exports of artificial indigo were 33,353 metric tons; in 1920, 6,509; in 1921 (8 months only), 6,033; and in 1922, 13,828 metric tons.

Dr. Albert Neuburger in a leading article in *Chemiker Zeitung* of April 5 discussed the effect upon the chemical industry of occupation of the Ruhr and urged more general employment of known processes to recover combustible substance from the slag waste from the firing process as one means of overcoming the coal shortage.

The Ruhr occupation has caused German interests to view with pessimism the prospects of producing synthetic nitrogen this year, as first proposed to help overcome the domestic food shortage, Mr. Daugherty reports. The Oppau works shut down about April 1 because of coal shortage and had been credited with a production of 75,000 tons of nitrogen, or about 22 per cent of the total estimated production possible. The needs of German agriculture alone are estimated at between 420,000 and 600,000 tons of nitrogen annually. Under normal conditions and with proposed extensions, it is estimated that production could be increased 50,000 tons a year, and in 5 years the maximum demand could be filled. Despite encouragement of imports, little saltpeter was imported from Chile last year.

Mines Bureau Opens Non-Metal Station With Oliver Bowles as Director

New Brunswick, N. J., Selected as Home for New Experiment Station, Due to Central Location and Available Facilities

RUTGERS College, New Brunswick, N. J., has recently been designated by the Secretary of the Interior as the location for the new non-metal experiment station of the Bureau of Mines.

Oliver Bowles, the mineral technologist, who has been in immediate charge of the bureau's work on the non-metals, has been selected to be superintendent of the new experiment station. Mr. Bowles is a Canadian by birth, but has been continuously engaged as an educator and government specialist in this country since 1908. In 1908 and 1909 he served the University of Michigan as an instructor in petrography. For the 4 years following, he taught geology and mineralogy at the University of Minnesota. He joined the staff of the Bureau of Mines in 1914 as a quarry technologist and since 1917 has been the mineral technologist for the Chemical Division of the bureau.

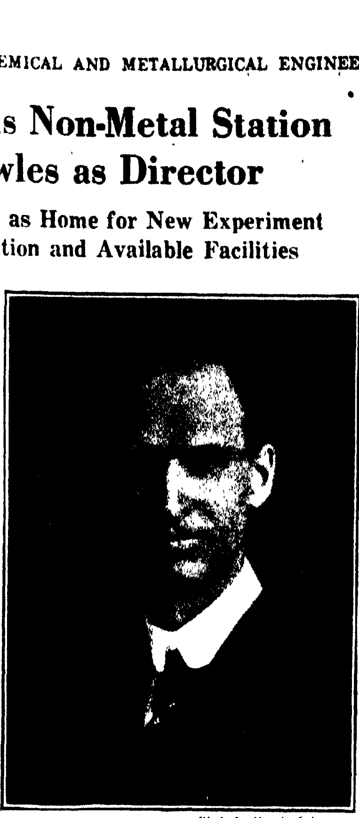


Photo by Harris & Ewing

OLIVER BOWLES

The new station will specialize in problems involved in the production and utilization of the non-metallic minerals. Of these minerals the most important at present are bauxite, cement, clay, feldspar, fullers earth, graphite, gypsum, lime, mica, phosphate rock, salt, sand and gravel, sand-lime brick, slate, stone, sulphur, mineral paints, garnet, asbestos and talc. The value of these non metallic minerals produced annually in the United States is in the neighborhood of a billion dollars.

Before recommending a location for this station, a very careful survey of the entire country was made by the Bureau of Mines. New Brunswick finally was chosen because nearly all of the talc output of the country is produced in the North, as is two-thirds of the feldspar, three-fourths of the silica, nine-tenths of the slate and three-fourths of the building stone. In addition, the gypsum, refractories, fluxing stone, monumental stone and dolomite output is confined almost entirely to the North. This makes New Brunswick a very central location with reference to the production and consumption of the non-metallic minerals. The total production of non-metals north of the Potomac is $245,000,000 and $92,000,000 south of the Potomac. The adjacent state of Pennsylvania, alone, has one and seven-tenths times as great a production of non-metallic minerals as have all of the states south of the Potomac and Ohio rivers combined.

Bradley Stoughton to Join Lehigh Staff

Bradley Stoughton, inventor of furnaces used in steel plants, writer on metallurgy and engineering, until recently secretary of the American Institute of Mining and Metallurgical Engineers and a prominent New York consulting engineer, has been appointed professor of metallurgy at Lehigh University. He succeeds in this capacity Prof. Joseph W. Richards, who died Oct. 12, 1921.

Mr. Stoughton has had teaching experience, for he was for some years acting head of the department of metallurgy at Columbia University. He has been connected with the Illinois Steel Co., the American Steel & Wire Co. and Benjamin Atha & Co., Newark, N. J. He became a consulting engineer in 1902.

Centrifugal Study Planned by Bureau of Mines

The advisability of taking up intensive research in connection with the use of centrifugal force in the concentration of ores, the thickening of pulp and the dewatering of various mill products is being considered by the Bureau of Mines. Before taking this step, however, bureau officials are anxious to get in touch with other investigators.

There is full recognition of the part of the bureau specialists of the difficulties on the mechanical side of centrifugal operations as well as of the other obstacles that must be surmounted. However, in view of the great advantages that would follow the successful application of this great force to the treatment of ores, there is a definite inclination to enter upon research along these lines.

Smaller Rosin Carry-Over Into New Crop Year

Turpentine Stocks, However, Are Larger Than in Preceding Statistical Period

The annual canvass of the stocks of turpentine and rosin on hand at the end of the crop year, which closed March 31, has been completed by the Bureau of Chemistry of the Department of Agriculture. The totals, as shown in the canvass, include supplies of turpentine and rosin held by and en route to factors, dealers and jobbers—but not consumers—at the primary ports and the important distributing points of the country.

The figures are shown in the following table:

	Turpentine Casks April 1, 1923	Turpentine Casks April 1, 1922
Southern primary ports	21,040	24,099
Eastern ports	2,652	1,675
Central distr. points	10,881	8,195
Western points	2,225	900
Total stocks	36,798	34,869

	Rosin, Round Bbls. April 1, 1923	Rosin, Round Bbls. April 1, 1922
Southern primary ports	278,414	349,730
Eastern ports	8,078	11,359
Central distr. points	46,938	49,043
Western points	1,340	6,447
Total stocks	334,770	416,579

In order to be more complete, the figures for stocks at the Southern primary ports include the total receipts during the first week of April at Savannah, Jacksonville and Pensacola, and an estimate of the same for the other ports, as representing, as nearly as can be judged, the quantity of turpentine and rosin which had already left the stills on April 1 and was en route to the ports. This material would not be included in the stocks held by producers at the stills, which will be shown in a later report. The figures which have thus been added in are as follows: for Savannah, 825 casks turpentine and 2,554 bbl. of rosin; for Jacksonville, 1,318 casks turpentine and 9,332 bbl. of rosin; for Pensacola, 290 casks turpentine and 1,499 bbl. of rosin; for Brunswick, Mobile and New Orleans, a total of 400 casks turpentine and 1,200 bbl. rosin.

German Potash Production at Minimum Capacity

Germany's potash properties are being worked at the minimum capacity allowed by law. Much of the work is confined to development. One of the government's consulting specialists, who has just returned from Germany, is convinced that the potash interests are sincere in their desire to reduce the price of potash to the point where its use will be greatly extended.

Under present conditions the German nitrogen plants are finding it extremely difficult to compete successfully with nitrate of soda from Chile. As a result production of synthetic nitrogen has been greatly reduced, this specialist reports.

Chemical Imports in February Fall Far Below January Totals

Coal-Tar Chemicals Did Not Share in Decline—Arrivals of White Arsenic Also Larger Than in January

IMPORTS of free list chemicals and allied products in February were valued at $6,954,847. The total value of those imports on the dutiable list was $2,629,664. This is a decided falling off from the January figures, when the value of free list imports was $9,155,648 and of dutiable imports $3,584,225.

The general decrease in imports did not apply to the coal-tar chemicals In fact, there was a slight increase in that total. In February these imports at all ports were valued at $1,193,361. In January, the total was $1,168,438 There was a decrease, however, in colors, dyes, stains, color acids and color bases. The February total was 200,094 lb., a decrease of 185,000 lb. as compared with January.

Imports of paints, pigments and varnishes during February were valued at $217,104. This is more than $100,000 less than the value of January imports. The February imports of fertilizers aggregated 142,350 tons, a reduction of more than 50,000 tons as compared with January.

One of the few items showing an increase was that of creosote oil. During February 5,530,443 gal of that commodity was brought into the country, a very material increase over January, when imports totaled 3,826,789 gal. The steady increase in imports of white arsenic continued during February, when the total brought from other countries reached 2,115,339 lb In January the total imported was 1,879,639 lb. There was a decided upturn in sulphuric acid imports in February, when the total reached 2,895,670 lb., as compared with 1,340,780 lb. in January.

The February imports of cyanide of potash amounted to 525,433 lb., an increase of 300,000 lb. over January. Even a more decided increase took place in the imports of sodium cyanide. The February total reached 2,633,133 lb.. or 650,000 lb. more than was imported in January.

The figures are those of the Bureau of Foreign and Domestic Commerce. Their compilation has been delayed since the enactment of the new tariff bill.

High-Grade Fertilizer Used This Season

Reports from the nineteen Middle West, Northern and Eastern States whose agronomists last winter voted to recommend high analyses mixed fertilizers show that a large proportion of the sales of commercial fertilizer this spring have been of these high analyses, according to officers of the soil improvement committee of the National Fertilizer Association.

In New York, which has an average normal consumption of 400,000 tons of commercial fertilizer annually, it is said that sales outside the five high analyses indorsed by the experiment station officials of that state have been very small. New York selected the smallest list of grades of any of the states which joined the movement to eliminate the low-content mixtures from official recommendations.

Peliminary reports indicate also that sales of fertilizer this spring have been greater in volume than last year and that there has been a substantial increase in the proportion of cash sales. Prices have been lower.

News Notes

Pasteur's memory is being honored in France by a series of meetings commemorating the one hundredth anniversary of his birth. At the first meeting U. S. Ambassador Myron Herrick presided and stated that Pasteur had accomplished more to abolish suffering than any other man in history.

Hampered standardization of weights and measures throughout the country is being caused by the lack of state appropriations for this work. At the sixteenth annual conference held on weights and measures at the Bureau of Standards last week this fact was reported by nearly every state except New Jersey.

Monel metal gauze for flame lamps to be used in gaseous or coal-dust laden atmospheres has been recommended by the Bureau of Mines. Unlike steel, Monel metal does not corrode badly in the atmosphere of damp mines.

Ether production in British Guiana has begun in the plant of an American company. This plant is of particular interest in connection with the development of the new industry for the production of alcohol motor spirit. This industry is enjoying rapidly brightening prospects in countries distant from petroleum production.

Germany's glass industry is in poor condition due mainly to the intense competition of the Belgian and Czecho-slovak industries. The inland demand and exports fell off one-third in April, with the result that many ovens were shut down altogether.

Biological topics featured the meeting of May 24 for the Southern California Section of the A.C.S., which met at Los Angeles. I. Grageroff, H. L. White and M. C. Terry were the speakers.

Tuberculosis treatment based on the use of an alkaline glycerol extract of steapsin or lipase, combined with a small amount of chloroform, is being studied at the Colorado School of Mines. Dr. L. G. Robinovitch, who is conducting the work, reports positive progress on the work so far undertaken,

Important zinc lands in Oklahoma have recently been purchased by the Schwab interests. Since 70 per cent of the country's zinc production, according to Mr. Schwab, is consumed by the steel industry, it is good business policy to have in its own hands a portion of the production of the raw material.

The dye importers' organization, reported some time ago as being under consideration, has not yet taken form, although meetings of parties interested have been held. It is expected that this week's meeting may answer the question of the form of the organization to be adopted.

Hydrocyanic acid may be used successfully in destroying animal pests in their burrows, according to recent Agriculture Department findings. The deadly nature of the gas and the need of caution in handling both it and the ingredients used in its production are emphasized, although it is stated there need be no hesitancy in using this as an anti-rodent if precautions are taken.

Several industrial films prepared by the Bureau of Mines are to be shown at the International Mining Exhibition in London. Copies of the following films have been sent: Story of Coal, Story of Petroleum, Story of Sulphur, Story of Ingot Iron, Story of Rock Drilling, Story of Asbestos, and Story of Alloy Steel.

The sum of $35,000 has been awarded in fellowships and scholarships in the Yale Graduate School for the coming year. Twenty-six fields of study will be represented by this group, the largest numbers being in English, 21; chemistry, and physiological chemistry, 13; history, 11; geology, 10; education, 7; and social and political science, 7.

Carnegie Tech Working on Oil Sludges

The elimination of sludge in turbine engine lubrication is receiving considerable attention at present in the research laboratories of Carnegie Tech. The occurrence of sludge in turbine lubricating oils has in the past greatly cut down the efficiency of these units. Dr. J. H. James is working with Prof. K. K. Stevens in studying the factors involved. Sufficient progress has already been made to allow Dr. James to make the following statement:

"A striking result of our preliminary experiments wa[illegible] all of [illegible] sludge compounds that we examined showed the presence of fatty acids, proving that the hydrocarbons of the mineral oils had been oxidized. These fatty acids were usually present in the form of metallic soaps. Examination of the sludge leads us to believe that these soaps are really forming greases which comprise the major portion of most of the sludges examined."

Small Stocks of Cottonseed Oil for Remainder of Crop Year

Monthly Consumption Averages 212,000 Bbl.—Seed Receipts at Mills Smaller Than Expected—Visible Supply of Oil Less Than at Corresponding Period Last Year

THE statistical position of cottonseed oil, according to an analysis of the April report of the Bureau of Census covering all cottonseed products, is extremely tight and tends to confirm opinion favoring a rather high level for prices over the remainder of the crop year. The consumption of cottonseed oil during April reached the total of 151,250 bbl., which compares with 110,000 bbl. in April a year ago. The figures were in line with private estimates and indicated that cheap lard did not seriously curtail business. The visible supply was reduced to 720,000 bbl., which compares with 861,000 bbl. on the last day of April a year ago.

Receipts of cottonseed were disappointing, the arrivals at the mills during April amounting to only 21,131 tons. Receipts of seed at the mills from Aug. 1, 1922, to April 30, 1923, amounted to 3,188,881 tons, against 2,871,143 tons for the corresponding period a year ago. The amount actually crushed for the 9 months ended April 30 was estimated at 3,132,666 tons, contrasted with 2,922,230 tons for the corresponding period a year ago.

Stocks of Crude Oil

The Bureau of Census reports production of crude oil for the August-April period at 962,580,720 lb., while for the same period a year ago the production figures were placed at 903,166,622 lb. Production of refined cottonseed oil for the 9 months ended April 30 amounted to 835,584,067 lb., against 790,768,610 lb. for the corresponding period a year ago.

Stocks of cottonseed at the plants on April 30 were estimated officially at 64,752 tons, which compares with 46,140 tons on the same date a year ago. The stocks of crude oil on the last day of April amounted to 37,484,169 lb., against 31,848,336 lb. a year ago.

The stocks of refined cottonseed oil at the plants on April 30 amounted to 236,001,125 lb., which compares with 302,079,057 lb. on the last day of April a year ago.

Consumption of cottonseed oil for the past 9 months shows an increase of 117,000 bbl. contrasted with the 9 months showing for the corresponding period last season. The consumption of oil by months with a comparison, follows:

	1922-23 Bbl	1921-22 Bbl
August	168,000	260 000
September	234,000	280,000
October	298,000	234,000
November	273,500	174,000
December	190,000	128,000
January	233,000	192,000
February	192,250	208,000
March..	167,000	204,000
April..	151,250	110,000
Totals ..	1,907,000	1,790,000

Average monthly consumption of cottonseed oil for the first 9 months of the crop year was 212,000 bbl., against 199,000 bbl. a year ago.

The cotton crop year begins with Aug. 1, but seed does not commence to move in volume before September and it takes another month to convert the seed into available oil. In other words, new crop oil will not come on the market in a large way before October and old crop material will have to fill in the gap between Aug. 1 and the time when the new crop production is actually available. At the close of the 1921-22 season the stocks on hand were estimated at 434,325 bbl., the monthly consumption of cottonseed oil for the last 3 months of the crop year amounting to 155,542 bbl. Later developments in the market proved conclusively that the carry-over was inadequate and a sharp uplift in prices resulted.

Seed Receipts Fall Off

Seed receipts have fallen off in all directions and trade authorities believe that the movement to the mills over the remainder of the season will be smaller than had been expected. Some traders go so far as to predict that not more than 52,000 bbl of oil will be made from seed that has not yet been accounted for, so that, in addition to the visible of 720,000 as indicated by the government figures as of April 30, a total of 772,000 bbl. will be available for the May-June-July period. Deducting 434,000 bbl. (last season's carry-over) from the 772,000 bbl. now in sight, the supply of cottonseed oil actually available for the next 3 months is reduced to 338,000 lb., or 112,700 bbl. for monthly distribution. Allowing for a larger crush of "invisible" seed, the result of these calculations would not change materially.

Indications now point to a larger cotton acreage for the 1923 season, but it is yet too early for the new crop to exert much of an influence upon the market. Because of the strong statistical position operators believe that new crop developments will not play so prominent a part in the cottonseed oil trade during the early summer months. Of course, it is possible that competing oils and fats will occupy a position of prominence before the new season gets under way and such development should check any sharp upturn in cottonseed oil prices. The speculative element has shown comparatively little interest in the long side of the market, while the existing short interest in old crop options has narrowed down considerably in the last month or so. At current prices for cottonseed oil export business is considered improbable.

Trade Notes

The Pacific Coast Borax Co. has announced a 10 per cent increase in wages for the employees at its plant in Bayonne, N. J.

Société Anonyme pour l'Industrie des Métaux, Lausanne, Switzerland, has taken over the aluminum and metal business of Le Mineral Société Anonyme. The latter company will continue to trade in bauxite and chemical products. C. W. Leavitt & Co., New York, are sole selling agents in the United States for both corporations.

Arthur S. Somers, of the F. L. Lavanburg Co., has been re-elected president of the Brooklyn Chamber of Commerce.

The plant of the New Jersey Chemical & Rubber Works at Hillside, N. J., was damaged by fire last week. Loss is placed between $65,000 and $75,000.

The steamship "President Wilson" arrived at San Francisco last week from Hong Kong and, included in the general cargo, there was 758 tons of china wood oil.

Alfred B. Sloan, president of the General Motors Corporation, has been elected a director of E. I. du Pont de Nemours & Co.

The next convention of the National Foreign Trade Council will be held in Boston, in May, 1924.

California petroleum production in 1922 increased 23,739,332 bbl. over that of the previous year. The gain is attributed to the rapid and intensive development of oil fields in Los Angeles and Orange Counties.

H. Mart Smith, manager of the vegetable oil department of W. R. Grace & Co., will leave today on a business trip through the Middle West.

Charles B. Street, general superintendent of Gutta Percha & Rubber, Ltd., Toronto, Canada, died at his home in that city last Tuesday.

George K. Morrow has been elected president of the American Cotton Oil Co. to succeed L. N. Hine, who will hereafter, as vice-president, devote only a portion of his time to the affairs of the company. Mr. Morrow also was elected a director.

W. M. Gimson, consulting engineer to the Kaurilite Manufacturing Co., of Auckland, New Zealand, is in New York.

Informal discussion on the prospects for trading in linseed oil options by members of the Produce Exchange attracted some attention. The movement, however, did not take on definite form. The proposition was considered some years ago, but was dropped because of lack of interest on the part of crushers. Many in the trade take the stand that an option market in linseed oil would tend to stabilize prices. Option markets in this commodity exist in London and the different Continental crushing centers.

Washington News

Tariff Commission Considers Foreign Organization

The Tariff Commission has under consideration the establishment of a permanent organization in foreign countries. Under the direction of the commission groups of experts have already been sent abroad. It is proposed that a permanent headquarters be established at some central point in Europe. Under the plan discussed experts would continue to be sent to handle special inquiries, but their activities would be co-ordinated through representatives of the commission stationed in Europe permanently.

The plans for a foreign organization, which have been discussed more or less from time to time, have been expanded considerably. It is now proposed that the foreign representatives of the commission shall make reports on industrial conditions and particularly on matters bearing on the tariff. Members of the commission desire to establish a closer contact with conditions in foreign industries regarding which information must be available in determining rates of duty under the flexible provisions of the tariff law.

Fellowships Offered by Bureau of Mines and Colleges

During the next school year, the following universities will offer graduate fellowships in mining, metallurgical and chemical research, in co-operation with the Bureau of Mines: University of Alabama, University of Arizona, Carnegie Institute of Technology, University of Missouri, Ohio State University, University of Utah and University of Washington.

This plan of fellowship first was effected through a co-operative agreement between the Bureau of Mines and the University of Utah in 1914. The results have been highly successful throughout that period. The fellowships are awarded graduates of colleges, preferably of mining schools, who have shown special aptitude for research and investigational work.

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Manufacturers of Picric Acid Subject to Tax

For the information of internal revenue officers and others concerned, C. R. Nash, acting Commissioner of Internal Revenue, has issued a statement to the effect that a person who manufactures and sells for military purposes picric acid containing 10 per cent water is a manufacturer of an explosive within the meaning of section 301, subdivision 1 (a) of the revenue act of 1916 and hence subject to the munition manufacturer's tax levied under Title III of that act.

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Ultramarine Plant Started

The National Ultramarine Co., organized by a group of West Virginia business men, will erect a $200,000 plant at Cincinnati, Ohio. It is announced that this company is to promote the invention of Ralph Baugher of Huntington, W. Va., in the manufacture of its product. The details of this method have not been disclosed.

Ultramarine blue is considerably used as a pigment in inks, in wallpaper whitening and in bringing food products such as sugar and flour to color.

Exposition Plans Course in Chemical Engineering

Exhibits as Planned Indicate an Extremely Interesting Show in September

Students of chemistry and chemical engineering who attend the Ninth National Exposition of Chemical Industries are to have an unusual opportunity to study the exhibits. Group conferences and a series of lectures have been planned. This short practical course to be given in connection with the 1923 exposition will be under the guidance of a number of the industry's biggest men, and will be without cost to the students. It will include plant equipment in disintegrating, mechanical separation and grading, thickening, filtration, and separation by centrifugals, evaporation, distillation, drying and the general handling of materials. The "why, when and where" of construction materials will also be given attention. Chemical distribution in commerce will be the third phase. Students desiring to attend and instructors wishing to enroll classes are required to file applications with the exposition management at the Grand Central Palace, New York, before the closing of colleges this year. Accommodations for students during their stay in New York will be arranged at Columbia University dormitories.

Preliminary Exhibition Plans

An endeavor is being made to have the exposition more complete this year than ever before. A consolidated dyestuff exhibit of a very elaborate nature, furnished by a number of the leading American manufacturers, has been planned. Dye for everything from the rug on the floor to the paper on the ceiling, including the apparel of the occupants, will be shown in a new way. The actual production of furfural from corncobs, a completely equipped modern chemical laboratory alongside of an ancient alchemist's shop, chemical warfare in operation, and other novel exhibits have been listed among the preliminary plans. The educational exhibits of the exposition, already taking shape under the direction of Major H. S. Kimberly, who was recently selected by the advisory committee for this work, will cover a broad field and aim to show the human relation, breadth and importance of the chemical industry, particularly its developments since the war, to the American business man and the public. To sell the idea of America's self-sufficiency in chemicals, dyes, chemical machinery and equipment, and complete independence from Europe, is being made the basis for the entire educational scope of the Ninth Chemical Exposition when it is held during the week of Sept. 17 to 22 at Grand Central Palace, New York.

Treasury Department Issues Instructions on Currency Conversion

Determines Necessity for Consular Invoices—Collectors' Also Instructed to Make Allowance for Shortages in Delivery

THE Treasury Department has issued instructions to customs collectors regarding the conversion of currency for the purpose of determining the necessity for consular invoices in making export shipments from foreign markets. The opinion as expressed by the Assistant Secretary of the Treasury is that if the proclaimed value of foreign currency in which the foreign value or the export value of the merchandise is expressed varies by less than 5 per cent from a value measured by the buying rate in the New York market at noon on the day of exportation, conversion must be made at the proclaimed value. This, it was stated, follows the provisions of section 522 of the Fordney-McCumber tariff act and if the result of such conversion exceed $100, a consular invoice is necessary. Under section 482 of the tariff act consular invoices are required for goods exceeding $100 in value.

If, however, the decision continues, the value of the foreign currency has not been proclaimed, or if the proclaimed value varies by 5 per cent or more from a value measured by the buying rate in the New York market at noon on the day of exportation, conversion shall be made at the rate certified by the Federal Reserve Bank of New York, also following the provisions of section 522, and if the result of such conversion exceeds $100, a consular invoice is necessary.

Another important decision was rendered by the Treasury Department. It had reference to an allowance in assessing duties, in cases where the delivery of goods to the consignee showed that a shortage existed, as compared with the quantity shown on the shipping documents. The decision was made as a result of a finding on the part of the Court of Customs Appeals and directs collectors to follow the rule laid down in the courts' decision that the collector shall make allowance in the absence of fraud for any deficiency reported to him by the appraiser when the merchandise has at all times been in the uninterrupted possession of the government, notwithstanding that the deficiency is due to robbery occurring after importation. The decision was handed down in the case of McKesson & Robbins and held that section 2991 of the Revised Statutes is unambiguous and mandatory in the requirement that the collector shall make the allowance mentioned for shortages.

The rule affects enforcement of the concluding provision of section 499 of the Fordney-McCumber tariff act and the first paragraph of article 608 of the Customs Regulations is amended to read as follows:

"Allowance shall be made in the liquidation of duties for deficiencies in packages found by the appraiser or other customs officer and so certified to the collector."

The second paragraph of article 608, as amended by T. D. 37813 has in consequence been amended by striking out the word "two" and substituting the word "five," thus extending the time within which applications may be filed for allowance in duties on account of shortage in an unexamined case.

Investigate Foreign Control of Crude Rubber

Plans for investigating the crude rubber situation, especially with reference to the monopoly of the industry as now held by foreign countries, have now been well advanced. The Commerce Department will undertake this investigation and will utilize a special staff of rubber experts. The latter will visit primary sources of supply and will make a study of the best methods of production with a view to developing possible American controlled sources of supply.

Lehigh Tests to Develop Metal Strain Measure

Stretching a metal until it squeaks and listening for the squeak with a microphone will give a test showing how much strain that metal can stand as a girder or as a rail, according to experiments conducted in the physics department of Lehigh University.

These experiments may develop a novel method for finding quickly and accurately the elastic limit of metals. By this method all forgings may be rapidly tested before they are put into use. Several kinds of metals have been successfully tested in the Lehigh laboratory.

It was found that squeaking, rasping sounds were produced after the pull had reached a certain definite value, and this value was different for the different metals used. The tests indicated that the sounds, caused by grating of the molecules, were not produced until the elastic limit of the material had been reached. The work is likely to be continued with more refined apparatus in the Lehigh physics laboratory.

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Hydrated 80-85 per cent was quiet with the general asking price at 7¾c. per lb. but on firm business it was stated that 7½c. per lb. could be done.

Chlorate of Potash—Heavy arrivals of German chlorate reached the market during the week. Sellers reported prices unchanged but there was an easier undertone and buyers did not appear to have much confidence in the quoted values. The quotation is 7½c. per lb. Domestic makes are held at 8½c. per lb., works.

Permanganate of Potash—The spot market is openly quoted at 18½c. per lb. with only moderate interest shown by buyers. The shipment market has been unsettled by the withdrawal of bids by importers and prices c.i.f. New York have been reduced in order to induce buying. Many sellers stated that there was no fixed price for nearby shipments but it was intimated that holders abroad would consider bids around 17c per lb.

Prussiate of Potash—Resale lots of yellow prussiate have been offered regularly and have had a disturbing effect on prices. Sales are said to have gone through at 36c. per lb. with 36½c. per lb. asked in different quarters. On shipments as low as 35c. per lb. has been heard. Red prussiate is inactive and it is a buyers' market with values variously reported from 65c. to 70c per lb.

Sodas

Soda Ash—There is an irregular demand for moderate sized quantities on new accounts but the greater part of the activity of the market is concerned with deliveries against contracts. Price changes are infrequent and prominent factors continue to quote light ash at 1.20c. per lb. in single bags, carlots, at works. Light ash in barrels is held at 1.40c. per lb., works. Dense ash is offered at 1.25c. per lb. in bags at works, basis 48 per cent. In the spot market light ash is quoted at 1.75c. per lb. in single bags and 1.95 per lb. in barrels.

Bichromate of Soda—The firm position of bichromate has continued through the week. Some large producers are reported to have sold large amounts prior to recent advances in price. With producing costs rising they did not care to take on further orders for large lots at the lower price level. Consequently they marked up prices and other producers followed suit. For the time being, at least, competition among sellers is not not keen and reports that current values are based on producing costs, are generally credited. Asking prices are 8½c. per lb., works, and upward on a quantity basis.

Caustic Soda—No improvement in export demand has been shown and though most sellers are quoting at unchanged price levels, the market can hardly be described as firm. In some quarters there is a disposition to hold the f.a.s. quotation for standard brands at 3.40c. per lb. but this figure is too high to interest buyers and 3.35c. per lb. is more representative of the market with the possibility of doing 3.30c. per lb. on outside brands. There is a steady withdrawal on contracts to domestic consumers with 2½c. per lb., carlots, works, quoted for basis 60 per cent. The spot market is steady at 3½c. per lb., flat for round lots.

Nitrate of Soda—Arrivals from primary points have brought out some selling pressure and reports were heard that spot material sold at $2.52½ per 100 lb. Stocks at southern points also are reported to be large and some resale material is reported to have changed hands as low as $2.40 per 100 lb. For June delivery local sellers were asking $2.57½ per 100 lb. For July forward the schedule as recently adopted was in effect with prices ranging from $2.45 to $2.60 per 100 lb. according to time of delivery. A report from Europe states that German synthetic nitrate is in supply barely sufficient for requirements in that country. The report further states that stocks of nitrate of soda in the United Kingdom held on speculative account have been liquidated and prices have firmed up. Production in Chile has not been curtailed to any extent as yet but exports for April exceeded production.

Prussiate of Soda—Slow demand and free offerings have added to the weakness of prices and buyers have been able to take on stocks at greater advantage during the past week. Spot material has been offered at 16¼c. per lb. without arousing any sustained interest from buyers. For June delivery there were sellers at 16c. per lb. and this included some prominent domestic producers.

Miscellaneous Chemicals

Arsenic — Very little change was noted in market during the week. Buyers are watching closely but are buying only when prices are made attractive. Arrivals from foreign markets are coming in regularly. Moreover stocks are held by numerous sellers and this makes consumers cautious about placing orders. The spot market was dull at 14¾@15c. per lb. It is possible that the inside figures could be shaded but for the most part holders are not pressing matters. Domestic producers are quoting 13½c. per lb. for prompt and 12c. per lb. for June-July. For the second half of the year they quote 11c. per lb.

Alum—Domestic makers of ammonia alum are holding prices on a steady basis with buying described as moderate. Lump is held at 3.50@3.60c. per lb. Chrome alum has responded to higher producing costs and the inside figure is now placed at 5¾c. per lb. Imported potash alum was quiet and easy in tone with quotations at 3@3¼c. per lb. for lump.

Calcium Arsenate—Demand is proving disappointing. Dealers and distributors placed orders some time ago but in many cases they have not yet taken April deliveries. Stocks are fairly large and it is a question whether selling pressure or buying demand will first assert itself. Prices are generally quoted at 17c. per lb. but some sellers admit they are open to bids and at present it is a buyers' market with 16c. per lb. as a figure at which business might be done.

Copper Sulphate—Leading makers continue to quote the market at 6c. per lb. on the large crystals and 5.90c. per lb. on the small. It was reported that smaller operators in domestic goods took on business down to 5.75c. per lb. Imported material was easier and prices heard during the week ranged from 5½@5¾c. per lb. immediate delivery. Stocks of foreign material were considered large. According to some reports Canadian buyers took on several lots of imported sulphate. The shipment quotation on German goods settled around 5¾c. per lb.

Epsom Salt—Several large parcels arrived from German ports, but, according to dealers, nearly all of this material will go into firm hands. The market settled at 90c.@$1.00 per 100 pounds.

Nickel Salts—There were transactions in less than carload lots on the former basis of 10½c. on the double and 11½c. on the single, in barrels.

Tin Oxide—The market eased off on the recent decline in the metal. The quotation was cut 2c. per lb., establishing the market on the 48c. per lb. basis. Demand was quiet all week. A slightly higher market for the metal set in just before the close and this seemed to steady prices for the oxide.

Sal Ammoniac—Pressure to sell imported material was in evidence and lower prices were named in more than one direction. The white granular, imported, in casks, closed nominally at 6½@6¾c. per lb., immediate delivery. Domestic held at 7½@7¾c. per lb. On the gray domestic the offerings were moderate and prices held at 8@8½c. per lb., f.o.b. point of production.

Sulphate of Ammonia—Contract business has made its appearance in fair volume and considerable business has been booked in the past two weeks. The prices quoted are on a basis of $3 for delivery at northern points and $3.15 for delivery in the south. The spot price is given at $3.25 per 100 lb. for bulk lots and f.a.s. quotations are $3.60 @$3.65 per 100 lb.

Alcohol

No additional price changes were reported by first-hands. The advance in denatured was maintained, although scattered parcels of imported material might have been picked up at concessions. The special, No. 1 formula, closed at 35c. per gal., in drums, and 41c. per gal., in bbl., carload basis. Completely denatured, formula No. 1, 188 proof, was offered by leading interests at 43c. per gal., in drums, and 49c. per gal., in bbl. Demand for denatured was quiet. Ethyl spirits, 190 proof, U. S. P., closed unchanged at $4.70 per gal. Methanol also was unaltered in price, producers asking $1.18 per gal. on the 95 per cent grade.

Coal-Tar Products

Naphthalene Imports Increase; Prices on Spot Easier—Cresylic Acid Lower—Phenol Unsettled—Salicylates Irregular

THE market for naphthalene was easier in nearly all directions. Trading was inactive and with foreign offerings lower some shading of spot prices was apparent. The importations of crude material again assumed large proportions, the bulk of the naphthalene arriving coming from Rotterdam. Intermediate makers appear to be stocked up for the time being and no new business of consequence went through.

One of the largest producers of salicylic acid reduced prices to the extent of 5c. per lb., due, no doubt, to the keen competition in the salicylates. This reduction narrowed the range of prices so that leading factors were only 5c. apart instead of 10c. Demand for the salicylates showed no improvement. Phenol on spot in outside channels was unsettled, but no radical change in prices occurred. A feature was the decline in cresylic acid, spot prices on the imported closing about 5c. per gal. lower. Domestic makers reported the market on cresylic as nominally unchanged.

Benzol demand was described as fair in some quarters, while other operators said that they could not interest buyers. The offerings of zylene on spot were scanty and firm prices prevailed in all quarters.

Aniline Oil—Producers reported a steady market notwithstanding the routine nature of business. Prices held at 16c. per lb. in drums, carlots, immediate and nearby delivery.

Aniline Salt—There were offerings of aniline salt at 23c. per lb., immediate shipment. The market was barely steady in some quarters.

Benzaldehyde—There was a fair inquiry for benzaldehyde, and leading producers continued to quote firm at 75@80c. per lb. on the technical grade, drums included.

Benzylchloride—Production is limited and spot prices were wholly nominal. On nearby material there were offerings at 30c. on the technical grade and 45c. on the 95@97 per cent refined.

Beta Naphthol—There were offerings of the technical grade on spot at 22c. per lb., indicating that first hands were no longer so firm in their ideas.

Benzene—The demand was restricted to the motor grades, according to first hands, and production of pure benzene was limited to actual requirements only. As a result of this policy prices for the pure were maintained on the 30c. basis in spite of the positive nature of business. The 90 per cent grade held nominally at 27c. per gal. tank-car basis.

Cresylic Acid—Offerings of spot material of foreign make were freer and prices again softened. There were sellers of the 97 per cent grade at $1.20 per gal. On the 95 per cent, dark, a price of $1.10 per gal. was named here. Domestic producers say that their output is sold ahead and refused to name a flat quotation.

Naphthalene — Importations were large, and with cables on crude easier, prices at the close were unsettled. Crude to import settled at 3⅝@3¾c. per lb. Flake on spot sold at 8¾c., a decline of ¼c. from the trading level of the week previous. On ball the market held around 9½@9¾c. per lb.

Phenol—One small parcel sold on spot at 49c. per lb., but additional offerings at this figure did not come out. In a general way the asking prices at the close ranged from 52@54c. per lb. for spot goods, which compares with 54@55c. per lb. a week ago. Demand was inactive and the undertone on resale material was barely steady. Producers report a sold up condition so far as they are concerned. Deliveries against contract are moving at 27@28c. per lb.

Salicylic Acid—One factor, who previously held out for 50c. on the U.S.P. grade, lowered his views to 45c. during the past week. In several other quarters the U.S.P. grade was offered at 40c. per lb. The demand was quiet, the recent exhibition of price cutting being too fresh in the minds of prospective buyers.

Paranitraniline—Producers held out for 75c. per lb., but in some quarters it was possible to pick up supplies at concessions. Second hands reported scattered business at 70@72c. per lb.

Solvent Naphtha—Demand was not so active and there were offerings on the basis of 27c. per gal. in tanks for the waterwhite immediate shipment from works.

Belgian Hand-Made Window Glass Production Declines

A report from Vice-Consul Schuler at Brussels states the manufacture of window glass in Belgium is undergoing a change, with the factories discarding the hand-making process for machines.

Factories now operating with Fourcault glass-making machines are operating at Dampremy and Montignies, while several plants at Roux are putting in glass-making machines. A new window glass-making plant which is also to use Fourcault machines is to be established at Zeebrugge. Glass manufacturers at Dampremy are interested in this proposed factory.

Another mechanical glass-making plant, that of Libbey Owens, in which American and Belgian capital is interested, has begun operation. This factory, work on which was started in 1921, is nearly finished. It will have a daily production of 40,000 sq.m. of glass.

Annual Coal-Tar Census to Be Issued in June

All data for the annual census of coal-tar dyes and chemicals and synthetic organic chemicals from other than a coal-tar base have been received by the Tariff Commission. The work of compilation will be started immediately under the direction of W. N. Watson, color specialist and acting chief of the chemical section, and it is hoped to issue the report some time before the end of June.

The census will present statistics on domestic production and on importations during 1922, arranged so the figures may be interpreted readily.

George Rossen to Head Produce Exchange

The annual election of officers to the New York Produce Exchange will be held on June 4. George Rossen has been nominated for president, P. H. Holt, vice-president and Edward R. Carhart, treasurer. W. A. Johns, L. W. Forbell, B. H. Wunder, W. W. Starr, Winchester Noyes and William Beatty are on the regular ticket as managers to serve for a period of 2 years.

Latest Quotations on Industrial Stocks

	Last Week	This Week
Air Reduction	61⅝	61⅛
Allied Chem. & Dye	67	68½
Allied Chem. & Dye, pfd	110	110
Am. Ag. Chem	18	17½
Am. Ag. Chem., pfd	43	40
American Cotton Oil	9¼	9⅜
American Cotton Oil, pfd	19⅝	19
Am. Drug Synd	5⅛	5½
Am. Linseed Co	27½	23
Am. Linseed Co., pfd	46¼	43
Am. Smelting & Refining	56	55⅝
Am. Smelting & Refining, pfd.	96½	96½
Archer-Daniels Mid. Co., w.i.	38½	37⅛
Atlas Powder	172	170
Atlas Powder, pfd	90	90
Casein Co. of Am	*60	*60
Certain-Teed Products	38½	*40
Commercial Solvents A	28	29½
Corn Products	131	126⅝
Corn Products, pfd	116¼	118
Davison Chem	27	23½
Du Pont de Nemours	131	123¾
Du Pont de Nemours db	86	86
Freeport-Texas Sulphur	15	13½
Glidden Co	9	8½
Grasselli Chem.	130	*130
Grasselli Chem., pfd	*103	*103
Hercules Powder	105	105
Hercules Powder, pfd	103	105
Heyden Chem.	1⅞	2
Int'l Ag. Chem. Co	3	5¾
Int'l Ag. Chem. Co., pfd	25	16⅛
Int'l Nickel	14½	13⅞
Int'l Nickel, pfd.	78	79
Int'l Salt	*90	*90
Mathieson Alkali	13	14⅝
Merck & Co.	85	86¾
National Lead	118⅞	113¼
National Lead, pfd	112½	112
New Jersey Zinc	163	162
Parke, Davis & Co.	81	81
Pennsylvania Salt	89	88
Procter & Gamble	*140	*140
Sherwin-Williams	*29½	28⅞
Sherwin-Williams, pfd	*101	*101
Tenn. Copper & Chem.	10⅛	9⅞
Texas Gulf Sulphur	60⅞	60⅞
Union Carbide	61	56⅝
United Drug	80	80
U. S. Inl. Alcohol	56½	51⅝
Va.-Car. Chem. Co.	11½	10
Va.-Car. Chem. Co., pfd.	37	30

*Nominal. Other quotations based on last sale.

Vegetable Oils and Fats

Cottonseed Steady on Light Offerings—Linseed Dull and Irregular in Forward Positions—Tallow Firmer

TRADING in vegetable oils was inactive, yet prices did not change much one way or the other. Cottonseed, both crude and refined, reflected the tight statistical situation and a feature during the week was the strength in the May option. New crop developments failed to exert much of an influence on the market. Arrivals of Argentine flaxseed were heavy, and with new business in oil disappointing it appears more than likely that the shortage in the supply available for immediate shipment will soon be a thing of the past. Coconut was unsettled on reports of lower prices on the coast. China wood was dull and prices named were wholly nominal. Soya bean oil was unchanged. Crude corn sold off in the west. Palm oils were easy early in the week on the drop in tallow, but steadied later. Tallow sold as low as 7¼c. ex-plant on the recent slump.

Linseed — Several crushers entertained firmer views on early June business, but in the absence of any imported trading, and with foreign oil available at concessions, the market favored buyers throughout the week. Spot and first half of June delivery closed at $1.13@$1.14 per gal., in cooperage, carload lots. On late June business prices ranged from $1.11@$1.12 per gal., while July forward held at $1.03@$1.04 per gal., carload lots, cooperage basis. The demand for futures was dull and crushers admitted that no real effort has been made for some time past to really sound the market on distant deliveries. Imported linseed oil was offered for immediate delivery at $1.05@$1.07 per gal., in bbl., duty paid. Duluth seed was easier at one time, but reports of frost in the flax belt steadied prices before the close. The planting season for all grains is late and this may result in a larger acreage to flax than was first predicted. With planting still under way it is too soon for any estimates on the acreage. Argentine offerings increased and the June option at Buenos Aires went down to $1.91½. Exports from the Argentine to all countries since the first of the year amounted to more than 31,000,000 bushels. Indian shipments for the past week amounted to 400,000 bushels consigned to the United Kingdom and 32,000 bushels consigned to the Continent. Export demand for cake in the New York market was quiet with prices nominal at $34@$35 per ton.

Cottonseed—In the option market for refined oil the feature was the strength in the May position. Shorts were buyers in a narrow market and with lard firmer prices showed moderate gains. Cash business was fair for this season of the year and generally operators felt that business will continue at a pace sufficient to exhaust the old crop offerings, especially if prices do not advance out of all proportion to the intrinsic value of the commodity. The statistical situation, reviewed elsewhere in this issue, is said to be the strongest in years. Crude oil offerings in the south were light and holders refused to quote less than 10c. per lb., buyers' tanks, f.o.b. mills, southeast and valley. In Texas scattered lots sold at 9¾c., f.o.b. mills. Bleachable oil was advanced ¼c., the market closing at 10⅝c. per lb., buyers' tanks, f.o.b. Texas common points. Consumption of oil during April amounted to 151,233 barrels, which compares with 167,000 bbl. in March and 110,000 bbl. in April a year ago. The April showing was better than expected, especially in view of the lower market for lard. Lard compound held at 12¾@13¼c. per lb.

China Wood Oil—Demand was lacking and prices were unsettled in all directions. Several round-lots arrived here last week, but most of this oil had been sold on contract. Spot oil settled at 28c. asked, with nearby at 25c. and futures at 23c. On Oct.-Nov.-Dec. business 21c. could have been done.

Coconut Oil—Offerings were liberal and prices again were unsettled. It was reported that a large soaper took on a long time contract at 8¼c. for Ceylon type oil, sellers' tanks, delivered. Spot and nearby Ceylon type oil closed at 8⅞c. asked, sellers' tanks, New York. On the Pacific coast nominal prices ranged from 8@8¼c., sellers' tanks, May-June-July shipment. Manila oil in bulk settled at 7¾@7⅞c., c.i.f. coast ports.

Corn Oil—Several cars of crude oil sold at 9¼c., f.o.b. point of production, a decline of ¼c. for the week.

Olive Oil Foots—Prime green foots were offered at 9@9¼c. per lb., spot New York, while on ex-dock material it was intimated that 9c. could have been shaded. The market was quiet.

Palm Oil—Lagos ex-dock was offered at 7¼c. at one time. No important business resulted. Niger settled at 7@7¼c., as to position and seller. Towards the close prices steadied a little on the recovery in tallow.

Menhaden Oil—The fishing will commence this week. Reports from several of the fish factories indicate that operators are experiencing difficulty in securing labor at reasonable wages and it is probable that the entire fleet may not be able to participate. This kind of talk tends to support oil prices in the face of quiet trading conditions. Crude menhaden oil was held at 50c., tank cars, works, forward delivery.

Tallow and Greases—The lowest trading basis for extra tallow was reached about a week ago when one lot sold at 7¼c. per lb., ex-plant. Later some export buying set in and this steadied the market. Late last week 7½c. ex-plant was paid for a round-lot, Oleo stearine sold down to 9c. per lb., 5 cars changing hands at this price. No. 1 oleo oil sold at 13⅝c. Yellow grease closed at 6¾@7c. per lb.

Miscellaneous Materials

Casein—Importations were heavy and this was reflected in irregular prices for spot material. At the close the lower grades were available at 19½@22½c. per lb.

Glycerine—There were offerings of C. P. glycerine by producers not so well established in this market at concessions which seemed to unsettle prices. Leading refiners offered C. P. at 17c. in drums, which compares with 17½c. a week ago. During the week outside goods sold down to 16½c. Dynamite was wholly nominal in the absence of demand of consequence and scattered lots might have been picked up for less than 16c. per lb., carload basis. The crude held relatively steady and 11c. appeared to be the inside trading level on domestic soap-lye, 80 per cent, loose, carload lots, but no sales were reported. Arrivals of foreign crude attracted some attention and, according to reports, refiners have been steady buyers of imported goods.

Naval Stores—The market for turpentine eased off again in sympathy with lower selling ideas in the south. There were offerings here at $1.11@$1.15 per gal. and prices at the close were very unsettled. Advices from the south revealed larger receipts, with only scattered buying. Export trade was slow in all directions. Rosins also developed weakness and final prices were from 5@10c. per bbl. lower. The "B" grade settled at $5.85@$5.90 per bbl.

Shellac — Cables from Calcutta reported an unsettled market and operators here appeared anxious to liquidate. T. N. on spot sold at 60@62c. per lb., which compares with 62@63c. per lb. a week ago. Bleached, bonedry, was lowered to 73c. on spot. Superfine orange settled at 66c., with the ordinary at 63@64c. per lb.

Varnish Gums—Batavian damar was in larger supply and quotations were revised downwards to 28@28½c. On futures prices ranged from 27½@27¾c. per lb. Demand was quiet.

White Lead—There was a steadier market for the metal, but leading interests continued to offer pig lead at 7½c., New York. Standard dry white lead was in good demand and corroders maintained prices on the basis of 9¾c. per lb., in casks, carload lots. Other lead products also closed the week unchanged. The undertone, however, was barely steady.

Zinc Oxide—New business was not so much in evidence, but deliveries against old contracts were sufficient to take care of production and everything considered the market presented a steady appearance. Leading producers held out for 8c. on the American process, lead free. Red seal, French process, was unchanged at 9¾c. per lb.

Imports at the Port of New York

May 18 to May 24

ACIDS—8 cs. lactic, Hamburg, C B Richard & Co , 100 csk. tartaric, Palermo, Order , 150 csk citric, Palermo, Order , 700 bbl. tartaric, Bari, Order ; 22 dr. cresylic Liverpool, W E Jordan & Bro., 160 dr cresylic, Liverpool, Order , 28 dr. cresylic, Glasgow, Guaranty Trust Co , 5 dr. cresylic, Glasgow, Order , 12 dr cresylic, London, M De Mattia Chem Co., 75 dr cresylic London, Order , 100 bbl stearic, Rotterdam, M & W Parson, 65 csk oxalic, Copenhagen Roessler & Hasslacher Chem Co , 57 dr. cresylic, Rotterdam, Lunham & Moore.

AMMONIUM—42 csk muriate, Glasgow, Guaranty Trust Co , 20 pkg carbonate, Liverpool, Brown Bros & Co , 125 cs. chloride, Liverpool, Wing & Evans, 20 csk perchlorate, Marseilles, C W. Campbell & Co.

ALUM—30 csk. chrome, Hamburg, Hummel & Robinson

ANTIMONY SULPHITE—8 csk , Hamburg, E L. Bullock & Sons.

ANTIMONY OXIDE—100 bg , Hankow, Banque Belge l'Etranger , 500 bg , Hankow China Hide & Prod Co

ANTHRACENE — 16 csk., Rotterdam, Lunham & Moore

AMYLACETATE — 15 dr , Rotterdam. Lunham & Moore.

ARSENIC 16 csk., Rotterdam, Lunham & Moore , 203 bbl , Tampico, Am Metal Co 371 cs , Kobe, J D Lewis 250 cs , Kobe, Chipman Chem Eng Co., 83 cs Kobe Collinge, Dawson & Co 20 cs , Kobe, Mackenzie & Foster , 283 cs , Kobe S W Bridges & Co., 119 cs , Kobe, Frazar & Co , 140 cs. Kobe, Busk & Daniels , 230 cs., Kobe, Order 100 cs , Yokohama, Mitsui & Co.

BARIUM OXIDE—131 csk , Hamburg, W. A Brown & Co

BARYTES—401 bg , Bremen, N. Y. Trust Co ; 106 csk , Bremen, Order.

BRONZE POWDER 84 cs , Bremen, Baer Bros , 20 cs., Hamburg J. E Mandlik

CAMPHOR – 100 cs crude, Shanghai Suzuki & Co , 80 cs , Kobe, Suzuki & Co

CASEIN—109 bg , Hamburg, D C Andrews & Co., 141 bg., Havre, Medit. & Gen Traders; 100 bg , Havre, Monite Waterproof Glue Co , 162 bg , Havre, Nat'l City Bank , 481 bg , Melbourne, Order , 340 bg , Auckland, A. Klipstein & Co , 677 bg., Auckland, Asia Banking Corp , 630 sk Wellington, Bankers Trust Co., 1,669 bg., Buenos Aires, T M. Duche & Sons.

CALCIUM CHLORIDE –100 bbl , Hamburg, Roessler & Hasslacher Chem Co

CHEMICALS — 181 dr., London, Mallinckrodt Chem. Works , 1,000 bg , Bremen, A. Klipstein & Co

CHALK 600 tons, London, Order , 500 tons, Dunkirk, J. W Higman Co , 1 615 tons, Dunkirk, Taintor Trading Co., 1,350 bg , Antwerp, Irving Bank-Col. Trust Co , 1,078 pkg. precipitated, Bristol, H J. Baker & Bro ; 510 tons, Bristol, Paper Makers' Mfg. Co ; 300 tons, London, Baring Bros & Co.; 25 csk precipitated, Bristol, McKesson & Robbins , 50 csk. do., Bristol, Schieffelin & Co.

COLORS—96 csk. aniline, Havre, Ciba Co.; 14 pkg. ultramarine, Liverpool, Fezandie & Spearle ; 2 csk. aniline, Liverpool, Kuthroff, Pickhardt & Co , 5 csk , Rotterdam, H A Metz & Co. 5 bbl., Rotterdam, Kuthroff, Pickhardt & Co ; 119 bbl. aniline, Barcelona, Nat'l Aniline & Chem Co,

COPPER OXIDE—50 dr., Hamburg, Order

COPPER SULPHATE—200 csk., Swansea, Order ; 50 csk , Bristol, Farmers' Loan & Trust Co.; 120 bbl , Marseilles, Order.

COPPERAS — 23 csk, green, Swansea, Order.

COPRA—4,857 bg , Papeete, A. B. Donald , 265 bg., Anns Bay, Franklin Baker & Co.

CRESOL—3 dr. ortho, Liverpool, W. E. Jordan & Bro.

CUTCH—2,200 bg , Singapore, Order

DIVI-DIVI — 517 bg., Curacao, Selma Merc. Corp

DEGRAS—90 bbl., Antwerp, Order

EPSOM SALT—1,000 bg , Bremen. E Suter & Co.

FERRO-CHROME — 26 csk , Hamburg, D. Heydemann & Co.; 106 tons, Hamburg, C. Hardy & Ruperti

FULLERS EARTH—350 bg , Bristol, L. A. Salmon & Bro

FUSEL OIL—8 dr., Belfast, Order ; 14 bbl., Hamburg, Order ; 11 dr , Libau, Order , 45 dr., Hamburg, Order ; 16 dr , Antwerp, Order ; 45 dr, Rotterdam, Credito Italo ; 15 dr., Dairen, F Naldatcha ; 18 dr., Rotterdam, Walford Fwdg. Corp.

GAMBIER—109 cs., Singapore, Order.

GLYCERINE—15 dr , Havana, Harshaw, Fuller & Goodwin Co.

GLAUBERS SALT—125 bbl , Hamburg, Roessler & Hasslacher Chem Co , 104 bbl., Hamburg, Farmers' Loan & Trust Co

GUMS—57 bg copal, Havre, L C Gillespie & Sons , 67 bg. damar, London Baring Bros & Co , 100 bg arabic, Sudan, Brown Bros & Co , 500 bg do , Sudan, T M Duche & Sons ; 2,455 bg do., Sudan, Thurston & Braidich , 450 bg. do , Sudan, Order , 350 bg arabic Sudan, Irving Bank-Col Trust Co , 350 bg arabic, Sudan, Carcacanda Bros., 500 bg arabic, Sudan, Anderson-Hillier Co , 1,127 bg yacca, Adelaide, Order , 179 pkg damar Singapore, Baring Bros & Co , 210 bg. arabic, Sudan, Guaranty Trust Co , 100 bg arabic, Sudan, Anglo-Egypt Bank , 100 bg do , Sudan, Order 327 sk kauri, Auckland, Baring Bros. & Co , 82 cs do , Auckland, Equitable Trust Co , 230 cs do Auckland, Asia Banking Corp , 368 cs do., Auckland, J D. Lewis 732 pkg. do , Auckland, Order , 100 bg yacca, Adelaide Baring Bros & Co , 50 cs damar Singapore, L C Gillespie & Sons , 240 pkg damar and 70 bg copal Singapore, Baring Bros & Co , 100 cs damar and 50 cs copal, Singapore, Irving Bank Col Trust Co , 119 pkg copal, Singapore, Kidder, Peabody & Co., 455 pkg copal, Singapore, Order , 300 cs damar, Batavia, Bank of the Manhattan Co , 50 cs. damar, Batavia, Irving Bank-Col Trust Co , 100 cs damar, Batavia, Bank of N Y 100 cs do Batavia, Central Union Trust Co., 50 cs do , Padang, Order

IRON OXIDE—89 csk Liverpool, Reichard-Coulston, Inc , 52 csk , Liverpool, J A McNulty , 69 csk , Malaga, Reichard-Coulston, Inc., 62 csk , Malaga, E M & F Waldo , 119 bbl , Malaga, C K. Williams & Co 228 bbl , Malaga, Hummel & Robinson , 20 bbl , Malaga, Nat'l City Bank

LITHOPONE — 501 csk , Antwerp, B Moore & Co. 100 csk , Antwerp, E. M & F. Waldo , 100 csk., Antwerp, A. Klipstein & Co , 60 csk , Rotterdam, F M. Witherill.

MAGNESITE—80,805 bg , Trieste, Am Refractories Co., 103 csk., Rotterdam, Spoden, Whitefield & Co

MYRABOLANS 1,359 bg , Vizagapatam, Br Bank of South Am , 20,416 pkt , Calcutta, Order , 5,600 pkt , Calcutta, First Nat'l Bank of Boston.

MANGROVE BARK—15,961 bg , Morondava, Order , 626 bg., Majunga, Order

NAPHTHALENE—972 bg., Rotterdam, Lunham & Moore , 331 bg., Rotterdam, Jayne & Sidebottom , 317 bg., Bristol, Order , 80 cs., Hamburg, Order , 290 bg , Bristol, Barrett Co , 165 bg , London, Order , 2,349 bg , Rotterdam, Lunham & Moore

NICKEL OXIDE — 30 cs., Hamburg, Roessler & Hasslacher Chem. Co

NICKEL SULPHATE—94 csk , Swansea, Order

OCHRE—24 bbl , Seville, C J. Osborn & Co.

OILS—China Wood—96 bbl , Hankow, Nat'l City Bank , 370 csk , Hankow, Viele, Blackwell & Buck ; 1,200 bbl., Hankow, **Order. Coconut**—1,250 tons, Manila, Philippine Refining Corp. ; 799 tons, Manila, Spencer, Kellogg & Sons. **Cod**—300 csk , St. Johns, R. Badcock & Co ; 160 csk , St. Johns, Nat'l Oil Products Co.; 200 bbl , Kobe, Cook & Swan Co. **Linseed**—50 bbl., London, Order , 173 bbl., Antwerp, Fontana Bros ; 288 bbl , Rotterdam, L & E. Frenkel , 80 bbl., Rotterdam, W. Benkert & Co.; 144 bbl., Rotterdam, Lockwood & Co., 318 bbl., Rotterdam, J. D. Lewis ; 145 bbl., Rotterdam, Meteor Products Co ; 583 bbl , Rotterdam, Order ; 140 bbl , Rotterdam, Elbert & Co **Olive Foots** (sulphur oil)—100 bbl., Palermo, Order ; 100 bbl., Catania, Order ; 100 bbl., Bari, Brown Bros. & Co. ; 100 bbl , Bari, Banco Comm Ital.; 600 bbl., Bari, Irving Bank-Col Trust Co.; 800 bbl., Bari, Nat'l City Bank ; 100 bbl., Bari, Order , 300 bbl , Seville, W. R Grace & Co.; 500 bbl , Seville, Deevsnap & Co **Olive** (denatured)—175 bbl., Bari, Nat'l City Bank. **Palm**—159 csk , Lagos, J. Holt & Co.; 1,402 csk., Liverpool, D. Bacon ; 160 csk., Liverpool, Nat'l City Bank ; 17 csk , Liverpool, African & Eastern Trading Co ; 467 csk , Liverpool, Nat'l Bank of Commerce ; 84 csk., Liverpool, Order ; 289 csk , Hamburg, African & Eastern Trading Corp.; 86 csk., Hamburg, Order. **Rapeseed**—256 bbl , Liverpool, Vacuum Oil Co. **Whale**—150 bbl., Hamburg, Order **Peanut**—15 bbl , Antwerp, Hummel & Co. **Perilla**—625 bbl., Dairen, Cook & Swan Co ; 300 bbl., Dairen, Balfour-Williamson & Co.; 500 bbl., Kobe, Balfour-Williamson, & Co.; 1,280 bbl., Kobe, Cook & Swan Co.

OIL SEEDS — Castor — 27,320 bg., Cocanada, Order. **Linseed**—72,951 bg., St. Lucia, Bank of the Manhattan Co , 42,634 bg., Ibicuy, Am. Linseed Co.; 47,992 bg. and 2,634,373 kilos in bulk, Montevideo, Order , 18,020 bg and 1,932,035 kilos in bulk, Rosario, Spencer Kellogg & Sons; 105,145 bg Rosario, Order , 48,963 bg. and 2,602 tons in bulk, Rosario, Order ; 8,413 bg., Buenos Aires, L. Dreyfus & Co., 33,413 bg., Buenos Aires, Order

POTASSIUM SALTS—38 csk. red prussiate, Hamburg, E Suter & Co , 1,000 csk chlorate, Hamburg, A J. Marcus, Inc.; 135 dr. permanganate, Hamburg, Order , 62 bbl caustic, Hamburg, Order , 4,000 bg sulphate, Bremen, Potash Import Corp., 20 bbl perchlorate, Swansea, Order , 18 bbl. hydrate, Hamburg, A J Marcus, Inc.; 6,000 csk. chlorate, Hamburg, Order , 6 dr salts, London, Mager, Sonderburg Co., 40 cs. caustic, Gothenburg, Mallinckrodt Chem. Works , 500 csk. chlorate, Marseilles, C. W Campbell & Co , 500 csk chlorate, Marseilles, Asia Banking Corp , 100 cs. perchlorate, Marseilles, Order.

PYRITES—7,815,810 kilos, Huelva, Pyrites Co

QUEBRACHO—1,024 bg, Buenos Aires, Order.

QUICKSILVER—11 fl., Tampico, I. Elizondo , 400 fl , Seville, Hurlsking & Co , 300 fl , Seville, H W Peabody & Co., 1,000 fl , Alicante, Order.

SAL AMMONIAC 87 csk , Hamburg Meteor Products Co , 20 csk. and 10 bbl , Bristol, C de P Field.

SHELLAC 18 cs. garnet, Hamburg, A Murphy & Co , 35 bg , Hamburg, Kaschner-Chatfield Shellac Co , 100 cs , London, London & Liverpool Bank , 100 cs , London, Order , 350 bg and 1,050 bg refuse, Calcutta, Bank of the Manhattan Co , 150 bg , Calcutta, Brown Bros & Co , 625 bg , Calcutta, Chase Nat'l Bank , 722 bg and 211 bg button, Calcutta, Order , 115 cs. sticklac, Bangkok, Order , 100 bg., Calcutta, Brown Bros & Co , 450 bg , Calcutta, First Nat'l Bank of Boston , 300 bg , Calcutta, London & Brazil Bank , 50 bg. Calcutta, Br. Bank of West Africa ; 100 bg , Calcutta, N. Y Trust Co ; 255 bg. Calcutta, Standard Bank of S A , 150 pkg , Calcutta, Iwai, Ltd ; 1,256 bg., Calcutta, Order , 25 bg. garnet lac, Hamburg, Order

SODIUM SALTS—40 cs bromide, Hamburg, R. W. Greeff & Co ; 130 bg silicate, Danzig, Hardy & Ruperti , 100 dr sulphite, Bristol, R F. Downing & Co , 336 cs cyanide, Havre, Nat'l City Bank , 24 csk. prussiate, Liverpool, H J. Baker & Bros., 28,067 bg. nitrate, Antofagasta, W R Grace & Co ; 10,885 bg. nitrate, Iquique, W R Grace & Co ; 120 dr. sulphite, Bristol, R F. Downing & Co.; 17 csk. prussiate, Rotterdam, Order , 336 cs cyanide, Marseilles, Nat'l City Bank; 137 csk. hyposulphite, Marseilles, Order.

STARCH — 500 bg potato, Rotterdam, Twenesche Bank ; 700 bg. do., Rotterdam, Stein, Hall & Co.; 1,250 bg. do., Rotterdam, Order.

SUMAC—200 bl., Palermo, Order ; 45 csk. extract, Glasgow, Am. Dyewood Co.

TALLOW—130 tc., Sydney, Nat'l City Bank ; 120 csk., Brisbane, Order ; 87 pipes, Melbourne, Order ; 100 csk , Lyttelton, Tupman, Thurlow & Co.; 298 tc., Buenos Aires, Armour & Co.

TARTAR—89 sk., Tarragona, C. Pfizer & Co.; 667 sk., Valencia, C. Pfizer & Co , 649 sk., Valencia, Royal Baking Powder Co ; 405 sk , Marseilles, Tartar Chem. Works ; 352 sk., Marseilles, C. Pfizer & Co

TURMERIC—178 bg., Cochin, Order ; 904 bg., Alleppey, Order ; 660 bg., Cochin, Order

VEGETABLE TALLOW — 500 pkg, Shanghai, Equitable Trust Co

WATTLE BARK—9,707 bl., Durban, E. J. Haley, Inc.; 1,999 bg , Durban, Bona Allen, Inc

WAXES—42 pkg. bees, Lisbon, E. A. Brummel & Co.; 212 pkg do., Lisbon, Strohmeyer & Arpe Co.; 168 pkg bees, Lisbon, Order ; 16 bg bees, Talcahuano, W. R. Grace & Co ; 88 bg. do , Talcahuano, Strohmeyer & Arpe Co ; 14 bg do , Talcahuano, Order , 84 bg do., Valparaiso, Strohmeyer & Arpe Co ; 74 bg do., Valparaiso, W. R. Grace & Co ; 40 bg bees, London, Order.

ZINC DUST—100 cs , Yokohama, Mitsui & Co.

ZINC SULPHIDE—2 csk., London, C. A. Sykes ; 6 csk., Rotterdam, E. L Bullock & Sons.

ZINC WHITE — 200 bbl., Marseilles, Reichard-Coulston, Inc ; 55 bbl., Marseilles, Order.

ZYLOL—12 dr., Rotterdam, Lunham & Moore.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

General Chemicals

Acetic anhydride, 85%, drums	lb	$0 38 –	
Acetone, drums	lb	25 –	25½
Acid, acetic, 28%, bbl	100 lb.	3 38 –	3 50
Acetic, 56%, bbl	100 lb.	6 75 –	7 00
Glacial, 99½%, bbl	100 lb.	12 00 –	12 50
Boric, bbl	lb	10½–	
Citric, kegs	lb	.49 –	52
Formic, 85%	lb.	14 –	16
Gallic, tech	lb.	45 –	50
Hydrofluoric 52%, carboys	lb.	12 –	12½
Lactic, 44%, tech., light, bbl	lb.	11½–	12
22%, tech., light, bbl	lb	05½–	06
Muriatic, 18° tanks	100 lb	90 –	1 00
Muriatic, 20°, tanks,	100 lb.	1 00 –	1 10
Nitric, 36°, carboys	lb	04½–	.05
Nitric, 42°, carboys.	lb	06 –	06½
Oleum, 20%, tanks	ton	18 50 –	19 00
Oxalic, crystals, bbl	lb	13½–	.13¾
Phosphoric, 50%, carboys	lb	07½–	08½
Pyrogallic, resublimed	lb	1 50 –	1 60
Sulphuric, 60°, tanks	ton	9 50 –	11 00
Sulphuric, 60°, drums	ton	13 00 –	14 00
Sulphuric, 66°, tanks	ton	16 00	16 50
Sulphuric, 66° drums	ton	20 00 –	21 00
Tannic, U.S.P., bbl	lb	65 –	70
Tannic, tech., bbl	lb	45 –	50
Tartaric, imp., powd., bbl	lb	36½–	
Tartaric, domestic, bbl.	lb	37½–	
Tungstic, per lb	lb	1 10 –	1 20
Alcohol butyl, drums, f.o.b. works	lb	26 –	.28
Alcohol ethyl (Cologne spirit), bbl	gal	4 75 –	4 95
Ethyl 190 p'f U.S.P., bbl	gal	4 70 –	
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 190 proof			
No. 1, special bbl	gal	41	
No. 1, 190 proof, special, dr	gal	35	
No. 1, 188 proof, bbl	gal	42	
No. 1, 188 proof, dr	gal	36	
No. 5, 188 proof, bbl	gal	40 –	
No. 5, 188 proof, dr	gal	34 –	
Alum, ammonia, lump, bbl	lb	03½–	03¾
Potash, lump, bbl	lb	02¾–	03¼
Chrome, lump, potash, bbl	lb.	05¼–	06
Aluminum sulphate, com., bags	100 lb	1 50 –	1.65
Iron free bags	lb	02½–	.02¾
Aqua ammonia, 26°, drums.	lb	06½–	07¾
Ammonia, anhydrous, cyl	lb	30 –	30½
Ammonium carbonate, powd casks, imported	lb	09½–	10
Ammonium carbonate, powd domestic, bbl	lb	.13 –	.14
Ammonium nitrate, tech., casks	lb	10 –	11
Amyl acetate tech., drums.	gal	3 50 –	3 75
Arsenic, white, powd., bbl	lb	14½	15
Arsenic, red, powd., kegs	lb	14¼–	14½
Barium carbonate, bbl.	ton	78 00 –	80 00
Barium chloride, bbl.	ton	85 00 –	90 00
Barium dioxide, drums	lb.	18 –	18½
Barium nitrate, casks		08 –	08½
Barium sulphate, bbl.	lb	04 –	.04½
Blanc fixe, dry, bbl	lb	04 –	.04¼
Bleaching powder, f.o.b. wks., drums	100 lb.	1 90 –	
Spot N.Y. drums	100 lb	2 40 –	
Borax, bbl	lb	05¼–	05½
Bromine, cases	lb	28 –	30
Calcium acetate, bags	100 lb	4 00 –	4 05
Calcium arsenate, dr.	lb	16½–	17
Calcium carbide, drums	lb	05½–	.05¾
Calcium chloride, fused, drums	ton	22 00 –	23.00
Gran. drums	ton	28 00 –	30 00
Calcium phosphate, mono, bbl.	lb.	06½–	07
Camphor, cases	lb.	86 –	88
Carbon bisulphide, drums	lb.	07 –	07¼
Carbon tetrachloride, drums	lb.	09½–	10
Chalk, precip.—domestic, light, bbl.	lb.	.04¼–	04½
Domestic, heavy, bbl.	lb.	03½–	03¾
Imported, light, bbl.	lb.	04½–	.05
Chlorine, liquid, tanks, wks	lb.	05½–	.05½
Cylinders, 100 lb., wks	lb.	.06 –	.06¼
Cylinders, 100 lb., spot	lb.	09 –	
Chloroform, tech., drums	lb.	35 –	.38
Cobalt oxide, bbl.	lb.	2 10 –	2.25
Copperas, bulk, f.o.b. wks.	ton	19 00 –	20 00
Copper carbonate, bbl.	lb	19 –	.20
Copper cyanide, drums.	lb.	47 –	50
Copper sulphate, dom., bbl.,	100 lb.	6.00 –	6.25
Cream of tartar, bbl	lb.	.25½–	.26½
Epsom salt, dom., tech., bbl.	100 lb.	1.90 –	2 15
Epsom salt, imp., tech., bags	100 lb.	.90 –	1.00
Epsom salt, U.S.P., dom., bbl.	100 lb.	2.50 –	2.60
Ether, U.S.P., drums	lb.	.13 –	.15
Ethyl acetate, 85%, drums	gal.	.80 –	.81
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 –	1.00

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available. In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

Formaldehyde, 40%, bbl	lb	$0 14	$0 15½
Fullers earth imp., powd.	net ton	30 00	32 00
Fusel oil, ref., drums	gal	3 55	4 00
Fusel oil, crude, drums	gal	2 50	2 60
Glaubers salt, wks., bags	100 lb	1 20	1 40
Glaubers salt, imp., bags	100 lb	90	95
Glycerine, c.p., drums extra	lb	17	17½
Glycerine, dynamite, drums	lb	15½	16
Glycerine, crude 80%, loose	lb	11	11½
Iodine, resublimed	lb	4 55	4 65
Iron oxide, red, casks	lb	12	18
Lead:			
White, basic carbonate, dry, casks	lb.	09½	10
White, basic sulphate, casks	lb	09½	
White, in oil, kegs	lb	12½	14
Red, dry, casks	lb	11½	12
Red, in oil, kegs	lb	13½	15
Lead acetate, white crys., bbl	lb	14	14½
Brown, broken, casks	lb	13	13½
Lead arsenate, powd., bbl	lb	23	24
Lime-Hydrated, bbl	per ton	16 80	17 00
Lime, Lump, bbl	280 lb	3 63	3 65
Litharge, comm., casks	lb	10½	11
Lithophone, bags	lb	07	07½
in bbl	lb	07	07½
Magnesium carb., tech., bags	lb.	08	08½
Methanol, 95%, bbl	gal	1 18	1 20
Methanol, 97%, bbl	gal	1 20	1 22
Nickel salt, double, bbl.	lb.	10½	
Nickel salts, single, bbl.	lb	11½	
Phosgene		60	75
Phosphorus, red, cases	lb.	35	40
Phosphorus, yellow, cases	lb.	30	35
Potassium bichromate, casks	lb.	.11½	12
Potassium bromide, gran., bbl	lb.	.19	20
Potassium carbonate, 80-85%, calcined, casks	lb	.06½	.06¾
Potassium chlorate, powd	lb.	.07½	08
Potassium cyanide, drums	lb.	45	.50
Potassium, first sorts, cask	lb	08½	09
Potassium hydroxide (caustic potash) drums	lb.	.07½	09
Potassium iodide, cases	lb.	3.65	3 75
Potassium nitrate, bbl.	lb.	.06½	.07½
Potassium permanganate, drums	lb.	.18½	19
Potassium prussiate, red, casks	lb.	.65	67
Potassium prussiate, yellow, casks	lb.	.35½	36½
Salammoniac, white, gran., casks, imported	lb.	.06½	.07
Salammoniac, white, gran., bbl, domestic	lb.	.07½	.07¾
Gray, gran., casks	lb.	.08	.09
Salsoda, bbl.	100 lb.	1.20	1 40
Salt cake (bulk)	ton	26.00	28.00
Soda ash, light, 58%, flat, bags, contract	100 lb	1 60	1.67
Soda ash, light, basis, 48%, bags, contract, f.o.b. wks	100 lb.	1.20	1 30
Soda ash, light, 58%, flat, bags, resale	100 lb.	1.75	1.80
Soda ash, dense, bags, contract, basis 48%	100 lb	1.17½	1.20
Soda ash, dense, in bags, resale	100 lb.	1.85	1.90
Soda, caustic, 76%, solid, drums, f.a.s.	100 lb.	3.[illegible]0	3 40
Soda, caustic, basis 60%, wks., contract	100 lb.	2 50	2 60
Soda, caustic, ground and flake, contracts	100 lb.	3.80	3 90
Soda, caustic, ground and flake, resale	100 lb.	3.72½	
Sodium acetate, works, bags	lb.	05½	06½
Sodium bicarbonate, bbl	100 lb	2.00	2 50
Sodium bichromate, casks	lb	08½	09
Sodium bisulphate (niter cake)	ton	6.00	7.00
Sodium bisulphite, powd., U.S.P., bbl.	lb.	.04½	.04¾
Sodium chlorate, kegs	lb.	.06½	.07
Sodium chloride	long ton	12.00	13 00
Sodium cyanide, cases	lb.	.20	.23
Sodium fluoride, bbl	lb.	$0.09 –	$0 10½
Sodium hyposulphite, bbl	lb	.02½–	.03
Sodium nitrite, casks	lb	.08 –	.08½
Sodium peroxide, powd., cases	lb	.28 –	.30
Sodium phosphate, dibasic, bbl	lb.	.03½–	.04
Sodium prussiate, yel. drums	lb.	.16 –	.16½
Sodium salicylic, drums	lb.	.47 –	.52
Sodium silicate (40%, drums)	100 lb.	.80 –	1.25
Sodium silicate (60%, drums)	100 lb.	2.00 –	2.25
Sodium sulphide, fused, 60-62%, drums	lb.	.04½–	.04¾
Sodium sulphite, crys., bbl.	lb.	03½–	03¾
Strontium nitrate, powd., bbl.	lb.	.12½–	13
Sulphur chloride, yel drums.	lb.	04½–	.05
Sulphur, crude	ton	18 00 –	20 00
At mine, bulk	ton	16 00 –	18.00
Sulphur, flour, bag	100 lb.	2.25 –	2.35
Sulphur, roll, bag	100 lb.	2 00 –	2.10
Sulphur dioxide, liquid, cyl.	lb	.08 –	.08½
Talc—imported, bags	ton	30 00 –	40.00
Talc—domestic powd., bags	ton	18.00 –	25.00
Tin bichloride, bbl	lb.	.12½–	.13½
Tin oxide, bbl	lb	.48 –	
Tin crystals, bbl	lb	.35½–	.36
Zinc carbonate, bags	lb.	.14 –	.14½
Zinc chloride, gran, bbl	lb	06½–	.06¾
Zinc cyanide, drums	lb.	.37 –	.38
Zinc oxide, lead free, bbl	lb.	.08 –	.08½
5% lead sulphate bags	lb.	.07½–	....
10 to 35%, lead sulphate, bags	lb	07 –	....
French, red seal, bags	lb	.09½–	......
French, green seal, bags	lb	.10½–	....
French, white seal bbl	lb	.12 –	......
Zinc sulphate, bbl.	100 lb.	2.50 –	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl	lb	$0 65 –	$0.80
Alpha-naphthol, ref., bbl	lb	75 –	.90
Alpha-naphthylamine, bbl.	lb.	35 –	37
Aniline oil, drums	lb.	16 –	.16½
Aniline salts, bbl	lb.	23 –	24
Anthracene, 80%, drums	lb.	.75 –	1.00
Anthracene, 80%, imp., drums, duty paid	lb.	.70 –	.75
Anthraquinone, 25%, paste, drums	lb.	.70 –	.75
Benzaldehyde U.S.P., carboys	lb.	1.40 –	1.45
tech, drums	lb	75	80
Benzene, pure, water-white, tanks and drums	gal.	.30 –	.32
Benzene, 90%, tanks & drums	gal.	.27 –	.30
Benzene, 90%, drums, resale	gal.	.30 –	.33
Benzidine base, bbl.	lb.	.85 –	.90
Benzidine sulphate, bbl	lb.	.70 –	.75
Benzoic acid, U.S.P., kegs	lb	.72 –	75
Benzoate of soda, U.S.P., bbl.	lb.	.57 –	.65
Benzyl chloride, 95-97%, ref., drums	lb.	.45 –	
Benzyl chloride, tech., drums	lb.	.30 –	.35
Beta-naphthol, tech., bbl	lb.	.22 –	.23
Beta-naphthylamine, tech	lb.	.80 –	.90
Cresol, U.S.P., drums.	lb.	.25 –	.29
Ortho-cresol, drums	lb.	.28 –	.30
Cresylic acid, 97%, resale, drums	gal.	1.20 –	..
95-97%, drums, resale	gal.	1.10 –	
Dichlorbenzene, drums	lb.	.07 –	.09
Diethylaniline, drums	lb.	.50 –	.60
Dimethylaniline, drums	lb.	.42 –	.43
Dinitrobenzene, bbl.	lb.	.19 –	.20
Dinitroclorbenzenee bbl.	lb.	.22 –	.23
Dinitronaphthalen, bbl	lb.	.30 –	.32
Dinitrophenol, bbl	lb.	.35 –	.40
Dinitrotoluene, bbl.	lb.	.20 –	.22
Dip oil, 25%, drums.	gal.	.25 –	.30
Diphenylamine, bbl.	lb.	.50 –	.52
H-acid, bbl	lb.	.80 –	.85
Meta-phenylenediamine, bbl.	lb.	1.00 –	1.05
Michlers ketone, bbl.	lb.	3.00 –	3.50
Monochlorbenzene, drums	lb.	.08 –	.10
Monoethylaniline, drums	lb.	.95 –	1.10
Naphthalene, flake, bbl.	lb.	.08½–	.09
Naphthalene, balls, bbl	lb.	.09½–	.10
Naphthionate of soda, bbl.	lb.	.58 –	.65
Naphthionic acid, crude, bbl.	lb.	.55 –	.60
Nitrobenzene, drums.	lb.	.10 –	.12
Nitro-naphthalene, bbl	lb.	.30 –	.35
Nitro-toluene, drums.	lb.	.15 –	.17
N-W acid, bbl.	lb.	1.25 –	1.30
Ortho-amidophenol, kegs	lb.	2.30 –	2.35
Ortho-dichlorbenzene, drums	lb.	.17 –	.20
Ortho-nitrophenol, bbl.	lb.	.90 –	.92
Ortho-nitrotoluene, drums.	lb.	.10 –	.12
Ortho-toluidine, bbl.	lb.	.14 –	.15
Para-amidophenol, base, kegs	lb.	1.20 –	1.30
Para-amidophenol, HCl, kegs	lb.	1.25 –	1.35
Para-dichlorbenzene, bbl.	lb.	.17 –	.20
Paranitroaniline, bbl.	lb.	.72 –	.75
Para-nitrotoluene, bbl.	lb.	.60 –	.65
Para-phenylenediamine, bbl.	lb.	1.45 –	1.50
Para-toluidine, bbl	lb.	.95 –	.98
Phthalic anhydride, bbl.	lb.	.35 –	.38
Phenol, U.S.P., drums.	lb.	.50 –	.52
Picric acid, bbl.	lb.	.20 –	.22
Pyridine, dom., drums	gal.	nominal	

Pyridine, dom., drums	gal.	$2.50 - $2.75
Resorcinol, tech., kegs	lb.	1.40 - 1.50
Resorcinol, pure, kegs	lb.	2.00 - 2.25
R-salt, bbl.	lb	.55 - .60
Salicylic acid, tech., bbl.	lb.	- .42
Salicylic acid, U.S.P., bbl.	lb.	.40 - .45
Solvent naphtha, water-white, drums	gal	.37 - .40
Crude, drums	gal.	.24 -
Sulphanilic acid, crude, bbl.	lb.	.18 - .20
Thiocarbanilide, kegs	lb.	.35 - .38
Toluidine, kegs	lb.	1.20 - 1.30
Toluidine, mixed, kegs.	lb.	.30 - .35
Toluene, tank cars	gal	.30 - .35
Toluene, drums	gal.	.35 - .40
Xylidines drums	lb	.47 - .49
Xylene, pure, drums	gal	.75 - 1.00
Xylene, com., drums	gal	.37 -
Xylene, com., tanks	gal.	.32

Naval Stores

Rosin B-D, bbl	280 lb	$5.85 -
Rosin E-I, bbl	280 lb	5.95
Rosin K-N, bbl.	280 lb	6.15
Rosin W.G.-W.W., bbl	280 lb	6.50 - 7.50
Wood rosin, bbl	280 lb	6.00 - 6.10
Turpentine, spirits of, bbl.	gal	1.12 - 1.14
Wood, steam dist., bbl	gal	1.00
Wood, dest. dist., bbl	gal	.75
Pine tar pitch, bbl.	200 lb	6.00
Tar, kiln burned, bbl.	500 lb	- 13.00
Retort tar, bbl.	500 lb	- 12.00
Rosin oil, first run, bbl	gal	.45 -
Rosin oil, second run, bbl	gal	.48 -
Rosin oil, third run, bbl	gal	.52 -
Pine oil, steam dist	gal	.75
Pine oil, pure, dest. dist	gal	.70 -
Pine tar oil, ref.	gal.	.48 -
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla	gal.	.32 - .32½
Pine tar oil, double ref., bbl.	gal	- .75
Pine tar, ref., thin, bbl.	gal	- .25
Pinewood creosote, ref., bbl	gal	- .52

Animal Oils and Fats

Degras, bbl	lb	$0.03¾ - $0.04¼
Grease, yellow, bbl	lb	.06½ - .06¾
Lard oil, Extra No. 1, bbl	gal	.90 - .92
Neatsfoot oil, 20 deg bbl	gal	1.30 -
No. 1, bbl	gal	.92 - .94
Oleo Stearine		.09 -
Red oil, distilled, d.p. bbl	lb	.10½ - .10¾
Saponified, bbl	lb	.10½ - .10¾
Tallow, extra, loose	lb	.07¾
Tallow oil, acidless, bbl	gal	.94 - .96

Vegetable Oils

Castor oil, No. 3, bbl	lb	$0.14 -
Castor oil, No. 1, bbl	lb.	.14½ -
Chinawood oil, bbl.	lb.	.26 - .28
Coconut oil, Ceylon, bbl.	lb.	.09½ -
Ceylon, tanks, N.Y.	lb	.08¾
Coconut oil, Cochin, bbl.	lb	.10 - .10¼
Corn oil, crude, bbl	lb	.12¼ -
Crude, tanks, (f.o.b. mill)	lb	.09¼ - .09½
Cottonseed oil, crude (f.o.b. mill), tanks	lb	.09½ -
Summer yellow, bbl.	lb	.12¾
Winter yellow, bbl.	lb	.13½ - .13¾
Linseed oil, raw, car lots, bbl	gal.	1.13 - 1.14
Raw, tank cars (dom.)	gal	1.08 - 1.09
Boiled, cars, bbl. (dom.).	gal.	1.15 - 1.16
Olive oil, denatured, bbl	gal.	1.10 -
Sulphur, (foots) bbl	lb	.09 - .09½
Palm, Lagos, casks	lb	.07½ - .07¾
Niger, casks	lb	.07 - .07¼
Palm kernel, bbl.	lb.	.08½ - .08¾
Peanut oil, crude, tanks (mill)	lb	.13½
Peanut oil, refined, bbl.	lb.	.16¾
Perilla, bbl	lb	.16 - .16½
Rapeseed oil, refined, bbl	gal	.83 - .84
Rapeseed oil, blown, bbl.	gal.	.88 - .89
Sesame, bbl	lb	.11¾ - .12½
Soya bean (Manchurian), bbl	lb	.12½ - .13
Tank, f.o.b. Pacific coast	lb	.10½ - .10¾
Tank, (f.o.b. N.Y.)	lb	.10¾ - .10¾

Fish Oils

Cod, Newfoundland, bbl.	gal	$0.70 - $0.72
Menhaden, light pressed, bbl.	gal	.76 -
White bleached, bbl.	gal	.78 -
Blown, bbl.	gal.	.82 -
Crude, tanks (f.o.b. factory)	gal	.50 -
Whale No. 1 crude, tanks, coast	lb	-
Winter, natural, bbl	gal	.76 - .78
Winter, bleached, bbl	gal	.79 - .80

Oil Cake and Meal

Coconut cake, bags.	ton	$30.00 - $31.00
Copra, sun dried, bags, (c.i.f.)	lb	.05¼ - .05½
Sun dried Pacific coast	lb.	.05½ - .05¾
Cottonseed meal, f.o.b. mills	ton	38.00 -
Linseed cake, bags	ton	34.50 -
Linseed meal, bags	ton	36.50 -

Dye & Tanning Materials

Albumen, blood, bbl	lb	$0.45 - $0.50
Albumen, egg, tech, kegs	lb	.90 - .95
Cochineal, bags.	lb	.33 - .35
Cutch, Borneo, bales	lb	.04½ - .05
Cutch, Rangoon, bales	lb	.13 - .13½
Dextrine, corn, bags	100 lb	3.69 - 4.01
Dextrine, gum, bags	100 lb	3.99 - 4.09
Divi-divi, bags	ton	38.00 - 39.00
Fustic, sticks	ton	30.00 - 35.00
Fustic, chips, bags	lb.	.04 - .05
Logwood, sticks	ton	26.00 - 30.00
Logwood, chips, bags	lb	.02½ - .03½
Sumac, leaves, Sicily, bags	ton	70.00 - 72.00
Sumac, ground, bags	ton	$65.00 - $67.00
Sumac, domestic, bags	ton	40.00 - 42.00
Starch, corn, bags	100 lb	2.97 - 3.07
Tapioca flour, bags	lb.	.06 - .06½

Extracts

Archil, conc., bbl	lb	$0.17 - $0.18
Chestnut, 25% tannin, tanks	lb	.02 - .03
Divi-divi, 25% tannin, bbl	lb	.04 - .05
Fustic, crystals, bbl	lb	.20 - .22
Fustic, liquid, 42°, bbl	lb	.08 - .09
Gambier, liq., 25% tannin, bbl	lb.	.08 - .09
Hematine crys., bbl	lb	.14 - .18
Hemlock, 25%, tannin, bbl	lb	.04 - .05
Hypernic, solid, drums	lb	.24 - .26
Hypernic, liquid, 51°, bbl	lb	.10 - .12
Logwood, crys., bbl	lb	.18 - .20
Logwood, liq., 51°, bbl.	lb	.09 - .10
Quebracho, solid, 65% tannin, bbl	lb	.04½ - .05
Sumac, dom., 51°, bbl	lb	.06½ - .07

Dry Colors

Blacks-Carbongas, bags, f.o.b. works	lb	$0.20 - $0.24
Lampblack, bbl	lb	.12 - .40
Mineral, bulk	ton	35.00 - 45.00
Blues-Bronze, bbl	lb	.55 - .60
Prussian, bbl	lb	.55 - .60
Ultramarine, bbl	lb	.08 - .35
Browns, Sienna, Ital., bbl	lb	.06 - .14
Sienna, Domestic, bbl	lb	.03½ - .04
Umber, Turkey, bbl	lb	.04 - .04½
Greens-Chrome, C.P. Light, bbl	lb	.32 - .34
Chrome, commercial, bbl	lb	.12 - .12½
Paris, bulk	lb	.30 - .35
Reds, Carmine No. 40, tins	lb	4.50 - 4.70
Oxide red, casks	lb	.10 - .14
Para toner, kegs	lb	1.00 - 1.10
Vermilion, English, bbl	lb	1.30 - 1.32
Yellow, Chrome, C.P. bbls	lb	.20 - .21
Ocher, French, casks	lb	.02½ - .03

Waxes

Bayberry, bbl.	lb	$0.35 - $0.36
Beeswax, crude, bags	lb	.20 - .21
Beeswax, refined, light, bags	lb	.32 - .34
Beeswax, pure white, cases	lb	.40 - .41
Candelilla, bags	lb.	.21 - .22
Carnauba, No. 1, bags	lb	.42 - .43
No. 2, North Country, bags	lb	.23 - .23½
No. 3, North Country, bags	lb.	.18½ - .19
Japan, cases	lb	.16½ - .16¾
Montan, crude, bags	lb.	.04½ - .04¾
Paraffine, crude, match, 105-110 m.p.	lb.	.04 - .04¼
Crude, scale 124-126 m.p., bags	lb	.02¾ - .03
Ref., 118-120 m.p., bags	lb.	.03 - .03¼
Ref., 125 m.p., bags	lb	.03½ - .03¾
Ref., 128-130 m.p., bags	lb.	.03¾ - .04
Ref., 133-135 m.p., bags	lb	.04½ - .04¾
Ref., 135-137 m.p., bags	lb.	.05 - .05¼
Stearic acid, sgle pressed, bags	lb.	.13 - .13½
Double pressed, bags	lb	.13½ - .13¾
Triple pressed, bags	lb	.15 - .15½

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb	$3.25 - $3.30
F.a.s. double bags	100 lb	3.85 - 3.90
Blood, dried, bulk	unit	4.00 -
Bone, raw, 3 and 50, ground	ton	27.00 - 30.00
Fish scrap, dom., dried, wks.	unit	3.75
Nitrate of soda, bags	100 lb.	2.52½ - 2.57½
Tankage, high grade, f.o.b. Chicago	unit	3.35 - 3.45
Phosphate rock, f.o.b. mines,		
Florida pebble, 68-72%	ton	$4.00 - $4.50
Tennessee, 78-80%	ton	8.00 - 8.25
Potassium muriate, 80%, bags	ton	34.55 -
Potassium sulphate, bags basis 90%	ton	43.67 -
Double manure salt	ton	25.72 —
Kainit	ton	7.22 —

Crude Rubber

Para—Upriver fine	lb	$0.27¾
Upriver coarse	lb	.23 - .23½
Upriver caucho ball	lb	.24½ - .25½
Plantation—First latex crepe	lb	.27¼ -
Ribbed smoked sheets	lb	.27¼ -
Brown crepe, thin, clean	lb.	.26½ -
Amber crepe No. 1.	lb.	.27 - .27¼

Gums

Copal, Congo, amber, bags	lb.	$0.12 - $0.13
East Indian, bold, bags	lb.	.23 - .23½
Manila, pale, bags	lb.	.20 - .20½
Pontinak, No. 1 bags	lb.	.20 - .20½
Damar, Batavia, cases	lb	.28 - .29
Singapore, No. 1, cases	lb.	.34 - .35
Singapore, No. 2, cases	lb.	.23 - .24
Kauri, No. 1, cases	lb	.65 - .67
Ordinary chips, cases	lb	.20 - .22
Manjak, Barbados, bags	lb	.09 - .09½

Shellac

Shellac, orange fine, bags	lb.	$0.64 -
Orange superfine, bags	lb.	.66 -
A. C. garnet, bags	lb.	nominal
Bleached, bonedry	lb	.73 -
Bleached, fresh	lb.	.61 - .62
T. N., bags	lb.	.60 - .61

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh. ton	$500.00 -
Asbestos, shingle, f.o.b., Quebec	sh. ton	$65.00 - $85.00
Asbestos, cement, f.o.b., Quebec	sh. ton	20.00 - 25.00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	16.00 - 20.00
Barytes, grd., off-color, f.o.b. mills bulk	net ton	13.00 - 15.00
Barytes, floated, f.o.b. St. Louis, bbl	net ton	28.00 -
Barytes, crude f.o.b. mines, bulk	net ton	10.00 - 11.00
Casein, bbl., tech.	lb	.19½ - .23½
China clay (kaolin) crude, f.o.b. Ga	net ton	7.00 - 9.00
Washed, f.o.b. Ga.	net ton	8.00 - 9.00
Powd., f.o.b. Ga	net ton	14.00 - 20.00
Crude f.o.b. Va	net ton	8.00 - 12.00
Ground, f.o.b. Va	net ton	14.00 - 20.00
Imp., lump, bulk	net ton	15.00 - 20.00
Imp., powd	net ton	45.00 - 50.00
Feldspar, No. 1 pottery	long ton	6.00 - 7.00
No. 2 pottery	long ton	4.00 - 5.50
No. 1 soap	long ton	7.00 - 7.50
No. 1 Canadian, f.o.b. mill	long ton	20.00 - 22.00
Graphite, Ceylon, lump, first quality, bbl	lb	.06½ -
Ceylon, chip, bbl.	lb	.05¾ -
High grade amorphous crude	ton	15.00 - 35.00
Gum arabic, amber, sorts, bags	lb	.14½ - .15
Gum tragacanth, sorts, bags	lb	.48 - .56
No. 1, bags	lb	1.50 - 1.60
Kieselguhr, f.o.b. Cal	ton	40.00 - 42.00
F.o.b. N.Y.	ton	50.00 - 55.00
Magnesite, crude, f.o.b. Cal.	ton	14.00 - 15.00
Pumice stone, imp., casks	lb	.03 - .05½
Dom., lump, bbl	lb	.05 - .05½
Dom., ground, bbl	lb	.06 - .07
Silica, glass sand, f.o.b. Ind.	ton	2.00 - 2.50
Silica, sand blast, f.o.b. Ind.	ton	2.50 - 5.00
Silica, amorphous, 250-mesh, f.o.b. Ill	ton	17.00 - 17.50
Silica, bldg. sand, f.o.b. Pa.	ton	2.00 - 2.75
Soapstone, coarse, f.o.b. Vt., bags	ton	7.00 - 8.00
Talc, 200 mesh, f.o.b. Vt., bags	ton	6.50 - 9.00
Talc, 200 mesh, f.o.b. Ga., bags	ton	7.00 - 9.00
Talc, 200 mesh, f.o.b. Los Angeles, bags	ton	16.00 - 20.00

Mineral Oils

Crude, at Wells

Pennsylvania	bbl.	$3.25 - 3.50
Corning	bbl	1.85 -
Cabell	bbl.	1.91 -
Somerset	bbl	1.75 -
Illinois	bbl	1.97 -
Indiana	bbl	1.98 -
Kansas and Oklahoma, 28 deg	bbl	1.30 -
California, 35 deg. and up	bbl	1.04 -

Gasoline, Etc.

Motor gasoline, steel bbls	gal.	$0.21½ -
Naphtha, V. M. & P. deod, steel bbls	gal	.20½ -
Kerosene, ref. tank wagon	gal.	.14 -
Bulk, W. W. export	gal.	.07 -
Lubricating oils		
Cylinder, Penn., dark	gal.	.22 - .25
Bloomless, 30@31 grav	gal.	.18½ - .20½
Paraffin, pale	gal.	.24 - .26
Spindle, 200, pale	gal.	.22 - .24
Petrolatum, amber, bbls	lb	.05 - .05¼
Paraffine wax (see waxes)		

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	ton	$45-50
Chrome brick, f.o.b. Eastern shipping points	ton	50-52
Chrome cement, 40-50% Cr_2O_3.	ton	23-27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st. quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	40-45
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	36-41
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65-68
9-in. arches, wedges and keys.	ton	80-85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48-50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	48-50
F.o.b. Mt. Union, Pa	1,000	42-44
Silicon carbide refract. brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N.Y.	ton	$200.00 - $225.00
Ferrochromium, per lb. of Cr, 6-8% C.	lb.	.11½ - .11¾
4-6% C.	lb.	.12 - .13
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	125.00 -
Spiegeleisen, 19-21% Mn.	gr. ton	40.00 -
Ferromolybdenum, 50-60% Mo, per lb. Mo.	lb.	2.00 - 2.50
Ferrosilicon, 10-15%	gr. ton	48.00 - 50.00
50%	gr. ton	95.00 -
75%	gr. ton	150.00 - 160.00

Ferrotungsten, 70-80%, per lb. of W.........	lb.	$0.90 -	$0.95
Ferro-uranium, 35-50% of U. per lb. of U.......	lb.	6.00 -	....
Ferrovanadium, 30-40%, per lb. of V.........	lb.	3.50 -	3.75

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$6 00 -	$9 00
Chrome ore Calif. concentrates, 50% min Cr_2O_3	ton	22 00 -	23 00
C i f. Atlantic seaboard	ton	20 50 -	24 00
Coke, fdry., f o b. ovens	ton	7 00 -	7 50
Coke, furnace, f.o b ovens	ton	6 00 -	6 50
Fluorspar, gravel, f o b. mines' Illinois..	ton	20 00	21 50
Ilmenite, 52% TiO_2	lb	01¼-	01½
Manganese ore, 50% Mn, c i f. Atlantic seaport	unit	.33 -	...
Manganese ore, chemical (MnO_2)	ton	75 00 -	80.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N. Y	lb	.65 -	70
Monazite, per unit of ThO_2, c i.f, Atl. seaport..	lb.	.06 -	08
Pyrites, Span., fines, c i f Atl. seaport	unit	.11½-	12
Pyrites, Span, furnace size, c i.f. Atl. seaport ..	unit	.11½-	.12
Pyrites, dom fines, f.o b. mines, Ga	unit	.12	
Rutile, 95% TiO_2	lb.	12 -	...
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3..	unit	8 50 -	8 75
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	8 00 -	8.25
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 -	3 75
Uranium oxide, 96% per lb. U_3O_8	lb.	2 25 -	2 50
Vanadium pentoxide, 99%..	lb.	12 00 -	14 00
Vanadium ore, per lb. V_2O_5.	lb.	1 00 -	....
Zircon, washed, iron free, f.o.b. Pablo, Fla.......	lb.	.04½-	.13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	15½- 15¾
Aluminum, 98 to 99%	26-27
Antimony, wholesale, Chinese and Japanese	7½- 8
Nickel, virgin metal	28-30
Nickel, ingot and shot	30-
Monel metal, shot and blocks	32 00
Monel metal, ingots	38.00
Monel metal, sheet bars	45.00
Tin, 5-ton lots, Straits	42 12½
Lead, New York, spot	7.25
Lead, E. St. Louis, spot	7 00
Zinc, spot, New York	6 85
Zinc, spot, E. St. Louis	6.50

Other Metals

Silver (commercial)	oz.	$0 67⅞
Cadmium	lb.	1 00
Bismuth (500 lb lots)	lb.	2 55
Cobalt	lb.	2 65@2.85
Magnesium, ingots, 99%	lb.	1 25 ..
Platinum	oz	114 00
Iridium	oz.	260.00@275.00
Palladium	oz.	80 00
Mercury	75 lb.	68 00

Finished Metal Products

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	24 25
Copper bottoms	29 75
Copper rods	25 25
High brass wire	19 37½
High brass rods	17 00
Low brass wire	21 10
Low brass rods	22 00
Brazed brass tubing	24 25
Brazed bronze tubing	29 00
Seamless copper tubing	25 25
Seamless high brass tubing	23 50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.60@11.80
Copper, heavy and wire	11 50@11.60
Copper, light and bottoms	10 00@10.10
Lead, heavy	5.75@ 6.00
Lead, tea	3.50@ 3 75
Brass, heavy	6.50@ 6 75
Brass, light	5.75@ 6 00
No. 1 yellow brass turnings	6.75@ .700
Zinc	3.75@ 4.25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.29	$3.14
Soft steel bars	3.19	3.04
Soft steel bar shapes	3.19	3.04
Soft steel bands	3.29	3.19
Plates, ¼ to 1 in. thick	3.29	3.14

Industrial

Financial, Construction and Manufacturing News

Construction and Operation

California

LOS ANGELES—The Pacific Coast Borax Co., Kohl Bldg, San Francisco, has work in progress on the first unit of its new refining plant at Wilmington, Los Angeles harbor, 210x252 ft, for which a general contract recently was awarded to the Davidson Construction Co, 1445 East 16th St., Los Angeles A power plant will be erected on adjoining site The structures, exclusive of equipment, will cost $418,000.

Georgia

EAST POINT—The Marion-Harper Oil Co. has tentative plans under consideration for the rebuilding of the portion of its cotton oil mill, destroyed by fire, May 14, with loss estimated at $50,000, including equipment.

Florida

ST. PETERSBURG—W. A. Kerr, 338 8th Ave., North, and associates are organizing a new company to construct and operate a local plant for the manufacture of inks and kindred products. Plans will be prepared at an early date.

Illinois

CHICAGO—Fritzsche Brothers, Inc., 82 Beekman St., New York, N. Y., manufacturer of essential oils, has purchased property at 118 East Ohio St., Chicago, as a site for a new plant. Plans will be prepared at an early date

CHICAGO—Gutmann & Co., 1511 Webster St, operating a tanning plant, will commence the immediate erection of a new 2-story tannery at Webster and Dominick Sts, 78x190 ft, estimated to cost $125,000, with equipment I. B. Stern is company architect.

DECATUR—The Home Oil Co, Arthur, Ill., is considering plans for a new branch works in the Cerro Gordo district, Decatur F. C. Phillips is general manager

Indiana

INDIANAPOLIS—The Bryan Pyroxylin Co has arranged for the operation of a new plant at Shadeland Ave. and the Pendleton Pike for the manufacture of composition products

INDIANAPOLIS—The Fairmount Glass Works, Inc., Keystone Ave, is considering tentative plans for a new plant on property recently acquired at Alabama and St. Clair Sts, 130x195 ft., to be used for the manufacture of hollow-ware products. John Rau is president

Kansas

WICHITA—The Roxana Petroleum Corp, Roxana, Ill. and Tulsa, Okla, is perfecting plans for the erection of its proposed new oil refinery on property acquired near Wichita, totaling 200 acres of land. The initial plant units will have a capacity of 5,000 bbl. per day and will cost close to $2,000,000, with machinery. The ultimate refinery will have a total output of 10,000 bbl., and is estimated to cost $4,000,000.

Kentucky

OWENSBORO—The Owensboro Clay Products Co., recently organized with a capital of $1,000,000, has preliminary plans for the establishment of a new plant estimated to cost in excess of $150,000, with machinery. John A. Bolger, Owensboro, heads the company.

Louisiana

BASTROP—The United States Carbon Co. is arranging for the erection of a new plant for the production of carbon black on local site, recently purchased. It will consist of two units, each comprising 36 buildings, with total daily production of 10,000 lb. of material The plant will cost in excess of $200,000, including equipment. Leonard Biddison heads the company.

MONROE—The Standard Carbon Co. has plans under consideration for extensions in its local plant, including the installation of additional machinery

Maine

PHIPPSBURG The Basin Quarries, Inc., Portland, Me, organized with a capital of $100,000, has plans under way for the erection of a new feldspar, quartz and mica plant, with pulverizing, screening and grinding departments, estimated to cost $50,000 with machinery. The mill will have an initial capacity of 30 tons per day. Joseph F. Perry is president, and Frank L. Marston, vice-president.

RUMFORD—The Oxford Paper Co. is arranging plans for a new addition to its bleach plant, 50x216 ft., to provide for an increased output of 1,900 tons of electrolytic bleach and 75 tons of caustic material. Extensions will also be built to the machine and beater buildings

Maryland

HAGERSTOWN—The Hagerstown Lime & Chemical Co. is completing the construction of a new plant on the State Road, near the city limits, on 112-acre tract of land recently purchased, and will commence operations at an early date for the manufacture of fertilizer products.

WOODLAWN (Baltimore)—The Powhatan Mining Corp., recently formed with a capital of $100,000, has tentative plans under consideration for the development of an extensive tract of asbestos property and the construction of a mill. Fred A. Mett is president and general manager; and K. H. Kiefer, vice-president.

Michigan

WATERVLIET—The Watervliet Paper Co. will make extensions and improvements in its plant, including the installation of electrical and other equipment.

MARINE CITY—Plans are being arranged for a reorganization of the Independent Sugar Co. and the early resumption of operations at the mill. The property will be offered for sale by the receiver on June 5, and will be acquired by the new interests. Extensions and improvements are planned.

New Jersey

TRENTON—The J. L. Mott Co., Hancock Ave., manufacturer of enameled iron products, has commenced the rebuilding of the portion of its enameling plant, recently destroyed by fire with loss estimated at $25,000, including equipment.

New York

CORNWALL—The Cornwall Chemical Corp., 111 Water St., New York, is said to be perfecting plans for the rebuilding of the portion of its plant at Cornwall, recently destroyed by fire with loss estimated at $100,000, including equipment.

GLENS FALLS—The Raymond Pectoral Plaster Co., Thompson Ave., has had plans prepared for the construction of a new 2-story and basement plaster mill, estimated to cost $25,000. Wetmore & Crandall, Inc., Glens Falls, are architects.

North Carolina

WILMINGTON—The Wilmington Pottery Co. has plans nearing completion for its proposed new plant at Surry and Wright Sts, for the manufacture of cement products. The company will remodel an existing building and install machinery. R. H. Young, Charlotte, N. C., is head.

Ohio

LIMA—The Lily White Oil Co., recently acquired by the Roxana Petroleum Co., Roxana, Ill., to be operated as a subsidiary organization, has tentative plans under con-

sideration for the erection of a new plant for the manufacture of lubricating oils, estimated to cost about $300,000, with machinery.

Pennsylvania

PITTSBURGH—The Waverly Oil Co., 54th St. and the Allegheny Valley Railroad, is having plans drawn for the erection of an addition to its plant to be equipped as a gasoline refinery. It is estimated to cost in excess of $100,000, including machinery. The Hunting-Davis Co., Century Building is engineer.

NILES—The Ohio Galvanizing Co., Ann St., is considering plans for the erection of a new 1-story addition to its plant, 100x125 ft., to cost about $15,000. F. F. Bentley is head.

PITTSBURGH—The Aiken Oil Co., Crafton Pa., has purchased property comprising about 2 acres of land near Woodville and Banksville Aves. as a site for a new plant for the manufacture of lubricating oils. Plans have been drawn and work will be commenced at an early date. Complete processing and other machinery will be installed. F. L. Aiken is president.

NEW CASTLE—The Shenango China Co. will make extensions and improvements at its local pottery, including the installation of additional equipment. A number of new kilns will be built.

BETHLEHEM—The Bethlehem Spark Plug Co., Inc., manufacturer of porcelain spark plugs, is arranging to increase production at its plant. The company has contracted to furnish all spark plugs required by the United States Post Office Department for the coming fiscal year.

Tennessee

KNOXVILLE—The American Glass Co has perfected arrangements for the establishment of a new plant at property recently acquired at 211 West Clinch St, and will install equipment.

Texas

DALLAS—The Shook Rubber Co., 2500-2 South Ervay St., will commence the immediate construction of a new 3-story works to cost about $35,000, exclusive of equipment.

HOUSTON—The Texas Portland Cement Co., Praetorian Bldg., Dallas, is completing plans and will soon commence the erection of an addition to its plant at Manchester, near Houston, estimated to cost about $30,000, exclusive of equipment. Grinding and other machinery will be installed to cost approximately $60,000. William Moeller is general superintendent.

EASTLAND—The Arab Gasoline Co., 23rd and Westmoreland Sts., Philadelphia, Pa., has plans under way for extensions in its gasoline-refining plant at Eastland, estimated to cost about $90,000, including equipment. The company has recently increased its capital to $700,000 for general expansion.

HOUSTON—The Myer Spalti Mfg. Co has plans under consideration for the erection of a new plant on local site, for the manufacture of cement and concrete products, estimated to cost $100,000, including equipment.

DALLAS—The Texas Co., 17 Battery Place, New York, is considering plans for extensions and improvements in its oil-refining plants in Texas and other localities, to cost close to $1 500,000 with equipment. The company has acquired a controlling interest in the Carib Syndicate, Ltd. for expansion in its refinery facilities.

HEARN—The Austin Cotton & Planters' Mills, Inc., is having plans prepared for a new cotton oil mill, to be 80x300 ft., estimated to cost close to $60,000, with equipment. Edwin C. Kreile, 803 Scarborough Bldg., Austin, Tex., is architect.

HOUSTON—The Magnolia Paper Co is completing plans for a new 3-story works at Pickney and Glaser Sts., estimated to cost close to $50,000. Work will soon be commenced.

Washington

VANCOUVER—The Columbia River Paper Mills Corp. will commence the installation of a new acid system at its sulphite plant. Other equipment will be installed later.

West Virginia

CHARLESTON—The Evans Lead Co. has commenced the erection of the first unit of its proposed local plant, comprising a 1-story building, 75x120 ft., and will install machinery at an early date. The company is also planning for the construction of a new laboratory building.

Industrial Notes

THE DORR CO. has moved its New York office from 101 Park Ave to 247 Park Ave.

THE OILGEAR CO. of Milwaukee, Wis., has recently appointed the Buffalo Machinery Sales Corp., 881 Ellicott Square, Buffalo, as sales representative for Oilgear products in the western New York territory. Announcement is also made that W. D. Creider, formerly in charge of the Milwaukee office of the Federal Machinery Sales Co. of Chicago, has been appointed sales manager of the Oilgear Co. at Milwaukee and that A. L. Ellis, for the past year acting sales manager at Milwaukee, has been appointed Eastern representative of the company, with headquarters in New York City.

THE PURE CARBON CO., Wellsville, N. Y., has recently established a Minneapolis representative in the firm of Charles A. Etem Co., 914-A Marquette Ave., Minneapolis, Minn.

The offices of the MINING AND METALLURGICAL SOCIETY OF AMERICA are now located at 2 Rector Street, New York City.

GIFFORD WOOD CO., of Hudson, N. Y., has changed the location of its Buffalo office to the Peoples Bank Bldg., Corner 4th Ave. and Wood St., Pittsburgh, Pa.

THE BARTLETT HAYWOOD CO. announces the removal of its New York office to 1607 Pershing Square Bldg., 42nd St., at Park Ave.

JOSEPH W. HAYS has organized a corps of consulting combustion engineers to be known as Joseph W. Hays and Associates. The headquarters of the organization will be Michigan City, Ind. It is prepared to render consulting service in steam plants in all parts of the country since no change will be made in the place of residence of any of the associates, and each member will look after the engineering work in his immediate territory.

THE GEORGE J. HAGAN CO. has moved its offices from the Peoples Bank Bldg. to the Chamber of Commerce Building, Pittsburgh, Pa.

THE PHILADELPHIA DRYING MACHINERY CO., Philadelphia, Pa., announces that Whitehead, Emmans, Ltd., of Montreal and Hamilton, Canada, will be its Canadian agent.

THE LINK-BELT CO.'s Pittsburgh branch office has been moved to 335 Fifth Ave.

THE CARBORUNDUM CO., Niagara Falls, N. Y., announces the appointment of Harry Collinson as district sales manager in charge of its Milwaukee office and warehouse. Mr. Collinson assumed the position May 1, succeeding J. H. Jackson, resigned. Mr. Collinson was previously district sales manager of the Carborundum Co. in the Province of Ontario. In this position he was succeeded by C. E. Bowman, lately connected with the sales department of Norman Macdonald, who has the agency for Carborundum products at Toronto, Ont.

New Companies

OKLAHOMA FIBER CO., Durant, Okla.; fiber products, $100,000. Incorporators: George F. Beck, Durant; and Guy C. Wallace, Caddo, Okla.

DIAMOND COLOR & CHEMICAL CORP., Jersey City, N. J.; chemicals, chemical byproducts, etc.; $20,000. Incorporators: Arthur R. Oakley and Robert A. Van Voorhis. Representative: Registrar & Transfer Co., 15 Exchange Place, Jersey City.

BAY CHEMICAL CO., Brooklyn, N. Y.; chemicals and chemical byproducts; $100,000. Incorporators: W. Kopp and C. Seifert. Representative: C. O. Echler, 481 Knickerbocker Ave., Brooklyn.

MANOLITS CARBON PAINT CO., Cincinnati, O.; paints, enamels, etc.; $500 000. Incorporators: E. Cunningham and N. C. Kelley, both of Cincinnati.

DENTAPERL CHEMICAL CO., INC., 1913-15 West Harrison St., Chicago, Ill., chemicals and chemical byproducts, $10,000. Incorporators: Howard Golden and John E. Rowe.

LYON LEATHER CO., Manchester, Conn., leather products; capital $50,000. Incorporators: C. E. House, W. A. Strickland and C. R. Burr, 138 Main St., Manchester.

MALTOSE CORP. OF NEW JERSEY, INC., Jersey City, N. J., glucose and kindred products, 20,000 shares of stock, no par value. Incorporators: John Milton, J. L. Ridley and John J. Tracy, 1 Exchange Place, Jersey City. The last noted is representative.

DIXIE INK CO., Mobile, Ala.; ink, adhesive products, etc.; $10,000. Incorporators: E. C. Bristol, John Whilburn and D. D. Gimon, all of Mobile.

DERMATAN CHEMICAL CO., New York, N. Y.; chemicals and chemical byproducts; $15,000. Incorporators: D. Ambrose, G. W. Moser and A. A. Cone. Representative: A. G. Mintz, 305 Broadway, New York.

CHARLES V. SPARHAWK CORP., Wilmington, Del.; chemicals and chemical byproducts; $200,000. Representative: Colonial Charter Co., Ford Bldg., Wilmington.

PERFECTION PAINT & PRODUCTS CORP., Room 815, 8 South Dearborn St., Chicago, Ill.; paints, varnishes and kindred products; $25,000. Incorporators: Henry Rutz, A. R. Sherick and Mortimer A. Sherick.

ATHENS FIRE BRICK CO., Athens, Tex.; firebrick and refractories; $25,000. Incorporators: T. A. Bartlett, A. S. Coke and C. D. Gregg, all of Athens.

VINE CHEMICAL CO., Jamestown, N. Y.; chemicals and chemical byproducts; $50,000. Incorporators: R. Osgood, L. Vine, and W. C. Davidson. Representative: A. C. Nelson, attorney, Jamestown.

HELVETIA OIL CO., San Antonio, Tex., petroleum products, $200,000. Incorporators: W. M. Aikman, K. R. Potts and W. C. Steubing, all of San Antonio.

FROST CORP., Wilmington, Del.; glass products; $100,000. Representative: Corporation Trust Co. of America, du Pont Bldg., Wilmington.

M & L RUBBER CO., 3025 Indiana Ave., Chicago, Ill.; rubber products; $20,000. Incorporators: W. M. Legnard, A. B. Legnard and A. E. McGregor.

HERCULITE PRODUCTS CORP., Jersey City, N. J., celluloid and composition products, $600 000. Representative: United States Corporation Co., 15 Exchange Place, Jersey City.

LINCOLN OIL MILLS CO., Lincolnton, N. C., refined oil products; $50,000. Incorporators: K. B. Nixon, R. F. Beal and J. E. Lipscomb, all of Lincolnton.

J. SCHANZENBACH & CO., INC., New York, N. Y.; chemicals and chemical byproducts, $10,000. Incorporators: J. Schanzenbach, A. B. Rose and J. A. Mitchell. Representative: Brown, Cropsey & Nines, 29 Broadway, New York.

BLUE BONNETT LIME CO., Fort Worth, Tex.; lime products; nominal capital, $6,000. Incorporators: A. D. and D. D. Thompson and G. W. Harding, all of Fort Worth.

HAWTHORNE GLASS CO., 3650 52nd Ave., Cicero, Ill., glass products, 500 shares of stock, no par value. Incorporators: F. H. King, Thomas J. Harper and E. A. Moynihan.

RESISTO PIPE & VALVE CO., 262 Bridge St., Cambridge, Mass.; acid-resisting lined iron pipe, valves, pumps, tanks, etc.; $100 000. E. A. Taft, president; G. A. MacDowall, treasurer.

THORBETTE OIL CORP., Wilmington, Del.; refined oil products; $1,000,000. Representative: Corporation Trust Co. of America, du Pont Bldg., Wilmington.

POLY CHEMICAL LABORATORIES, INC., Jersey City, N. J.; chemicals and chemical byproducts, $25,000. Incorporators: Frank Haber, Louis Rothstein and George P. Williamson. Representative: Ezra L. Nolan, 25 Old Bergen Rd., Jersey City.

Opportunities in the Foreign Trade

Parties interested in any of the following opportunities may obtain all available information from the Bureau of Foreign and Domestic Commerce at Washington or from any district office of the bureau. The number placed after the opportunity must be given for the purpose of identification.

COTTONSEED OIL, sesame oil, soya oil and peanut oil. Belgrade, Jugoslavia. Purchase or agency.—6449.

TIN PLATE for making sardine cans. Vigo, Spain. Purchase.—6459.

PAPER, PRINTING INKS. Rio de Janeiro, Brazil. Agency.—6479.

WALL PAPERS, principally job borders and friezes, both cut-outs and straight. London, England. Purchase and agency.—6471.

ALLOYS of aluminum and silicate, providing 10 per cent silicon. Lyon, France. Purchase.—6486.

PAINTS AND BUILDING MATERIAL. Berne, Switzerland. Agency.—6489.

OXIDE OF TIN (extra light for enameling on iron), in quantity of 2, 3 or 5 ton lots. Newcastle, England. Purchase.—6490.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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Future Progress in Steel Making

MOST of the "big men" who attend the meetings of the American Iron and Steel Institute go to hear Judge GARY'S estimate of the trade conditions, to meet their business friends and competitors, and to discuss with them the state of the union. Then there are a large number of plant managers and engineers whose main interest is to renew acquaintances and find out what the other fellow is thinking about and doing. Finally, there may be found a larger number of men who do business with the other groups (or would like to) who are there because it is a good place to be.

In such a gathering one anticipates that science and technology would occupy inconspicuous seats. However, they are very useful to fill in between the president's opening address and dressing time for the banquet. They are quite distinguished and above any suspicion which might survive from "Gary dinners," and it is well that they are useful in these circumstances, as in many others. If it were not for the technical program—prepared often by mandatory invitation—a large part of our huge metallurgical industry would be inarticulate.

Knowing the origin of some papers on the program and guessing at the careful scrutiny they receive before release, it is perhaps permissible to place more weight on a statement that "only through unremitting and untiring research can chemistry continue to serve the steel industry as it has in the past" when coming from a metallurgist with the Steel Corporation than if it came from a chemist with the Bureau of Standards. Can it be that the remark reflects the tardy realization that the steel companies in America are very remiss in studying the essence of their processes? Few are so backward that they have no investigations of any sort under way, but in nearly every instance they are working on minor plant troubles or disputes with customers.

But there seems to be an undercurrent of opinion that we are on the very brink of revolutionary changes. The minute it is admitted that the conventional steel plant has nearly reached its theoretical possibilities, it immediately follows that the next improvements will come through radically different methods. If, for instance, the mechanical gas producer cannot be appreciably improved, when may we expect the "slagging gas producer" gasifying coal at ten times the rate? If the iron blast furnace has reached its limit, is not that very fact ushering in the new metallurgy which will exist when oxygen is produced for five dollars a ton? (One hears that two thoroughly trustworthy organizations are guaranteeing less than that figure!) Or for that matter, cannot the principles of ore concentration, so well known in the West, be used to produce a very pure iron oxide, and this be reduced directly to high-grade steel without the expensive refining operation?

Truly, it would be well for the large producing interests to gather to themselves men of vision and widest scientific training, so that they will be forewarned and prepared against discoveries which can turn a million dollars worth of steel plant into a few thousand dollars worth of junk.

Bio-Chemical Engineering

SIGNIFICANT REMARKS made recently by Dr. C. P. STEINMETZ indicate the interrelation of the sciences and the need for a catholicity of viewpoint on many of the research problems of the day. For example, economical sugar production demands more than a consideration of the final phases of processing; much of the success of the beet-sugar industry in recent years has been due to the intensive cultivation of the plant, by which the yield of sugar per unit of weight has been increased largely. The distinguished engineer of the General Electric Co. spoke of biological engineers, citing LUTHER BURBANK as the dean of a new professional group. There is nothing incongruous in the new classification. If one accepts the verdict that an engineer is essentially creative, it must be admitted that Mr. BURBANK is more entitled to the use of the appellation than is the individual who manipulates levers, or who directs the process of exterminating insects, or who moves furniture, or who turns a deaf ear to our pleas for heat in winter time. There is a close connection between biology, chemistry and the supply of fuel for the human frame.

Comparatively recently we have begun to realize the connection between biology and the supply of ordinary fuel, which suggests that future power requirements may be met in whole or in part by the intensive cultivation and the economic utilization of plant life. The simplest manner of taking advantage of this possibility is to permit the sun to function at maximum efficiency, for light is an essential to the process. We know that deposited crystals need be removed from an evaporator as they form, else efficiency drops rapidly; similarly, no estimate of the possible value of natural biological products is possible without taking into consideration the advantages of scientific harvesting. Thus it has been proved that seaweed may be cut from shallow-water deposits at frequent intervals, whereupon Nature replenishes the store of raw material for the possible supply of potash, iodine and other byproducts. Recent biochemical research has shown that at least one type of seaweed, in the presence of an ample supply of carbon dioxide, can fix atmospheric nitrogen and form carbohydrates and protein; that bacteria unconnected with

leguminous plants can nitrify the soil; that the wheat plant can assimilate free nitrogen from the atmosphere. Scientific progress in this direction indicates that we are probably on the threshold of discoveries of importance, discoveries that may profoundly affect the problem of nitrate production for fertilizer purposes; and it behooves the chemical engineer, for economic as well as for technical reasons, to keep in close touch with the advances being made in a closely related science.

A Self-Starter In Automotive Research

A FEW YEARS AGO there was scarcely an industry so backward in scientific interest and acumen as the automobile industry. But there came a day when the manufacturers began to sense that a pink-powder puff and a cigar lighter in the body of a car would no longer serve as selling arguments. There was less talk about the "perfect car" that used 4 or 5 per cent of the energy of the gasoline and wasted the rest. This change in attitude is traceable almost directly to the achievements of a single laboratory out in Dayton, Ohio.

The other night at a dinner it was our privilege to sit beside C. F. KETTERING, head of the General Motors Research Corporation. We found him neither solemn, nor glum, nor cryptic. He is, according to the slang of the day, a live wire. To hear him talk for an hour is a liberal education. The incidence of a successful mind on research is always interesting and for the benefit of our readers we want to quote from memory a few of his observations as well as a story or two told us by one of his associates. A problem in hand included 18 months' work with negative results. The report was 300 pages long. When it was brought to Mr. KETTERING he was not interested; said he "wouldn't give a damn for it"; it was not complete. "There are 300 blank pages on the backs of this record," said he, "and there is room to put down the reasons why you did not succeed. Please see that they're there before you bring it back to me." This very study developed the key to the solution of an important problem in the automotive industry. It brought out the fact that a material was needed that was not available. The next and rather simple step in the procedure was to find that material.

He has no patience with the substitution of mathematics for physical chemistry. Mathematics, he insists, is a tool of no value whatever until you have an idea. "If I want to build a garage," said he, "I don't need mathematics until I have made up my mind what I want, where my garage is to be built and how the windows and doors are to be placed. I must see it in my mind's eye first. Then it is time for me to begin to measure, not before." It goes without saying that mathematics as a tool is in constant and active use in the Dayton laboratory.

It is easy to understand why those who work with him love to do so. It is lively business—exceedingly lively business. He expects everybody to think for himself, and not to dawdle about it either. To him science is all one great subject so interrelated in its various parts that the research chemist who cannot grasp a problem in mechanics is not an adequate chemist, nor is the engineer who cannot sense a problem in chemistry a complete engineer.

The story is told of an address he made to a class of graduating engineers in one of the leading universities. He offered handsome fellowships to any members of the class who could answer a simple question within 60 seconds. "Why," he asked, "does a sharp knife cut better than a dull one?" There was no answer forthcoming. He expects a reason in mechanical philosophy for everything that happens.

He encourages opinions, wants lots of them, but will brook no confusion between an opinion and a fact. The distinction between the two is very clear in his mind, and he does not seem ever to forget it.

TOM MIDGELEY, of whose work in overcoming the knock in internal-combustion engines we have published considerable already, said: "We had worked 2 years on this problem without results. Then Mr. KETTERING furnished the hell that gave us the necessary religion to enable us to worry out our salvation."

One doesn't need champagne or any other stimulant to liven up the talk if C. F. KETTERING sits across the table; especially if one is interested in research. The difficulty is to keep the sparks alight and to remember them all when the evening is over.

Reserves of Natural Nitrate

BY PUBLICATION last fall of an exhaustive report on the economic value of the nitrate in Californian deserts, the U. S. Geological Survey set at rest many rumors as to the possibility of starting domestic production somewhat on the lines of the Chilean nitrate industry. The conclusions reached indicated that nitrate occurs in the United States in insignificant amount, which it would not pay to recover. The possibility of discovering deposits other than those that are already known is so remote as to be of negligible significance. It is, therefore, a matter of considerable importance at the present time that industry form a correct impression of the reserves of this most important raw material.

The policy of underrating the resources of a competitor is one that is likely to prove a boomerang. At the annual meeting of the British Association for the Advancement of Science at Bristol, England, in 1898, Sir WILLIAM CROOKES, noted physicist, shared honors with the fake explorer, LOUIS DE ROUGEMONT, in startling the world. The latter held his audience spellbound while he recounted an amazing series of adventures in a country which, it was discovered later, he had never even visited. Sir WILLIAM predicted an almost immediate nitrate famine, consequent on the early exhaustion of the deposits of caliche in Chile. His national and international reputation served to add weight to his contention, with the result that the prophecy has reverberated for 25 years, being used as a text by writers of all types and aspirations and for purposes too numerous to mention. During the war it served to awaken interest in preparedness, which was justifiable; but it is pertinent to note that after all the great conflict was won with Chilean nitrate, and that the South American industry in the meantime has pursued the even tenor of its way. Apart from the effect of economic fluctuations caused by the war aftermath, in spite of steadily increasing output, the Chilean deposit has shown no evidence of strain, much less of exhaustion, since the utterance of Sir WILLIAM'S prophecy.

During the past 2 years an attempt has been made in the technical press of the United States to present the facts, as determined by first-hand experience, and to explain the real situation in Chile. The conclusions that

have withstood the acid test of criticism suggest that the air of secrecy which has shrouded the industry has been due in large measure to the deplorable technological standards prevailing on the pampa, consequent on the retention of inefficient methods of beneficiation and inadequate scientific control. The lack of definite statistics as to the technical operation of the plants has synchronized with a professed ignorance of the exact amount of caliche available for future mining, which, however, is easily explicable: The cost of the investigation necessary would be prodigious, and the Chilean Government would be stupid to incur the expense. Further, the introduction of efficient, large-scale methods of beneficiation and modern ore-handling equipment will permit the addition to the known reserves of an immense amount of low-grade caliche the economic value of which is now considered negligible.

It is generally conceded by engineers who have visited the country that the Chilean deposit is too gigantic and too scattered to permit statistical estimate of quantity or to justify pessimistic opinion as to probable life. Recently a change of tone is noticeable in published statements. For instance, Sir E. J. RUSSEL, the director of the Rothamstead Experimental Station, writes in *Discovery* that the caliche has been estimated to last from 200 to 300 years, adding that "the period is not long in the history of the world." True; but even after a heavy discount, the estimate is one that will occasion no alarm to the Chilean authorities. If it is necessary to pare the export tax, which brings so much to the national coffers, to meet competition with synthetic nitrate, the government will doubtless transfer the tax to copper, which, thanks to the utilization of efficient large-scale methods, is now being produced at an exceedingly low figure in the Chuquicamata plant. For the immediate future, therefore, Chile has no qualms.

In the United States, however, the problem is different. Adequate preparation against national emergency would be a fundamentally wise precaution; and this can be insured only by the maintenance, in successful operating condition, of sufficient synthetic nitrate plants to insure independence from foreign supplies in the event of international complications. It is only remotely possible that such plants could compete with the natural product under ordinary conditions, after considering the possibility of the removal of the export tax and the cheapening of production by the introduction of modern methods; but this fact should not deter research and the formulation of a definite policy in anticipation of every possible national contingency.

At some time in the future all the nations of the world will be self-supporting in regard to nitrate: the principal source of the raw material—air—will be available to all on equal terms. Those countries favored with ample water power and possessed of skilled technologists will fare best. At such time the United States will have no cause for apprehension. In the meantime it is pertinent to recall Germany's action before the war in purchasing, cheaply, immense amounts of nitrate from Chile; statistics show an importation into Germany of over three quarters of a million tons per annum prior to August, 1914. The productiveness of her land was so increased that the yield of wheat per acre was raised to 35 bushels, as compared with 15 in the United States, and the yield of potatoes mounted in about the same proportion. It may be suggested that a concentrated output permits cheaper harvesting, and that the amount of Chilean nitrate being imported into the United States at the present time might be increased with advantage to all concerned. It has also been proposed that large stocks should be purchased and stored in the arid regions of this country. In any event, the American chemical engineer should be encouraged to lend his aid in the efficient recovery of nitrate in Chile, to remedy the deplorable technical conditions that exist; so that reduced cost of production would stimulate increased utilization, more efficient farming and a market for American equipment.

Reducing the Fire Risks In Chemical Plants

TO THE average manufacturer, particularly in our chemical engineering industries, the underwriter of fire insurance is a bugbear whose periodic visits to the plant are filled with many anxious and heart-sinking moments. This attitude of fear and trepidation may be the result of sad experiences in the past or it may be the manufacturer's idea of expediency, but in any event it only hints at the real difficulty in the situation. What is most needed is a community of understanding between the industry and those who are endeavoring to indemnify it against the ravages of fire.

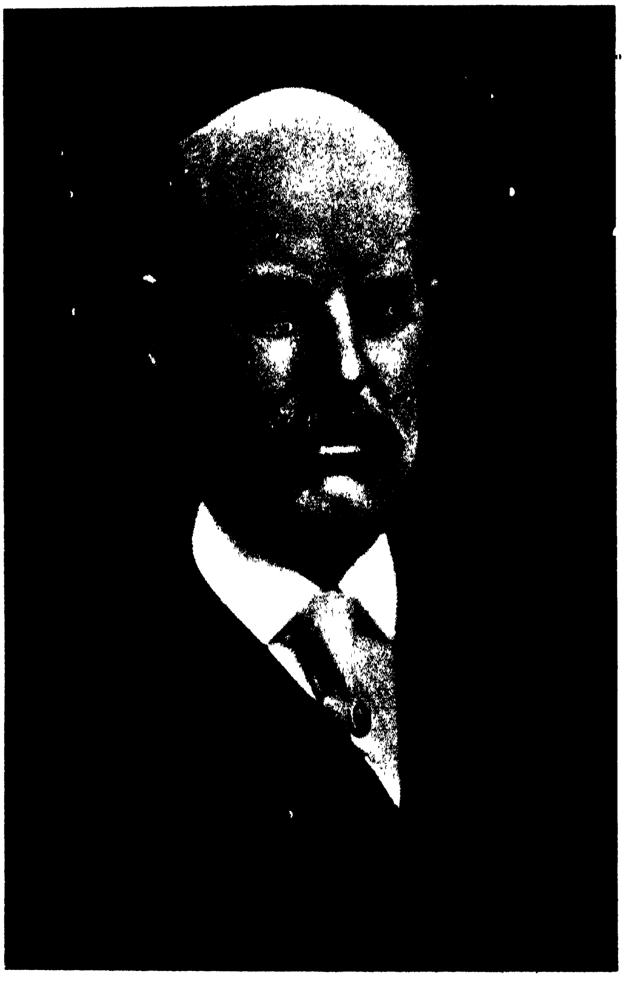
Our manufacturing procedures are as a closed book to the average underwriter. Discouraged at the complicated chemical reactions involved and the manufacturer's reticence in explaining them, the insurance man often finds himself thrown back on his own resources and judgment. Naturally he is likely to err. For example, in at least one fire insurance company of which we have knowledge, any sublimation process is regarded as an obstacle to the acceptance of a chemical plant. The reason for this is that during the war, when haphazard methods were more generally in vogue, a certain manufacturer heated his sublimers over an open fire and in the disaster that followed his plant was completely destroyed. The folly of condemning all sublimations merely because of such an unfortunate experience is, of course, obvious, but it calls attention to a neglected duty on the part of our technical men. They hold the solution to problems of this kind in their own hands. They understand the conditions to be met and were they to co-operate with the underwriters in deciphering these fire hazards, they could pave the way for remedial measures of benefit to both the insurer and the insured.

An interesting example of what can be accomplished in this way was shown in the case of a dye plant the manufacturing procedures of which involved only a single hazardous operation. The underwriter correctly judged that the entire plant was thus endangered and he recommended and collected an unusually high rate for the insurance. Later on the case came to the attention of the chemical engineer in the plant, who immediately recommended that the dangerous process be removed from the other operations. As a result of this segregation the plant became a better fire risk, the insurance was materially reduced and this in turn had its effect as a considerable saving in manufacturing costs.

The fact that in these individual cases frank discussion between the technical man and the insurance company has proved so effective suggests the possible benefit that might come from concerted efforts on the part of our industries. Appropriate committees from our trade associations or technical societies should find here a proper field for constructive study and co-operation.

Edward G. Acheson

Whose achievements in the domain of industrial electrochemistry have written a new chapter in the Romance of Technology.



THE early careers of men of achievement are especially interesting to the Professors of Can-do in the great University of Hard Knocks. For the more particular benefit of these we shall record a few notes on Dr. Edward G. Acheson while he Was Himself in the Making.

His father was manager and part owner of a blast furnace at Washington, Pa., where he was born. Will Stewart, a neighbor, was studying medicine, but had studied chemistry, and Edward thought he would like to follow the latter profession. In 1872 he was recalled from school to go to work in view of impending bad times which his father sensed. Dr. Otto Wuth of Pittsburgh refused to take the 16-year-old boy into his laboratory as an apprentice, because "there was nothing in chemistry." Ten years later substantially every iron and steel works in the district had its own corps of chemists.

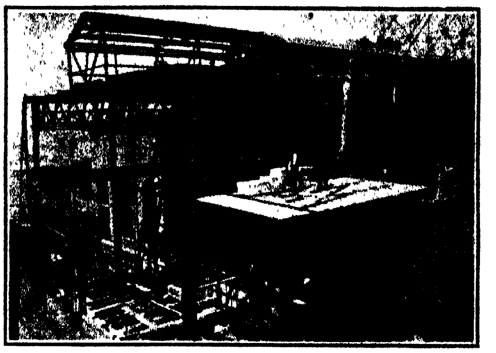
Young Acheson at 23 "took to" electricity, and at the end of a year, against all friendly advice, he came to New York. He spent weeks hunting a job and finally with money almost gone he landed as a draftsman in the Edison establishment at Menlo Park.

When work was slack in the drafting room he undertook to develop a notion he had of a new meter to measure currents. Mr. Edison came along and asked what he was doing. "I don't pay you for this," he exclaimed. "Suppose it turns out useful. Then if I adopt it you'll say I stole your invention!" "No sir," replied young Acheson. "I'm working here on your time and you pay me for it. Anything I bring out is yours!" And soon thereafter he was turned loose in the Edison laboratory.

A senior fellow-worker at the Edison laboratory was Dr. Edward L. Nichols, later of Cornell University. He had studied with Helmholtz and been a research fellow at Johns Hopkins. They took rooms jointly with a clergyman at Metuchen, 2½ miles away, and on their walks back and forth discussed physics and chemistry. Dr. Acheson got his scientific education through conversation with carefully selected friends and from directed reading. In the Romance of Technology our readers will find no more interesting chapter than the story of his career, of the inventions that resulted in carborundum, siloxicon, aquadag, oildag, and artificial graphite, and of the many distinctions and honors in science that have been accorded him.

Manufacture and Application of Lightweight Concrete Slabs

BY ALAN G. WIKOFF
Assistant Editor, Chem. & Met.



WHILE the setting of concrete involves complex chemical reactions, the process proceeds satisfactorily without chemical supervision, so that the production of cast concrete forms by a chemical company is at once an indication of some new or unusual feature. For some time the Porete Manufacturing Co., Newark, N. J., has been manufacturing, for construction purposes, concrete slabs containing so many air cells that their weight is only about one-third that of the corresponding solid slabs. The necessity for chemical control in this case arises from the method that has been devised for making the concrete porous.

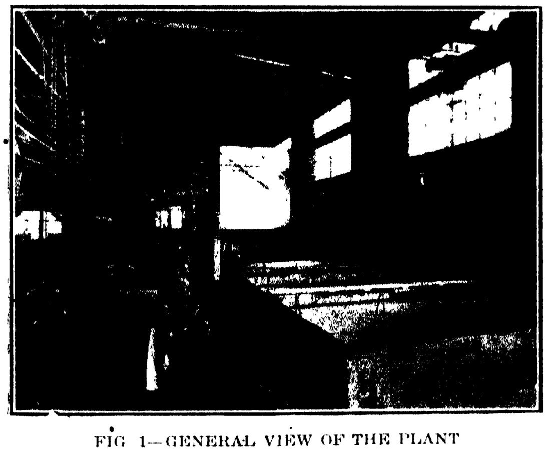


FIG. 1—GENERAL VIEW OF THE PLANT

A material that is solid at ordinary temperatures but melts easily in hot water is formed into round pellets about $\frac{1}{16}$ to $\frac{1}{8}$ in. in diameter, by allowing the liquid material to flow through a perforated plate into a tank of cold water. The pellets are discharged upon a screen to drain and when the requisite quantity has been prepared the screen is dumped into a mixer below. Cement and sand are added so that the final proportions are three parts of cement, one of sand and seven of pellets. After mixing thoroughly with a measured amount of water, the concrete is dumped into a hopper provided with a measuring device which delivers a uniform volume of concrete to the forms. These are of steel so constructed that they may be taken apart to facilitate removal of the completed slabs. Before filling, a piece of expanded metal reinforcing is placed in the form and supported evenly about $\frac{1}{4}$ in. above the bottom plate. After the concrete has been leveled off with a hand trowel the filled forms are placed in racks, where they remain until evening. In order to regulate the setting process, the racks are then placed in a tank of warm water over night. An electric hoist mounted as a traveling crane is used in handling the racks.

By morning the concrete has set sufficiently so that the slabs may be removed from the forms, which are then cleaned and made ready for further use. In order to render the slabs porous it is, of course, necessary to get rid of the pellet material, and since this is relatively much more valuable than the other constituents of the concrete, it is desirable to recover it as completely as possible. The combined step of removal and recovery is thus a very important part of the manufacturing process. The slabs are sealed in an oven which can be heated externally by a coal fire and which is also provided with connections for admitting steam to the interior of the oven. As the slabs warm up the pellet material melts and runs out through an opening in the bottom of the oven into a sump. The remaining pellet material is removed by introducing superheated steam, which carries the vapor through an outlet in the top of the oven to a water-cooled condenser. By means of an automatic temperature regulator it is possible so to condense this mixture of steam and vapor that the pellet material remains liquid and collects with the material already in the sump. The recovered material is pumped from the sump to the pellet-forming machine, thus completing the cycle.

Part of the building in which Porete is manufactured is shown in Fig. 1. In the right foreground are the tanks that regulate the setting of the concrete; back of these is the oven and to the left of the oven the condenser for recovering vaporized pellet material.

PROPERTIES AND APPLICATION OF PORETE

The finished slabs are 24x32x1$\frac{1}{8}$ in. and weigh about 30 lb., including the expanded metal, while a solid concrete slab of the same dimensions and com-

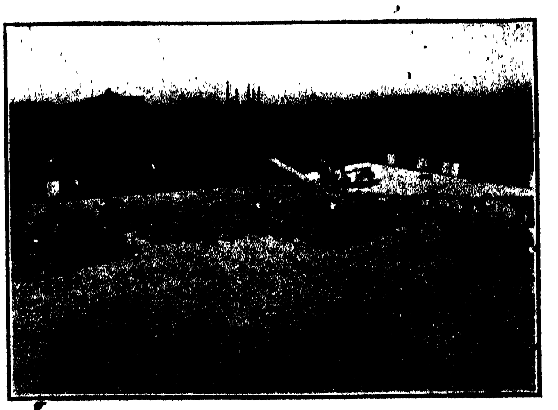


FIG. 2—ROOF CONSTRUCTION

FIG 3—PORETE ROOF FOR FOUNDRY

position would weigh about 75 lb. This is equivalent to about 55 lb. per cu.ft., or 6 lb. per sq.ft. of surface These slabs are admirably adapted for building purposes, for sidings, roofing or flooring, as they may be nailed directly to wood studs without injury, or clipped to steel beams or purlins. The side of the slabs which was in contact with the steel form is comparatively smooth and solid, whereas the other presents the appearance of concrete sponge. In construction work this porous side is kept toward the outside, thus furnishing an excellent base for the application of stucco. For roofing and flooring the surface is treated with a cement finish. Because of the light weight of this material the roof members of a steel frame structure may be of a much lighter construction than would otherwise be required.

Although light in weight, the slabs are very strong. They are designed like a reinforced concrete slab. The steel near the bottom takes care of the tensile stresses, and the cement finish that is applied to the top and makes a perfect bond with the rough surface takes care of the compressive stresses produced by the bending moment. In the way in which the slabs are used on roofs they will carry a live load of 40 lb. per sq.ft. (which is required by most building departments), with a factor of safety of over 6. In tests, specimens have broken at 300 lb. per sq.ft. on a 32-in. free span. Figs. 2, 3, 4 and the headpiece illustrate the use of Porete for roofing and flooring.

Because the slabs are reinforced with a surplus of steel, a greater amount of cement finish on top will increase their strength. For instance, in concrete floors, after a ½-in. thickness of cement is applied to the top of the slabs, this finish makes them strong enough to carry heavy floor loads of 125 lb. per sq.ft. with a factor of safety of 5, where beams are set on 32-in. centers. This gives a very lightweight, shallow and strong floor construction, especially valuable for mezzanine floors.

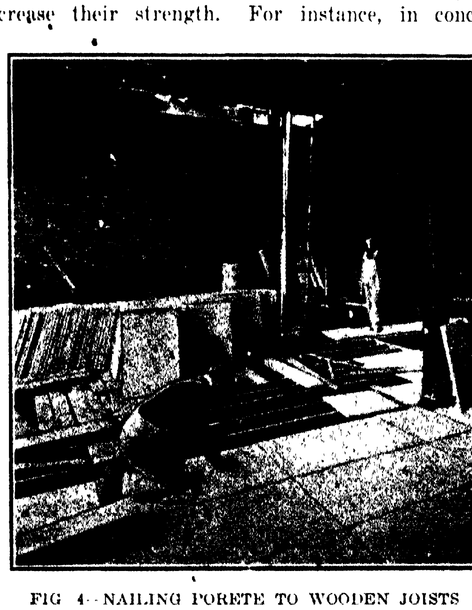


FIG 4—NAILING PORETE TO WOODEN JOISTS

On account of the cellular structure of Porete, it makes a much better heat-insulating material than solid concrete. Tests made by Lichtin[1] indicate that the heat-insulating value is about the same as that of wood. This is an additional feature which makes Porete desirable on roofs.

The saving in steel on account of the light weight of Porete is especially pronounced on a long span construction, and Porete roofs have been used and are in the course of construction on power plants, factories, public garages, theaters, schools, etc. The company expects soon to have other exterior building units, where light weight and nailability combined with weatherproofness are desirable features.

This material would seem particularly valuable in the construction of roofs and floors of large and small buildings around chemical plants, as the material is resistant to the effects of heat, steam and many chemical fumes. No interior finish is required, the slabs being simply nailed to wooden studs or clipped to the beams and given an outside coating of cement. The building in which Porete is made is an excellent example of this type of application. As will be noted in Fig. 1, the sides and roof are formed of Porete slabs clipped to a light steel framework.

For data used in the preparation of this article, the writer is indebted to Ernest Walter, vice-president of the company and inventor of the process, and R. D. Hudson, superintendent.

Action of Sulphurous Gases on Nickel-Chromium Alloys

In discussing alloys resistant to corrosion before a recent meeting of the Faraday Society, J. F. Kayser said that practically all manufacturers claim that their nickel-chromium alloys are quite resistant to the action of sulphur in furnace gases. He tested several such commercial alloys, and some would withstand the action of steam, carbon dioxide, carbon monoxide, ammonia and even pure oxygen for indefinite periods without scaling. Mixtures of those gases were also found to be quite harmless upon most of his samples. The introduction of either H_2S or SO_2—particularly the former—proved, however, to be fatal to even the highest grade nickel-chromium alloy.

Strong Bronzes

The Engineer notes in its issue for May 4 that the Brentford Foundry has produced a very remarkable bronze (or rather brass) called "coronium." Its composition is 80:15:5 Cu:Zn:Sn, and is apparently similar to the Oreide (80.5:14.5:4.85:0.1 Cu:Zn:Sn:Pb) noted in Professor Campbell's list of alloys, and is closely kin to screw brasses containing up to 1½ per cent lead. Sand castings have given 36,000 to 40,000 lb. per sq.in. breaking strength. Taking special precautions in pouring and cooling, specimens are reported having ultimate strength of 50,000 lb. per sq.in., elongation 38 per cent in 2 in., and contraction 37 per cent.

[1]James J. Lichtin, "Relative Heat Conductivities of Some Insulating and Building Materials," *Chem. & Met.*, vol. 24, p. 388, March 2, 1921.

Manufacture of Activated Carbon

BY ARTHUR B. RAY
Union Carbide & Carbon Research Laboratories, Inc., Long Island City, N. Y

THE diversified and extensive industrial applications of activated carbon are causing this product to be manufactured in larger and larger quantities. The National Carbon Co., Inc., of Cleveland, Ohio, began in 1919 the manufacture of the type of activated carbon particularly suited for adsorbing gas and vapors, and also the types adapted for purifying and decolorizing liquids and catalyzing various reactions. At the present time it is the only concern in the United States producing all these types in commercial quantities. Several other plants are now engaged in making the type of activated carbon that is suitable only for purifying and decolorizing liquids. The demand for the gas-adsorbing type of activated carbon for use in extracting gasoline from natural gas, recovering solvents, abating odors, purifying gases, etc., is growing rapidly, because its relative commercial value in comparison with oils, cresols and other absorbents is becoming widely recognized. New commercial uses for this unique material are being found constantly, and it is predicted that in a few years many industries will consider it indispensable. The demand for the type of carbon used in purifying and decolorizing liquids is also increasing, as its relative efficiency in comparison with boneblack and fullers earth is gaining general recognition.

The many industrial applications of the new types of highly activated carbons recently made available indicate that the manufacture of these carbons is destined to be an important industry in the United States. There is, however, no one type of carbon that can be universally effective for all purposes. All so-called activated carbons contain more or less active carbon (which is regarded as a fairly definite physical entity), but they also have extremely important secondary properties of density, strength, hardness, etc. For industrial gas and vapor absorption, for instance, a granular activated carbon which is mechanically strong, relatively dense and highly active is required. The soft, finely pulverized, highly porous and generally moderately active decolorizing carbons are practically worthless for this purpose. In order to supply the carbons most effective for the different industrial applications the manufacturer must by proper selection of activating method and raw materials be able to control the activity and also the secondary properties such as hardness and density of his product.

Activated carbon is a comparatively new product. A number of so-called decolorizing carbons, which are carbons activated to some extent, have been on the market for several years, but the new and very different product now being produced and used commercially for gas and vapor adsorption was developed during the war in answer to the demand for a material of great adsorptive capacity for use in gas masks. The discovery of the fundamental factors involved in its production is without doubt one of the outstanding scientific achievements of recent years. But gas mask carbon, although more highly active than any carbon produced before its development, does not effectively decolorize and purify many liquids. The fundamental reasons for this and the essential characteristics of highly activated carbon which will most effectively decolorize and purify various types of liquids were later discovered, however, by the writer.

One distinction should be clearly made at the outset to avoid possible confusion. *Active* carbon, as will be seen in the subsequent discussion, is regarded as a fairly definite physical entity of well-defined properties. The so-called *activated* carbons of commerce are not pure active carbon, and may vary enormously in porosity or density, strength, hardness, etc., by reason of the associated inactive carbon structure. Yet upon these secondary and incidental properties may depend the commercial usefulness of the carbon for a given industrial purpose. It is now known that the carbon must not only be active but must also possess special physical and structural characteristics to make it effective for special purposes. There is no one type of activated carbon that can be universally effective for all purposes. Two activated carbons may contain the same percentage of active carbon, but one may be extremely valuable as a commercial vapor adsorbent, while the other, because of its low density, softness, etc., may be practically worthless for this purpose, though very valuable for decolorizing sugar solutions. Therefore the art of manufacturing activated carbon and its commercial possibilities depend as much upon the knowledge of how to control these secondary properties by proper selection of method and materials as upon the basic properties of the active carbon content itself. This fact should be kept in mind by prospective users of activated carbon.

In order that the discussion of the manufacturing processes may be clearer, let us first discuss in some detail the nature and chemistry of formation of active carbon and the structural characteristics of activated carbons.

The only theory of the nature and formation of activated carbon which satisfies the known facts is that given by Dr. N. K. Chaney.[1] According to this theory, active carbon exists as a distinctive physical modification differing from other known inactive forms of carbon by some characteristic peculiarity of molecular structure or arrangement. To this characteristic structure are attributed its special properties—namely, its unique adsorptive power for gases and vapors and, for certain substances in solution, its unusual chemical activity, and the limited temperature range of its formation. The nature of this physical or structural difference has been left to subsequent research for more complete definition. To quote the original paper: "It would be premature to assert that these two forms of carbon (active and inactive) are true allotropic modifications. It is not yet established that both forms are amorphous. . . . This much is established: The two forms are characteristically distinct and easily differentiated, both by their properties and conditions of formation." In the absence of direct evidence, the presumption

[1] *Trans. Amer. Electrochem. Soc.*, vol. 36, pp. 91-111 (1919).

of the theory has been that the active form would prove to be the simplest in structural form if not completely amorphous. Prof. Henry Briggs[1] has recently expressed the same underlying idea by referring to the active form as probably less highly "polymerized" and possessing interstices of molecular dimensions.

It has been experimentally demonstrated that the elementary carbon formed by the decomposition of carbon-containing compounds may exist in two forms—one of which is active and the other inactive. The temperature of carbon deposition appears to be the controlling factor—the carbon deposited below 500-600 deg. C. being active and that deposited above this temperature range being inactive. Carbon deposited by the catalytic decomposition of carbon monoxide by ferric oxide at 300 deg. C. is highly active. Also carbon deposited by the reaction between carbon tetrachloride and mercury[3] or sodium amalgam[4] at relatively low temperatures is active. On the other hand, the carbon deposited by cracking methane, for example, at high temperatures is inactive. It appears to be well established, therefore, that the temperature at which elementary carbon is deposited determines whether it is the active or inactive variety.

Applying this theory to the commercial preparation of activated carbon, it will be seen that the low-temperature carbonization of vegetable materials such as wood, nut shells, etc., would be expected to give a certain amount of active carbon. Why, then, does not ordinary charcoal exhibit the properties of activated carbon? The answer is that during the ordinary process of carbonization the active carbon formed adsorbs certain hydrocarbons and stabilizes them so that they are retained under conditions of temperature and pressure which would ordinarily decompose or eliminate them. This has been experimentally shown. The active carbon being already saturated cannot, therefore, exhibit any further adsorptive power. The term *primary carbon* has been applied to this complex of stabilized hydrocarbons adsorbed on an active carbon base. Ordinary vegetable chars, low-temperature carbonization cokes, blacks and coals belong to the class of primary carbons and from all these products activated carbons suitable for commercial uses can be prepared. On the other hand, cokes and other forms of carbon that are formed at high temperatures invariably consist largely of the inactive variety of carbon and cannot be activated.

STRUCTURE OF ACTIVATED CARBON

The adsorptive power or "activity" of an activated carbon is determined by the amount of available active carbon that it possesses. If an ineffective activating process has been employed or if the material has not been subjected to the activating process for a sufficient length of time the proportion of the active carbon present that is rendered available will be small and its "activity" and value as an adsorbent will be correspondingly low. These slightly activated products may contain a large percentage of carbon that has not been freed from its adsorbed hydrocarbons or they may contain inactive carbon that has been formed by the cracking of hydrocarbons at elevated temperatures. Activated carbons are evaluated by methods which really measure their *available* active carbon content.

To be effective as an adsorbent the active carbon must be exposed and accessible. All highly adsorptive activated carbons are therefore either highly dispersed or are traversed by innumerable canals or capillaries whose chief function is to permit free access to the particles of active carbon. The diameter of the submicroscopic capillaries in a highly activated coconut charcoal has been calculated from vapor pressure measurements to be of the order of 10^{-6} cm. These capillaries enable gas or vapor molecules to reach an enormous surface of active carbon—render it available. The surface thus rendered available per cubic centimeter of this carbon has been variously calculated to be from 120 to 1,000 sq.m. There are also in such a carbon many visible pores of relatively large diameter which merely act as outlet channels for the sub-microscopic pores.

When such a carbon is exposed to a high concentration of condensible vapor, a certain amount is adsorbed on the immense surface of active carbon exposed and a further amount is condensed in the capillaries of varying sizes. However, if such a carbon is exposed to a very low concentration of vapor, a considerable amount will still be adsorbed by the active carbon, but none will be condensed in the larger capillaries. This ability of activated carbon to take up vapors that are present in extremely low concentrations is one of its characteristics which distinguish it from other absorbents that are merely porous and whose adsorptive capacity under these conditions is very small.

Gas-Adsorbing Carbons—The desideratum for a gas-adsorbing carbon is that it shall have the maximum adsorptive capacity per unit of volume, rather than per unit of weight. This means that the largest *mass* of active carbon must be contained in unit space consistent with maintaining free access or passageway to all the particles in such mass. In other words, the carbon must not be too dense or its permeability is destroyed, and it must not be porous to the extent of needlessly sacrificing adsorbent material. If the density of the carbon falls below a critical minimum value, adsorptive capacity per unit of space begins to be lost. The best gas-adsorbent carbon is relatively dense. Activated coconut charcoal of maximum adsorptive capacity per unit of volume has a block density of approximately 0.66. A higher density than this indicates that the maximum surface is not exposed, and a lower density indicates that the carbon is traversed by larger pores and that the adsorptive capacity per unit volume is decreased. Aside from the proper size and number of pores is the question of mechanical strength. Carbons that are to be used for industrial gas and vapor adsorption must be mechanically strong in order to resist the crushing and abrading action to which they are usually subjected. Fortunately, the materials such as activated coconut charcoal and certain activated synthetic products which have maximum adsorptive capacity per unit volume are also mechanically strong and eminently suited to resist crushing and abrading action.

Decolorizing Carbons — Considering now activated carbons for use in adsorbing substances from liquids, we find that again the extent of the available active carbon determines the decolorizing or purifying value of the carbon. In the case of gas-adsorbing carbon, capillaries of almost molecular dimensions are desired to open up the active carbon, because the smaller the capillaries and the more numerous they are the greater the adsorptive capacity per unit volume of carbon. But in the case of adsorbing substances from liquids, in many

[1] *Proc. Roy. Soc.* (London), vol. 100A, pp. 88-102 (1921).
[3] G. Tamman, *Z. anorg. Allegem. Chem.*, vol. 115, pp. 145-58 (1921).
[4] B. Fetkenhuer, *Z. anorg. Allegem. Chem.*, vol. 117, p. 281 (1921).

instances the small capillaries which satisfactorily make available or open the active carbon for gases and vapors do not make it available for adsorbing colloidal materials or larger molecular aggregates. Presumably these small pores are plugged by such substances and so to all intents and purposes the active carbon which these pores expose is not available because it cannot be reached. The type of activated carbon that is most effective under these conditions is a highly porous material traversed by pores of relatively large size which render the active carbon available for adsorbing colloidal particles and large molecules. Such a carbon has a low apparent density and is more readily crushed than the dense gas-adsorbing type of carbon. Since this type of carbon is generally used in a finely divided form, its relative softness is not an undesirable property. Such a carbon, however, should not powder or "slime," because in this condition it cannot be readily filtered from the liquid. A finely divided "grainy" or fibrous carbon such as the carbon produced by the Chaney activation process from wood is not only a most effective adsorbent but an excellent filtering medium. While moderately bulky or low density carbons are desired, an extremely bulky carbon is undesirable, particularly in treating liquids which are to be saved, such as oils, because they entrain too much of the liquid.

It is evident that the structure of an activated carbon determines its value for a particular use. In the foregoing, the writer has pointed out some of the structural differences between the two general types of carbons. There are also many structural differences among the various types of gas-adsorbing carbons and among carbons that are intended for treating different liquids.

Processes of Manufacture

From the foregoing it is evident that in the manufacture of activated carbon a large amount of active carbon must be exposed and made available for adsorbing the desired substances. It has been shown that no one type of activated carbon can be made which can be used universally with high efficiency. It is further evident that raw materials and processes that are eminently suitable for the manufacture of highly porous finely powdered decolorizing carbons cannot be used with success for the manufacture of dense and mechanically strong granular carbons for the absorption of gases and vapors.

The raw materials available for the manufacture of activated carbon are, as previously indicated, various vegetable substances or chars prepared from these substances, coals or low-temperature cokes, and many other organic substances such as oils, gases, etc., which can be decomposed to give carbon. No matter what material is employed, it is essential that the carbon be deposited at temperatures below 600-700 deg. C. and that the adsorption of hydrocarbons by the active carbon be prevented or that the adsorbed hydrocarbons be eliminated in such a manner as to leave the active carbon base free. As has been explained, it is also essential that the activated carbon material have the proper physical characteristics. This is determined by the proper selection of raw materials and activating processes.

To prepare a material containing a high percentage of active carbon is a very difficult matter and it must be understood that not all processes in use are equally effective. Most of the older processes that have been suggested are for preparing decolorizing carbons from specially selected raw materials. These decolorizing carbons are classed as activated carbons, but many of them contain a relatively small percentage of active carbon and cannot compare in adsorptive power with the highly activated carbons now produced. Practically none of the processes or raw materials available for preparing highly porous pulverulent decolorizing carbons can be used to prepare highly active granular gas-adsorbing carbons. The processes by which various types of activated carbon can be made may be classified as follows:

(1) Processes depending on the action of inorganic chemical compounds either naturally present or added to prevent the formation of the adsorption complex during carbonization or to cause the breaking down and elimination of the adsorbed hydrocarbons during the succeeding calcination.

(2) Processes depending on solvents to eliminate the hydrocarbons.

(3) Processes depending solely on long-continued calcination to eliminate the hydrocarbons.

(4) Processes depending on selective oxidation to break down and remove the adsorbed hydrocarbons and to alter the porosity of the carbon.

Activation Processes Depending Upon the Action of Chemicals Naturally Present or Added to Raw Materials—By far the greater number of processes for producing decolorizing carbons that have been disclosed or patented belong in this group.[5] The raw materials employed in these processes are practically all of such a character as to give soft, highly porous products which contain some active carbon. The carbons produced by these processes have value for decolorizing liquids because of their very great dispersion, but because of their usual low content of active carbon and physical characteristics they are practically worthless for adsorbing gases and vapors.

In certain cases a raw material such as kelp[6] and rice hulls[7] contains a sufficient amount of the proper sort of substances to enable a decolorizing carbon of value to be prepared from it by a simple carbonization, calcination at high temperatures and subsequent purification.

In most cases, however, the raw material is admixed or impregnated with various chemicals. The disclosures in journal and patent literature show that the number of compounds that may be used more or less successfully in producing decolorizing carbons is large. The following may be mentioned: Alkali hydroxides, carbonates and sulphates; alkaline earth oxides, carbonates, chlorides, sulphates, phosphates and acetates; zinc chloride; manganese oxides; and phosphoric and sulphuric acids. Various proportions and mixtures of these chemicals are employed and to be most effective they must be mixed with the vegetable materials prior to their carbonization. The final calcination is in general carried out at temperatures around 900 deg. C. The residual chemicals must be removed before the carbon can be used, and in those cases where acid is required the extraction is costly. As a rule the raw materials are used in a finely divided form, so the final products appear in the form of a powder.

Activation Processes Depending on the Action of Solvents—Since the formulation of the activation theory previously discussed, suggestions have been made from

[5]F. W. Zerban, et al., Bulletin 167 (May, 1919), Agricultural Exp. Station of the Louisiana State University and A. & M. College.
[6]J. W. Turrentine et al., *J. Ind. Eng. Chem.*, vol. 14, No. 1, p. 19 (1922).
[7]W. G. Taggert, *La Planter*, vol. 58, p. 581.

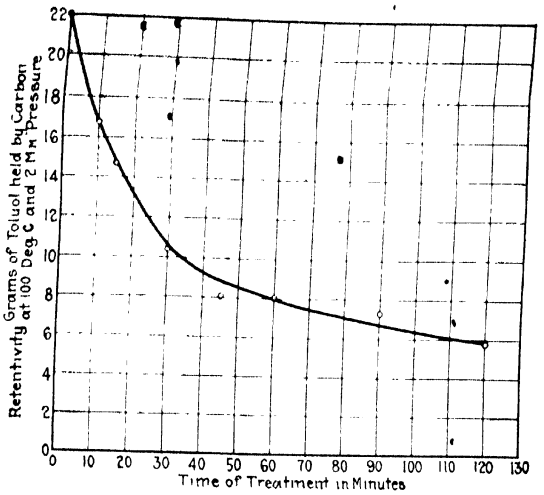


FIG 1—DEACTIVATION OF ACTIVATED CARBON BY "GAS TREATING"

Natural gas passed over activated coconut charcoal held at 1,000 deg C Retentivity for toluol taken as measure of activity

time to time that the hydrocarbons with which the active carbon base of primary carbons is saturated be removed by suitable solvents. All the various well-known solvents for resins, tars and pitches have been suggested. The use of selenium oxychloride for this purpose has been patented.[7] Even assuming that all the objectionable hydrocarbons are soluble in the special solvent, the trouble with these schemes is that no provision is made for removing the solvent which is readily adsorbed or for controlling the porosity of the carbon, both of which steps are necessary before the carbon can have any special value as an adsorbent.

Activation Processes Depending on Long-Continued Calcination at Elevated Temperatures—It is claimed that certain carbonization products or primary carbon materials may be partly activated by long-continued heating in a neutral atmosphere at temperatures around 850 deg. C. Our experience and the experience of others indicate that any activation obtained by such treatment is fortuitous in that it is largely due to the oxidizing action of air[8] originally held in the pores of the primary carbon or which enters the apparatus during the calcination. Activation by heat-treatment alone cannot be successfully accomplished because the hydrocarbons present are cracked at the high temperatures employed and inactive carbon is deposited upon the active carbon base. The resulting product has little or no activity. That active carbon is actually deactivated by a very slight deposition of inactive carbon upon it by the cracking of such a hydrocarbon as methane at 1,000 deg. C. is shown by the curve in Fig. 1. The activity of the carbon, which is measured by the amount of toluol held at 100 deg. C. and 2 mm. pressure, decreases as the amount of inactive carbon deposited increases and is practically nil when less than 1 per cent of inactive carbon has been deposited. This deposition of inactive carbon by the cracking of contained hydrocarbons when a primary carbon is calcined at high temperature is the fundamental reason, therefore, why the manufacture of a highly active carbon is a difficult matter.

Activation Processes Involving Selective Oxidation—Processes in which a selective oxidation is employed to render available active carbon initially present in the material treated are far superior to any other as yet developed for the preparation of highly activated carbons possessing particular structural characteristics. It is only by the use of such processes that it is possible, at the present time, to manufacture in quantity a carbon which meets the requirements of a commercial gas and vapor adsorbent.

It was this method of activation that was employed exclusively by the U. S. Chemical Warfare Service during the war and which made it possible for the Service to supply, in enormous quantities, a gas mask carbon which far surpassed in efficiency any that was available elsewhere. The process was developed under the stress of urgent war-time necessity by Dr. Chaney and those under his direction—an accomplishment all the more notable when it is considered that the United States was the last of the warring nations to be confronted with the necessity of an effective gas mask carbon.

Incidentally, the difference in the requirements of a carbon for decolorizing purposes and of one for gas adsorption is made strikingly apparent by consideration of the facts that while decolorizing carbons of fair quality had been made and sold before the war, these carbons were practically useless for gas masks, and the scientists of the other warring nations had been unable to produce modifications of them which were comparable in efficiency for gas mask use with the product of the Chaney process.

Fundamentals of Chaney Process

Dr. Chaney's contribution consisted essentially in an apprehension of the following fundamentals:

(1) Certain varieties of carbon are inherently inactive, and selective oxidation can be effective in causing activation only when applied to materials sufficiently free from the less easily oxidizable inactive carbon.

(2) A material amenable to activation by selective oxidation and free from inactive carbon can be prepared only if the carbon is liberated below certain critical temperature limits.

(3) A material containing active carbon is ordinarily useless as an adsorbent until this active carbon is freed from the hydrocarbons saturating it, and maximum adsorbing efficiency can be attained only when the maximum proportion of the active carbon present has been rendered available.

The principles enunciated by Chaney, and the process which he based on them, are the foundation on which has been built the National Carbon Co.'s output of activated carbon.

Despite the limitations imposed by the first principle, it was early demonstrated that the raw materials in which a sufficient amount of active carbon, sufficiently free from inactive carbon, was present or could be produced were more numerous than the materials that theretofore had been regarded as promising sources of gas-adsorbent carbon. It has further been found possible to produce superior decolorizing carbons from a variety of raw materials by employing the selective and limited oxidation processes which enable the dispersion or porosity of the activated product to be controlled. In fact all types of primary carbons may be activated by this general process to give many new and different types of activated carbons suitable for different purposes.

The primary carbons as defined by Chaney include all chars, cokes and carbon materials formed at low temperatures—below 600-700 deg. C. Vegetable chars, carbon blacks, lampblacks, low-temperature cokes and coals containing a small amount of volatile matter come under this definition. Some of these materials may be heated to temperatures above 700 deg. C. without be-

[7]V. Lehner and F. M. Dorsey, U. S. Pat. 1,423,231 (1922).

[8]Phillips et al., *J. C. S. Trans.*, vols. 117-118, pp. 362-699 (1920).

coming seriously contaminated by inactive carbon deposition as a result of "gas-treating." Other materials will become self-gas-treated if heated at a high temperature and then cannot be activated because selective oxidation will destroy the active carbon rather than the inactive carbon thus deposited.

When a gaseous oxidizing agent is employed, such gases as air, carbon dioxide and steam may be used. The process employing air as the activating agent has the advantage of relatively low-temperature operation—around 350 deg. C.—but the rise in oxidation potential with temperature is very rapid and the process is extremely difficult to control. As previously explained a *selective oxidation* of the residual hydrocarbons is desired. The oxidation by air, however, has been shown to be less highly selective and consequently, while a considerable amount of carbon is oxidized, the remaining carbon is only moderately activated. While the highest quality active carbon has not been produced by air activation process, an appreciable percentage of the carbon made by the U. S. Chemical Warfare Service for gas masks during the war was so activated.

Processes employing carbon dioxide or steam have the disadvantage of high-temperature operation—around 900 deg. C.—but these reagents exercise a selective oxidizing effect and the reaction, being endothermic, is readily controlled. Flue gas containing carbon dioxide has been used to produce some fairly well activated carbon, but after a very extended investigation it has been concluded that more highly activated carbon can be produced by steam activation. It appears also that the removal of the hydrocarbons with a minimum of "cracking" and consequent deposition of inactive carbon can be accomplished only when the concentration of the oxidizing agent is high. This means that the steam, for instance, must be introduced in excess and that the reaction products must be effectively led away. The operating difficulties are further increased by the fact that all primary carbon materials are very poor conductors of heat.

Variations in Properties

The great advantage of the Chaney process is that by employing proper steam rates for different periods, at selected temperatures, the characteristics of the activated product may be widely varied within limits depending upon the character of the primary carbon employed. This may be strikingly shown by data concerning the relative variations in properties of coconut charcoal activated under one set of conditions for various lengths of time. These data are presented graphically in Fig. 2. The variations in sorptive characteristics are shown by the curves marked "saturation" and "retentivity." To obtain the saturation value the carbon is dried, evacuated and then saturated with the vapor. This value, therefore, is a measure of the total sorptive capacity of the carbon when the vapor is held both by capillary condensation and intermolecular forces. When the saturated carbon is heated at 100 deg. C. while the pressure is reduced to 2 mm., the vapor condensed in the capillaries is largely removed and only the vapor is retained that is strongly held by the specific adsorptive power of the exposed active carbon. The weight of the vapor retained gives the "retentivity" or specific adsorptive capacity value. This value, therefore, is proportional to the active carbon exposed.

The curves show that the activation process proceeds

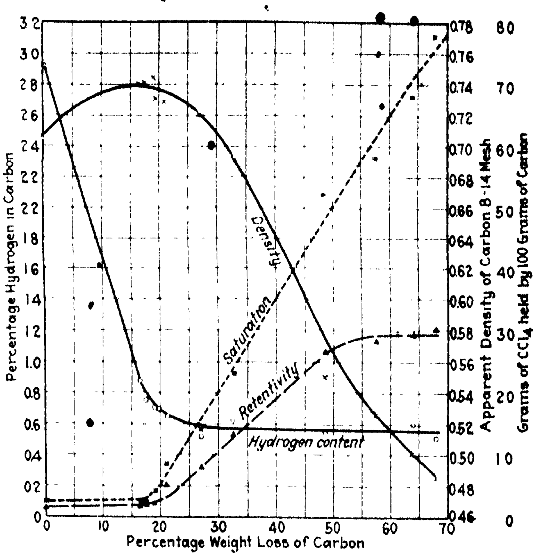


FIG. 2—VARIATIONS IN PROPERTIES OF COCONUT CHARCOALS ACTIVATED FOR VARIOUS LENGTHS OF TIME

Activation temperature, 1,000 deg. C. Weight of charge, 20 grams

in two distinct stages—viz., a stage in which the percentage hydrogen content is being rapidly reduced and a stage in which the percentage hydrogen content is being reduced very little or not at all. Approximately 20 per cent of the charcoal is gasified during the first stage. The material removed has an average percentage hydrogen content of 11.6 and is quite evidently hydrocarbons. Until the bulk of these hydrocarbons are removed the material has no appreciable saturation or retentivity value.

As the activation proceeds into the second stage, however, the material removed by selective oxidation has an average percentage hydrogen content of 0.78 and must, therefore, comprise a comparatively very large proportion of uncombined carbon and a comparatively small proportion of hydrocarbon. The fact that the percentage of residual hydrogen ultimately becomes approximately constant probably indicates that some of the hydrogen is disseminated through the active carbon base in such a fashion that it is not accessible to the oxidizing agent, as would be expected in dealing with particles of considerable size, in this particular case 8 to 14 mesh. During this stage both the saturation and retentivity increase, the saturation increasing at an approximately constant rate to the limit to which the tests were carried and the retentivity increasing at a diminishing rate to a maximum when about 60 per cent of the charcoal has been oxidized. The apparent density decreases at an approximately constant rate during this stage.

The saturation values in conjunction with the other values show that when the bulk of the hydrocarbons had been removed and the active carbon base was laid bare the capillary spaces began to increase at an approximately constant rate as the carbon was eroded by oxidation. Certain conclusions may also be arrived at from a consideration of the retentivity values in conjunction with percentage hydrogen content. The fact that the retentivity begins to increase while the percentage hydrogen content is still decreasing probably indicates that the layer of adsorbed hydrocarbons is not of uniform thickness, or not uniformly accessible to the oxi-

dizing agent. After the percentage hydrogen content becomes approximately constant, indicating that oxidation of the exposed hydrocarbons is complete, the retentivity continues to increase. The indications are that the phenomenon is due to an increase in the amount of exposed active carbon. The fact that the retentivity reaches a limit indicates that the amount of exposed active carbon per unit weight of material also reaches a limit.

From these considerations it is obvious that, to produce a carbon for use as a gas or vapor adsorbent having maximum adsorptive capacity per unit of volume, a dense primary carbon must be used, and the activation process continued only long enough to obtain a maximum of active carbon exposed. If, however, a highly porous carbon is desired for storing gases or for removing coloring matters and impurities from certain liquids, a highly porous primary carbon may be used and the activation continued only until maximum active carbon is exposed, or a dense primary carbon may be subjected to selective oxidation until it possesses the necessary porosity.

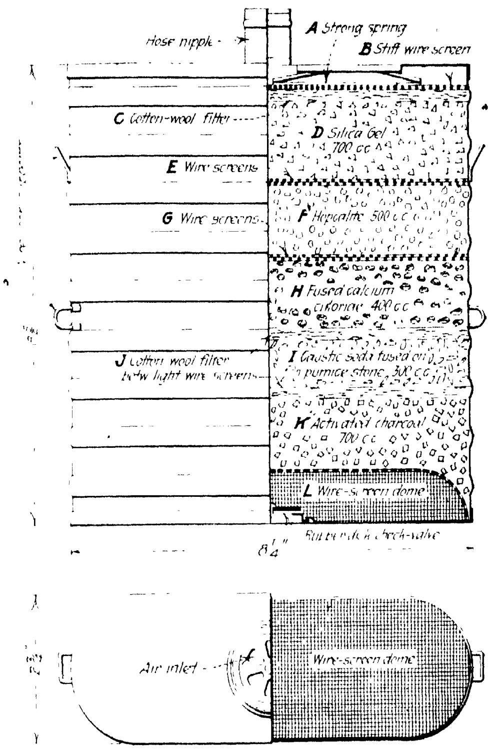
In the foregoing paper the numerous activating processes, most of which are for the manufacture of decolorizing carbons, have been considered. It is pointed out that the Chaney selective oxidation process appears to be the only one by which the new highly active and most efficient gas- and vapor-absorbing carbon can be produced. It is also shown that because this process gives maximum activity and allows the secondary properties, such as porosity, to be altered at will, it can be employed in the manufacture of decolorizing carbons of high efficiency. In fact, by activating suitable raw materials through some modification of the Chaney process carbons can be prepared that have the desired characteristics for any application.

Universal Gas Mask

Many Possible Uses for New Tpye of Mask Developed by Bureau of Mines

To fill the need felt for masks of general utility in the chemical, metallurgical and related industries, the Bureau of Mines has developed a new Universal mask. A special type of the same mask has been developed for use by firemen. Although special masks have been developed previously for use against specific gases, such as carbon monoxide or ammonia, this is the first efficient mask to be developed which may be used in either of these as well as in many other contaminating atmospheres. To combine efficiency in one canister the absorbents for all noxious gases is difficult, because the absorbents for certain gases are best used moist, while the absorbents for carbon monoxide may be used only when perfectly dry.

As shown in the cut, the following chemicals are used in the mask: *D*—Silica gel to remove ammonia and any other organic vapors which escape the charcoal at the bottom of the mask, also to guard against moisture reaching the hopcalite from above. *F*—Hopcalite to remove the carbon monoxide from the dry gas. *H*—Calcium chloride to remove any particles that may pass the caustic pumice. *I*—Caustic soda, on granules of pumice stone, to absorb acid gases such as carbon dioxide, chlorine, formic acid, hydrogen cyanide, muriatic acid gas, oxides of nitrogen and sulphur dioxide, and gases of similar chemical properties, also to extract



CROSS SECTION SHOWING CHEMICALS IN MASK

water vapors from the air, thus preventing the moisture from contaminating and inhibiting the hopcalite. *J*—Filter of cotton wool, about ¼-in. thick, between two light wire screens, to filter out the supensoids, including smoke, mist and dust. *K*—Charcoal, used to absorb organic vapors, including alcohol, aniline, benzene, ether, carbon bisulphide, carbon tetrachloride, toluene, etc.

In those industries in which a workman requires protection against only a single gas or class of gases, it would be cheaper to use a single absorbing medium in the canister. However, in many industries workmen may encounter a variety of gases and city firemen may meet almost any sort of gas or vapor. Men using the Universal type of mask can face these conditions and do work that they could not possibly do otherwise. Tests conducted on a wide variety of gases show that the probable life of a mask is considerably in excess of 6 hours, but, due to the fact that carbon monoxide may go through unabsorbed after this period and since this gas is not detected readily because it is odorless, this arbitrary time limit has been placed on the use of the mask.

Among the ordinary gases in which the mask is not efficient in protecting the wearer is methane. It cannot be used in atmospheres deficient in oxygen, as in the flues of industrial plants, mines and closed rooms after fires and explosions. It is also dangerous to use the mask in atmospheres containing higher concentrations of gases, as in chemical and metallurgical apparatus tanks containing gasoline or other volatile liquids or in inadequately ventilated rooms in which large quantities of gas are evolved. In general the mask should not be used in toxic gases having a concentration of more than 1 or 2 per cent. The canisters are more active when warm, so in cool or cold weather should be worn under a coat to receive the body heat.

Current Practice of Making Electric Steel

Best Practice Still Undecided on Many Features—Are Acid Furnaces Best for Low-Sulphur Charges?—Basic Will Eliminate More Sulphur, but Pure Raw Materials and Expert Refiners Are Necessary for Superfine Steel

BY BRADLEY STOUGHTON
Consulting Engineer

THE electric steel industry is not yet standardized: First, because progress is so rapid that it keeps ahead of the dissemination of information, which those who are doing the best work are not always willing to give out. Differences of opinion, due to lack of full knowledge, therefore, persist. A second cause is due to the fact that all recent improvements are not open to general use without royalty, and that conflicting claims are not always free from selfish interest. This is always the situation where an industry is so new that patents control some of the desirable features.

TYPES OF FURNACES

It would be impossible to give a description of all the recent furnaces now in use, but Table I classifies the types in accordance with the chief features, which vary largely in respect to: (*a*) Methods of heating the charge; and (*b*) methods of making electrical connection.

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is scarce and costly, to melt steel scrap to a temperature of 1,400 deg. C. or higher, carburize it until it contains 3½ to 4 per cent carbon, and then give it the desired composition in silicon by means of appropriate alloys, especially where the metal from the electric furnace may be cast directly into molds. During the war there were many plants engaged in this process, making "synthetic cast iron" in France, Canada, United States and Germany. Most of these died with the change of commercial conditions consequent on the ending of the war, but there are still isolated localities where iron castings may be made in this way cheaper and better than by any other known method. A notable example is an iron foundry connected with a large gold mine in Alaska, where both fuel and cast iron are costly but where there is a supply of steel scrap. There are many mining localities in South America where the saving effected by a quick repair would exceed many times the cost and overhead of a synthetic cast iron foundry.

There were two methods of making synthetic cast iron—namely, straight melting in the electric furnace, and melting in a cupola followed by superheating in an electric furnace.

Order of Excellence in Steels

There is now a general agreement among engineers that the quality of carefully made steel by the different older processes is in the following order of excellence: First, crucible; second, acid open hearth; third, basic open hearth; fourth, acid bessemer; fifth, basic bessemer. Whether electric steel is equal to or subordinate in quality to crucible is still a controversial point.

The presence or absence of "sonims" (solid nonmetallic impurities) is the final test as to the supreme quality of steel, because all other impurities are controlled without great difficulty. The relative excellence of crucible or electric steel therefore comes to this: We know that well-made crucible steel is free from sonims; electric steel is not always so certain, although it should be, and almost always is, free from these impurities when well made. In the matter of large ingots the electric furnace has the advantage of making the steel in big units and doubtless gives a greater assurance of uniformity than when many crucibles have to be poured into one ingot mold. At the present moment conservatism and carelessness on the part of some electric furnace operators leave the advocate of the crucible furnace in the stronger position of the two.

From the standpoint of excellence—that is, very low content in phosphorus, sulphur, sonims and gases—the basic-lined electric furnace has the better of the argument with the acid electric. But, from the standpoint of "superexcellence"—that is, absolute freedom from gases and sonims the acid process has these points in its favor: (*a*) Pure raw materials must be employed, and pure raw materials are essential for the production of "superexcellent" steel in any type of electric furnace; (*b*) the slag also is purer; (*c*) recarburizing in the acid furnace is less likely to produce sonims than in the basic furnace.

On the other hand, the acid slag is subject to great viscosity, which introduces a serious danger of sonims, while the basic slag is the better degasifier of the two. Skill and care in operating are doubtless much more potent factors for superexcellence than either set of advantages mentioned. For example, merely to pour electric steel out of the furnace introduces far more sonims than any factor mentioned so far. Indeed, it seems fair to declare that "superexcellent steel" cannot be made unless the metal is tapped from a quiet bath without slag being carried with it.

Super-Refining Liquid Steel

The cheapest method of making steel of very high quality is to put liquid steel in an electric furnace and then super-refine it. Since the super-refining is chiefly for the purpose of eliminating sonims and gases, and since the electric furnace is not adapted to much refining in one step, the acid electric furnace might be used. It has the advantage of affording a quicker and cheaper operation, but the acid slags are very sticky and they will not hold calcium carbide, which is the most effective agent for desulphurizing and degasifying a steel bath. True, the acid process can remove a little sulphur by the judicious use of manganese, but the amount is limited and is usually less than must be eliminated from liquid steel coming from other furnaces. For instance: the upper limit of sulphur in molten steel introduced in even the basic electric furnace is now 0.08 per cent and this sometimes requires two carbide slags before it is reduced to 0.03 per cent, which is the maximum sulphur expected in an electric furnace product. Super-refining is the ideal function of the electric furnace; when we try to accomplish the ordinary operations of refining or even attempt too big a step in super-refining the result is excessive cost and poorer quality. The lesson of recent electric furnace experience is that we can add only the top notch of excellence; if we start with too low purity of raw material, the highest quality is never attained.

One of the worst problems in super-refining practice still remains to be overcome. I refer to the chilling of the liquid metal when poured into the furnace. Following the preceding heat the roof and lining must be examined and repaired carefully to avoid costly troubles from these sources. As an average figure it will perhaps take 500 lb. of dolomite to repair a 25-ton furnace lining, although this figure will vary greatly from operation to operation and plant to plant. This repair work takes time and cools the furnace. The metal from the basic open hearth also cools in transit. Furthermore its melting point is relatively high, because it must be 10 to 25 points lower in carbon than the desired final analysis of the super-refined product, to allow for carbon picked up from the carbide slag. The arc furnace is not a good instrument to handle a bath of metal frozen on its surface and especially along the sides, where it is furthest removed from the source of heat. Here again some means of keeping the bath stirred would be of great commercial advantage. Twenty to forty minutes on power are usually required to recover the lost heat.

Another serious difficulty is to estimate exactly the weight of metal charged to the furnace. This information is important in order to determine the weight of additions for "recarburizing." When nickel steel is being made the established practice is to add a known amount of nickel to the bath as soon as charged. As soon as this is all melted the analysis of the bath, compared with its composition before the nickel was added, gives a close means of estimating its weight.

Recent electric furnace practice retains at least 0.20 per cent manganese in the bath throughout the operation. This decreases the burden of the slag while deoxidizing the bath and reduces the final manganese addition, with its concomitant danger of sonims. It is

Current Practice of Making Electric Steel

Best Practice Still Undecided on Many Features—Are Acid Furnaces Best for Low-Sulphur Charges?—Basic Will Eliminate More Sulphur, but Pure Raw Materials and Expert Refiners Are Necessary for Superfine Steel

BY BRADLEY STOUGHTON
Consulting Engineer

THE electric steel industry is not yet standardized: First, because progress is so rapid that it keeps ahead of the dissemination of information, which those who are doing the best work are not always willing to give out. Differences of opinion, due to lack of full knowledge, therefore, persist. A second cause is due to the fact that all recent improvements are not open to general use without royalty, and that conflicting claims are not always free from selfish interest. This is always the situation where an industry is so new that patents control some of the desirable features.

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the costly metalloids. From ½ to 3 per cent of carbide should be maintained in the slag. As soon as a pool is formed, coke is shoveled into the furnace, and more is used when necessary. Greater precautions are observed in keeping the doors closed and luted than in super-refining liquid steel, and it is usual to scatter coke dust over the top of the slag whenever the door is opened. While the addition of coke to the slag will reduce manganese or chromium back into the metal, in case any has been oxidized, it requires both coke and high temperature to reduce tungsten.

There is this important difference between the two types of super-refining: That the carbon in the steel produced from liquid charges is usually lower than that in tool steel made by melting scrap. Therefore coke may be more freely used in the latter. Also it is much commoner and safer to add silicon in small doses in early stages of the practice we are now discussing, especially when tungsten is present, because tungsten serves as a warning preceding slag difficulties that might arise from oxidation of silicon. Silicon in the bath during super-refining assists degasification and makes the steel sounder and denser The amount of slag is greater in this type of super-refining, and varies from 3 to 7 per cent of the weight of the metal. Its composition is about the same, except for higher carbide. It should not exceed 18 to 20 per cent silica, and some operators prefer to use chiefly fluorspar for thinning, in order to increase the excess of lime present. Then, however, volatile fluorine compounds increase the corrosion of walls and roof.

In the basic electric furnace a good operator can melt and super-refine pure scrap in 4½ to 6 hours, with a power consumption of 600 to 800 kw.-hr. per ton of product. The main reason for the excess power consumption over liquid-steel super-refining is that great power irregularities occur during melting. Furthermore, smaller sized furnaces are ordinarily used, together with a larger slag volume.

Acid Versus Basic

In melting pure stock in the electric furnace the basic process loses its chief commercial advantage—viz., low cost of raw material. In every other respect—labor, time, electric power, overhead, repairs, lining, fluxes and recarburizers—the acid process is cheaper. The acid furnace is handicapped in removing sulphur, but a liberal use of manganese will bring it down quite a little, and the difference in cost is not great between 0.04 or 0.08 per cent sulphur scrap pure in other respects. It is now customary to use one acid slag for more than one operation, because impurities do not accumulate in it. No ferrosilicon is added, because silicon is reduced from the slag. This saves cost and the danger of silicon sonims. Acid steel is less oxidized and less gasified than basic steel after melting, so less manganese is used. The sticky acid slag is more easily entangled than are basic slag particles, but the more subtle danger of silicon or manganese sonims is greatly reduced. Finally, the engineers' prejudice in favor of acid steel helps sell the product in competition. The acid furnace has the disadvantage that it cannot be used on occasion for purifying impure scrap unavoidably accumulated or available under advantageous conditions.

Melting and Refining Impure Scrap

As ordinarily conducted this process is cheaper than melting and super-refining pure scrap, but gives a product of lower grade. Of course, only basic furnaces can be used. Even then the phosphorus must be under 0.09 per cent or the oxidizing period will be extended beyond the point of economy. Limestone, instead of lime, is spread on the hearth. Sometimes pig iron is used to make the bath melt down hard or to increase the yield by using more ore; if so, the pig is placed on top of the limestone. On top of this is placed enough iron ore to oxidize the silicon and phosphorus, and these should be gone by the time the "lime comes up." The temperature of the bath should never reach the point where manganese or carbon are oxidized instead of phosphorus. Good modern practice produces a melted bath with residual manganese, carbon 10 to 25 points less than the desired final analysis, phosphorus less than 0.02 per cent. Some prefer to melt down soft and, when the white slag is melted, add carbon in the form of pig iron, washed metal, coke, charcoal or ground electrode stumps. This stirs the bath, removes dissolved oxygen and increases the yield slightly. It is both difficult and dangerous to make low-carbon steel by this process, because some carbon is always added from the carbide slag, and if you melt down very soft it oxygenates the bath severely. In case a second black slag must be used it is evidence of bad practice or too impure raw charge. Every pound of black slag must be removed before the white slag is charged.

The white slag is mixed outside the furnace, of lime, fluorspar, silica, and coke. It contains more than 55 per cent lime and one shovel of coke to three of lime. After it is charged the analysis is adjusted carefully, the temperature being raised as rapidly as possible meanwhile. If carbon is added, it goes in first, then enough ferrosilicon to give 0.10 to 0.20 per cent of silicon in the metal, which is maintained to the end. Next comes ferromanganese, if necessary. Some operators prefer to melt down with only a small residual manganese, in order to add ferromanganese after ferrosilicon, with the object of removing silicon sonims. Others add ferromanganese after the deoxidizing slag has become white, thus saving some manganese. All additions made after the white slag should be in small doses. The more oxidizable elements, such as tungsten and vanadium, should never be added until the slag is entirely white. When this point is reached the real super-refining begins; more coke and lime are added to the slag and a carbide slag with at least 1 to 3 per cent of CaC_2 content is maintained to the end. The operation is practically the same as that already described.

The total time of melting, refining and super-refining occupies from 4½ to 7 hours, depending on the degree of purification and the skill of the operator.

Aluminum Production

The value of the new aluminum produced in the United States during 1922 is reported as $13,622,000, an increase of about 25 per cent over the value in 1921. Exports of aluminum during 1922 included 1,538,079 lb. of ingot and scrap aluminum and alloys containing aluminum, 2,808,946 lb. of plates, sheets, bars, strips and rods, and 4,548,939 lb. of manufactured articles, which represents a very large increase over the amount exported during the previous year. Imports, on the other hand, also increased to 31,482,983 lb. during the early part of 1922, as compared to 26,177,852 lb. for the corresponding period in 1921. This amount includes aluminum in crude form, scrap and alloys of any kind in which aluminum is the material of chief value.

Meeting of the Iron and Steel Institute

Committee Reports Against 12-Hour Day—Papers on Chemistry in the Iron and Steel Industry, Gas Producer Operation and Firebrick Disintegration

After a year's consideration, a committee composed of the chairmen of the large steel companies has presented a preliminary report on the 12-hour day. Judge Gary read its findings at the opening of the Iron and Steel Institute in New York, May 25.

The report stated that the problem was taken up because of the widespread impression that long hours in the steel industry were undesirable and injurious. Despite the opinion held by the committee that this sentiment was kept alive not by the workmen themselves but by outsiders, a careful investigation was made. In the light of the information obtained the committee reports that the 12-hour shift is not injurious to the worker, physically, mentally or morally—in fact, it believes that the managers of important plants generally have the workers' welfare so much at heart that such influences would be quickly detected and corrected. The committee believes, in fact, that the laborers would rather work 12 hours and earn the extra money, since the intermittent nature of their duties requires less total exertion than an 8-hour shift in many other trades.

Intricate economic questions also have a great bearing on the decision. In view of the demands of commerce, local and international, it is necessary that a great amount of iron and steel products be created at the lowest possible cost. The short shift would derange this desirable state of affairs by increasing the selling price about 15 per cent. Furthermore 60,000 additional employees would be needed, but could not be found—in fact, there is a serious labor shortage at the mills now.

While the 12-hour day can gradually be eliminated during periods of large labor supply, the committee, having in view the sentiment of the employees, employers, purchasers and general public, cannot now recommend the abolition of the 12-hour day, but promises that it will be done should the general public and the laborers concerned demand it, and purchasers of the metal become willing to pay the advanced cost.

Gary Says European Common People Are War Weary

Judge Gary, the president of the Institute, then continued with his formal address. For the most part it consisted of an account of a recent tour throughout the Near East, and a religious homily inspired by the devout, industrious and war-weary people he saw there. His audience revived its interest when he mentioned the Ruhr. Without commenting on the political situation involved, he deplored the appalling damage caused to both sides and to neutrals. He felt that the common people in France, Belgium and Germany would be very glad to break the deadlock, and that speedily. Perhaps the submission of the dispute to a neutral nation or jurist as arbitrator would be the best solution.

Before reaching the usual business survey, in which he could see no reason to doubt continued operations at capacity for the next 6 months, Judge Gary's voice and strength broke, and he was forced to ask another to continue the reading, meanwhile leaving the rostrum.

In the forenoon session, a brief account of the utility of chemical analysis was given by W. A. Forbes of the U. S. Steel Corporation. He pointed out how raw materials are selected and how furnace operations and products are controlled by repeated analyses. Since smelting and refining operations are essentially chemical reactions occurring at elevated temperatures, modern practice owes much to the rational application of chemical theory. "The electric furnace process could not have been developed without it, since this process involves a more scientific application of chemistry than all other steel processes combined." Recognizing that variations in steel quality are caused by small amounts of dissolved gases or chemical compounds which at present cannot be isolated or determined, the speaker asked the question, "How may further progress in the application of chemistry to the iron and steel industry be maintained? The answer is: In untiring and unremitting research."

Bradley Dewey, of the Dewey & Almy Chemical Co., in commenting on the foregoing paper, stressed the fact that general chemical theory should be of greatest aid to the steel industry of the future, which will require a great number of men of vision and scientific training to correlate existing data from many fields. After mentioning the tremendous success that has followed the introduction of physical metallurgy to the study of alloy and special steels, he predicted an entirely new metallurgy, with its host of new problems, when oxygen gas may be had for less than $5 per ton. He ventured even to predict a sizable tonnage of iron, coming as a byproduct from nitrogen fixation processes.

Gas Producer Operation

Waldemar Dyrssen, of the U. S. Steel Corporation, presented a voluminous study of "Gas Producer Practice." He had long been aware that the equilibrium diagrams between hot carbon, air and steam, determined in the laboratory, were inapplicable to gas producer studies, simply because gas rushes through the hot fuel bed so rapidly that the time element is lacking. So he attacked the problem from the other end. Possessing detailed studies of a number of producers, he worked back to what might be called the kinetic equilibrium of the producer. From such derived data he was able to draw most useful conclusions regarding all factors playing a part in coal gasification. He was also able to determine the optimum temperature of blast and gas. He showed that it is possible to control operations closely by merely regulating the temperature in the gas main. Ordinary bituminous coal when treated properly will produce the following gas: C_2H_4, 0.6 per cent; CH_4, 3.6; CO, 29.1; H, 13.3; CO_2, 3.4 and N, 50.0 (exclusive of H_2O and tarry vapors).

Disintegration of Firebrick

After an examination of the shattered firebrick in a blast-furnace lining, C. E. Nesbitt and M. L. Bell, research engineers of the Carnegie Steel Co., concluded that disintegration was due to reactions between Fe_2O_3 in the brick and CO in the furnace atmosphere. Reaction at 325 to 525 deg. C. is fairly rapid, depositing voluminous graphitic carbon, which bursts the brick into many pieces. It is apparent that a brick very free in ferric oxide should be used for blast-furnace linings—to test this point samples may be heated for 6 hours at 450 deg. C. in an atmosphere of CO. If the brick remains intact, it will not disintegrate from carbon deposition; if the sample breaks during the test, such brick should not be included in the furnace lining.

How Does Production Affect Profits?

Above a Given Production Value the Total Profit on a Commodity Becomes Less—Below That Value the Total Profit Has Not Reached Its Maximum—This Article Discusses Both Why This Is So and How the Optimum May Be Determined

BY WARREN K. LEWIS
Consulting Chemical Engineer and Professor of Chemical Engineering at M. I. T.

IN THE operation of manufacturing plants it is a principle thoroughly appreciated that production should be forced to the utmost limit not inconsistent with efficiency in manufacture and with the disposal of the product. This principle is sound, but its formulation is indefinite and vague. The object of this discussion is to develop an exact criterion for the application of the principle, in order to make it more useful in the control of industrial practice.

As the basis of the dicussion there will be assumed a definite plant producing one specific article. It will be granted that the plant is operating on a definite schedule and is being managed in the most efficient possible way. In the control of such a plant there is, however, one variable of paramount importance which can be effectively manipulated by the management—namely, the production to which the plant is forced. The object of discussion is to determine the optimum production at which the plant should be operated.

The novice in managerial work is prone to focus attention solely upon methods of reducing costs. It is often more effective to develop methods for wisely increasing costs. An improvement in production method resulting in reduced cost should be forced, often to the point where cost is actually increased, because by so doing production can be increased to more than compensate therefor.

In any plant unit costs can be subdivided into three major categories. The first of these can be designated as organization costs. The existing plant and physical equipment represent an investment on which a return must be paid. Furthermore, in order to operate the plant on any scale commensurate with its capacity, there must be maintained a personnel for management and supervision, which, though nonproductive, is a prerequisite to production. The cost of maintaining this whole organization, including both physical equipment and directive personnel, represents an unavoidable expense, which remains practically constant so long as operation is kept up. All changes of this description should be grouped together as *organization costs*. Such expenses are obviously made up of investment charges, taxes and insurance, include management and superintendence, and perhaps, in some cases, office expenses, and the like.

The second category is best described as *production costs*, and consists of items of which usually the major are labor and materials, charges that are practically proportional to the production of the plant regardless of the rate of production.

Finally, in the third category, which will be called super-production costs, fall a series of charges that increase more rapidly than production. Among the most important of these are depreciation, maintenance and repairs. In a plant that is running at a low production these items can, with careful management, be kept down to a very low figure; even when expressed as unit charges per unit production the figures will be moderate. When, however, it is attempted to force plant and processes, the wear and tear thereon increase and the upkeep expenses mount out of all proportion to the production. To the items enumerated above, there should be added in this third category those charges covering the decreased efficiency of labor that always results from forced production. For example, losses due to rejections of product upon inspection are of this character. In some cases, these last items are of paramount importance. (One of the advantages of the piece price system lies in the fact that the exact cost of securing increased productivity of labor, whether through the production bonus or otherwise, can so readily be determined.)

It will, therefore, be tentatively assumed that charges can be distributed among these three categories: organization costs, production costs, and super-production costs.

If in a given plant the production be small, the unit costs will be high, because the organization costs are distributed over a small production. With increased production the organization costs are distributed over a wider area, and the unit costs go down accordingly. But if production be carried further, the influence of the super-production costs referred to above will become evident, and the inefficiency of production caused thereby will tend to compensate for the lower organization costs per unit production. Thus costs will no longer decrease with further increase in production. Indeed, if production be forced to a still further degree, costs will actually increase. As a result of these relationships the cost of production in any plant is determined by the total production of that plant, and furthermore, with increase in production the cost curve first decreases rapidly, then becomes constant at a minimum cost, and finally increases due to the action of super-production costs. While the cost curves of no two plants and no two products will be the same, the general shape of these cost curves is always that outlined above, and is shown graphically in Fig. 1.

Tentatively assume that the product discussed above is one that is sold on specification. Then the quality of that product must be maintained up to standard in order to move it, but need not be pushed above the standard. Assume, furthermore, that the plant in question produces such a small fraction of the total consumption of its market that any variation in its own pro-

duction does not appreciably affect the price in that market. In such a case the selling price of the product will be a constant quantity, independent of the production of the plant.

The profit per unit product is obviously the difference between the selling price and the cost, it being assumed either that the costs mentioned above are the true total costs including the selling expenses, or else that the selling price is net selling price—i.e., total price less the selling costs. (This alternative should be adopted only when the product is sold by an outside organization at a fixed figure—e.g., on a commission—because selling costs, like all costs, fluctuate with the value of product handled.) The profit per unit product will, therefore, be determined by the production of the plant, the curve being of the shape of the cost curve upside down. These three curves are indicated in Fig. 2.

The total profit from this plant is obviously the unit profit times the total production. Inspection shows that the unit profit curve passes through zero at the two points where the cost curve cuts the selling price curve. Since the total profit is the product of unit profit times production, the total profit curve must also pass through zero at the same points. It is evident also that the general shape of the total profit curve must be similar to that of the unit profit curve, and since it starts from and returns to zero, the total profit curve must at some intermediate point reach a maximum, and this maximum is the point of optimum production at which the plant will earn the largest possible return on the investment and profits for the management.

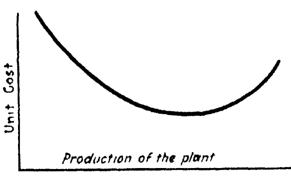


FIG. 1

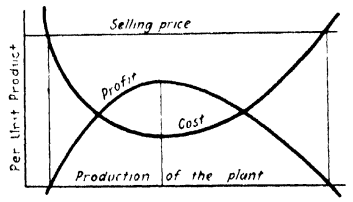


FIG. 2

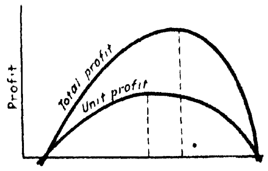


FIG. 3

Total Profit and Unit Profit

It is obvious that, for the case assumed, the unit profit curve goes through a maximum at a production corresponding to the minimum of the unit cost curve. At this maximum point, however, the unit profit curve is flat. This means that, if at this maximum point the production be slightly increased, the unit profit does not appreciably decrease. The product of unit profit into production must, therefore, increase. The consequence of this is that at the point of maximum unit profit the total profit curve—i.e., the product of total production into unit profit—is still increasing, and therefore the maximum of the total profit curve must lie to the right of that of the unit profit curve. (Fig. 3.) If, therefore, production be forced beyond the point of maximum unit profit, total profit will be increased. Inasmuch as the plant should be operated at the point of maximum total profit, this means that the plant should be forced at the sacrifice of an increase in unit cost in order to realize the maximum return.

This relation between cost and production is the key to the whole situation. It means that low costs of production are not a sufficient criterion of efficiency in plant management. A properly run plant can always reduce its costs by reducing its production, but thereby it would also reduce its profits. A management that is too anxious to keep costs down is likely to err in this regard, especially during periods of high prices. For example, during the early years of the war prices were so high that almost any increase in cost which brought about an increase in production was justifiable, because the increased production overbalanced the increased cost. Production costs must be scientifically adjusted to correspond with the market of the product.

Production costs are often used as a basis of judging managerial ability. This is peculiarly unfair, because the truly efficient manager will have higher production costs than the man, with equal technical ability, who is striving for low costs without an appreciation of the importance of a proper balance between costs and production. A direct comparison of the production costs of two plants or departments is inadequate and inconclusive. Efficiency in plant management will result in a low cost *curve*, but the more efficient of two plants may necessarily run at a production cost which is actually higher than that of the other. This fact is largely overlooked by industry.

With a variation in selling price the height of the unit profit curve changes, and the shape of the total profit curve is also modified. With increased selling price the unit profit increases and the total profit curve is bent toward the right so that the maximum point of the total profit diagram is forced to a point of higher production. With decreasing selling price the opposite is true—i.e., the maximum of the total profit curve not only decreases but also moves toward the left.

Two special cases are of interest. First, let it be assumed that selling price falls to such a point that it is exactly equal to the minimum cost of production corresponding to the lowest point on the unit cost curve. In such a case the profit is negative in value, except at a production corresponding to the minimum of the unit cost curve, at which point the unit profit becomes zero. If the total profit curve be constructed (Fig. 4) it will also obviously be negative at all values except at this same point, where it will have a "maximum" as before, but this "maximum" will be zero profit. Obviously, therefore, the plant under these conditions should be operated at the point of minimum cost, because at this point no money is being lost, whereas at any other production a loss will be sustained.

If the selling price be further reduced, the plant must obviously run at a loss. The unit profit curve (Fig. 5) is still the difference between the cost of production and selling price, but is now negative—i.e., becomes a unit loss, throughout its extent. The total profit curve also becomes negative—i.e., represents a loss—but it still has the same general shape as before, and still has a highest point, if considered as a profit, and a lowest point, if considered as a loss. This point will lie to the left of the point of lowest cost of production, and, if the plant be operated at this production, the loss on

the plant will be a minimum. Obviously this is the point of best economic operation.

Evidently a plant will not operate under such conditions except in the following cases: The first case is when the management feels that there is reasonable expectation of a future increase in selling price so that the plant will again produce a profit. The other exists when the total cost includes fixed charges which, though entirely legitimate because they represent an earning capacity of the money invested which can be realized in other similar lines of business, must be sacrificed because liquidation of the business would involve a loss in capital so great that the total return in interest on the capital salvaged would be less than the money actually earned for interest charges by the plant as it stands. Such conditions, however, so frequently prevail that the criterion outlined above for determining the best operating conditions is usually applicable.

It is not intended to intimate that these curves should be used as a rigid criterion of production. Labor conditions, future prospects of the market, the situation with regard to raw materials, and the like, are factors of paramount importance in determining modifications of production policy. On the other hand, the curves outlined above serve as an indication of the direction in which production should be modified, and of the extent to which it is desirable to go.

For example, in the case of a plant operating at a loss because of selling prices falling below the minimum cost of production, it is usually stated that the reason for maintaining operation is to keep intact the managing organization, and to keep available the labor for future expansion. This is quite true, but it is also true, as above demonstrated, that there is a definite production condition to which corresponds a lowest loss at which the plant can be run, and obviously under such a market situation this minimum loss should, if possible, be realized.

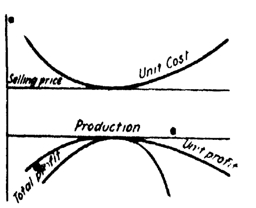


FIG. 4

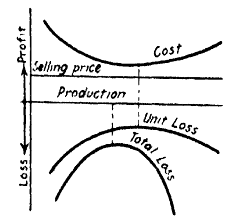


FIG. 5

Furthermore, this minimum loss can easily be realized without materially interfering with the maintenance of an organization and a suitable labor supply, because, under such conditions of manufacture as here assumed, it is usually possible to control the labor supply within wide limits by modifying the total hours of labor, and to maintain as a working organization the most desirable individuals to serve as a skeleton for future development.

The above discussion has been based on the tentative assumption of uniform selling price under given market conditions; this assumption, however, is in nowise necessary to a utilization of the curves and of this method of analysis of production costs, but was adopted solely to simplify the first presentation of the concept. Usually with an increased output the selling price of the product decreases more or less rapidly, due to the increased supply on the market or to a tendency of the product to fall in quality with increased production. In other words, the selling price curve assumes the shape indicated in curve *A*, Fig. 6. This modification of the selling price curve will somewhat modify the general shape of the unit profit and the total profit curves. A marked increase in production may result in a price curve of type *B*, involving the necessity of sharp decrease in price in order to open up new uses and markets to absorb the increased supply of the material. The maximum of the total profit curve is still the point of optimum production, and, in general, the selling price curve is sufficiently flat at the point of minimum cost of production so that the maximum point of the total profit curve lies to the right of this point. This is always true in a properly designed plant—i.e., in a plant the size of which is properly adjusted to the market for the product. Unfortunately the war placed many plants in the wrong category.

In using these curves, construction of the unit cost

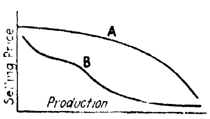


FIG. 6

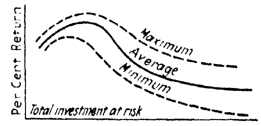


FIG. 7

curve as a function of production is the first essential point. The cost curve must in general be estimated, because it is not usually practicable to determine actual points thereon by arbitrary modifications of production. The estimation of this cost curve becomes relatively easy, however, if the production analyst will rearrange and reclassify, along the lines already described, the data available in the cost department. To make the classification and interpretation of these data reliable, the analyst must secure the close co-operation and advice of the cost department and especially of the operating engineers, because the data for any given plant can be interpreted correctly only in the light of a clear appreciation of the conditions and methods of operation in that individual plant. Subdivide costs into organization, production and super-production costs. The operating department can give a reasonable estimate as to the change of the last with increased or decreased production, and this rate of change of super-production costs with production is the only item seriously influencing the shape of the cost curve which it is difficult to estimate. The point on the cost curve corresponding to actual production being definitely and accurately known, it thus becomes possible to get a close estimate on the costs for any other production which differs not too greatly therefrom.

In determining the distribution of special items of cost the decision must depend upon the influence upon these items of change in production. For example, while raw materials almost always fall under production costs, direct labor is often an organization cost. Thus most of the labor about a blast furnace should be charged to organization and not to production, because the nucleus of the labor staff must be maintained to keep the furnace in operation at all, whether the production of the furnace be high or low, and in the case of such a furnace the labor nucleus is a large proportion of the total labor. The factor limiting the production of a blast furnace is the life of the lining. Again, the day-rate spinner in a textile mill should be charged to organization, because the number of spinners is fixed by the number of frames in operation, not by the speed, and hence the production of those frames. Doffing, however, is a production cost.

Similarly in each specific case the character of each item of cost can be determined.

The cost curve once established should, in a given plant, be relatively stable. It will, of course, be influenced by changes in prices of raw materials and in wages, but the influence of these changes can be readily estimated. The selling price will, in general, be much more subject to fluctuation. At regular periods, the length of which will vary from industry to industry, depending upon the rapidity of fluctuation of the selling price, the charts indicated above should be constructed and placed before the management as a guide in directing policy with regard to production.

Arghan—A New Fiber

THE cheapness of cotton during the past half century has militated against the introduction of a substitute, but it is interesting to note that the pioneer of the plantation rubber industry, Sir Henry Wickham, realized the possibilities of a plant, now known as arghan, about 50 years ago; but economic conditions during the intervening period did not warrant its cultivation and exploitation. More recently, however, because of the high price of cotton and flax, the inroads of the boll weevil and other factors of economic and international importance, attention was paid in Great Britain to the possibility of the transporting of arghan plants and their cultivation on a large scale. Russia, before her economic collapse, was an important producer of flax. This source is now almost entirely barren, with the result that a shortage of over 500,000 tons per annum must be met by the substitution of other material. A company to develop the arghan industry was organized in London late in 1919, with Sir Henry Wickham as technical adviser.

Transplanting the Plants

As with the beginning of the rubber industry, investigations were made and steps were taken to transplant a large number of arghan plants from their native habitat in the wilds—the precise locality is a secret—and to establish them in a desirable area in the British dominions. From this fact it would appear that arghan, like rubber, is indigenous to a country in which exploitation would be economically impracticable, because of governmental or national instability, of the probability of hampering interference with exportation, or restrictive if not confiscatory legislation. The collection of the plants and their transport to the Federated Malay States proved a delicate task, as was the case with the rubber seeds that were surreptitiously removed from Brazil. More than 500,000 plants were collected, the time involved being over 12 months; of these, less than 4,000 arrived alive at their destination. However, careful attention only was needed to preserve the stock, and recent reports indicate that the success of the enterprise, from the technical standpoint at least, has been complete. A nursery was established far from the native habitat of the plants. Various governments within the British Empire showed a keen desire to co-operate. The government of the Federated Malay States first granted the company a concession of 30,000 acres free of all premium, with a nominal land rent of 50 cents per acre, rising to a maximum of $1·per acre. The value of this concession is indicated by the fact that the rubber companies thereabout pay $4 per acre per annum for the same privileges. This indicates that the colonial government must have been satisfied as to the merits and possibilities of the new fiber. More recently, other colonial governments have evinced a desire to facilitate the expansion of the new industry, and negotiations are under way with India and Ceylon.

Character of the Fiber

Arghan is a perennial, and therefore is easier to produce than cotton or flax (being less liable to the effect of seasonal variations), both of which are annuals. Maturity is reached within 2½ years after planting. The fiber is of unusual strength and resistive power, particularly in regard to salt water. Tests have shown that when fabricated it can bear a strain of 50 per cent above the same class of goods manufactured from Italian hemp or Russian flax. A tensile strength three times that of silk and, weight for weight, the same as steel has been claimed. The fiber content of the leaf amounts to about 20 per cent of its weight, as compared with 3 to 4 per cent in sisal hemp. The analysts to the Federated Malay States Government state that it contains 75 per cent of cellulose, which is above the average for fiber of this class; that it resists alkaline hydrolysis, and that it is remarkably free from lignone. Immersion in salt water for several months showed that the fiber possesses a high degree of chemical resistance. One pound of arghan has been spun into 7,500 yards of material, and even improved results are expected when its properties are better understood. It has been shown to have satisfactory adsorptive qualities, and to take dye satisfactorily. It also bleaches well. The new fiber, which is obtained from the leaf, differs from ramie in that no decortication and degumming difficulties are met with. The method of treatment for the recovery of the fiber is simple, cheap and effective.

A committee of Lancashire manufacturers and spinners has reported that the new fiber will be suitable for twine, cordage, fishing-net yarns, tapes and beltings; and that it will eventually displace cotton from all classes of heavy canvas, particularly where strength is of paramount importance. As to the cost of producing arghan under methods involving scientific plantation control, Sir Henry Wickham states that the plant that yields the fiber is now being placed under cultivation for the first time, and that all estimates are tentative. But, as it belongs to a botanical order characterized by unusual hardiness and rapid growth, it is more than probable that an industry may be established and maintained over large areas of suitable land in the Eastern tropics, at a lower cost than is possible with any other staple product. A preliminary estimate shows that arghan can be produced and marketed for less than 12 cents per pound to yield a satisfactory profit.

Development of the Industry

The parent corporation has instituted a plan for the development of the new industry, whereby subsidiary companies are formed and financed to develop plantations of 5,000 acres each. More recently arrangements have been made with the rubber companies in the Federated Malay States, whereby they are permitted to produce and sell arghan on a royalty basis. This fact is of significance to those interested in the supply of crude rubber. It indicates that the restricted output of plantation rubber may not end in financial disaster to the growers, as has been predicted by manufacturers who would welcome a radical reduction in price.

Equipment News

From Maker and User

Machinery and Appliances for Production and Control

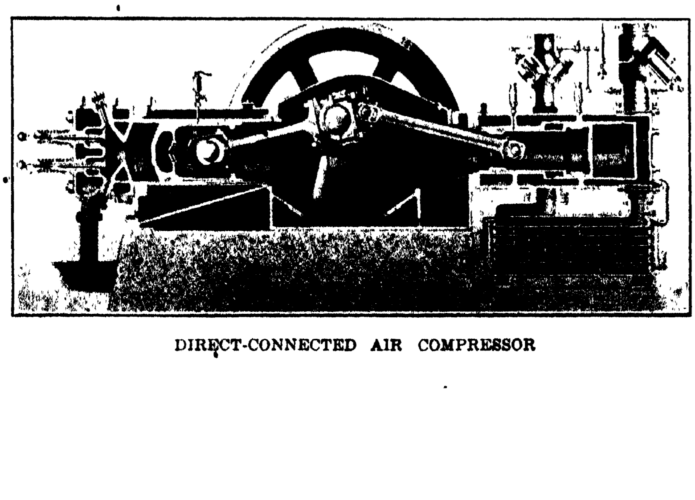
Materials and Accessories for Chemical Industries

Direct-Connected Air Compressor Unit

The accompanying photograph shows an extremely interesting development of the Price horizontal oil engine which has recently been made by the Ingersoll-Rand Co., of 11 Broadway, New York. In this photograph is shown an oil engine with its cylinder directly in line with the air cylinder of a compressor set on the opposite side of the crankshaft. In the development of 100 lb. air pressure, a two-stage air cylinder is used, with the intercooler situated below the cylinder and forming a support for it. For lower air pressures than this a single-stage cylinder is used, which is connected directly to the oil engine frame. In both the single and two-stage cylinders the air cylinder is double acting, which serves to help the balance of the oil engine. The photograph here shown is of the type used with the 100-hp. unit. In the 50-hp. unit the air cylinder is vertical and mounted on top of the engine directly above the crankshaft.

This same combination of units has also been made in the case of ammonia compressors. In this case, with the 100-hp. unit, there is an actual delivered capacity of gas equivalent to 63 tons of refrigeration, and with the 50-hp. unit, to 31 tons of refrigeration.

It is claimed by the manufacturers of these combined units that great economies are effected by the use of an oil engine in connection with a compressor. In making a comparison with electrically driven units, it is claimed that with fuel oil at 6 cents per gallon the oil-burning engine works on a par with electric power at 1¼ cents per kw.-hr., and with fuel at 12 cents per gallon with electric power at 1½ cents per kw.-hr.

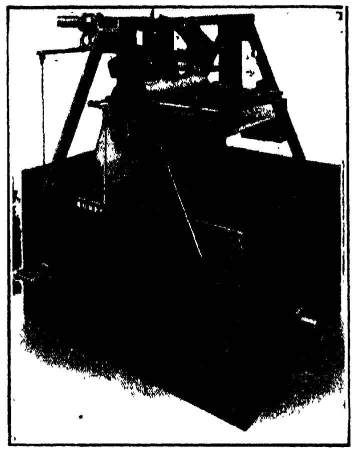


DIRECT-CONNECTED AIR COMPRESSOR

A Weighing Meter For Liquids

The weighing meter shown herewith actually weighs the liquid by balancing a bucket against a balance weight on a scale beam. The bucket rests upon the beam by frictionless trunnions, while the beam is supported on knife-edge bearings. When a certain weight of water has accumulated in the bucket, the latter sinks until it escapes a latch and then quickly turns over and discharges its contents.

During the time that the bucket is rotating, the inflowing water is received in a detaining chamber. As soon as the bucket has discharged, it swings back so that the liquid in the detaining chamber flows into the main bucket, which thereupon proceeds to revolve slowly to its initial position. In so doing it travels a short distance past the latch and then, as more water flows in, slowly comes back against the latch, engaging and locking with the latter, the balance weight having already returned the bucket to its original elevation. There is no shock, jar nor impact at any time during the operation.



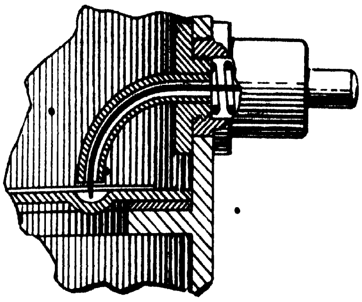
WEIGHING MOTOR WITH OPEN TANK

The bucket trunnions roll upon plane surfaces and there is practically no wear. Each dumping is registered by a counting train. The accuracy is within 1 per cent, plus or minus, at all rates of flow up to the maximum. The meter is easily calibrated by weighing a single discharge and can be adjusted by moving one or both of the counterweights.

This weighing meter can be built in small capacities for which a V-notch would be unsuitable. The receiving tank into which the meter discharges can be fitted with a float controlling a valve in the inlet connections, where the amount is controlled by the apparatus to which the liquid flows rather than by the apparatus from which it comes. This meter is being marketed by the H. S. B. W.-Cochrane Corporation of Philadelphia, Pa.

Time Punch For Recorders

As an additional feature in connection with the "Columbia" line of temperature recorders made by the Schaeffer & Budenberg Manufacturing Co., of Brooklyn, N. Y., a time punch has been added. This feature consists of a punch located



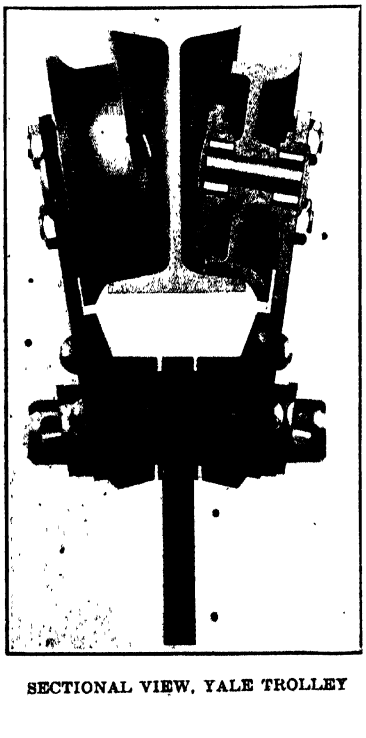
TIME PUNCH

in the rim of the recorder, as shown by the accompanying drawing. When the button is pushed the curved wire makes a perforation in the recorder chart—indicating the time of the punching operation. This feature obviously has numerous uses, such as recording the time at which certain operations are performed or readings taken, or it may be made to serve as a watchman's clock or for similar purposes.

An I-Beam Trolley

The Yale & Towne Manufacturing Co., of Stamford, Conn., has recently designed and placed on the market a new I-beam trolley of the roller-bearing steelplate type. This trolley represents the latest features of this company's trolley design and embodies the following features:

Strength—A reserve of seven times the rated capacity.



SECTIONAL VIEW, YALE TROLLEY

Flexibility—A 1-ton trolley will run on a 21-in. radius curve.

Roller Bearings—These are heat-treated, hardened and ground to give easy lateral motion. They have a grease chamber designed to prevent the dust from reaching them.

Axles—These are set parallel to the I-beam flange, pressed into the wheel hubs and supported by the inner bearing plate. In this way they are subjected to practically no bending strain.

Wheels—These are chilled iron threads conforming to the shape of the I-beam flange, designed to reduce the wear from dust and grit.

Equalizing Pin—This is of cold-rolled steel and will support a shackle, an eye, or a clevis. Where extra headroom is desired, the chainblock can be hooked directly over this pin.

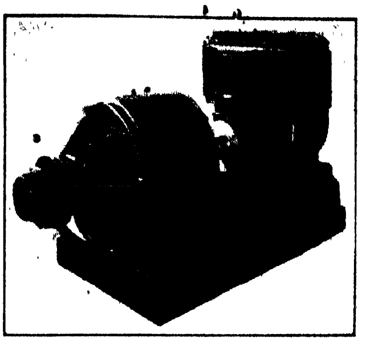
In demonstration of the strength of this trolley, the manufacturer offers the following test: The trolley was loaded with a 28,000-lb. load and the I-beam on which it was supported broke without any damage occurring to the trolley.

Temperature Regulator

The Fulton Co. of Knoxville, Tenn., has recently placed on the market a new temperature regulator which it calls No. 932. This regulator is the latest member of "Sylphon" line of temperature regulators, and is used for regulating the temperature of liquids.

It consists primarily of a thermostatic element, a power transmission unit and a regulating valve. It is in three parts and so arranged that the thermostatic element can be installed in the tank containing the liquid whose temperature is to be regulated, independently of the installation of the outer parts. The valve in the steam line can also be independently installed. After the installation of these two parts, the power transmission unit can be connected between the two, by means of a quick-detachable T-slot connection.

Power between the tnermostat and the regulating valve is transmitted by liquid pressure acting betwen two small "Sylphon" bellows. The liquid contained in this system is a non-freezing liquid which is recommended by the manufacturers as giving frictionless and satisfactory operation. The bellows are of the "Sylphon" corrugated metal type.



THE NEEDHAM BLOWER

Needham Blower

Many offices, such as telephone and telegraph companies, brokers' offices and newspaper offices, use pneumatic conveyor systems for handling papers and other materials between various rooms. For this use, the Needham blower has long had much popularity. In fact these blowers are in use in all the best known telegraph, cable and telephone companies.

The satisfactory operation and many good qualities of this machine, whether used as blower or exhauster, have recently impelled the manufacturers to recommend it for other uses. It is offered for the attention of chemical and allied industry as a solution of some of the problems which are here met with in obtaining satisfactory blowing equipment.

This machine is built in capacities from 75 ft. to 1,500 ft. per minute. It is direct connected through a flexible coupling to a motor mounted on the same base. It has ball bearings throughout, which makes for efficient operation and permits of easy replacements.

The drive is from the motor to a worm which is direct connected to the motor shaft. This worm drives two worm-wheels, one on each shaft of the blower. By this means, power is transmitted evenly to each shaft and any spring in shafts or impellers is eliminated. The impellers are cast integral with the shafts. Shafts are vertical. The general design is along similar designs to that of other well-known positive blowers.

The manufacturers claim that in this machine they have a blower of great reliability which is noiseless; and that it is particularly adapted to automatic control. It is also claimed that it develops double the capacity, for a given size, of any other type of blower.

Review of Recent Patents

Some Hints for the Technical Man

Patents Dealing With Cane Juice Purification, Wool Cleaning and Paper Recovery Deserve Attention

THE TREND of industry as revealed by patent literature in the last decade shows a marked increase in the number of new alloys patented. This is significant. It is an indication of the increasing attention that is being focused on the scientific production of alloys and metallic products. Less and less the old cook-book methods, more and more an intelligent application of clear-headed, planned experimentation.

This observation was stimulated by a patent on the manufacture of silicon-manganese-iron alloys, (1,449,373, issued to W. J. Beck and J. A. Aupperle, assigned to the American Rolling Mill Co. of Middletown, Ohio; March 27, 1923.) By the addition of 2 to 4½ per cent silicon to iron to which has also been added manganese, a corrosion-resistant alloy is produced. The addition of manganese to an alloy increases its workability. The theory is that the iron alloyed with silicon when exposed to natural oxidation takes on a thin, velvety, protective coating, made up largely of black magnetic oxide of iron, together with silicate of iron. The silicon in the alloy prevents the formation of higher oxides upon the surface of the metal. This coating acts as an enamel covering on the surface of the metal, preventing formation of ordinary rust-ferric oxide, Fe_2O_3.

Purifying Raw Cane Juice

The cost and time required in the purification of raw cane juice are excessive and all effort expended on the diminution of these invaluable commodities is in lin with economic progress and health. This is by way of explanation of our interest in such patents as this one (referred to below) and to enunciate from time to time a useful criterion of attention value. The clarification of raw cane juice is complicated by several factors. If it is filtered and then neutralized with milk of lime and filtered again, the filtration is slow, unless a filter aid is used. On the other hand, if the preliminary filtration is omitted, the fine fibers from cane give up albuminous matter which is coagulated on neutralization and heating. This makes filtration extremely difficult. C. J. G. Sorenson, of Frederiksted, Virgin Islands, has patented a method for handling this problem. (1,448,421; March 13, 1923.) The raw juice is neutralized with milk of lime and heated under 40 lb. pressure to a temperature of 110 deg. C. The juice still contains the small fibrous particles, bagacilio, of cane. By pumping directly to a filter press out of contact with air, the albuminous matter is kept from coagulating.

Advance in Paper Technology

The increasing cost of new stock for paper manufacture is creating a condition that makes improved recovery

American Patents Issued May 22, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem & Met* readers. They will be studied later by *Chem & Met's* staff and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,455,785—Screening and Sizing Process and Apparatus. G. C. Hackstaff, Denver, Colo.

1,455,789—Apparatus for Automatically Extinguishing Fires in Oil Tanks and Other Structures. O. J. Holmes, Tulsa, Okla.

1,455,791—Flux or Solvent for Use in Technical Process. A. A. Kelly, London, England, assignor to Borax Consolidated, Ltd., London.

1,455,809—Elastic Gasket Composition. J. Ritter, Pittsburgh, Pa., assignor to Whitaker-Glessner Company, Wheeling, W. Va.

1,455,834—Method of and Apparatus for Cleaning Gases. A. N. Diehl, Duquesne, Pa.

1,455,846—Air-Conditioning or Humidifying and Heating System. L. L. Lewis, Plainfield, N. J., assignor to Carrier Engineering Corporation, New York.

1,455,893—Unvulcanized Rubber Composition. F. W. Stockton, Pittsburgh, Pa., assignor to Aluminum Seal Co., New Kensington, Pa.

1,455,907—Vibrating Trommel Screen. A. C. Daman, Denver, Colo.

1,455,911—Oil Purifier. A. R. Giffin, Cleveland, Ohio, assignor to J. E. Heene, Cleveland.

1,455,927—Method of and Apparatus for Preventing the Absorption of Air by Boiler-Feed Water or Other Liquid. D. B. Morison, Hartlepool, England.

1,455,963—Lithopone and Method of Manufacture. V. F. Meister, Collinsville, Ill.

1,455,966—Mechanism for Conveying Hot Glassware. M. J. Owens, Toledo, Ohio, assignor to Owens Bottle Co., Toledo.

1,455,975—Apparatus for Puffing or Disintegrating Material. A. R. Spencer and W. J. Plews, Cleveland, Ohio.

1,455,995—Bleaching Earth. C. Cramer, Zurzach, Switzerland.

1,456,016—Liquid Heater and Vaporizer. C. E. Ward, Charleston, W. Va.

1,456,019—Process for Extracting Oil. H. A. Wentworth, Deer Island, N. B., Canada.

1,456,023—Furnace Arch Construction. L. H. Hosbein, Chicago, Ill., assignor to M. H. Detrick Co., Chicago, Ill.

1,456,035—Metal Dust and Process of Making the Same. M. H. Newell, San Francisco, Calif., assignor to the Alloys Co., San Francisco.

1,456,044—Positioned Electrode. W. W. Strong, Mechanicsburg, Pa., assignor to Research Corporation, New York.

1,456,057—Fuel Economizer. W. G. Griffin, Washington, D. C.

1,456,064—Process and Apparatus for Making Sulphuric Acid. W. F. Lamoreaux, Isabella, Tenn.

1,456,065—Manufacture of Sulphuric Acid. W. F. Lamoreaux, Isabella, Tenn.

1,456,067—Apparatus for Screening Granular Materials. R. A. Leahy, Bonne Terre, Mo.

1,456,095—Pressure Oil Filter. F. E. Collins, Conshohocken, Pa.

1,456,102—Chemical Apparatus. B. B. Fogler, Cleveland, Ohio, assignor to General Electric Co.

1,456,111—Clay Products and Process of Preparing Same. E. G. Acheson, New York.

1,456,112—Reflocculated Product and Process of Preparing Same. E. G. Acheson, New York.

1,456,147—Agitating Device. T. J. Putnam, Boston, Mass.

1,456,165—Ore Separator. S. H. Whitney, San Francisco, Calif., assignor of one-fourth to A. A. Eddie, San Francisco.

1,456,224—Method and Machine for Making Prepared Roofing. A. E. Currier, Millis, Mass., assignor to Baker Rubber Cement Co., Boston.

1,456,252—Process of Coating Metals with Metal Phosphides. S. Peacock, Wheeling, W. Va., assignor to Wheeling Steel & Iron Co., Wheeling.

1,456,255—Apparatus for Heat Exchange. E. Shaw, Toronto, Ont., Canada.

1,456,270—Sugar-Washing and Water-Measuring Device. W. W. Hartman, Los Angeles, Calif.

1,456,274—Process of Rendering Metal Non-Oxidizable and the Metal. W. J. Keep, Detroit, Mich.

1,456,303—Acid-Proof Mortar. P. G. Ekstrom, Stockholm, Sweden, assignor to Aktiebolaget Syrefast Murning, Stockholm, Sweden.

1,456,312—Combined Sludge Separating and Drying Basin. K. Imhoff, Essen, Germany.

1,456,323—Process for Treating Woods and Other Porous Substances. E. H. McPherson, Los Angeles, and J. M. Abrams, San Francisco, Calif.

1,456,332—Process of Drying and Preparing Fertilizing Materials. F. J. Nash, Brooklyn, N. Y.

1,456,341—Explosive Composition. W. O. Snelling, Allentown, Pa., assignor to Trojan Powder Co., New York.

1,456,353—Mill. D. D. Bare, West Jefferson, N. C.

1,456,360—Air Filter. A. Budil, Berlin-Tempelhof, Germany.

1,456,360—Thermoplastic Composition and Process of Compounding the Same. E. de Stubner, New York, assignor to Columbia Graphophone Manufacturing Co., Bridgeport, Conn.

1,456,370—Process of Making Waterproof Rigid Articles from Pulp. W. H. Drake and J. J. Drake, Cleveland, Ohio.

1,456,390—Safety Device for Plants Delivering Inflammable Liquids. M. Ludwig, Berlin-Lichterfelde, Germany, assignor to Martine & Hüneke Machinenbau-Aktien-Gesellschaft, Berlin.

1,456,392—Retort for the Treatment of Carbonaceous or Other Materials. F. D. Marshall, Westminster, London, England.

1,456,419—Process and Apparatus for the Production of Low Boiling Point Hydrocarbons. J. C. Black, Destrehan, La.

1,456,438—Liquid Filter. K. J. E. Hesselman, Saltsjo-Storangen, Sweden.

1,456,486—Compound for Cleaning Aluminum. C. M. Hemen, Washington, D. C.

1,456,492—Surfacing Composition for Highways and the Like. D. M. Hepburn, Philadelphia, Pa.

1,456,494—Oilproof Coating or Impregnating Agent. A. J. Rowland, Cincinnati, Ohio.

1,456,495—Manufacture of Carbon Electrodes. S. E. Sieurin, Hoganas, Sweden, assignor to Höganäs Billesholms Aktiebolag, Helsinborg, Sweden.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

methods for old stock highly desirable. B. M. Baxter, of Cleveland, Ohio, seeks to make possible the recovery of fiber in waste paper contaminated by various foreign materials. (1,451,522, assigned to Air Reduction Co. of Pittsburgh, April 10, 1923.) In principle the apparatus consists of a long rotating slotted drum suspended partly submerged in a tank of water. The drum is provided with openings in both ends. Into one end the paper waste is fed. The waste in rubbing over these slots as the drum revolves is reduced to pulp and flows out into the tank. Angle irons are so located as to elevate waste solids to the discharge opening. The process is thus continuous and is claimed to give cheaper and more satisfactory recovery of fiber from refuse than any method now in use.

Zinc Oxide Process

The New Jersey Zinc Co., through J. A. Singmaster and F. G. Breyer, has patented an operating improvement in the Wetherall process. (1,450,704; April 3, 1923.) This process is a preliminary step in the production of zinc oxide and consists in making the zinciferous material ready for the production of zinc oxide. It consists essentially in adding to the charge itself an admixture of porous non-slagging material. This diminishes the tendency to slag and block up the charge—a process that effectively prevents further roasting. Furthermore, the process suggests the use of a layer or bed of this non-slagging porous material between the working charge and the ignition fuel. It is claimed that greater facility of operating is obtained, greater flexibility of operating conditions and correspondingly better yield of well-roasted ore.

"Dry Cleaning" Wool

The removal of dirt and grease from wool without the assistance of a liquid solvent is claimed by H. Y. McBride. (1,449,613; March 27, 1923, assigned to the United States Wool Co.) Gypsum is the degreasing agent, but it must be prepared by burning to a point where it will no longer take up any moisture. In other words, it is completely dead-burned. In addition it is necessary to grind the gypsum to a very fine powder—about 250 mesh. The wool is rotated with the gypsum in a tumble barrel and then removed and shaken free by a dusting process which is standard trade practice. It is claimed that the wool may then be spun and dyed with unusual facility.

Sizing Composition for Paper

A sizing composition especially suitable for the tub treatment of high-grade paper results from the treatment of alum-tanned leather scrap with water at higher temperatures. Pieces of scrap in a tub or vat are washed with water to remove as far as possible the salt and alum. The salt is washed out thoroughly and the solution, consisting of scrap mixed with ten times its weight of water, is heated by steam until the leather has been entirely dissolved. A clear light-colored sizing composition results. This may be applied directly, but the addition of enough alum to give 10 per cent concentration on the basis of the dry leather scrap originally used is recommended. After this addition the mixture should be heated sufficiently to incorporate the alum thoroughly. (1,449,892, issued to P. W. Codwise; March 27, 1923.)

Fireproofing Compound

A cheap method of producing fireproof construction is suggested by W. L. Wooton of Brooklyn. (1,451,485; April 10, 1923.) Essentially it means the impregnation of wood and fiber with calcium chloride with which is mixed small quantity of salt and gypsum. It is prepared by adding to 150 parts of slaked lime and one part of salt a mixture containing 99 per cent by volume of hydrochloric acid and 1 per cent sulphuric acid. This mixture can be used directly for impregnating cotton and other textile fabrics, plaster, wood and so forth. The composition, being infusible, renders the impregnated material fireproof. No details are given as to method of impregnation.

Book Reviews

Nitrogen—In Peace or War

Review of Some Current Literature of International Significance

By Grinnell Jones

THE NITROGEN INDUSTRY By *J R Partington* and *L. H. Parker* xi + 336 pp. 23 figures and 19 plates. Constable & Co, London, 1922 (D Van Nostrand, New York, 1923) Price, $6

THE rapid growth of the nitrogen industry and the great stimulus to research on nitrogen fixation during and since the war have inspired the publication of several new books. A German, B. Waeser, has produced a typical Teutonic handbook, "Die Luftstickstoffindustrie," systematic, detailed, ponderous, but relatively free from critical analysis and comparison of the various processes; essential to the reference library and to the specialist on nitrogen fixation, but a bore to most readers.

Les Mémoires de la Société des Ingénieurs Civils de France (eighth series, vol. 75, pp. 172-342, 1922) contains a series of articles broadly covering the nitrogen industry, chiefly notable for the best available description of the Claude process, written by Claude himself.[1]

The splendid group of American chemists at work in the Fixed Nitrogen Research Laboratory at Washington have published a "Report on the Fixation and Utilization of Nitrogen" (No. 2041, 1922), which contains a detailed description and a critical comparison of the existing processes. This report also contains considerable disclosures of the conclusions reached as a result of the research that has been carried out in this laboratory, but it is not burdened with the details of the experimental proof of the conclusions.

From England we have the "Final Report of the Nitrogen Products Committee to the Ministry of Munitions of War" (1919), together with a later "Statistical Supplement" (1921), which, although weak on the purely technical side, is unique for its systematic compilation of the world statistics of the industry and for its discussion of the competitive strength of the different branches of the nitrogen industry.

[1]For an abstracted translation see *Chem. & Met.*, vol. 28, No. 11, pp. 498-501. March 14, 1923.

"The Nitrogen Industry"

From England we have also the volume by Partington and Parker, the primary subject of this review. This book is so profoundly influenced by the earlier British report just referred to that it may almost be regarded as a popularized edition of it, with many good pictures and much more or less superficial technical descriptions added. The authors emphasize the vital importance of nitrogen fixation to Great Britain in war and peace and freely criticize the handling of the situation by British officials and financiers.

The book discusses the Chilean nitrate industry, byproduct ammonia, synthetic ammonia, the cyanamide process, the arc process and the oxidation of ammonia. The chapters dealing with the Chilean nitrate industry and the oxidation of ammonia are the best. Many statistical tables are taken from the earlier British report with little if any effort to bring them down to date. The thermodynamic and kinetic theory of the processes is touched on very lightly. Indeed, the presentation is so simple, clear and superficial that it can be followed by a reader having only the most elementary knowledge of chemistry. Disclosures of information which has not already appeared in the technical press are conspicuously absent. Thus the description of the catalysts for the ammonia synthesis is confined to the following:

> The catalysts are usually mixtures of various substances. Metallic iron is the main constituent, but small amounts of other substances called "promoters" are added. One of these is molybdenum. Uranium may also be used. Very pure

iron, according to Nernst, has a very slight action only. . . . . The catalyst was stated to be the same as that used in ammonia oxidation, probably oxide of iron and chromium; it remains active for 2 years

In view of the fact that the German plants have been visited by British, French and American chemists and that the authors have been members of a British organization which has been active in research work on nitrogen fixation the inference is plain that the authors, if they had desired to do so, could have given a much more detailed and accurate account of the chemical nature of the catalysts; of the method of their preparation; their efficiency under various conditions of temperature, pressure and gas velocity; and their sensitiveness to poisons.

This book will be the least valuable to the specialists of any of the new books on nitrogen fixation referred to above. But the book can be fairly judged only with reference to the purpose of the authors—viz., to impress upon the general public the unique position of "the greatest, the most important key industry of all." Judged in the light of this purpose, this book is admirable. It is to be hoped that in America, as well as in Great Britain, it will reach a large public chemists, newspaper editors, Congressmen, investors, public spirited citizens. Let every chemist buy a copy to lend to his friends and see that a copy is made available in the public library in his home town!

CONTRASTING OUR POSITION WITH ENGLAND'S

The American reviewer feels constrained to reply to this criticism of Great Britain by a Briton. If the submarine had actually secured command of the sea, as it so seriously threatened to do in 1917, Great Britain would have been forced to acknowledge defeat through starvation with or without a nitrogen fixation industry at home. It was therefore sound public policy for Great Britain, in the crisis of the war, to concentrate her full resources in steel, labor, and in the brains of her scientific men and inventors to the conquest of the submarine, to the neglect of all other things Even a well-developed nitrogen industry yielding a large surplus for fertilizer above the military requirements could not make Great Britain independent of imports of food. The submarine was mastered in the nick of time and the policy of the government was thus justified by success.

In the United States, on the other hand, the situation was and remains fundamentally different. In 1917 the possibility had to be faced that the submarine would secure virtual command of the sea. In such a contingency the United States, although denied a definite victory, could at least avoid defeat through invasion as long as the supply of explosives did not cease through lack of nitrates. With an adequate supply of nitrates available from the air, the United States and Canada together could defend themselves against invasion indefinitely even if completely shut off from imports by sea. A failure in the supply of rubber would be embarrassing and of coffee inconvenient, but no imported article, except sodium nitrate, is really essential for the national existence and military defense. This is the reason that the United States in 1917 and 1918 made frantic efforts to secure a supply of nitrates from a source beyond the reach of the submarine, whereas Great Britain postponed the problem until after the war. The lesson of this English book on "The Nitrogen Industry" is thus even more vital to the United States than it is to Great Britain.

Index for Engineers

CATALYSIS IN ORGANIC CHEMISTRY. By York, 1923, The American Society of Mechanical Engineers. 675 pp. Price, $6

This work, the best yearly index of periodical literature from the engineer's point of view, reaches with this issue its twenty-first volume. Throughout its long record of service the book has year by year become more valuable; its field of action has been made broader by the inclusion of more and more publications among those received, and the presentation, especially with reference to the method of classifying and cross-indexing, has been improved.

The number of publications reviewed now covers fully 1,300, including periodicals, reports and other items. Of these, articles to be indexed have been selected from over 600, of which approximately 50 per cent are foreign publications. The individual references have been written in a much more concise form than formerly, thus permitting an index of greatly increased scope to be published with the addition of but few pages.

G. L. MONTGOMERY.

Important Articles in Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem & Met* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature and consequently should be of considerable interest to our readers Those that are of unusual interest will be published later in abstract in this department, but since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage The magazines reviewed have all been received within a fortnight of our publication date

FORMATION, CHEMICAL CONSTITUTION AND UTILIZATION OF OIL. Eugene Grandmongin The first of a series of reviews on industrial science written for the engineer *Le Génie Civil*, May 12, 1923, pp 144-6

AUTOMATIC REGULATION OF NITROGEN OXIDES IN THE CHAMBER PROCESS OF SULPHURIC-ACID MANUFACTURE. Kai Warming Outline of a proposed system based on temperature differences between chambers. *Chimie et Industrie*, April, 1923, pp. 671-3.

SYNTHETIC TANNINS R. B. Croad. Review of the history, methods of manufacture and use of these products. *J Soc Chem. Ind.*, May 11, 1923, pp 203T 207T.

THE LLANDARCY REFINERY OF THE ANGLO-PERSIAN CO. A semi-technical discussion of the first Anglo-Persian plant to be installed in South Wales. *Chemistry & Industry*, May 18, 1923, pp 482-6.

THE STREAM-LINE FILTER. J. W Hinchley. A note on a new filter invented by Prof. Hele Shaw. *Chemistry & Industry*, May 18, 1923, p. 489.

METHODS OF ESTABLISHING WAGE RATES AND DETERMINING PROMOTIONS H P Carruth. A reduction of personnel problems to a fixed basis by use of questionnaires and graphic ratings. *Paper Trade Journal*, May 24, 1923, pp 49-58.

CONTINUOUS DIGESTION OF PAPER PULP. Raymond Fournier. A proposed apparatus which makes continuous digestion possible under moderate pressure. *Paper*, May 23, 1923, pp. 5-6.

LEACHING OF TANNIN MATERIALS. J. A. Reavell Notes on the Thorncroft Patent Leaching Apparatus. *Chemical Age* (London), May 12, 1923, pp. 506-8

MOST MODERN CEMENT PLANT IN FRANCE J. Prouteau. Poliet & Chausson Plant at Gargenville has most up to date apparatus on all departments. *Rock Products*, May 19, 1923, pp. 11-20.

COAL CARBONIZATION AS APPLIED TO POWER-PLANT PRACTICE. V. Z. Caracristi. The lead bath method of low-temperature carbonization applied in the boiler house. *Power*, May 29, 1923, pp. 831-6.

Fundamentals of Catalysis

CATALYSIS IN ORGANIC CHEMISTRY. By *Paul Sabatier*, translated by *E. Emmet Reid* 406 pages. D Van Nostrand Co., New York, 1922. Price, $5.

There is only one reason now why Sabatier's text on catalysis in organic chemistry should be read in the original French. If you are unskilled in the reading of scientific French, Sabatier's book is a good text to study, with its relatively simple language forms, its wide range of scientific words and the general interest of the subject to hold your attention. But Professor Reid's translation is a far more useful text if it is information on the subject of catalysis that you need. It is broader, it is better, more accurate and more detailed than the original, which itself is a classic. So it is not even necessary to say that the book is indispensable. Anyone who takes catalytic work seriously, and most of us ought, would be foolish to be without it.

The book is a detailed record of the contributions of the catalytic investigators to preparative organic chemistry. It is especially concerned with the reactions of hydrogenation and dehydrogenation, hydration and dehydration, those reactions in which the Sabatier researches have been most fruitful, in which the contact catalyst has meant the ready attainment of otherwise difficult ends and in which new processes of the laboratory and the industry have found their origin. As a compendium of such it is invaluable. It has a further value to those who would know what has already been accomplished and who would embark upon the labors of extension and amplification; because, on reading this book, one cannot but be struck with the largely empirical nature of the achievements in contact catalysis. And to some of us there must come a desire to see the empirical make way for the more rational. To do this, however, we must know, thoroughly, the empirical.

It is on the theoretical side that Sabatier's book is weakest. Professor Reid has helped materially to correct this by incorporating a chapter by Professor Bancroft on theories of catalysis. Reading this section, how-

ever, the reviewer feels that a considerable period of time must have elapsed between the receipt of the contribution and the publication of the book. Professor Bancroft's views have already progressed materially beyond the thoughts expressed in the chapter he contributes to this book. In addition to this chapter there are copious signed footnotes by various interested workers in the field in this country which amplify very helpfully the data in the text.

The method of paging is confusing, the numbers being on the inside edge of the page, paragraph numbers occupying the position usually occupied by page numbers. One doubts whether this is wise.

From the graceful biography of Sabatier contributed by the translator the pessimistic research man may take courage. The work which has rendered Sabatier's name illustrious in the annals of his science was all done after 20 years of research work in another branch for which he is practically unknown.

HUGH S. TAYLOR.

Men in the Profession

E. E. AYARS, chairman of the refractories division of the American Ceramic Society and recently superintendent of the silica brick plant of the American Refractories Co., at Joliet, Ill., has severed his connection as a result of the change in management of this plant. Mr. Ayars had been in the employ of the American Refractories Co. in various capacities in the operating department for 5½ years.

MARION G. BRYCE, president of the United States Glass Co., Pittsburgh, Pa., was tendered a testimonial dinner by stockholders in the company at the William Penn Hotel, May 22. Ernest Nickel, treasurer of the company, acted as toastmaster.

H. V. BURGARD, consulting metallurgist, of Hollywood, Calif., has returned from an extended trip in Arizona and Nevada on professional business.

J. V. N. DORR has been made an honorary member of the Phi Lamda Upsilon scholastic chemical fraternity.

R. C. HARTONG, formerly chief chemist at the plant of the Goodyear Tire & Rubber Co., of Akron, Ohio, has been elected president and treasurer of the Chemitex Products Co., recently organized to establish a plant at Mogadore, near Akron.

Dr. VICTOR F. HESS, chief physicist of the U. S. Radium Corporation, has resigned to assume the chair of experimental physics at the University of Graz, in Austria.

Dr. GUSTAVE E. LANDT has resigned his position on the teaching staff of Columbia University to engage in research and development work with the Agosote Millboard Co., Trenton, N. J.

D. S. MCAFEE, of the Dorr Co., was recently in San Francisco.

JOSEPH MCAULIFFE has resigned as mill superintendent of the Caribou Metals Co. to devote his entire time to the Mace Co. G. G. GENTRY has succeeded Mr. McAuliffe as mill superintendent of the Caribou Metals Co.

E. B. MILLER, vice-president of the Davison Chemical Co., Baltimore, Md., addressed a meeting, held under the auspices of the local sections of the American Society of Mechanical Engineers and the American Chemical Society, at Baltimore, on May 25. His address was on "The Refining and Recovery of Petroleum Oils by Silica Gel."

GEORGE K. MORROW has been elected president of the American Cotton Oil Co., New York, succeeding Lyman N. Hine. Mr. Hine will become vice-president and devote a portion of his time to the affairs of the company.

F. N. RHODES, assistant works manager for the Wilson Portland Cement Co., Ltd., of Auckland, New Zealand, was in San Francisco recently and visited nearby cement plants.

Dr. E. E. SLOSSON is en route to Sweden to be a guest, along with a small group of journalists, of the municipality of Gothenburg at its tricentennial.

Obituary

JOHN VAN VORST BOORAEM, aged 86, for half a century a prominent engineer in the sugar-refining industry, died on May 24 at his home in Brooklyn, N. Y., after a brief illness. As a young man Mr. Booraem studied engineering for 5 years in France and Germany. In 1861 he was engaged as a marine engineer for the government. From 1870 to 1882 he was connected with the Decastro & Donner Sugar Refining Co. and from 1882 until 1898 he was consulting engineer for the American Sugar Refining Co.

WILLIAM D. FRERICHS, a pioneer in the terra cotta industry and one of the organizers of the Atlantic Terra Cotta Co., New York, died at his residence on Amboy Road, Tottenville, Staten Island, May 17, aged 77 years. He entered the employ of the Perth Amboy Terra Cotta Co., Perth Amboy, N. J., about the time that this company was formed, in 1877, then the only company in America devoted to this line of manufacture. Following a reorganization of the Atlantic Terra Cotta Co, several years ago, Mr. Frerichs resigned and became affiliated with the Federal Terra Cotta Co., Woodbridge, N. J.

Dr. HANS GOLDSCHMIDT, inventor of the "thermit" reaction between metallic oxides and powdered aluminum, now widely used as a process for welding steel and for producing some of the less common metals and alloys, and the originator of many other scientific inventions, died suddenly in Baden-Baden, Germany, on May 20, 1923. Professor Goldschmidt was born in Berlin in 1861. His father was the proprietor of chemical works and tin smelters which he had founded in 1847. Hans Goldschmidt studied at the universities of Berlin, Leipzig, Heidelberg, Strassburg and at the Institute of Technology at Charlottenburg, receiving the degree of Ph.D. from the University of Heidelberg in 1886. In 1887 Goldschmidt entered the firm of Th. Goldschmidt, Essen Ruhr, Germany, in joint partnership with his brother. The attention of the latter was applied mainly to the business management of the company, while Hans devoted himself to scientific research. Under their joint guidance the firm grew rapidly in importance. Professor Goldschmidt visited this country very frequently in the years before the war, to supervise his interests in the Goldschmidt Thermit Co. (now the Metal & Thermit Corporation). Through his death the world loses a chemist of great knowledge and inventive genius.

Calendar

AMERICAN ASSOCIATION OF CEREAL CHEMISTS, ninth annual convention, Hotel Sherman, Chicago, June 4 to 9.

AMERICAN CHEMICAL SOCIETY, fall meeting, Milwaukee, Wis., Sept. 10 to 14.

AMERICAN CHEMICAL SOCIETY, New York Section, regular meeting, Rumford Hall, Chemists' Club, June 8.

AMERICAN ELECTROCHEMICAL SOCIETY, forty-fourth meeting, Dayton Ohio, Sept. 27 to 29 (dates provisional)

AMERICAN ELECTROPLATERS SOCIETY, eleventh annual meeting, Providence, R. I., July 2 to 5

AMERICAN GAS ASSOCIATION, annual convention, Atlantic City, Oct. 15 to 20.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, summer meeting, Wilmington, Del., June 20 to 23.

AMERICAN LEATHER CHEMISTS ASSOCIATION, twentieth annual convention, Greenbrier, White Sulphur Springs, W. Va., June 7, 8 and 9.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS, iron and steel exposition, Buffalo, N. Y., Sept. 24 to 28.

AMERICAN SOCIETY FOR TESTING MATERIALS, twenty-sixth annual meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, June 25 to 30.

INSTITUTE OF MARGARIN MANUFACTURERS, fourth annual convention, Hotel Traymore, Atlantic City, June 14 and 15.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (NINTH), New York, Sept. 17-22.

NATIONAL FERTILIZER ASSOCIATION, thirtieth annual convention, White Sulphur Springs, W. Va., June 11 to 16.

NATIONAL LIME ASSOCIATION, fifth annual convention, Hotel Commodore, New York City, June 13 to 15.

SOCIETY FOR STEEL TREATING, Eastern sectional meeting, Bethlehem, Pa., June 14 and 15.

TAYLOR SOCIETY, Hotel Onondaga, Syracuse, N. Y., June 7 to 9.

Industry and Trade

Current News and Market Developments

Summary of the Week

The Geological Survey reports material increases in production of lead and zinc pigments for 1922.

German producers of chemicals and dyes are reported to be considering establishment of plants in the United States.

Official customs returns show that exports of chemicals and allied products for April were valued at about the same totals as those for March.

Standards of strengths for coal-tar products are expected to be announced very soon. They will form a basis for levying duties on imports.

Advices from Germany state that there is a scarcity of caustic soda in that country.

Imported chemicals are held in large amounts in the spot market and prices are being shaded on many selections.

The lower selling prices for gasoline have brought out an easier situation in motor benzol.

The shortage of arsenic, which was predicted earlier in the season, has not stimulated buying and prices are working lower.

Prices for future positions of linseed oil are considerably under spot prices, reflecting an easier market for seed.

Copper sulphate of foreign make is steadily declining in price with considerable stocks to be worked off.

As a result of the recent conference of the American States, trademarks of this country may be recognized in South American countries.

A committee has investigated conditions in the customs service at New York and made suggestions to expedite the passage of imported goods to the consignees.

The Tariff Commission is reported to have under consideration a plan to compile its own figures on imports and exports, independent of the Commerce Department.

Resale lots of phenol sold at 45c. per lb., which is a drop of 10c. per lb. from the recent high.

The U. S. Treasury is seeking $40,000 as duty charges against the cargo of German dyestuffs brought in on the submarine "Deutschland."

A decrease in the April wholesale trade of 9 per cent from the March record was announced by the Federal Reserve Board.

Electrochemical interests are negotiating for water power rights in North Carolina and Tennessee.

French chemist claims to have devised process whereby coal can be dissolved.

The daily average production of petroleum in April increased to the high record of 1,937,767 bbl.

Some round lots of cyanide of soda changed hands, with imported bringing 20c. per lb.

Germany Striving to Preserve Its Chemical Industry

Intensive Efforts to Maintain Manufacture on Large Scale—Relief From Export Taxes Asked—Lower Freight Rates and Reduced Coal Prices Demanded—Establishment of Plants in United States Considered

GERMANY is more anxious to preserve its chemical industry than any other activity within its boundaries. Latest advices from that country indicate that intensive efforts to that end are being exerted. The Germans would rather maintain their chemical industry than even the manufacture of iron and steel, despite the success which always has attended their operation of metallurgical plants.

The principal reason for the desire to make the chemical industries Germany's greatest industrial endeavor is the fact that it uses German raw materials almost exclusively. It provides more labor for Germans and presents a field in which the Germans believes they are particularly skilled.

To this end the German chemical manufacturers are demanding relief from export taxes. In addition, they are asking special reductions in the matter of freight rates and coal prices. It is contended that all other industries can afford to contribute something to the effort to restore the chemical industry to its former pre-eminence.

It is known that the Aniline Cartel is only awaiting the agreement on reparations to begin a very active campaign. The cartel is more concerned because of the loss of American business than over any other development of the post-war period. The fact that American dye manufacturers now are furnishing 93 per cent of all dyes used in the United States is a severe blow to the cartel. The successful production of blue indanthrene in America has convinced the German chemists that the American industry soon will attain as high efficiency as ever was reached in Germany.

Serious consideration is still being given to the establishment of large plants in the United States. Once that the reparation matter is settled, it is believed that Carl von Weinberg will make the long-promised survey of the American situation. Apparently there is a widely held belief that the interests of the Bädische can be forwarded by the establishment of plants in the United States.

It is known that most of the French dye manufacturers believe their interests would be served best by effecting a close working agreement with the Bädische. There is every reason to believe that the progress already made in that direction will continue.

April Exports of Chemicals Practically of Same Volume as March Shipments

Soda and Fertilizer Groups Show Increase—Outward Movement of Explosives Displays Decided Slump

EXPORTS of chemicals and allied products in April continued in practically the same volume as during March. In the grand total there was a difference of $360,000 in favor of March, but there were several instances of decided increases among the chemicals proper. Both the soda and fertilizer groups showed increases over March. The value of April exports was at a rate nearly $2,000,000 in excess of the rate of the chemical exports in April, 1922.

Sodas and sodium compounds to the extent of 36,605,402 lb. were exported in April. The value of pigments, paints and varnishes exported in April was about $200,000 less than in March, but still is decidedly ahead of the rate of exportation in April of 1922.

Fertilizers and fertilizer materials to the extent of 98,236 tons were exported in April. This compares with 89,519 tons in March and 87,161 tons in April of 1922. The increase applied as well to sulphate of ammonia. The April exports of that commodity amounted to 15,670 tons, as compared with 12,951 tons in March and 12,743 tons in April, 1922. The heavy movement of this commodity to Spain has ceased entirely, but shipments in greater volume are moving to the Orient.

One of the big slumps of the month was in the explosives group. In March 3,254,747 lb. of explosives was exported. This fell to 1,744,405 in April.

Certain of the individual items in which decided changes in movement are taking place are as follows:

	April, 1922	April, 1923
Quinine, oz	9,102	22,038
Sulphuric acid, lb	1,991,368	368,586
Wood and denatured alcohol, gal ..	62,579	81,085
Ammonia and ammonium compounds, lb .	281,817	562,594
Calcium carbide, lb	1,559,138	407,658
Bleaching powder, lb	2,788,056	659,335
Copper sulphate, lb	917,495	47,010
Cyanide of soda, lb	180,070	447,773
Borax, lb	1,625,025	4,217,604
Caustic soda, lb	15,017,777	12,284,777

The figures are those of the Department of Commerce. They have just been compiled from the returns from the forty-eight customs districts in the United States.

Electric Founders Continue Research Activities

The Electric Steel Founders' Research Group held a regular meeting of executives of the five electric steel foundries conducting co-operative research work, at Wernersville, Pa., May 14 to 17. The various phases of the research work being done by the members of the group to improve the quality of steel castings and increase efficiency in methods were discussed in detail. Formal reports giving the status of the present research investigations were read on such subjects as facing sand mixtures, core sand mixtures, electric furnace practice, heat-treatment of steel castings, production control and porosity in castings.

At this meeting plans were made for conducting research investigations on additional steel foundry problems. The results obtained from the work done so far have been so beneficial as to make it highly desirable to study intensively some of the additional complex problems involved in making thin section electric steel castings of intricate design.

Plans for Paper and Pulp Research Announced

During the coming year the Technical Association of the Pulp and Paper Industry proposes to carry on the work of research which has been undertaken during the past few years. The general standing committee covering the manufacturing processes—mechanical, sulphite, sulphate and soda pulp—will continue its investigation of proposed modifications and of the use of newly developed apparatus, at the same time fostering improvements in efficiency and the establishment of standard practice.

Among the subjects of research will be gum and wax papers, the development of special test methods for special products, and research on drying of paper and pulp products. The work of the waste committee on white water losses and on heat losses throughout the mill will be carried on vigorously. As an aid in cellulose research, it is intended to co-operate with the Cellulose Division of the A.C.S.

Sigurd Dyrup on European Trip

Sigurd Dyrup, formerly of Copenhagen, Denmark, now technical director of the Cook Paint & Varnish Co., Kansas City, Mo., has sailed for a couple of months' trip abroad, checking up latest developments in the paint and varnish industry. While abroad, Mr. Dyrup will visit the plants manufacturing some of the most important basic commodities. He will return to this country in time to supervise arrangement and installation of new mechanical and chemical apparatus in Cook's new factory, which will be completed by that time.

A farewell dinner was given Mr. Dyrup previous to his departure, at which Charles R. Cook, president of the Cook Paint & Varnish Co., presented him with a sapphire and diamond scarf pin.

Vigorous Activity in California Cement Industry

Expansion in the hydro-electric power industry in the West is largely responsible for a considerable spurt in the production of cement in California. The Santa Cruz Portland Cement Co. is doubling the capacity of its plant at Davenport, Santa Cruz county, and will soon be in a position to put out 10,000 bbl. per day. A new corporation, headed by John F. Humberg, vice-president of the Engels Copper Mining Co., has been formed to utilize the cement material in the quarries of the Three Rivers district and to erect a plant, to cost about $4,000,000, about 6 miles from Exeter, Tulare county. The Monolith Portland Cement Co. is enlarging its plant at Monolith, Kern county, and plans to be in a position to supply 6,000 bbl. per day by the end of 1923.

Deutschland Duties Dispute Focused in Baltimore

The wheels of time grind slowly. The U. S. Treasury is now seeking $40,000 of duties claimed on the cargo of the submarine "Deutschland." Circuit Court Judge Rose is hearing the case. A. Schumacher & Co., consignees of the cargo, admit that $10,000 is due. District Attorney Woodcock, conducting the government's side in the proceedings, said the dyestuffs cost $332,000 when bought in Germany. The freight charges on the cargo, Mr. Woodcock said, were $998,000. The government contends that a part of this sum really was part of the purchase price for the dyestuffs and should be included in the duty charges.

London Tallow Auction

At the weekly London tallow auction held May 30, the offerings consisted of 1,524 casks. Sales reached 480 casks and prices realized were 9 pence lower.

Power Developments Proposed for South

Electrochemical and electrometallurgical interests are negotiating for water-power rights on the Pigeon, Clinch, Powell and Holston rivers in western North Carolina and eastern Tennessee. It is believed that the water powers on the western slope of the southern Appalachian range can be developed as successfully as has been done by the Southern Power Co. on the eastern slope. Incidentally, this plan is meeting with opposition from those most interested in Muscle Shoals development, who would like to see these industries locate at that point.

American Cotton Oil to Be Reorganized

A short time ago reports were current to the effect that the American Cotton Oil Co. was to be merged with other cotton oil concerns. Either these reports were not based on facts or negotiations did not work out successfully, as no merger has been made and denials of any contemplated merger came from parties directly mentioned as principals. It is now unofficially reported that plans for reorganizing and recapitalizing the company are being worked out by the officials and directors.

Capital consists of $14,562,300 authorized 6 per cent non-cumulative preferred stock, of which $10,198,600 is outstanding, and $20,237,100 common authorized and outstanding. Funded debt totals $13,500,000, of which $5,000,000 is 20-year 5 per cent bonds due in 1931 which while a direct obligation are not a mortgage. The rest of the funded debt consists of $8,500,000 5-year 6 per cent notes due September, 1924, originally $10,000,000 dated September 10. Under terms of the indenture company agreed to retire $500,000 annually.

Phosphate Rock Shipments in 1922

According to the Department of the Interior, 2,417,883 tons of phosphate rock valued at $10,828,346, was shipped from mines in the United States during 1922, as shown by statistics collected by the Geological Survey. Florida, the leading state, shipped 2,058,593 tons, worth $8,347,522, more than nine-tenths of which was land-pebble phosphate. From Tennessee, 353,309 tons, worth $2,107,382, was reported, including a comparatively small quantity from Kentucky, most of which was brown rock. Small shipments were reported from Idaho and South Carolina.

Electro-Metals Planning California Development

Important developments in electrometallurgy in California are presaged by the announcement that plans have been proposed for the construction of a dam at Ishi Pishi Falls, on Klamath River, at the base of which a 110,000-hp. hydroelectric plant will be erected. This project, sponsored by the Electro-Metals Co., is preliminary to the manufacture and distribution of electrometallurgical products at a point on the Californian seaboard.

The Electro-Metals Co. is equipped to carry the project to a successful technical and business conclusion. Officials include Bulkeley Wells, vice-president and managing director of the Metals Exploration Co.; W. W. Crocker, vice-president of the Crocker National Bank of San Francisco, and William Braden, former president of the Braden Copper Co., of New York. Frank Langford, mining and electrochemical engineer, has made a study of plants and processes in operation in France, Germany, Switzerland and Scotland, and has visited the bauxite deposits of France and Italy, as well as other potential deposits in Ceylon and India. The result is that sufficient data are available to indicate that ore could be delivered at Trinidad or Eureka, Calif., at a lower cost than would be incurred by a railroad haul of a few hundred miles. Construction work on the new dam is expected to commence when the necessary government and state permits have been issued.

Corrosion Data Available in the Near Future

The Chemical Warfare Service's data on the corrosion of metals and materials by acids and alkalis is likely to be available within a few weeks. Major Gibson, speaking for this branch of the service, says:

"This compilation is not being issued by the Chemical Warfare Service, due to the fact that it is desired that those scientists who contributed important parts to the compilation may have full credit for the same, and may be able to present the results of their work before scientific societies, and have published under their respective signatures the papers embodying the data for which each is responsible.

"Papers by Messrs. Calcott and Whetzel, together with a paper by Mr. Whittaker, will be published by the American Institute of Chemical Engineers as a monograph on corrosion. This monograph should cover the essentials of the Chemical Warfare compilation on this subject."

Zinc Institute Seeks Co-operation of Galvanizers

The steps taken at the St. Louis meeting of the American Zinc Institute looking to closer co-operation with the galvanizers are regarded by H. Foster Bain, director of the U. S. Bureau of Mines, as one of the most important outcomes of the meeting. Heretofore the galvanizers have believed that the zinc industry has had little concern for their problems. Now that the Zinc Institute has taken the initiative looking to close co-operation, it is believed that much can be accomplished toward overcoming difficulties that are harmful alike to the zinc industry and to the galvanizers. Each is interested, Mr. Bain believes, in improving the quality of galvanized sheets.

Since the change from iron to steel, galvanized sheets have gradually lost much of the good reputation they once had, Mr. Bain points out. This is due to the fact that a different and a more difficult technical process must be employed. He believes the technology in galvanizing steel sheets can be brought to the same plane of efficiency as was obtained with the use of iron sheets. By the production of a better product, it will be possible, he believes, to increase very greatly the domestic market for zinc.

Stamford Chemists Dine

About forty-five members and guests of the Stamford Chemical Society gathered at the annual banquet on Monday, May 28. Retiring President Stevens outlined the work done during the past year and asked Dr. Getman to tell the visitors of the prizes the society has offered to the high school students in Stamford for essays on chemical subjects. President-elect H. W. Banks then introduced Charles Wadsworth, assistant editor of *Chem. & Met.*, as toastmaster. Addresses were made by Schuyler Merritt, Representative in Congress from the Stamford district, and by Harrison E. Howe of the American Chemical Society.

April Petroleum Output Is Greater Than Consumption

During April, according to the statistics of the Geological Survey, the daily average production of petroleum increased to the high record of 1,937,767 bbl. Daily average imports of crude petroleum, as reported to the Survey by importers (165,500 bbl.), decreased 22,887 bbl.; daily average consumption (1,856,900 bbl.), as indicated by deliveries to consumers, decreased slightly, with the result that for the first time since April, 1922, domestic production of crude petroleum was greater than consumption plus exports of domestic and imported crude petroleum.

Pipe line and tank line stocks of crude petroleum increased 5,889,000 bbl. during the month.

New Yellow Dye Is Produced in U. S.

E. I. du Pont de Nemours & Co. announce the development of an important acid yellow dye, especially noted for its excellent resistance to light, being one of the fastest acid yellows in this respect. The new color is known as Pontacyl Light Yellow 3G, and on account of its good solubility and bright clear shade is an important color for lakes, being well adapted for use in the manufacture of printing and lithographic inks. On paper, it is suitable for dipping, coating and calender coloring.

This dye is one of those which has been imported in important quantities from Europe, and its development here makes it available for American manufacturers as a native color.

Drop in Wholesale Trade

A decrease in the April wholesale trade of 9 per cent from the March record was announced by the Federal Reserve Board last Thursday. The board attributed the loss to seasonal causes and reported that it was not indicative of any serious economic condition. The sales for April this year are 17 per cent greater than those for April, 1922. The greatest sales decreases were in jewelry, shoes, dry goods, clothing and diamonds.

Washington News

Standards for Coal Tars to Be Issued This Month

The Treasury Department expects to issue early in June its official list of standards of strengths of coal-tar dyes and chemicals which is to be the basis of assessment of duty on imports.

A tentative list, specifying approximately 100 dyes, was drawn up a month ago and copies were sent to importers and domestic producers for criticism and suggestion. Copies of the replies have been submitted for study to collectors and appraisers at the leading ports, especially at New York, where more than 95 per cent of the coal-tar products are entered and where the chemical laboratory of the Customs Division is located. Those suggestions which appear to improve the tentative list will be incorporated in the final draft.

The 1922 tariff act provides that coal-tar products be assessed for customs duty according to the weakest strength of similar products imported in commercial quantities prior to July 1, 1914, as many such products now are being imported in stronger concentrations. The list of so-called standards of strength is being compiled for this purpose.

Drawback Allowed on Refined Soya Bean Oil

The customs service of the Treasury Department granted an import drawback last week on refined soya bean oil and soap stock manufactured by the Portsmouth Cotton Oil Refining Corporation, of Portsmouth, Va., from imported crude soya bean oil, the regulations being amended to provide that the manufacturing record and abstract therefrom should show the value of the refined soya bean oil obtained instead of the value of the imported crude soya bean oil used.

Shortage of Caustic Soda in Germany

A new period of shortage of caustic soda in Germany seems to have set in. The Russians and Austrians appear to be willing to pay more for this commodity than domestic buyers in Germany are willing to pay. In turn the Germans are reluctant to buy abroad in the face of the present currency situation.

Services of Chemists in Demand

Practically no unemployment among chemists exists, reports to Washington indicate. Not only are the services of competent chemists in great demand, but the sum of salaries and compensation being paid chemists exceeds by far any previous total ever paid in the history of the American chemical industry.

Tariff Board May Compile Import and Export Statistics

The Tariff Commission has had under consideration the advisability of collecting its own reports on the monthly imports and exports. It is held that by such procedure the totals for our foreign trade would be more readily available to the commission and changes in tariff schedules might be made more promptly in cases where developments would make such changes necessary. This work would be independent of the Commerce Department and would require expansion in the New York office to handle the collection of import and export figures.

Trademark Agreement With South America

Henry P. Fletcher, Ambassador to Belgium, has returned from the conference of American states recently held at Santiago. Mr. Fletcher stated that at the conference an agreement had been reached whereby a United States trademark registered at Montevideo, Uruguay, or at Havana, Cuba, may secure recognition in all of the South American states.

Canada May Appoint Customs Official at New York

A report from Ottawa states that the Minister of Commons has informed the members of the House that the appointment of a Canadian customs officer at New York is still under consideration. The question arose on a discussion of the all-water route from Canadian eastern ports to Vancouver, via the Panama Canal. A Canadian customs officer, it was pointed out, would be needed to supervise transshipment of cargoes broken in bulk at New York.

Tariff Commission Reports to Be Ready This Month

The Tariff Commission has notified the President that reports covering surveys undertaken by the commission to determine the necessity for investigations into different commodities for the purpose of adjusting duties will be completed by the latter part of the month. The report on one commodity is said to be ready now. It is the intention of the commission to take action upon four or five other commodities and to forward reports of its preliminary surveys as completed.

Increased Arsenic Production in Canada

Increasing amounts of white arsenic are being produced at the silver mines of northern Ontario. The fact that the arsenic is bringing high prices has resulted in no little stimulation to the production, it is stated.

Gains in Output of Lead and Zinc Pigments

From figures compiled by the Geological Survey, it is evident that substantial increases in production were made in the cases of lead and zinc pigments in 1922. The figures as issued give totals marketed rather than produced but are relatively true in either case as an index of larger supplies.

Notable increases were made in the sales of all zinc pigments and salts except zinc chloride, but there was a falling off in the average price per ton. The largest output of zinc oxide made in the history of the industry was recorded, the gain amounting to 73 per cent over the output in 1921. The amounts marketed were as follows:

	1921		1922	
	Short Tons	Value Per Ton	Short Tons	Value Per Ton
Sublimed lead*				
White	11,568	$122 61	13,765	$132 94
Blue	463	126 55	972	132.95
Red lead	21,814	156 36	30,509	167 30
Orange mineral	379	240 59	370	224 38
Litharge	41,953	136 84	58,261	152 63
White lead:				
Dry	26,695	140 47	41,598	139 07
In oil	143,634	192 94	153,393	193 80
Zinc oxide	74,329	151.11	128,465	140.07
Leaded zinc oxide	16,103	129 93	19,613	114 80
Lithopone	55,016	121 45	83,360	110.53
Zinc chloride	59,457	59 75	41,627	48 27
Zinc sulphate	3,295	57 47	5,078	49.53

* Includes basic sulphate lead.

Cease and Desist Order Against Philadelphia Company

The Federal Trade Commission has issued its order against Dudley D. Gessler, Philadelphia, Pa., who sells dyestuffs and chemicals under his own name as well as under the name of the Keystone Chemical Co. The Commission's order reads as follows: That respondent, Dudley D. Gessler, and his agents, cease and desist from, directly or indirectly, giving or offering to give to superintendents, foremen or other employees or representatives of customers or prospective customers without the knowledge or consent of their employers, cash commissions, sums of money or other things of value, in order to induce such employees or representatives to purchase, on behalf of their employers, the products of respondent or to recommend such purchase to their employers, or as promised rewards for having induced such purchase by their employers.

Surcharge Rates for Duties Paid in Spanish Currency

Assistant Secretary of the Treasury Moss has issued to collectors of customs the currency conversion values for computing countervailing duties on materials from Spain, imported during the first quarter of the year. The rates of surcharge for duties paid in Spanish silver coins or notes of the Bank of Spain were, for the months indicated, as follows: January, 23.79 per cent; February, 23.39 per cent; March, 23.29 per cent, and April, 24.62 per cent.

Committee Investigates Customs Service at Port of New York

Suggestions for Prompter Release of Goods From Government Custody—Importers Protested Against Delays—Congestion at Appraiser's Stores Has Been Relieved

ERNEST W. CAMP, director of the customs service, was head of a special committee recently appointed to make an investigation of conditions in the various departments of the customs service at the port of New York. This committee was an outgrowth of protests lodged by importers who claimed that serious delays were encountered in securing delivery of goods after the latter had reached the local port. Assistant Secretary of the Treasury Moss accordingly appointed a committee headed by Mr. Camp to analyze the situation and recommend plans for improving the customs service and expediting the movement of goods to consignees.

The committee completed its investigation a week ago and while no public announcement of the finding of the committee has been made, it is said that the report offers several suggestions for the betterment of customs service. The increase in imports undoubtedly has had something to do with the delays in passing goods through the customs service and the new tariff law with its provisions for valuations and ad valorem duties also has slowed up the work of officials, especially in the Appraiser's Stores. It is not expected that the situation will be aided by any additions to the present force, as funds are lacking, but practical suggestions for simplifying the handling of goods through the various departments are expected to be followed by good results. Incidentally it is stated that work in the Appraiser's Stores, where the greatest cause of delay existed, has been arranged so that the period of congestion has passed and fairly prompt deliveries of goods through the customs service are now being made.

Trade Notes

Ralph Black, formerly with E. I. du Pont de Nemours & Co., has joined the sales department of The Kalbfleisch Corporation.

A report from Melbourne states that olive oil guaranteed to be the pure product of olives, made in Mildura, is now obtainable in Victoria, Australia.

Erdoel U. Kohlewertung and Dr. Franz Zernik of Berlin, Germany, have perfected a process for manufacturing an odorless soap from naphthene acid.

The Belgian linoleum industry manufactures almost exclusively for domestic consumption, there being less than 50 metric tons exported during 1922. Production is limited to medium and low grades, while high grades of linoleum are imported. During 1922 Belgium imported 3,675 metric tons, valued at 14,231,775 francs.

The Roessler & Hasslacher Chemical Co., New York, with plant at Perth Amboy, N. J., has presented a claim of $708,864.02 against the German Government for damages sustained during the war.

Sales of pumice stone in this country in 1922 amounted to 50,047 short tons, which compares with 37,108 short tons in 1921.

The annual consumption of casein in Japan is estimated at 500 tons, most of which is imported from Australia. Due to a shortage in Australia this year, casein has been increasing in price. At present it is 0.60 yen per pound Casein is used by the Japanese in the manufacture of art paper.

The Hercules Silica Asphalt Co. has been organized at Sheffield, Ala. The company owns extensive asphalt deposits near Sheffield.

J. L. Boisse has been designated as the New York City representative of the Hermitite Chemical Corporation. The corporation is organized under the laws of Delaware with an authorized capital stock issue of $1,000,000.

Thomas C. Craven, president of the Cumberland Chemical Co., 47 West St., New York, has been indicted by the Federal Grand Jury on charges of conspiring to defraud the government through violation of the Volstead law.

E. A. Brand, secretary of the Tanners' Council of America, has been elected president of the New York Society of Trade Secretaries. Mr. Brand has been prominent in trade association work for a number of years. Prior to directing the work of the Tanners' Council he was engaged in foreign trade promotion work for the government.

J. V. Finamore has organized the Paterson Dyestuff & Chemical Co., with headquarters at 134 Sheridan Ave., Paterson, N. J.

Complaints against several prominent oil companies charging them with forcing their customers into using exclusively their own oil tanks and equipment have just been dismissed by the Federal Trade Commission.

Edward Mallinckrodt, of St. Louis, has given $500,000 to Harvard University for a chemical laboratory.

News Notes

French occupation of the Ruhr now shows a net expense of nearly 10,000,000 francs below receipts. To what extent this favorable balance is due to dyestuff seizures is not revealed.

Improved transportation of newsprint is about to make possible a printed sheet in New York 3 days after the paper is manufactured in the woods of Canada. With available stocks both at the mills and in the publishers' warehouses extremely low, this fast freight service is expected to fill a real need.

The Western New York section of the American Chemical Society held its annual meeting at Canisius College on May 29. W. H. Watkins addressed the meeting and the scientific moving picture "The Einstein Theory of Relativity" was shown.

Sixty-five students in the mining engineering college, University of Pittsburgh, Pittsburgh, Pa., are taking a month's training in field work under the direction of Professors Henry Leighton and R. A. Sommers. Trips of inspection are being made to a number of metallurgical plants.

The Willard Gibbs medal was awarded Prof. Julius Stieglitz, University of Chicago, at a meeting held May 28. The presentation was made by Mr. Converse, founder of the prize. Professor Stieglitz spoke on "The Theory of Color Production in Dyes."

Simplification of asphalt varieties from 102 to 13 was decided on at a conference of producers and consumers held recently in Washington It was decided that the eighty-eight varieties of asphalt used for paving purposes could be reduced to nine, and the fourteen varieties used as brick and stone block fillers could be cut to four.

The Appropriation Committee of the State Legislature, Austin, Tex., is considering an appropriation of $1,526,500 for a College of Mines and Metallurgy. A like fund is to be granted during the second year, or a total of $3,053,000.

The Engineering Section of the National Council will hold its second meeting of the year at Detroit, Mich., in co-operation with the Detroit Safety Council on June 12. Problems of safety in welding and cutting by various methods will be discussed. Industrial sanitation, especially with reference to prevention of infection due to use of cutting oils, will likewise be taken up.

The New York Chapter of the American Institute of Chemistry held its monthly meeting at Mucci's, New York, on May 28. Problems of membership and publicity furnished the topic for the evening's discussion.

Advices from Washington state that customs receipts for the fiscal year up to the last week of May passed the half billion dollar mark and set a record for government revenues from this source.

Development of Sources of Supply for Mangrove Bark and Extract

Bark Found on All Tropical Islands—Manufacture of Extract in Producing Countries Not Sufficiently Developed

A VERY comprehensive report on mangrove bark and extract, with especial reference to sources of supply, has been made by H. M. Hoar, of the Research Division of the Department of Commerce. The report says that mangrove extends as far north and south as the twenty-ninth parallel. It forms a dense growth in patches on the low coasts of all tropical islands. In the United States it occurs along the shores of southern Florida, at the mouth of the Mississippi River and on the coast of Texas. The low coast marshes of Porto Rico produce abundant supplies of mangrove, but, while used locally for both its wood and its bark, the industry has not yet reached an export basis. Mangrove barks constitute the greatest single source of tannin in the Philippines. Analyses prove Philippine barks as rich in tannin content as those used in the cutch factories of Borneo—in fact, the same species of mangrove are common to both regions. Notwithstanding the abundance of mangrove in the Philippines, there are no cutch factories, although the swamp area of one bay in Mindanao covers 25,000 hectares, which, estimating 25 tons of bark to the hectare, would yield a total of 625,000 tons of bark. With a 20-year rotation this should be sufficient to supply a large factory indefinitely. Foreign markets for the bark have not been developed.

Germany Formerly a Large Importer

Prior to the war Germany was active in the exploitation of mangrove bark as a tanning agent. Its main source of supply was East Africa, whose barks seem to be richer in tannin than those of the East Indies. In the former German protectorate the bark was most carefully stripped from the living tree (stripped trees are said to renew their bark in four to six months) under the supervision of the forest department and prepared for export. The export of bark containing less than 45 per cent of tannin was prohibited.

Madagascar exported 21,938 metric tons of mangrove bark in 1913, the greater proportion of which was taken by Germany. In 1917 its exports totaled only 3,410 tons. This decrease was due largely to lack of transportation facilities. Post-war exports, however, have not yet reached the 1913 level. While West Africa has extensive mangrove swamps, no serious attempt at bark collection has yet been made, except in British West Africa, where the industry is well established. Some years ago bark collection was started in Senegal by a French company, which allowed the trees to be cut down without making provisions for replanting, with the result that rapid erosion of the foreshore took place. The government prohibited further exploitation by that company. Stocks of mangrove bark in Burma were practically exhausted in 1919. The problem of working important areas of mangroves in the Andaman Islands is receiving the serious consideration of the authorities.

Manufacture of Extract

The manufacture of extract in the principal countries producing mangrove bark has not been as effectively developed as that of quebracho extract in Argentina and Paraguay. If, however, the industry could be promoted in those countries possessing abundant supplies of mangrove, not only the poorer grades of bark could be utilized but also the leaves, which contain considerable tannin. The leaves are rarely exported, owing to deterioration during transportation. To avoid certain unfavorable chemical changes which the bark undergoes within 48 hours after cutting, it is considered essential to work it up as soon as possible. For this reason the factory should be located in or near the mangrove area. It requires 4 to 6 tons of bark to produce 2 or 2½ tons of cutch. The elimination of waste, greater convenience for shipment and savings in transportation costs should make for further expansion in this industry.

In Dutch and British Borneo the manufacture of extract has become an industry of great importance. The principal factories are located at Pontianak, Rejang, Brunei, Kudat and Sandakan. The latter two are under Scotch control. In 1919 the Netherland Indies exported 3,547 metric tons of mangrove cutch, against 805 tons in 1918.

The extraction of tannin from mangrove bark is a well-organized industry of East Africa. The interest which that region takes in its expansion is manifested in two recent concessions for exploitation of mangrove forests in Portuguese East Africa and Madagascar, both of which contain provisions making it obligatory on the concessionnaires to inaugurate tannin-extract factories within certain specified periods of time. Statistics of exports of this product from East Africa are not available.

The activity of the tannin-extract industry in Colombia was evidenced by its exports to the United States of 2,075,991 lb. of mangrove extract in 1914, the only year for which statistics are obtainable. The principal factories are located at Cartagena and Sinu, each of which has an annual productive capacity of 3,000 tons. With, however, a world-wide reduction in industrial activities during the period of post-war depression, mangrove-extract production in Colombia has been greatly diminished. Both Venezuela and Brazil manufacture mangrove extract for local consumption.

Tannin Content of Mangrove Extract

Mangrove extract is imported in large blocks of a reddish-brown color and has a tannin content ranging from 48 to 72 per cent, according to country of origin. The higher grades come from East Africa and Borneo. Used alone, this extract yields a good, pliant workable leather, but of undesirable color. To modify this objection German tanners blend it with myrobalans valonia, sumac and similar materials the British, with pine, oak and mimosa barks; and in France the favorite mixture is: Mangrove bark, 30 per cent hemlock bark, 40 per cent; oak bark, 20 per cent; and mimosa bark, 10 per cent. The French blend yields a superior grade of leather with an excellent color for general use.

Eimer & Amend Honor Old-Time Employees

Rudolph Zimmermann and Louis Moses, employed by Eimer & Amend for the past 50 years, were tendered a golden jubilee celebration on June 1 at Cavanagh's restaurant. The happy occasion also marked the completion of 25 years or more of continuous service by the following twenty-four employees: E. Kuehnemann, F. Lange, H. Ferber, D. Frattolillo, F. Kuebler, F. J. P. Arndt, H. E. Broestler, Albert Belling, J. R. Cahill, W. Deuvelsdorf, W. Duncan, P. Effertz, William Harres, C. Klinger, T. Schnecke, H. F. Smith, B. E. Ulrich, H. Wachter, W. Then, M. F. Mai, Mary C. Lyden, Mazie Mejo, M. A. Magee and Louise Sormani.

As a token of appreciation the directors presented to each of the two employees completing 50 years of faithful service a check for $5,000. Reviewing an old custom of the house, those completing 25 years of service were presented with suitably engraved gold watches.

August Eimer, president of the company, presided. The other directors who attended the celebration were: Otto P. Amend, vice-president; Carl G. Amend, secretary and treasurer; E. B. Amend, superintendent; A. O. Eimer, assistant treasurer; W. R. Eimer, assistant secretary, and Elenore Amend, director.

Demand for Paraffin in Vera Cruz

Advices from Mexico state that there is a demand in the Vera Cruz district for paraffin to be used in the manufacture of candles. Candles are universally used by the poorer classes for lighting purposes, and the houses of the better classes, although equipped with electric lights, always have a supply of candles on hand for emergencies. A large number of candles are also used in the churches, it being estimated that during normal times candles to the value of 10,000 pesos a month were used in the churches throughout the republic.

Facts and Figures That Influence Trade in Chemical Products

Market Conditions

Current Prices Imports and Exports The Trend of Business

Continued Slow Demand Depresses Prices for Arsenic and Calcium Arsenate

Contract Holders Slow to Take Deliveries—Copper Sulphate Sells at Lower Levels—Imported Caustic Potash Weak—Sal Ammoniac Reduced — Prussiate of Soda Reaches New Low — Bichromates Continue Strong—Permanganate of Potash Irregular but Sells at Advance

REDUCED buying orders and large supplies of imported materials have continued as factors in the local market. This has resulted in further shading of prices and a buyers market is reported for many commodities. Holders of foreign-made oxalic acid have granted concessions and the same holds true for imported caustic potash, prussiate of soda, copper sulphate and sal ammoniac. Arsenic also is listed among the materials which have presented a weak appearance. This appears to be due to failure of consumers to buy in the volume expected and the increase in unsold supplies held by local importers. The position of calcium arsenate also has a bearing on arsenic as the former has not been moving up to expectations and calls for deliveries against contracts are not satisfactory. Predictions of a larger call for arsenic and arsenate, during June, are heard but there is no real indication, as yet, of the accuracy of such predictions.

Many domestic chemicals are holding a firm position. High producing costs, scarcity of labor, sold up condition of producers, and a continued period of active buying, are the principal reasons given for this strength in prices. Among the acids sulphuric and muriatic are very firm due to the unusually large volume of business booked earlier in the season. Acetic acid also is held at the advanced price level which went into effect a few weeks ago. Bichromates have been advanced ½c. per lb. in the past 2 months and some producers are practically out of the market at present. Scarcity of labor undoubtedly has restricted production of bichromates and competition among sellers has been practically eliminated.

Official figures show that exports of chemicals in April were about the same in value as for the month preceding. The soda products figured prominently in the export totals. At present export demand for chemicals is not heavy. Caustic soda, which was shipped to various countries earlier in the year, is still moving well but new orders for June and July shipment are not coming to hand in a large way and prices have eased off but are still too high to arouse interest in markets abroad.

Agricultural chemicals have been featured by placing of contracts for sulphate of ammonia. Nitrate of soda has met with only moderate buying interest and other fertilizer materials have found the usual seasonable conditions prevailing. Potash salts have received considerable attention and large orders are reported as about to be placed.

Acids

Acetic Acid — The various grades have come in for more attention and in different quarters it is reported that the movement to consumers is satisfactory. There has been no change in asking prices, but with producing costs holding up, the situation looks firm as long as buyers show a willingness to take on supplies. Quotations are: 3.38c. per lb. for 28 per cent; 6.75c. per lb. for 56 per cent, and 12@12.78c. per lb. for glacial.

Boric Acid—Call for export is said to be very light but a fairly steady movement to domestic users has kept stocks from accumulating and in general the market is regarded as healthy. The quotations of producers are well maintained at 10@11½c. per lb. with the range varying according to container.

Citric Acid—Different reports are heard about supplies of domestic makes. In some cases it is stated that producers are behind with contract deliveries while other reports say that imported material is of no interest, because of its high price and because domestic goods are offered freely enough to fill consuming requirements. The lowest price heard for imported was 52c. per lb. on spot and shipments are higher than the spot price. The movement of prices seems to depend on demand as a larger buying movement would have a strengthening effect. Domestic is still quoted at 49@50c. per lb.

Lactic Acid—Foreign offerings have been too high in price to be much of a factor and the market is in control of domestic producers. Moderate sized amounts are moving well and values are well maintained with sellers quoting: 4½@5½c. per lb. for 22 per cent dark and 5½@6½c. per lb. for light; 9½@10½c. per lb. for 44 per cent dark and 11½@12½c. per lb. for light.

> **"Chem. & Met." Weighted Index of Chemical Prices**
>
> Base = 100 for 1913-14
>
> | | |
> |---|---|
> | This week | **177.64** |
> | Last week | 177.58 |
> | June, 1918 | 272.00 |
> | June, 1919 | 229.00 |
> | June, 1920 | 274.00 |
> | June, 1921 | 147.00 |
> | June, 1922 | 157.00 |
>
> Easier prices prevailed for copper sulphate, caustic soda for export, benzene and linseed oil, but so far as the index number was concerned the advance in crude cottonseed oil more than offset the declines. The index number was raised 6 points in the past week.

Muriatic Acid—Buying orders have fallen off in volume and a quiet week was reported. Stocks, however, are light and some producers are using their output to take care of contracts. Prices are quoted at 90c.@$1 per 100 lb. for 18 deg. in tanks, with the 22 deg. acid held at $1.75@$2.

Oxalic Acid—Lack of consuming interest has weakened values for imported grades. Holders have been willing to shade prices in order to lessen stocks on hand and there were open quotations at 13c. per lb. Even at the lower prices there was no activity among buyers and only small lots were said to be moving.

Sulphuric Acid—Some of the large consuming trades are not so active at present and call for this acid is less urgent than a short time ago. However, producers, for the most part, have had no chance to accumulate stocks as contract deliveries still take up the bulk of production. Prices are firm at $9.50@$12 per ton for 60 deg. and $15@$16 per ton for 66 deg.

Tartaric Acid—Domestic grades are reported to be strong at an inside price of 37½c. per lb. Imported was rather easy and offerings were on the market at 36½c. per lb. with intimations that on firm bid, odd lots could be picked up under that figure.

Potash

Bichromate of Potash—Buyers are not keen to trade heavily at current prices but sellers are not burdened with stocks and there is no sign of weakness. First hands are holding 11½c. per lb. as an inside quotation and resale material is not a factor in the present market.

Caustic Potash—This material was offered freely by importing firms at 7½c. per lb. and the market for foreign goods has failed to gain any strength. Holdings on spot have been difficult to dispose of and while some shipment quotations have been above the spot selling price, they had no effect on buyers or

sellers. Some factors say that foreign markets are very anxious to keep up volume of sales and selling pressure may keep up for some time.

Carbonate of Potash—Buyers were still able to do 6½c. per lb. in the spot market for 80-85 per cent and forward positions also were offered at that price. Hydrated 80-85 per cent was quiet and easy with 7½c. per lb. given as representing the price for spot goods. On shipments 7½c. per lb. also was quoted but this figure was said to be subject to some shading. Some offerings of 90-95 per cent are said to be on the local market at very attractive prices, in fact it has been quoted as low as the 80-85 per cent.

Permanganate of Potash—While some sellers report prices as irregular with the tone easy, there was an attempt to stabilize values and many sellers were asking 19c. per lb. In fact at least one large lot was sold at the 19c. per lb. level. The shipment market was dull and merely nominal in the absence of buying interest. Many hold that prices will decline considerably from present levels but if anything the market appeared firmer than last week.

Prussiate of Potash—Red prussiate was very quiet and no change of importance was noted. There is some difference in price according to sellers with 65c. to 68c. per lb. covering sellers' views. Yellow prussiate has not been moving well for some time and buyers are interested only when prices are made attractive. The spot market is held at 36@36½c. per lb. with shipments little better than nominal around the spot prices.

Sodas

Soda Ash—New business is not heavy but is fair considering present trading standards. Withdrawals against contracts are going on steadily and this absorbs large quantities. As a result producers are not carrying large stocks. Prices are firm with producing costs said to have advanced since the present price schedule was adopted. Quotations remain at 1.20c. per lb. in single bags for carlots at works and 1.40c. per lb. in bbl., basis 48 per cent.

Acetate of Soda—Only moderate demand has been reported for several weeks and judging from a supply and demand basis there is nothing in sight to bring about a recovery in prices. Sellers offer spot goods at 5½@6c. per lb.

Bichromate of Soda—There is undoubted firmness in the market. Some sellers are not offering freely and some of the leading factors are holding out for 9c. per lb. for carlots with the usual advance for less than carlots. Stocks do not appear to be large in any quarter and reports of diminished output are borne out by the inability of certain sellers to take on orders for prompt shipment. Fair inquiry is reported but higher prices have curtailed interest in large lots.

Caustic Soda—Improvement in export business has not been noted and while prices are subject to some negotiation there was an easier feeling, especially with reference to the so-called outside brands and as low as 3.22½c. per lb., f.a.s. New York, was heard. For standard brands the quotation was held at 3.35c. per lb., f.a.s. Deliveries to domestic consumers remain of good proportions and the price is steady at 2½c. per lb. for carlots, works, basis 60 per cent. For spot material the quotation is 3½c. per lb., flat.

Cyanide of Soda—A large lot of imported cyanide was sold during the week at 20c. per lb. Demand has not been active and the price for imported while generally held at 20½c. per lb. and upward is subject to shading on desirable business. Domestic makers are holding their goods at 22@23c. per lb.

Fluoride of Soda—Sales of imported goods were reported at 9c. per lb. with 9@9½c. per lb. covering the prices asked. The market as reported was inactive with scattered inquiry. Domestic fluoride is not a factor in the local market and is quoted at 10½@11c. per lb.

Prussiate of Soda — Producers of domestic grades have announced a price of 16c. per lb. for June deliveries. Demand has fallen off and weakness in price has failed to bring about any large buying. Imported prussiate was decidedly weak and as low as 15c. per lb. could be done according to local handlers. Competition between domestic and foreign sellers is keen and the market is not in a position to withstand selling pressure.

Sulphide of Soda—There is a firm tone to the market for domestic material and fused is well maintained at 4½c. per lb. and broken at 5½c. per lb. Crystals are in small supply and are quoted at 2¾c. per lb. Imported sulphide is less firm in tone and prompt shipment is reported as available at 3½c. per lb. For spot imported the lowest figure heard is 3.60c. per lb.

Miscellaneous Chemicals

Arsenic—The fact that buying has not improved to the extent expected is a disturbing factor. Large lots had been imported in recent weeks and a good part of these arrivals were not sold but were held to take care of the demand which had been predicted would follow. So far this demand has been far from as heavy as predicted. Some holders of contracts also are slow in ordering out goods and prices are sagging as certain holders get tired of carrying stocks. There were offerings on spot as low as 14c. per lb. and even this price was not considered strong by some members of the trade. Domestic arsenic is passing direct to consumers and has not been much of a factor in the spot market. Prices for domestic have been under the levels openly quoted for spot material. Producers quote shipments over the last half of the year at 11c. per lb. and July shipment at 12½c. per lb.

Bleaching Powder—While new business is not heavy there is a steady delivery against old orders and producers are not forced to press matters in view of the ready absorption of stocks. Prices are steady at 1.90c. per lb. for large drums at works.

Cream of Tartar—The market is easy in tone with imported material offered freely and buyers are not taking on much. Spot prices are 25½@26c. per lb. and forward positions are offered about 1c. per lb. under the spot levels.

Calcium Arsenate—Very little if any improvement in demand was reported last week and despite reports that June would bring out a better call for stocks, the market has been easy in tone. The open quotation is given at 16c. per lb. but this could be shaded materially and the actual trading basis was largely a matter of private terms between buyer and seller.

Copper Sulphate—A sale of imported copper sulphate was reported at 5c. per lb. There is very little stability to prices for goods of foreign origin and while some holders are refusing to sacrifice, others are willing to meet buyers' ideas in order to get rid of stocks. Open quotations for imported in the latter part of the week ranged from 5.10c. per lb. to 5½c. per lb. with the range depending on seller and make. Domestic goods were held at 5.90c. per lb. for large crystals.

Chloride of Barium—The market is suffering from the lack of interest taken by consumers and prices are not holding any too steady. Quotations are given at $85@$90 per ton for spot or futures, but reports are heard to the effect that bids under the inside figure have found acceptance.

Formaldehyde—First-hands reported a steady market and maintained prices at 15@15½c. per lb., the inside figure obtaining on round-lots. The demand was moderate only, and it was reported that a few odd lots held by second-hands could have been secured at 14½@14¾c. per lb.

Sal Ammoniac—Further reductions in price were heard for imported goods and 6c. per lb. was given as the figure at which buyers could operate. Domestic makers were holding nominally unchanged at 7½@7¾c. per lb. with gray at 8@8½c. per lb. f.o.b. works.

Alcohol

Producers reported a fair volume of business and prices for the denatured ruled steady at the recent advance. Several small parcels of denatured arrived at New York from the West Indies. The special grade, formula No. 1, held at 38c. per gal. in drums, the customary premium obtaining for wooden containers. The formula No. 1, completely denatured, held at 43c. per gal., in drums. The market for ethyl spirits was nominally unchanged on the basis of $4.70 per gal. for the 190 proof, U. S. P. Methanol was unchanged, closing at $1.18 per gal. on the 95 per cent and $1.20 on the 97 per cent.

Coal-Tar Products

Spot Phenol and Naphthalene Unsettled on Freer Offerings—Benzol Easier—Solvent Naphtha Holds Firm

THE volume of new business placed in the coal-tar division of the chemical market did not come up to expectations and with selling pressure in evidence in some of the items in the list prices appeared to be more or less unsettled. Interest centered in phenol and scattered lots held by second hands sold at prices ranging from 45@50c. per lb. Rumors were about to the effect that new production would soon come out at comparatively low prices and this frightened some holders of spot goods. In naphthalene the market was easy and sales of flake were put over at 8¼c. per lb. The recent reduction in gasoline finally did bring out a lower range of prices on benzene and from all indications offerings were plentiful at the recently reduced level. In solvents, however, the situation continues to favor sellers and while no price changes were announced some traders felt that a higher trading level was not at all out of the question. Salicylic acid was inactive and prices in several quarters were considered barely steady. Several shipments of pitch arrived from English ports during the past week, but, upon investigation, it was learned that this material was not a coal-tar product.

According to official figures exports of coal-tar products from the United States for the first quarter of the year were valued at $2,761,118, which compares with $1,810,331 for the corresponding period a year ago. Most of the exports consisted of crudes. Producers say that domestic business over the first quarter also gained considerably, contrasted with the corresponding period a year ago.

Aniline Oil—Trading last week was inactive, but leading makers continued to quote the market as steady on the basis of 16c. per lb. on carload lots, immediate and nearby delivery.

Aniline Salt—While several handlers held out for 23½@24c per lb. in the salt, others offered supplies freely at 23c. per lb. Demand was quiet.

Benzaldehyde—With not much available on spot the market ruled steady. The lull in trading had little or no influence upon sellers, who continued to quote on the basis of 75c. per lb., nearby delivery.

Benzene—Increased competition with gasoline was reflected in easier prices on benzene and it develops that leading interests lowered prices a short time ago. The 90 per cent grade was offered by leading producers at 25c. per gal., tank cars, f.o.b. works, with the pure at 27c. per gal., in tank cars, f.o.b. works. The pure in drums, on spot, closed nominally at 30@32c. per gal.

Creosote—There were offerings of the 25 per cent for immediate shipment at 26c. per gal. Demand was slow and prices were barely steady.

Cresylic Acid—The market for cresylic was unsettled all week so far as second-hand offerings were concerned and closing prices were more or less nominal, depending upon the seller and quantity. On the 97 per cent grade there were offerings on spot at $1.15 per gal. Domestic producers had nothing to offer except on contract to regular consumers. There were no new developments in connection with the tariff situation.

Dimethylaniline—Producers reported a steady market for this intermediate, the output apparently being well taken care of. Prices were repeated at 42@43c. per lb., prompt and nearby delivery.

Naphthalene—An irregular market was witnessed on flake for immediate delivery and offerings late in the week could be located at 8¼c. per lb. In fact several lots sold at this figure. Demand was inactive, the weakness in foreign crude restricting business. New contract prices by domestic producers were not announced, but it was intimated that the quotations will show a higher trading level contrasted with last year's contract basis. Imported crude for shipment settled around 3¼@3½c. per lb.

Phenol—Sales of U.S.P. phenol went through in outside channels, for immediate delivery, as low as 45c. per lb., which compares with 50c. per lb., the settling price a week ago. The market on re-sale goods was irregular and prices at the close were considered to be little more than nominal. It was rumored that new production could be purchased for deferred delivery at prices considerably below 28c. per lb., and this kind of talk brought out a feeling of uneasiness and restricted business to a minimum.

Salicylic Acid—No further price changes were announced, but factors reported a quiet market with the undertone barely steady, due, in part, to the easier feeling in phenol. One prominent producer offered the U.S.P. grade at 45c. per lb., while others named a price of 40c. per lb. Some traders raised some questions about the 40c. quotation, claiming that round-lots could not be obtained at this figure. However, as no inquiry developed for round-lots the "argument" could not be settled.

Solvent Naphtha—Large producers say that there is a ready market for all of the solvent naphtha available and they regard the general situation as firm. Nominal quotations were repeated at 27@32c. per gal., the inside figure prevailing on tank car business.

French Chemist Claims He Can Dissolve Coal

A process has been devised whereby coal can be dissolved much in the same manner as sugar dissolves in water, according to an announcement made before the Paris Society of the Chemical Industries by A. Kling, director of the Parisian Municipal Chemical Laboratory. The experiments were conducted in co-operation with Florentin and Pictet. Dr. Kling contends that they succeeded in suspending a pure pulverized coal in carburetted hydrogen and by subjecting it to pressure and heat a solution resulted from which motor fuels and other products can be made.

What Is Standard Newsprint?

The definition of standard newsprint, made necessary for the purpose of admitting that commodity under the free list of the tariff act, has been difficult to make. Newspaper interests have protested the tentative formula suggested by Secretary Mellon. This formula defined standard newsprint as a commodity weighing approximately 32 lb. to the ream, 24 x 36 in., and composed of a mixture of mechanically ground wood pulp and sulphite pulp in the relative proportions of 80 per cent and 20 per cent. Clauses for taking care of slight variations were also included. It is expected that despite the delay occasioned by the protest the final ruling will soon be issued.

Latest Quotations on Industrial Stocks

	Last Week	This Week
Air Reduction	61¼	61¾
Allied Chem & Dye	68½	71
Allied Chem & Dye pfd	110	110
Am Ag Chem	17¼	19⅛
Am Ag Chem pfd	40	42½
American Cotton Oil	9⅝	8
American Cotton Oil, pfd	19	17⅛
Am Drug Synd	5½	5⅜
Am Linseed Co	23	26⅜
Am Linseed Co, pfd	43	44
Am Smelting & Refining	55⅝	61⅛
Am Smelting & Refining, pfd	96½	98
Archer-Daniels Mid Co, wi	37⅛	36½
Atlas Powder	170	*170
Atlas Powder, pfd	90	*90
Casein Co of Am	*60	*60
Certain-Teed Products	*40	*40
Commercial Solvents	29⅛	28
Corn Products	126⅝	131⅛
Corn Products, pfd	118	118
Davison Chem	23½	24¼
Dow Chem Co	46	46
Du Pont de Nemours	123⅜	126⅜
Du Pont de Nemours, db	86	85
Freeport-Texas Sulphur	13⅛	14¼
Glidden Co	8⅜	8½
Grasselli Chem	*130	133
Grasselli Chem, pfd	*103	101
Hercules Powder	105	105
Hercules Powder, pfd	105	105
Heyden Chem	2	2
Int'l Ag Chem Co	5¼	5⅛
Int'l Ag Chem Co., pfd	16⅜	17
Int'l Nickel	13⅞	14
Int'l Nickel, pfd	79	78½
Int'l Salt	*90	*90
Mathieson Alkali	44⅜	49
Merck & Co	86¼	87
National Lead	113¾	124
National Lead pfd	112	112½
New Jersey Zinc	162	162
Parke Davis & Co	81	*81
Pennsylvania Salt	88	88
Procter & Gamble	*140	*140
Sherwin-Williams	28¾	*29
Sherwin-Williams pfd	*101	*101
Tenn Copper & Chem	9⅞	9⅞
Texas Gulf Sulphur	60¾	62¾
Union Carbide	56⅝	58½
United Drug	80	80
U. S. Intl Alcohol	51⅝	56
Va.-Car. Chem. Co.	10	10
Va.-Car. Chem. Co., pfd	30	27¼

*Nominal. Other quotations based on last sale

Vegetable Oils and Fats

Linseed Dull and Easier—Crude Cottonseed Steady—China Wood Declines—Tallow Slightly Higher

BUSINESS showed no improvement and an easier feeling prevailed in most quarters of the vegetable oil trade. Crude cottonseed was a shade firmer than a week ago, while tallow actually sold at a slight advance, but these developments were more than offset by the unsettlement in linseed, china wood, coconut and palm oils. Traders were interested in the oil seeds situation, especially the new crop developments in cotton. Advices from Europe indicated that business in vegetable oils was anything but satisfactory. Easier prices were reported in hogs, in the western markets, which was reflected in the unsettled market for lard.

Linseed Oil—Demand was dull and with seed markets lower the undertone at the close was easy. There were offerings of prompt shipment oil on the basis of $1.12 per gal., carload lots, cooperage included, but most traders in the domestic product continued to quote $1.14 per gal. On second-half of June business, however, several crushers stood ready to trade at $1.12 per gal., with a possibility of shading this figure on a firm bid. July oil was offered at $1.04 per gal., in cooperage, with August forward at $1 per gal. Large consumers showed no buying interest in futures. The absence of new business will do much to ease the supply situation and it seems altogether probable that stocks of oil will be something like normal in another month or so. During the past week foreign oil for prompt shipment from New York was offered on the ex-dock basis of $1.02 per gal., in cooperage, duty paid, one lot of approximately 1,000 barrels pressing on the market. English oil for June shipment from the other side was offered freely at $1.02 per gal. landed weights, duty paid, c.i.f. New York. London cables reported dull trading in all of the British as well as Continental markets. Offerings of Argentine seed increased, while Indian sellers also appeared more anxious for business. During the week previous 28,000 bushels of Indian seed were shipped to the United States. The stocks of flaxseed at Minneapolis increased to 19,236 bushels in the past week, which compares with 9,396 bushels a week ago and 62,517 bushels on the corresponding date a year ago. Minneapolis reported dull trading in linseed meal, the market settling around $37 per ton. New York exporters said that foreign inquiry for cake was absent and prices of $33@$34 per ton f.a.s. were wholly nominal.

Cottonseed Oil—The option market on the Produce Exchange was a narrow affair, yet prices held remarkably steady considering the small volume of sales and the irregularity in competing oils and fats. The developments in cotton were not considered favorable and the speculative element refused to operate in the new crop months on an extensive scale. The spot position in prime summer yellow oil settled around 11.80c. per lb., bid, which compares with a 10c. market on October and 9c. for December. Traders look for no important movement in old crop prices, notwithstanding the fact that the statistical position is extremely tight. Cash trade in oil was inactive, while business in lard compound also was slow. Several cars of crude oil actually sold at 10c. per lb., f.o.b. mills, an advance of ¼c. from the nominal price named a week ago. The offerings of crude were scanty. Nothing was heard in connection with new crop crude oil. Bleachable oil for prompt shipment from Texas common points closed nominally at 10½c. per lb.

China Wood Oil—The feature in the market was the easier position of futures. There were offerings of July-August-September shipment from the Pacific coast at 19c. per lb., but this failed to bring out any buying interest. Spot oil in New York was available at 25½@28c. per lb., the inside figure obtaining on a tank car.

Coconut Oil—Several cars of Ceylon type oil sold for prompt shipment from New York at 8⅞c. per lb., which price prevailed up to the close. Trading, taken as a whole, was inactive, and the undertone easy in sympathy with copra. On the Pacific coast there were offerings of nearby oil on the tank car basis of 8c. per lb., with forward material available at 7¾c. per lb. Copra was offered at 4⅝c. per lb., c.i.f. Pacific coast ports, and at 5c. per lb., c.i.f. New York. It was reported that buyers' views were nearer 4½c. per lb., c.i.f. coast.

Corn Oil—The market for crude was up a little in the west, last sales going through at 9½c. per lb., f.o.b. point of production. This quotation represents a gain of ¼c.

Olive Foots—There were sellers at 9@9½c. per lb., spot, with business dull. On futures the market for prime green settled at 9c. asked.

Palm Oils—The market was inactive, but the slight recovery in tallow brought out a better feeling. Lagos settled nominally at 7⅞@7½c. per lb., with Niger at 7@7⅛c. per lb., the price depending upon the position.

Menhaden Oil—Chesapeake Bay advices indicate that only one-half of the fleet of 46 boats took part in the first week's fishing operations. A fair catch was reported. The market for oil was dull so far as new business was concerned, but traders continued to quote 50c. per gal., tank cars, f.o.b. factory.

Tallow and Greases—The sale of several hundred drums of extra tallow was put through about a week ago at 7⅝c. per lb., an advance of ⅛c. Offerings were not pressing on the market, but inquiry at the advance fell away quite perceptibly. Soapers refused to anticipate their wants. Yellow grease was steady, closing nominally at 7c. asked on low acid stock. Oleo stearine held at 9c., the last trading basis.

Miscellaneous Materials

Glycerine—Reports on the condition of the market were conflicting, but most traders regarded the situation as a little more favorable, especially where the C. P. grade was concerned. Some contract business was put through around 17c. per lb., in drums, carload lots. In the middle west C. P. was offered at 16½c. On a brand not so well established there was a possibility of doing 16½c., New York. The dynamite grade was inactive and nominally unchanged at 15¾@16c. per lb. Soap-lye crude, basis 80 per cent, closed at 11c. asked, loose, New York. An odd car or so sold during the week at concessions. Western producers held out for 10½c. on the soap-lye. Saponification, 88 per cent, closed nominally at 12¼@12½c. per lb., loose, with no sales reported.

Naval Stores—The market developed further weakness and toward the close spirits of turpentine stood at $1.06@$1.08 per gal. Demand was quiet, both in an export and domestic way. Southern markets were subjected to a little pressure. Rosins did not change much, the lower grades closing at $5.95@$6.10 per bbl.

Chalk—Importations have been heavy, but demand continues satisfactory and quotations ruled steady at $5@$5.50 per ton, cargo basis, c.i.f. New York.

Shellac—Early in the week prices went off a little, but later offerings were not so plentiful and with Calcutta advices slightly firmer the market steadied a little. Buying was hand-to-mouth in character and traders appeared to show no desire to book ahead under present conditions. T. N. on spot settled at 58@59c. per lb. Bleached, bonedry, closed at 72@73c. per lb. Superfine orange was offered at 64@65c. per lb.

Lithopone—Domestic producers admit that business has slowed up a bit, but with no change in basic material they continue to quote from 7@7¼c. per lb., carload lots, the inside figure obtaining for the material put up in bags.

White Lead, Etc.—The metal held at 7.25c. per lb., New York. Since the reduction in pig lead prices, which occurred about a month ago, corroders have not altered prices for the pigments. Business in white lead has been quite active and this accounts for the steady position of the leading producers. Dry white lead, basic carbonate, held at 9⅝c. per lb., in casks, round-lots. Dry red lead held at 11⅝c., in casks. Litharge was unchanged at 10¾@11c. per lb.

Zinc Oxide—Prices were repeated at 8c. on the lead free and 7@7¼c. on the 10@35 per cent leaded, American process oxide. French process held at 9⅝c. on the red seal, in bags. The market was steady.

Financial Notes

Belgo Paper Co., of Montreal, which is passing into Canadian control, shows average net earnings after maintenance and repairs of $1,742,570 for the past four years, and $1,989,054 for eight months ended April 30.

American Druggists Syndicate has notified stockholders change in par value of capital stock from $10 to $50, recently authorized at a special meeting of stockholders, cannot be carried out, owing to fact publication of notice has not been legally complied with. This will necessitate another meeting to properly authorize the change, for which due notice will be given.

Glidden Co. and subsidiaries for six months ended April 30, 1923, show net profit of $445,106, after interest, federal taxes, reserve for contingencies and depreciation. Company states that fiscal year begins November 1, and consequently above statement covers operations during five cold and unseasonable months of the year. Business for the last six months covers the real paint and varnish consuming months.

Formal transfer of Acme Cement Plaster Mills at Acme has been made to the Certain-teed Products Corp. of New York.

Special meeting of stockholders of Standard Oil Co. of New York, scheduled for last week, to approve proposed increase in authorized capital stock from $225,000,000 to $300,000,000 of $25 par, was not held as not sufficient proxies were received to comply with statutory provisions.

The balance sheet of the Pacific Oil Co., covering operations in 1922, shows a surplus of $11,792,226 after depreciation, depletion, federal taxes, etc., equivalent to $3.37 a share on its 3,500,000 shares of outstanding no par value stock. In 1921 net income amounted to $16,261,292, or $4.64 a share on the stock.

The United Dyewood Corporation reports for the past year's operation a balance of $1,816,212 available for dividends on the common stock. This is equivalent to $13.04 a share on the 139,183 shares outstanding.

The Chino Copper Co. reports for the first quarter of 1923 total income, exclusive of depreciation and federal taxes, of $405,611, equal to 45c. a share on the 900,000 shares of capital stock of $5 par value outstanding. This compares with total income of $182,629, or 20c. a share, in the final quarter of 1922.

The American Copper Mining Co. has announced that on and after June 30, 1923, it would redeem all its outstanding 7 per cent, 10-year secured gold bonds, series B, at a premium of 3 per cent.

Imports at New York

May 25 to May 31

ACIDS—89 dr cresylic, London, Celluloid Co., 280 bx. formic and 30 csk. oxalic, Rotterdam, W. R. Greeff & Co., 183 dr cresylic, Liverpool, Order, 200 keg. tartaric, London, Russian Produce Co, 100 csk. citric, Palermo, R F Downing & Co, 150 csk, Palermo, W. Neuberg, 140 csk tartaric, Palermo, Order, 100 csk citric, Palermo, Order

AMMONIUM—20 pkg. carbonate, Liverpool, Brown Bros & Co.

ALCOHOL—200 bbl. Arecibo, C Estena

ARSENIC—51 csk, Liverpood, Order, 100 bbl, Tampico, Am Metal Co.

ASBESTOS—1239 bg., Southhampton, W. D Crompton & Co

BARIUM BINOXIDE—63 cylinders, Havre, Mallinckrodt Chem Works.

CAMPHOR—100 cs., Hamburg, A Oehse Co

CASEIN—298 bg, Bombay, Casein Mfg Co, 163 bg, Bombay, Order, 417 bg, Buenos Aires, Equitable Trust Co., 1667 bg, Buenos Aires, Kalbfleisch Corp, 163 bg, Havre, N. Y Trust Co

CERIUM FLUORIDE—40 csk, Hamburg, Pfaltz & Bauer.

CHEMICALS—12 cs, Antwerp, Vandegrift & Co, 107 pkg., Rotterdam, Order, 90 csk, Bremen, Roessler & Haaslacher Chem Co, 38 csk, Bremen, Order, 120 csk, Newcastle, E Hills Son & Co, 32 bbl, Hamburg, A Murphy & Co, 45 bbl., Hamburg, Roessler & Hasslacher Chem Co

COLORS—22 cs. dry, London, R F Downing & Co.; 10 csk., Liverpool, Order, 4 csk aniline, Havre, Irving Bank-Col. Trust Co, 12 pkg do., Havre, W Sykes & Co, 6 csk, Havre, B Bernard, 5 csk, Havre, H R Ackerman, 22 csk, Havre, Geigy Co, 129 csk., Havre, Ciba Co, 2 bbl, Antwerp, B Bernard, 12 pkg Havre, Irving Bank-Col. Trust Co, 9 csk, Rotterdam, H A. Metz & Co, 6 pkg, Rotterdam, Organic Products Co., 21 cs, Hamburg, E C Foster, 40 csk, Hamburg, Kuttroff, Pickhardt & Co, 6 csk, Hamburg, H A. Metz & Co., 10 csk., Hamburg, H R John, 10 csk, Hamburg, Equitable Trust Co, 13 csk dry, Southampton, Stanley Doggett, Inc, 126 csk aniline, Havre, Ciba Co, 26 bbl dry, Havre, Reichard-Coulston, Inc, 11 csk earth Hamburg, Reichard-Coulston, Inc.

COPPER SULPHATE 100 csk, Hamburg, A. J Marcus

COPPER OXIDE—50 dr., Hamburg, American Metal Co, 11 csk, Newcastle, Int'l Comp Co

CREAM TARTAR—10 bbl., Bordeaux, R. W Greeff & Co

COPRA 100 bg, Santiago, Order, 477 bg, St Anns Bay, Order, 152 bg., Morant Bay, Franklin Baker Co

DEGRAS—90 bbl. Bordeaux, Order, 60 csk Bremen, C. H Hilbert, 150 bbl., Hull Nat'l City Bank

DIVI-DIVI—75 bg., Maracaibo, Int'l Forwarding Co

DYESTUFFS—2 csk, Southampton, Am. Exchange Nat'l Bank, 3 csk, Havre, Carbric Color & Chem. Co,

FERROSILICON—511 csk, Stockholm, C. Hardy & Ruperty, 328 cs, Skien, Norwegian Nitrogen Products Co; 320 cs, Skein, Order

FUSEL OIL—11 csk, Havre, Order, 19 dr., Dunkirk, Guaranty Trust Co.; 16 dr, Dunkirk, Mass & Waldstein.

GLYCERINE—20 csk, Bordeaux, Order; 35 csk, Havre, Thornett & Fehr.

GUMS—58 bg tragacanth, Bombay, Goschens & Cunliffe, 486 bg Persian, 140 bg karaya and 180 bg. arabic, Bombay, Guaranty Trust Co; 140 bg karaya, Bombay, Brown Bros & Co, 68 bg. tragacanth and 560 bg. karaya, Bombay, Order; 105 bg copal, Antwerp, Brown Bros & Co, 409 pkg do, Antwerp, Chem. Nat'l Bank, 915 bg. copal, Antwerp, Order; 320 bg. copal, Antwerp, H W. Peabody & Co.; 30 bg copal, Liverpool, Order

IRON OXIDE—18 csk, Liverpool, J. A McNulty; 70 csk, Liverpool, Reichard-Coulston, Inc, 17 csk., Liverpool, L. H. Butcher & Co

MANGROVE BARK—1,352 bg., Hamburg, Bingham & Co.; 8,000 bg., Hamburg, Bingham & Co

MINERAL WHITE—200 bg., Hull C. B. Chrystal & Co; 1,200 bg., Hull, Hammill & Gillespie.

MYRABOLANS—2,312 bg, Bombay, Fourth Atl Nat'l Bank; 4,766 bg., Bombay, Order; 9,720 pkt., Calcutta, Nat'l City Bank; 15,006 pkt., Calcutta, Standard Bank of South Africa, 4,480 pkt., Calcutta, Order

NAPHTHALENE—660 bg., Liverpool Martin & Co.; 1,162 bg., Liverpool, Order

OILS—**Castor**, 100 bbl., Hull, Order. **Coconut**—114 pipes, Cochin, Volkart Bros, 94 hhds, Cochin, Order. **Cod**—100 bbl., Aberdeen, Order. **Linseed**—285 bbl., Rotterdam, Thomas Tucker & Co.; 146 bbl., Rotterdam, Lockwood & Co; 200 bbl., Southampton, Hudson Oil Co.; 867 bbl., Hull, National City Bank, 897 tons (bulk) Hull, Order **Rapeseed**—1,000 bbl., Liverpool, Vacuum Oil Co.; 100 bbl., Hull, National City Bank; 500 bbl, Hull, Vacuum Oil Co, 425 bbl., Hull, Order. **Sesame**—100 dr., Rotterdam, Order. **Palm**—128 csk., Liverpool, African & Eastern Trading Corp, 100 csk., Liverpool, E. F. Drew & Co, 496 csk, Liverpool, Order, 158 csk., Rotterdam, J Holt & Co., 37 csk, Liverpool, Standard Bank of S. Africa, 34 csk. and 48 bbl., Liverpool, D. Bacon, 140 csk., Liverpool, Order. **Peanut**—300 bbl., Liverpool, E F Drew & Co; 200 bbl., Hull, E. F Drew & Co. **Soya Bean**—325 bbl., Liverpool, I R Boody & Co. **Whale**—23,200 bbls, Montevideo, Order.

OIL SEEDS—**Castor**—7,130 bg, Bombay, Volkart Bros., 1,358 bg., Bombay, Order; 5,464 bg., Coconada, Volkart Bros. **Linseed**—2,563 bg., Montevideo, Order, 17,852 bg, Rosario, Order, 44,730 bg, San Lorenzo, Order, 35,884 bg., Rosario, Order; 16,408 bg, Buenos Aires, Spencer Kellogg & Sons

POTASSIUM SALTS 2,000 bg manure salt, Hamburg, Order, 2,000 bg, sulphate, Order, 35 dr caustic, Bremen, Innis, Speiden & Co, 1,120 bg., muriate, Bremen, A. Vogel, 3,500 bg, sulphate, Hamburg, Order, 71 csk. carbonate, Hamburg, Peters, White & Co, 25 dr. permanganate, Hamburg, Order.

PITCH 600 bbl., Hull, Tunley & Co., 100 bbl., Hull, Order.

PYRIDINE—11 dr, Liverpool, R W. Greeff & Co, 9 dr, Liverpool, Order

QUEBRACHO—50,569 bg, Buenos Aires, Tannin Corp, 1,074 bg., Buenos Aires, Fourth At'l Natl Bank.

QUICKSILVER—250 fl., London, Order.

QUINIDINE—77 dr, Rotterdam, R. W. Freeff & Co.

SHELLAC—600 bg., Calcutta, Philadelphia Nat'l Bank, 250 bg., Calcutta, Order, 100 cs, London, Order, 71 bg., Havre, Standard Bank of South Africa, 35 bg, Hamburg, Order, 740 bg, Calcutta, Brown Bros. & Co, 10 bg, Calcutta, Lee, Higginson & Co., 50 bg, Calcutta, Bank of Brit. West Africa, 100 bg, Calcutta, N Y Trust Co., 46 bg., Calcutta, Bank of Montreal, 2,140 pkg., Calcutta, Order; 422 bg, Calcutta, Anglo So. Am. Bank; 537 bg., Calcutta, Bank of N Y & Trust Co.; 500 bg refuse, Calcutta, Bank of Manhattan Co, 150 bg, Calcutta, First Nat'l Bank of Boston; 550 bg garnet, Calcutta, Bank of America, 50 bg., Calcutta, London & Braz Bank; 50 bg, Cal-Calcutta, Mech. & Metals Nat'l Bank, 500 bg, Calcutta, Chase Nat'l Bank; 1,002 bg., Calcutta, Order

STARCH—250 bg potato, Rotterdam, Chatham & Phenix Nat'l Bank.

SODIUM SALTS—168 cs. cyanide, Havre, C. Hardy & Ruperty; 250 cs cyanide, Havre, Meteor Products Co, 243 cs, Havre, Asia Banking Corp.; 34 csk prussiate, Liverpool, H J Baker & Bros., 113 csk. hydrosulphite, Rotterdam, H. A Metz & Co., 4,115 bg. and 343 csk. synthetic nitrate, Skien, Order; 25,089 bg. nitrate, Antofagasta, Wessel, Duval & Co., 92,317 bg nitrate, Tocopilla, Wessel, Duval & Co., 15,766 bg. nitrate, Mejillones, W. R. Grace & Co; 29 dr. perborate, Hamburg, International Acceptance Bank; 55 dr sulph.-hydrate, Hamburg, C. S. Grant & Co

SUMAC—200 bl, Palermo, Order

TANNING EXTRACT—30 csk., Liverpool, Brown Bros. & Co.

TARTAR—100 bg, Bordeaux, Order

TURMURIC—369 bg, Aleppy, Darragh, Small Co; 1,400 bg., Cochin, Order.

ULTRAMARINE—16 csk, Liverpool, Fezandie & Sperrle

WHITING—5125 bg, Dunkirk, Taintor Trading.

WAXES—32 bg. bees, London, Order; 20 bg. bees, Rio de Janeiro, London & Brazilian Bank; 18 bg., Rio de Janeiro, Storrs Mica Co.; 34 pkg. bees, Havana, Order; 100 cs spermacette, Glasgow, Order

ZINC OXIDE—34 csk., Liverpool, L. H. Butcher & Co.

ZINC WHITE—20 bbl, Southampton, Houbegart, Inc.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

General Chemicals

Acetic anhydride, 85%, drums	lb.	$0 38 -	..
Acetone, drums	lb.	.25 -	.25½
Acid, acetic, 28%, bbl..... 100	lb.	3 38 -	3 50
Acetic, 56%, bbl 100	lb.	6 75 -	7 00
Glacial, 99½%, bbl. 100	lb.	12 00 -	12 50
Boric, bbl...	lb.	.10½-	
Citric, kegs	lb.	.49 -	.52
Formic, 85%.............	lb.	.14 -	.16
Gallic, tech	lb.	.45 -	.50
Hydrofluoric, 52%, carboys	lb.	.12 -	12½
Lactic, 44%, tech., light, bbl.	lb.	.11½-	12
22% tech, light, bbl ..	lb	.05½-	06
Muriatic, 18° tanks . 100	lb.	.90 -	1 00
Muriatic, 20°, tanks, 100	lb.	1 00 -	1 10
Nitric, 36°, carboys... .	lb	04½-	.05
Nitric, 42°, carboys..... .	lb.	.06 -	.06½
Oleum, 20%, tanks	ton	18.50 -	19.00
Oxalic, crystals, bbl ..	lb.	.13 -	.13½
Phosphoric, 50% carboys	lb.	.07½-	.08½
Pyrogallic, resublimed.....	lb	1.50 -	1.60
Sulphuric, 60°, tanks	ton	9 50 -	11 00
Sulphuric, 60°, drums... .	ton	13.00 -	14 00
Sulphuric, 66°, tanks.... .	ton	16.00 -	16.50
Sulphuric, 66° drums.... .	ton	20 00 -	21 00
Tannic, U.S.P., bbl........	lb	.65 -	.70
Tannic, tech, bbl.	lb	.45 -	.50
Tartaric, imp, powd, bbl.	lb.	.36½-	. .
Tartaric, domestic, bbl.....	lb.	.37½-	.
Tungstic, per lb .	lb.	1.10 -	1 20
Alcohol, butyl, drums, f.o b. works. ..	lb.	.26 -	.28
Alcohol ethyl (Cologne spirit), bbl	gal.	4.75 -	4.95
Ethyl, 190 p'f U S P, bbl .	gal.	4 70 -	..
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 190 proof			
No 1, special bbl	gal.	41 -	..
No. 1, 190 proof, special, dr	gal	35 -	...
No 1, 188 proof, bbl	gal	42 -	.
No 1, 188 proof, dr	gal.	.36 -	. .
No 5, 188 proof, bbl . ..	gal	40 -	..
No 5, 188 proof, dr .	gal.	.34 -	.
Alum, ammonia, lump, bbl ..	lb.	.03½-	.03¾
Potash, lump, bbl .	lb.	.02¾-	.03¼
Chrome, lump potash, bbl.	lb.	.05½-	.06
Aluminum sulphate, com., bags . 100	lb.	1.50 -	1.65
Iron free bags .	lb.	.02½-	.02¾
Aqua ammonia, 26°, drums..	lb.	.06¼-	.07¼
Ammonia, anhydrous, cyl. ..	lb.	.30 -	.30½
Ammonium carbonate, powd casks, imported	lb.	.09½-	.10
Ammonium carbonate, powd. domestic, bbl .	lb.	.13 -	.14
Ammonium nitrate, tech, casks .	lb.	.10 -	11
Amyl acetate tech, drums..	gal	3.50 -	3 75
Arsenic, white, powd, bbl.....	lb	14 -	.14½
Arsenic, red, powd, kegs.....	lb	14½-	.
Barium carbonate, bbl.....	ton	78 00 -	80 00
Barium chloride, bbl	ton	85.00 -	90 00
Barium dioxide, drums.. .	lb.	.18 -	.18½
Barium nitrate, casks ...		08 -	.08½
Barium sulphate, bbl.. .	lb	04 -	.04½
Blanc fixe, dry, bbl .	lb.	04 -	.04¼
Bleaching powder, f.o b. wks., drums 100	lb.	1 90 -	.
Spot N Y. drums....... 100	lb.	2 40 -	
Borax, bbl.	lb.	.05½-	.05½
Bromine, cases	lb.	28 -	30
Calcium acetate, bags... . 100	lb.	4 00 -	4.05
Calcium arsenate, dr ..	lb.	.16	.16½
Calcium carbide, drums	lb.	05½-	05¾
Calcium chloride, fused, drums	ton	22 00 -	23.00
Gran. drums. .	ton	28 00 -	30.00
Calcium phosphate, mono, bbl.	lb.	.06½-	.07
Camphor, cases	lb.	.86 -	.88
Carbon bisulphide, drums....	lb.	.07 -	07½
Carbon tetrachloride, drums.	lb.	.09½-	.10
Chalk, precip.—domestic, light, bbl.	lb.	.04½-	.04½
Domestic, heavy, bbl.....	lb.	.03½-	.03¾
Imported, light, bbl. .	lb.	.04½-	.05
Chlorine, liquid, tanks, wks..	lb.	.05½-	.05½
Cylinders, 100 lb, wks	lb.	.06 -	.06½
Cylinders, 100 lb, spot ...	lb.	.09 -	..
Chloroform, tech., drums....	lb.	.35 -	.38
Cobalt oxide, bbl...........	lb.	2.10 -	2 25
Copperas, bulk, f.o.b. wks....	ton	20 00 -	21 00
Copper carbonate, bbl..... .	lb.	.19 -	.20
Copper cyanide, drums. ..	lb.	.47 -	.50
Coppersulphate, dom., bbl., 100	lb.	5.90 -	...
Cream of tartar, bbl..... .	lb.	.25½-	.26½
Epsom salt, dom., tech., bbl................ 100	lb.	1.90 -	2.15
Epsom salt, imp., tech., bags................ 100	lb.	.90 -	1.00
Epsom salt, U.S.P., dom., bbl.................. 100	lb.	2.50 -	2.60
Ether, U.S.P., drums........	lb.	.13 -	.15
Ethyl acetate, 85%, drums.	gal.	.80 -	.81
Ethyl acetate, pure (acetic ether, 98% to 100%).....	gal.	.95 -	1.00

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available. In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

Formaldehyde, 40%, bbl .	lb.	$0 14½-	$0 15½
Fullers earth—imp, powd., net	ton	30 00 -	32 00
Fusel oil, ref, drums.. . .	gal.	. .	
Fusel oil, crude, drums	gal	. .	. .
Glaubers salt, wks, bags... 100	lb	1 20 -	1.40
Glaubers salt, imp, bags 100	lb.	90 -	.95
Glycerine, c p, drums extra...	lb	.17 -	.17½
Glycerine, dynamite, drums .	lb	.15½-	.16½
Glycerine, crude 80%, loose .	lb	11	11½
Iodine, resublimed .	lb.	4.55 -	4.65
Iron oxide, red, casks ...	lb.	.12 -	.18
Lead:			
White, basic carbonate, dry, casks	lb.	.09½-	.10
White, basic sulphate, casks	lb	.09½-	
White, in oil, kegs......	lb.	.12½-	14
Red, dry, casks	lb.	.11½-	12
Red, in oil, kegs .	lb.	13½-	.15
Lead acetate, white crys, bbl.	lb	14 -	14½
Brown, broken, casks	lb	13 -	13½
Lead arsenate, powd., bbl..	lb	23 -	24
Lime-Hydrated, bbl... .	per ton	16 80 -	17 00
Lime, Lump, bbl	280 lb	3 63 -	3 65
Litharge, comm, casks...	lb.	10½ -	.11
Lithophone, bags........	lb	.07 -	07½
in bbl..	lb	.07 -	07½
Magnesium carb, tech., bags	lb	08 -	.08½
Methanol, 95%, bbl .	gal.	1 18 -	1 20
Methanol, 97%, bbl. . .	gal	1 20 -	1 22
Nickel salt, double, bbl....	lb.	.10½-	. .
Nickel salts, single, bbl	lb.	11½-	
Phosgene		.60 -	.75
Phosphorus, red, cases.......	lb.	.35 -	.40
Phosphorus, yellow, cases..	lb.	.30 -	.35
Potassium bichromate, casks	lb.	.11½-	.12
Potassium bromide, gran., bbl	lb.	.19 -	.20
Potassium carbonate, 80-85%, calcined, casks. .	lb.	.06½-	.06¾
Potassium chlorate, powd.	lb.	.07½-	.08
Potassium cyanide, drums	lb.	.45 -	.50
Potassium, first sorts, cask	lb.	.08½	.09
Potassium hydroxide (caustic potash) drums	lb.	.07½-	.09
Potassium iodide, cases......	lb.	3.65 -	3.75
Potassium nitrate, bbl .	lb.	.06½-	.07½
Potassium permanganate, drums	lb.	.18½-	.19
Potassium prussiate, red, casks	lb.	.65 -	.67
Potassium prussiate, yellow, casks	lb.	.35½-	.36½
Salammoniac, white, gran., casks, imported .. .	lb.	.06 -	.06½
Salammoniac, white, gran., bbl, domestic	lb.	.07½-	.07¾
Gray, gran., casks.........	lb.	.08 -	.09
Salsoda, bbl.. 100	lb.	1.20	1.40
Salt cake (bulk)........	ton	26.00 -	28.00
Soda ash, light, 58% flat, bags, contract... ... 100	lb.	1.60 -	1.67
Soda ash, light, basis, 48%, bags, contract, f.o.b.. wks... 100	lb.	1.20 -	1.30
Soda ash, light, 58%, flat, bags, resale . . 100	lb.	1.75 -	1.80
Soda ash, dense, bags, contract, basis 48% 100	lb.	1.17½-	1.20
Soda ash, dense, in bags, resale . . 100	lb.	1.85 -	1.90
Soda, caustic, 76%, solid, drums, f.a.s... 100	lb.	3.22½-	3.35
Soda, caustic, basis 60%, wks, contract. . 100	lb.	2.50 -	2.60
Soda, caustic, ground and flake, contracts 100	lb.	3.80 -	3.90
Soda, caustic, ground and flake, resale. ... 100	lb.	3.72½-	....
Sodium acetate, works, bags..	lb.	.05½-	.06½
Sodium bicarbonate, bbl .. 100	lb.	2.00 -	2.50
Sodium bichromate, casks.. .	lb.	.09 -	09½
Sodium bisulphate (niter cake)	ton	6.00 -	7.00
Sodium bisulphite, powd., U.S.P., bbl.	lb.	.04½-	.04½
Sodium chlorate, kegs...... .	lb.	.06½-	.07
Sodium chloride	long ton	12.00 -	13.00
Sodium cyanide, cases	lb.	.20 -	.23
Sodium fluoride, bbl. .	lb.	$0.09 -	$0 10½
Sodium hyposulphite, bbl..	lb.	.02½-	.03
Sodium nitrite, casks . .	lb.	.08 -	.08½
Sodium peroxide, powd, cases	lb.	.28 -	.30
Sodium phosphate, dibasic, bbl.....	lb	.03½-	.04
Sodium prussiate, yel. drums	lb.	.15 -	.16
Sodium salicylic, drums	lb.	.47 -	.52
Sodium silicate (40°, drums) 100	lb.	.80 -	1.25
Sodium silicate (60°, drums) 100	lb.	2.00 -	2.25
Sodium sulphide, fused, 60-62% drums.... . .	lb.	04½-	.04½
Sodium sulphite, crys, bbl	lb	.03½-	.03¾
Strontium nitrate, powd., bbl.	lb	.12½-	.13
Sulphur chloride, yel drums.	lb	04½-	.05
Sulphur, crude	ton	18 00 -	20.00
At mine, bulk	ton	16 00 -	18 00
Sulphur, flour, bag .. . 100	lb.	2.25 -	2.35
Sulphur, roll, bag ... 100	lb.	2.00 -	2.10
Sulphur dioxide, liquid, cyl. .	lb.	.08 -	08½
Talc—imported, bags .. .	ton	30 00 -	40.00
Talc—domestic powd., bags.	ton	18.00 -	25.00
Tin bichloride, bbl. .	lb.	.12½-	.13½
Tin oxide, bbl . ..	lb.	.48 -	
Tin crystals, bbl .	lb	.35½-	.36
Zinc carbonate, bags. .	lb.	.14 -	.14½
Zinc chloride, gran, bbl.	lb.	.06½-	.06¾
Zinc cyanide, drums.. ..	lb.	.37 -	.38
Zinc oxide, , lead free, bbl..	lb.	.08 -	.08½
5% lead sulphate, bags ...	lb.	.07½-	......
10 to 35 % lead sulphate, bags .	lb.	.07 -	.....
French, red seal, bags . .	lb.	.09½-	. . . .
French, green seal, bags .	lb.	.10½-	.....
French, white seal, bbl	lb	.12 -	. . .
Zinc sulphate, bbl.... . 100	lb.	2.50 -	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl....	lb.	$0 65 -	$0.80
Alpha-naphthol, ref., bbl. .	lb.	.75 -	.90
Alpha-naphthylamine, bbl....	lb.	35 -.	37
Aniline oil, drums	lb.	.16 -	.16½
Aniline salts, bbl.	lb.	.23 -	24
Anthracene, 80%, drums... .	lb.	.75 -	1.00
Anthracene, 80%, imp., drums, duty paid... ...	lb.	.70 -	.75
Anthraquinone, 25%, paste, drums .	lb.	.70 -	.75
Benzaldehyde U.S.P, carboys	lb.	1.40 -	1.45
tech, drums . .	lb	75	80
Benzene, pure, water-white, tanks and drums .	gal.	.27 -	.32
Benzene, 90%, tanks & drums	gal.	.25 -	.30
Benzene, 90%, drums, resale..	gal.	.28 -	.32
Benzidine base, bbl.	lb.	.85 -	.90
Benzidine sulphate, bbl .. .	lb.	.70 -	.75
Benzoic acid, U.S P, kegs . .	lb.	.72 -	75
Benzoate of soda, U.S.P., bbl.	lb.	.57 -	.65
Benzyl chloride, 95-97%, ref., drums	lb.	.45 -	...
Benzyl chloride, tech., drums	lb.	.30 -	..35
Beta-naphthol, tech., bbl.....	lb.	.22 -	.23
Beta-naphthylamine, tech . .	lb.	.80 -	.90
Cresol, U.S P., drums. ..	lb.	.25 -	.29
Ortho-cresol, drums	lb.	.28 -	.30
Cresylic acid, 97%, resale, drums	gal.	1.15 -	1.20
95-97%, drums, resale... .	gal.	1.10 -	....
Dichlorbenzene, drums......	lb.	.07 -	.09
Diethylaniline, drums...... .	lb.	.50 -	.60
Dimethylaniline, drums.....	lb.	.42 -	.43
Dinitrobenzene, bbl,...	lb.	.19 -	.20
Dinitroclorbenzenee bbl.....	lb.	.22 -	.23
Dinitronaphthalen, bbl....	lb.	.30 -	.32
Dinitrophenol, bbl....	lb.	.35 -	.40
Dinitrotoluene, bbl..........	lb.	.20 -	.22
Dip oil, 25%, drums.........	gal.	.25 -	.30
Diphenylamine, bbl.........	lb.	.50 -	.52
H-acid, bbl.................	lb.	.80 -	.85
Meta-phenylenediamine, bbl.	lb.	1.00 -	1.05
Michlers ketone, bbl.	lb.	3.00 -	3.50
Monochlorbenzene, drums...	lb.	.08 -	.10
Monoethylaniline, drums....	lb.	.95 -	1.10
Naphthalene, flake, bbl......	lb.	.08½-	.09
Naphthalene, balls, bbl.......	lb.	.09½-	.10
Naphthionate of soda, bbl....	lb.	.58 -	.65
Naphthionic acid, crude, bbl.	lb.	.55	.60
Nitrobenzene, drums........	lb.	.10	.12
Nitro-naphthalene, bbl......	lb.	.30 -	.35
Nitro-toluene, drums........	lb.	.15 -	.17
N-W acid, bbl..............	lb.	1.25 -	1.30
Ortho-amidophenol, kegs....	lb.	2.30 -	2.35
Ortho-dichlorbenzene, drums	lb.	.17 -	.20
Ortho-nitrophenol, bbl.... ..	lb.	.90 -	.92
Ortho-nitrotoluene, drums...	lb.	.10 -	.12
Ortho-toluidine, bbl....... .	lb.	.14 -	.15
Para-amidophenol, base, kegs	lb.	1.20 -	1.30
Para-amidophenol, HCl, kegs	lb.	1.25 -	1.35
Para-dichlorbenzene, bbl.....	lb.	.17 -	.20
Paranitroaniline, bbl...	lb.	.72 -	.75
Para-nitrotoluene, bbl.......	lb.	.60 -	.65
Para-phenylenediamine, bbl.	lb.	1.45 -	1.50
Para-toluidine, bbl	lb.	.95 -	.98
Phthalic anhydride, bbl......	lb.	.35 -	.38
Phenol, U.S.P., drums.......	lb.	.45 -	.50
Picric acid, bbl.............	lb.	.20 -	.22
Pyridine, dom., drums.......	gal.	nominal	

Pyridine, imp., drums	gal.	$2.50 -	$2 75
Resorcinol, tech., kegs	lb.	1 40 -	1 50
Resorcinol, pure, kegs	lb.	2 00 -	2.25
R-salt, bbl.	lb.	.55 -	.60
Salicylic acid, tech., bbl.	lb.	37 -	42
Salicylic acid, U.S.P, bbl.	lb.	.40 -	.45
Solvent naphtha, water-white, drums	gal.	.27 -	.32
Crude, drums	gal.	.24 -	
Sulphanilic acid, crude, bbl.	lb.	.18 -	20
Thiocarbanilide, kegs	lb.	35 -	.38
Toluidine, kegs	lb.	1.20 -	1 30
Toluidine, mixed, kegs	lb.	30 -	.35
Toluene, tank cars	gal.	.30 -	35
Toluene, drums	gal.	.35 -	.40
Xylidines drums	lb.	.47 -	49
Xylene, pure, drums.	gal.	.75 -	1.00
Xylene, com., drums	gal.	37 -	......
Xylene, com., tanks	gal.	.32 -	......

Naval Stores

Rosin B-D, bbl	280 lb	$5 90 -	
Rosin E-I, bbl.	280 lb.	6 00 -	
Rosin K-N, bbl.	280 lb.	6 20 -	
Rosin W G-W.W., bbl.	280 lb	6 50 -	7.50
Wood rosin, bbl	280 lb	6 00 -	6 10
Turpentine, spirits of, bbl	gal.	1 07 -	1 09
Wood, steam dist, bbl.	gal.	1 00 -	
Wood, dest dist., bbl	gal.	75 -	
Pine tar pitch, bbl	200 lb	-	6 00
Tar, kiln burned, bbl.	500 lb.	-	13 00
Retort tar, bbl.	500 lb	... -	12.00
Rosin oil, first run, bbl	gal	.45 -	..
Rosin oil, second run, bbl	gal	48 -	...
Rosin oil, third run, bbl	gal	.52 -	...
Pine oil, steam dist	gal.	75 -	......
Pine oil, pure, dest dist	gal.	70 -	......
Pine tar oil, ref.	gal.	48 -	... ..
Pine tar oil, crude, tanks f.o.b Jacksonville, Fla.	gal.	32 -	.32½
Pine tar oil, double ref, bbl.	gal.	-	75
Pine tar, ref, thin, bbl	gal.	-	.25
Pinewood creosote, ref, bbl	gal	-	.52

Animal Oils and Fats

Degras, bbl	lb.	$0 03½	$0 04½
Grease, yellow, bbl	lb.	06¾ -	07
Lard oil, Extra No 1, bbl	gal.	90 -	92
Neatsfoot oil 20 deg bbl.	gal	1 30 -	
No 1, bbl	gal	92 -	94
Oleo Stearine		09 -	
Red oil, distilled, d p bbl	lb	10¼	10¾
Saponified, bbl	lb	10¼	10¾
Tallow, extra, loose	lb	07¾ -	
Tallow oil, acidless, bbl	gal	94 -	96

Vegetable Oils

Castor oil, No 3, bbl	lb	$0 14 -	.
Castor oil, No 1, bbl.	lb	14½ -	...
Chinawood oil, bbl	lb	26 -	28
Coconut oil, Ceylon, bbl.	lb.	09½ -	
Ceylon, tanks, N Y	lb	08¾	
Coconut oil, Cochin, bbl.	lb.	09¾ -	10
Corn oil, crude, bbl	lb.	12¼ -	..
Crude, tanks, (f o b mill)	lb	09½	
Cottonseed oil, crude (f o b. mill), tanks	lb	09¾ -	
Summer yellow, bbl.	lb	12¼ -	
Winter yellow, bbl	lb	13 -	13¾
Linseed oil, raw, car lots, bbl	gal	1 12 -	
Raw, tank cars (dom)	gal	1 07 -	..
Boiled, cars, bbl (dom.)	gal	1 14 -	...
Olive oil, denatured, bbl.	gal	1 10 -	
Sulphur, (foots) bbl	lb	08¾	09¼
Palm, Lagos, casks.	lb	07¼ -	07½
Niger, casks	lb	07 -	07¼
Palm kernel, bbl	lb	08½ -	08¾
Peanut oil, crude, tanks (mill)	lb	13 -	13¼
Peanut oil, refined, bbl	lb.	.16½ -	..
Perilla, bbl	lb	16 -	16¼
Rapeseed oil, refined, bbl	gal	83 -	.84
Rapeseed oil, blown, bbl	gal	.88 -	.89
Sesame, bbl	lb	11¾ -	12
Soya bean (Manchurian), bbl.	lb	.12¾ -	13
Tank, f o b Pacific coast.	lb	.10¼ -	10⅜
Tank, (f o.b. N Y.)	lb	.10¼ -	.10½

Fish Oils

Cod, Newfoundland, bbl	gal.	$0 70 -	$0 72
Menhaden, light pressed, bbl.	gal.	76 -	
White bleached, bbl.	gal.	78 -	
Blown, bbl	gal.	82 -	
Crude, tanks (f o b factory)	gal.	.50 -	
Whale No. 1 crude, tanks, coast	lb	-	
Winter, natural, bbl	gal	76 -	.78
Winter, bleached bbl.	gal	.79 -	.80

Oil Cake and Meal

Coconut cake, bags	ton	$30 00 -	$31 00
Copra, sun dried, bags, (c i f)	lb	05 -	
Sun dried Pacific coast	lb.	04¾ -	
Cottonseed meal, f o b. mills	ton	38 00 -	
Linseed cake, bags	ton	33 00 -	34 00
Linseed meal, bags	ton	35 00 -	36.00

Dye & Tanning Materials

Albumen, blood, bbl	lb	$0 45 -	$0 50
Albumen, egg, tech, kegs	lb	.90 -	95
Cochineal, bags	lb	.33 -	35
Cutch, Borneo, bales.	lb.	.04¾ -	05
Cutch, Rangoon, bales	lb	13 -	13½
Dextrine, corn, bags.	100 lb	3 69 -	4 01
Dextrine gum, bags.	100 lb	3 99 -	4 09
Divi-divi, bags.	ton	38 00 -	39 00
Fustic, sticks	ton	30 00 -	35.00
Fustic, chips, bags	lb	.04 -	.05
Logwood, sticks	ton	26 00 -	30.00
Logwood, chips, bags.	lb.	.02½ -	.03½
Sumac, leaves, Sicily, bags	ton	70.00 -	72.00
Sumac, ground, bags	ton	$65 00 -	$67 00
Sumac, domestic, bags.	ton	40.00 -	42 00
Starch, corn, bags	100 lb	2.97 -	3 07
Tapioca flour, bags.	lb	06 -	.06¼

Extracts

Archil, conc, bbl.	lb.	$0.17 -	$0.18
Chestnut, 25% tannin, tanks.	lb	02 -	.03
Divi-divi, 25% tannin, bbl	lb.	.04 -	.05
Fustic, crystals, bbl	lb	.20 -	.22
Fustic, liquid, 42°, bbl	lb	08 -	09
Gambier, liq, 25% tannin, bbl	lb	.08 -	.09
Hematine crys, bbl	lb	.14 -	18
Hemlock, 25% tannin, bbl.	lb	.04 -	.05
Hypernic, solid, drums	lb	.24 -	26
Hypernic, liquid, 51°, bbl	lb	.10 -	12
Logwood, crys, bbl	lb	18 -	.20
Logwood, liq, 51°, bbl.	lb.	.09 -	.10
Quebracho, solid, 65% tannin, bbl	lb.	.04½ -	.05
Sumac, dom., 51°, bbl	lb.	.06½ -	.07

Dry Colors

Blacks-Carbongas, bags, f o b. works	lb	$0 20 -	$0 24
Lampblack, bbl	lb	12 -	40
Mineral, bulk	ton	35 00 -	45 00
Blues Bronze, bbl	lb	.55 -	60
Prussian, bbl	lb	.55 -	60
Ultramarine, bbl	lb	.08 -	35
Browns, Sienna, Ital, bbl	lb	.06 -	.14
Sienna, Domestic, bbl	lb	.03½ -	04
Umber, Turkey, bbl	lb	.04 -	.04½
Greens-Chrome, C P Light, bbl	lb.	32 -	34
Chrome, commercial, bbl	lb	12 -	12½
Paris, bulk	lb	30 -	35
Reds, Carmine No 40, tins	lb	4 50 -	4 70
Oxide red, casks	lb	.10 -	14
Para toner, kegs	lb	1.00 -	1 10
Vermilion, English, bbl	lb.	1.30 -	1 32
Yellow, Chrome, C P bbls	lb.	.20 -	.21
Ocher, French, casks.	lb.	.02½ -	.03

Waxes

Bayberry, bbl	lb.	$0 35 -	$0.36
Beeswax, crude, bags	lb.	20 -	.21
Beeswax, refined, light, bags	lb	32 -	34
Beeswax, pure white, cases	lb.	40 -	41
Candelilla, bags	lb	21 -	.22
Carnauba, No 1, bags	lb.	42 -	43
No 2, North Country, bags	lb	23 -	.23½
No 3, North Country, bags	lb.	18½ -	19
Japan, cases	lb.	16¼ -	16½
Montan, crude, bags	lb.	.04¼ -	04½
Paraffine, crude, match, 105-110 m p	lb.	.04 -	.04¼
Crude, scale 124-126 m p., bags	lb.	.02¾ -	.03
Ref, 118-120 m p, bags.	lb.	03 -	03⅛
Ref, 125 m p., bags	lb.	.03½ -	03⅝
Ref, 128-130 m p, bags	lb.	.03¾ -	04
Ref, 133-135 m p, bags	lb.	.04½ -	04¾
Ref, 135-137 m p, bags	lb	.05 -	05¼
Stearic acid, sgle pressed, bags	lb.	13 -	.13¼
Double pressed, bags.	lb	.13½ -	13¾
Triple pressed, bags	lb	.15 -	.15¼

Fertilizers

Ammonium sulphate, bulk, f o b works	100 lb	$3 25 -	$3 30
F.a.s double bags.	100 lb	3 85 -	3 90
Blood, dried, bulk	unit	4 00 -	
Bone, raw, 3 and 50, ground	ton	27 00	30 00
Fish scrap, dom, dried, wks	unit	3 75	
Nitrate of soda, bags	100 lb.	2 52½ -	2 57½
Tankage, high grade, f.o.b. Chicago	unit	3.35 -	3 45
Phosphate rock, f o b mines, Florida pebble, 68-72%	ton	$4 00 -	$4 50
Tennessee, 78-80%	ton	8 00 -	8 25
Potassium muriate, 80%, bags	ton	34 55 -	
Potassium sulphate, bags basis 90%	ton	43 67 -	...
Double manure salt	ton	25 72 —	
Kainit	ton	7 22 —	....

Crude Rubber

Para—Upriver fine.	lb.	$0 28¼ -	..
Upriver coarse	lb.	.25 -	.....
Upriver caucho ball.	lb.	.26 -	.....
Plantation First latex crepe	lb.	.29 -	
Ribbed smoked sheets	lb.	.29 -	....
Brown crepe, thin, clean	lb.	27½ -	...
Amber crepe No 1	lb.	.28½ -	.....

Gums

Copal, Congo, amber, bags.	lb.	$0.12 -	$0.13
East Indian, bold, bags	lb.	.23 -	.23½
Manila, pale, bags	lb.	.20 -	.20½
Pontinak, No 1 bags	lb.	.20 -	.20½
Damar, Batavia, cases	lb.	.28 -	.29
Singapore, No 1, cases	lb.	.34 -	35
Singapore, No 2, cases	lb.	.22 -	23
Kauri, No 1, cases	lb.	.65 -	67
Ordinary chips, cases	lb	.20 -	22
Manjak, Barbados, bags	lb.	.09 -	.09½

Shellac

Shellac, orange fine, bags	lb.	$0 62 -	$0 63
Orange superfine, bags.	lb.	.64 -	.65
A. C garnet, bags.	lb.	nominal	
Bleached, bonedry	lb.	.71 -	72
Bleached, fresh	lb.	.59 -	60
T. N., bags	lb.	.58 -	.59

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh. ton	$500 00 -	....
Asbestos, shingle, f.o.b, Quebec	sh. ton	$65.00 -	$85.00
Asbestos, cement, f.o.b, Quebec	sh. ton	20.00 -	25 00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	16.00 -	20 00
Barytes, grd, off-color, f o b. mills bulk.	net ton	13.00 -	15 00
Barytes, floated, f.o.b. St. Louis, bbl	net ton	28.00 -	
Barytes, crude f.o b. mines, bulk	net ton	10.00 -	11 00
Casein, bbl, tech.	lb.	.18½ -	20
China clay (kaolin) crude, f.o.b Ga	net ton	7.00 -	9 00
Washed, f o b Ga.	net ton	8 00 -	9 00
Powd., f.o b Ga.	net ton	14 00 -	20 00
Crude f.o.b Va.	net ton	8 00 -	12.00
Ground, f.o b Va	net ton	14 00 -	20.00
Imp, lump, bulk.	net ton	15 00 -	20.00
Imp, powd.	net ton	45 00 -	50.00
Feldspar, No 1 pottery	long ton	6 00 -	7.00
No 2 pottery	long ton	4 00 -	5 50
No. 1 soap	long ton	7.00 -	7 50
No. 1 Canadian, f.o.b. mill	long ton	20.00 -	22 00
Graphite, Ceylon, lump, first quality, bbl	lb.	.06½ -	
Ceylon, chip, bbl.	lb.	05½ -	
High grade amorphous crude	ton	15.00 -	35 00
Gum arabic, amber, sorts, bags	lb	.14½ -	15
Gum tragacanth, sorts, bags	lb.	.48 -	56
No 1, bags	lb.	1.50 -	1 60
Kieselguhr, f o b Cal.	ton	40 00 -	42 00
F o b N.Y.	ton	50 00 -	55 00
Magnesite, crude, f.o b Cal.	ton	14 00 -	15.00
Pumice stone, imp, casks	lb	.03 -	.05½
Dom, lump, bbl	lb.	.05 -	.05½
Dom, ground, bbl	lb.	.06 -	.07
Silica, glass sand, f.o b Ind	ton	2 00 -	2 50
Silica, sand blast, f o b Ind.	ton	2 50	5 00
Silica, amorphous, 250-mesh, f o b Ill	ton	17 00 -	17 50
Silica, bldg sand, f o b Pa	ton	2 00 -	2 75
Soapstone, coarse, f.o.b. Vt., bags	ton	7 00 -	8 00
Talc, 200 mesh, f.o b., Vt, bags	ton	6.50 -	9.00
Talc, 200 mesh, f o.b. Ga., bags	ton	7.00 -	9 00
Talc, 200 mesh, f o b Los Angeles, bags.	ton	16.00 -	20.00

Mineral Oils

Crude, at Wells

Pennsylvania	bbl.	$3 25 -	3 50
Corning	bbl	1 85 -	..
Cabell	bbl.	1 91 -	
Somerset	bbl.	1 75 -	
Illinois	bbl.	1 97 -	
Indiana	bbl.	1 98 -	
Kansas and Oklahoma, 28 deg	bbl.	1 30 -	...
California, 35 deg and up	bbl.	1 04 -	

Gasoline, Etc.

Motor gasoline, steel bbls	gal.	$0 21½ -	
Naphtha, V M & P deod, steel bbls	gal	20½ -	
Kerosene, ref tank wagon	gal	14 -	
Bulk, W W export.	gal.	07 -	
Lubricating oils			
Cylinder, Penn, dark	gal	22 -	.25
Bloomless, 30@31 grav.	gal.	.18½ -	.20½
Paraffin, pale	gal.	.24 -	.26
Spindle, 200, pale	gal.	.22 -	.24
Petrolatum, amber, bbls.	lb.	.05 -	.05¼
Paraffine wax (see waxes)			

Refractories

Bauxite brick, 56% Al_2O_3, f o.b. Pittsburgh	ton	$45-50
Chrome brick, f.o b. Eastern shipping points	ton	50-52
Chrome cement, 40-50% Cr_2O_3.	ton	23-27
40-45% Cr_2O_3, sacks, f.o b. Eastern shipping points	ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f.o b Ky wks	1,000	40-46
2nd quality, 9-in shapes, f o.b. wks.	1,000	36-41
Magnesite brick, 9-in straight (f o b wks.)	ton	65-68
9-in arches, wedges and keys.	ton	80-85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48-50
Silica brick, 9-in sizes, f.o.b. Birmingham district	1,000	48-50
F o b Mt Union, Pa	1,000	42-44
Silicon carbide refract brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18%, f o b. Niagara Falls, N Y.	ton	$200.00 -	$225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11½	.11¾
4-6% C.	lb.	.12 -	.13
Ferromanganese, 78-82% Mn, Atlantic seabd., duty paid.	gr. ton	125.00 -	......
Spiegeleisen, 19-21% Mn	gr. ton	40 00 -	....
Ferromolybdenum, 50-60% Mo, per lb Mo	lb.	2 00 -	2.50
Ferrosilicon, 10-15%.	gr. ton	48 00 -	50 00
50%	gr. ton	95.00 -	
75%	gr. ton	150.00 -	160.00

Ferrotungsten, 70-80%, per lb. of W........ lb.	\$0.90 - \$0.95
Ferro-uranium, 35-50% of U per lb. of U...... lb.	6.00 - ...
Ferrovanadium, 30-40%, per lb. of V....... lb.	3.50 - 3.75

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	\$6.00 - \$9.00
Chrome ore Calif. concentrates, 50% min Cr_2O_3	ton	22.00 - 23.00
C.i.f. Atlantic seaboard	ton	20.50 - 24.00
Coke, fdry., f.o.b. ovens	ton	7.00 - 7.50
Coke, furnace, f.o.b. ovens	ton	6.00 - 6.50
Fluorspar, gravel, f.o.b. mines, Illinois	ton	20.00 - 21.50
Ilmenite, 52% TiO_2	lb.	.01¼ - .01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.33 - ...
Manganese ore, chemical (MnO_2)	ton	75.00 - 80.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N. Y.	lb.	.65 - .70
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb.	.06 - .08
Pyrites, Span., fines, c.i.f. Atl. seaport	unit	.11½ - .12
Pyrites, Span., furnace size, c.i.f. Atl. seaport	unit	.11½ - .12
Pyrites, dom. fines, f.o.b. mines, Ga.	unit	.12
Rutile, 95% TiO_2	lb.	.12 - ...
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.50 - 8.75
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	8.00 - 8.25
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 - 3.75
Uranium oxide, 96% per lb. U_3O_8	lb	2.25 - 2.50
Vanadium pentoxide, 99%	lb	12.00 - 14.00
Vanadium ore, per lb. V_2O_5	lb	1.00 - ...
Zircon, washed, iron free, f.o.b. Pablo, Fla.	lb	.04½ - .13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	14¾ 15¼
Aluminum, 98 to 99%	26-27
Antimony, wholesale, Chinese and Japanese	7½- 8
Nickel, virgin metal	28-30
Nickel, ingot and shot	30-
Monel metal, shot and blocks	32.00
Monel metal, ingots	38.00
Monel metal, sheet bars	45.00
Tin, 5-ton lots, Straits	42.50
Lead, New York, spot	7.25
Lead, E. St. Louis, spot	7.05
Zinc, spot, New York	6.85
Zinc, spot, E. St. Louis	6.50

Other Metals

Silver (commercial)	oz.	\$0.66
Cadmium	lb.	1.00
Bismuth (500 lb. lots)	lb.	2.55
Cobalt	lb	2.65@2.85
Magnesium, ingots, 99%	lb	1.25
Platinum	oz	114.00
Iridium	oz.	260.00@275.00
Palladium	oz	80.00
Mercury	75 lb	68.00

Finished Metal Products

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	24.25
Copper bottoms	29.75
Copper rods	25.25
High brass wire	19.37½
High brass rods	17.00
Low brass wire	21.10
Low brass rods	22.00
Brazed brass tubing	24.25
Brazed bronze tubing	29.00
Seamless copper tubing	25.25
Seamless high brass tubing	23.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.60@11.80
Copper, heavy and wire	11.50@11.60
Copper, light and bottoms	10.00@10.10
Lead, heavy	5.75@6.00
Lead, tea	3.50@3.75
Brass, heavy	6.50@6.75
Brass, light	5.75@6.00
No. 1 yellow brass turnings	6.75@.700
Zinc	3.75@4.25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	\$3.29	\$3.14
Soft steel bars	3.19	3.04
Soft steel bar shapes	3.19	3.04
Soft steel bands	3.29	3.19
Plates, ¼ to 1 in. thick	3.29	3.14

Industrial

Financial, Construction and Manufacturing News

Construction and Operation

Alabama

BIRMINGHAM—The Standard Sanitary Mfg Co, Bessemer Bldg., Pittsburgh, Pa., manufacturer of sanitary enameled iron products, has acquired property at 5th Ave and 22nd St, Birmingham, as a site for a new branch plant estimated to cost about \$100,000. Plans will be prepared at once.

PELHAM—The Superior Lime & Hydrate Co, Inc, has commenced the construction of a new hydrate lime-manufacturing plant with capacity of about 500 bbl per day, estimated to cost close to \$100,000 with machinery. A list of equipment to be installed is being arranged. H. C. Bridgewater is secretary and manager.

Arkansas

CAMDEN—The Morris Oil Co, recently organized by Harry Morris and associates, has concluded negotiations with the local Chamber of Commerce for a site for a new oil-refining plant, to have a capacity for handling 3,000 bbl. of crude petroleum per day. It is estimated to cost about \$350,000, including machinery.

California

GLENDALE—The California Tylite Co, Inc, has work in progress on the first unit of a new plant near the junction of San Fernando Rd and Vine St., to be equipped for the manufacture of concrete tile products under a special process. It will have an initial daily output of 30,000 tiles. Frank H. Boettcher is president; and Charles H. Davies, vice president and general manager.

LOS ANGELES—The White Star Oil Co. has acquired property at Wilmington, Los Angeles Harbor, and plans for the construction of a new oil refinery to cost close to \$1,000,000 with machinery. A gasoline refinery will also be installed. The company is operating oil properties at Santa Fe Springs, Cal.

LOS ANGELES—The Amargosa Talc Co., 224 Santa Fe Ave., has plans in preparation for the erection of a 1-story addition to its mill, 45x100 ft. Additional equipment will be installed.

Connecticut

SOUTHBURY—The Star Oil Co., Danbury, Conn., is planning for the construction of a new oil storage and distributing plant on local site, estimated to cost in excess of \$75,000, with equipment.

Florida

BLOUNTSTOWN—The Florida Orchard & Packing Co., Thomasville, Ga., has tentative plans under consideration for the erection of a new plant for the manufacture of fertilizer products at its properties near Blountstown. W. H. Baxley, Blountstown, is president and general manager.

CANAL POINT—The Florida Sugar & Food Products Co, Lake Worth, Fla., has plans under way for extensions and improvements in its local sugar mill and properties, estimated to cost \$350,000, including equipment. F. E. Bryant is head.

MIAMI—The Southern Alpha Tile Co. has preliminary plans under consideration for the erection of a new plant on local site for the manufacture of tile products, estimated to cost in excess of \$50,000 with equipment. Allan J. Reynolds is president.

Illinois

GENESEO—The Tri-City Oil Co., 825 1st Ave., Rock Island, Ill., has tentative plans under consideration for the construction of a new oil storage and distributing plant on local site. A similar plant will also be erected at Erie, Ill. A list of equipment to be installed will be arranged at an early date. D. N. Johnson is president.

Iowa

DAVENPORT—The Linwood Stone & Cement Co, Kahl Bldg, has preliminary plans under way for the construction of a new cement-manufacturing plant to cost close to \$200,000, including equipment. J. E. Schroeder is secretary.

Kansas

ARKANSAS CITY—The Roxana Petroleum Corp, St Louis, Mo., will construct by day labor its proposed new oil-refining plant on property recently acquired. It will cost \$400,000, including machinery. Sub-contracts will be let for equipment at once. E. R. Moore is construction manager in charge.

HUTCHINSON—The State Board of Administration has completed plans for the construction of a 1-story addition to its clay products manufacturing plant, 75x120 ft, estimated to cost \$20,000, exclusive of equipment. C. M. Rutledge, State Capitol Bldg., Topeka, is state architect.

Louisiana

MONROE—The North American Carbon Co, Shreveport, recently organized with a capital of \$200,000, has preliminary plans under consideration for the construction of a new plant in the vicinity of Monroe for the manufacture of carbon black. It is estimated to cost \$80,000. C. W. Brown is president, and J. S. McCullough, vice-president.

Maryland

NORTH EAST—The North East Porcelain Co has perfected plans for immediate operations at its new local plant, and will develop maximum capacity at an early date. The company was recently organized.

Massachusetts

LEOMINSTER—Fire, May 23, destroyed a portion of the celluloid and composition goods plant of the Standard Comb Co., with loss estimated at \$25,000. It is planned to rebuild.

EAST WALPOLE—Bird & Son, Inc, manufacturer of prepared roofing products, has work nearing completion on a new plant addition, and plans to install equipment at an early date. It will cost in excess of \$175,000.

Michigan

LANSING—The Dudley Paper Co., 740 East Shiawassee St., has plans prepared for extensions and improvements in its plant, including the installation of additional equipment, estimated to cost about \$45,000. W. C. Dudley heads the company.

LUDINGTON—The Michigan Oil Development Co, recently organized with a capital of \$500,000, is perfecting plans for the development of oil properties in the vicinity of Ludington and Manistee, and the construction of a new plant in this section. A stock issue of \$100,000 has been arranged, the entire proceeds to be used for equipment and operations.

Mississippi

MERIDIAN—The Meridian Fiber Co. has completed plans and will commence the erection of an addition to its plant to cost about \$40,000. It is purposed to install additional equipment to double, approximately, the present capacity.

New Jersey

GARFIELD—The Johnson Products Co., 138 Paris St., Newark, manufacturer of cellulose products, etc., has acquired the plant of the Newark Rubber Co., at Garfield, comprising a 1-story structure with about 20,000 sq.ft. of floor space. The new owner will make improvements in the factory and plans to occupy at an early date. Charles

Johnson is president; and H. C. Johnson, vice-president and treasurer.

NORTH MILLVILLE—Frederick & Dommock, Inc., has commenced the construction of a new local plant to be equipped for the manufacture of fine glass products, including vials, etc.

NUTLEY—The Texdel Chemical Co., 391 Claremont Ave., Jersey City, has leased a factory fronting on the Passaic River, Nutley, aggregating 12,000 sq.ft., and will use the structure for a new plant. Immediate possession will be taken and equipment installed.

JERSEY CITY—The Stratford Oakum Co., Cornelison Ave., has commissioned Dodge & Morrison, 160 Pearl St., New York, N. Y., architects, to prepare plans for extensions and improvements in its 1- and 2-story plant, to provide for increase in capacity.

New York

PORT HENRY—Witherbee, Sherman & Co., 2 Rector St., New York, operating local blast furnaces, plan for the immediate rebuilding of its ore-separating plant at Witherbee, near Port Henry, destroyed by fire, May 18, with loss estimated at $300,000, including crushing, separating and other machinery. The reconstruction is estimated to cost approximately the amount of the loss.

NEW YORK—The United States Steel Corp., 71 Broadway, New York, has acquired fluorspar properties in Crittenden County, Ky., and contemplates the installation of a complete mining plant and commercial reduction works.

NEW YORK—The Publicker Commercial Alcohol Co., Water and Snyder Sts., Philadelphia, Pa., has purchased the 6-story building at 133 Washington St., and will occupy the structure for a branch works.

Ohio

LIMA—The Radiant Oil Co., recently organized with a capital of $1,000,000, has preliminary plans under way for the erection of a new plant on local site for the manufacture of lubricating oils. The company has a 3-acre tract, and will also construct a laboratory and preliminary compounding mill, the initial plant units will cost approximately $250,000, with machinery. At a later date it is purposed to construct a gasoline-refining plant, adjoining the present structures. E. E. Bessire is vice-president and general manager.

EAST AKRON—The Rote Leather Products Co., Doyle Block, Akron, has negotiations nearing completion for the purchase of the plant of the Phoenix Rubber Co., inactive for a number of months past, for a consideration said to be $150,000. The Rote company will remodel and improve the factory, and install equipment for the manufacture of leather substitute products.

CLEVELAND—The Standard Oil Co. has preliminary plans under consideration for the construction of a new storage and distributing plant on 3-acre tract of land on the Berea Rd., near Fischer Rd., recently acquired for a consideration of $21,000. It is estimated to cost in excess of $75,000, with equipment.

Pennsylvania

PHILADELPHIA—The R. E. Tongue & Brothers Co., Amber and Allegheny Sts., manufacturer of glass products, has work in progress on a new plant addition to cost about $60,000, and plans to install equipment at an early date.

LEWISTON—The Pennsylvania Wire Glass Co., Pennsylvania Bldg., is perfecting plans for the construction of the initial unit of its proposed new plant on property recently acquired at Lewiston, estimated to cost about $80,000, with equipment. Other units will be built later. Frank L. Martin is head.

PHILADELPHIA—The Pennsylvania Salt Mfg. Co., Widener Bldg., has filed plans for a 1-story extension at its plant at Porter and Delaware Sts.

NORTHAMPTON—The Atlas Portland Cement Co. has negotiations nearing consummation for the purchase of the plant of the Western States Portland Cement Co., Independence, Kan., and plans to take over the mill at an early date. Extensions and improvements will be made, including the installation of additional equipment.

UNIVERSAL—The Universal Portland Cement Co. has purchased a tract of 230 acres of land heretofore held by the Carnegie Steel Co., including its plant site and adjoining property, for a consideration said to be in excess of $2,000,000, and will utilize for general operations and expansion.

Texas

BEAUMONT—The Atlantic Refining Co., 3144 Passyunk Ave., Philadelphia, has commenced preliminary work for the construction of its proposed local oil-refining plant, estimated to cost in excess of $300,000, and purposes to inaugurate building erection at an early date.

DALLAS—The Camel Chemical Co., Portland, Ore., C. W. Hall, president, has organized the Camel Chemical Co. of Texas, as a subsidiary company, to operate a local plant. One of the former buildings of the government in the Love Aviation Field, near Dallas, has been acquired and will be remodeled and improved for an initial plant, to specialize in the manufacture of a chemical solution for battery service. Alexander D. Hudson is head of the subsidiary company.

PARIS—The Blossom Cotton Oil Co. has abandoned plans for the proposed rebuilding of the portion of its local mill destroyed by fire a number of months ago, and it is purposed to dissolve the company.

TEXAS CITY—The Texas Sugar Refining Co. has work in progress on its proposed local refining plant, and plans to have the initial buildings ready for the machinery installation at an early date. The new refinery will cost in excess of $300,000. E. T. Thomas, engineer for the company, is in charge.

New Companies

LEBANNON CHEMICAL CO., Pawtucket, R. I., chemical products; $10,000. Incorporators: Eugene X. Murphy, James Hand and Edward J. Duffy, 47 Kepler St., Pawtucket.

INTER CONTINENTAL TIRE & RUBBER CO., Indianapolis, Ind., tires and rubber products; 200,000 shares of stock, no par value. Incorporators: J. D. Wiggings, S. T. Davis and Herbert W. Lantz, all of Indianapolis.

LINDEN CHEMICAL PRODUCTS CO., New York, N. Y., chemicals and chemical byproducts; $50,000. Incorporators: M. and J. M. Marshall. Representative: E. B. Schulkind, 2 Rector St., New York.

EAST TENNESSEE CHEMICAL CO., Etowah, Tenn., chemicals and chemical byproducts; $100,000. Incorporators: W. H. Chancey, Paul H. Snapp and F. T. Purdue, all of Etowah.

HILLCREST SANITARY SPECIALTY MFG. CO., Trenton, N. J., sanitary pottery products; $50,000. Incorporators: Herman A. Jangch, Martin Boller and Frank Schuh, Homan and Hilton Sts., Trenton. The last noted is representative.

PAINT PIGMENT CO. OF AMERICA, INC., Wilmington, Del., paint pigments, etc.; $150,000. Representative: United States Corporation Co., Dover, Del.

SOFT PHOSPHATE FERTILIZER CO., Tampa, Fla., fertilizer products, organized. William G. Brooks, president, and Samuel Borchardt, secretary, both of Tampa.

BARBER TANNING CO., North Adams, Mass., operate a leather tannery; $250,000. Oliver Hall is president, and George E. Cox, North Adams, treasurer and representative.

HILL CHEMICAL CO., Wilmington, Del., chemicals and chemical byproducts; $1,000,000. Representative: Corporation Service Co., Equitable Bldg., Wilmington.

PARA CORP., Belleville, N. J., chemicals and chemical byproducts; $20,000. Incorporators: Walter H. and J. W. Zillessen and Edward G. Meyers, 372 Main St., Belleville. The last noted is representative.

REVELLE OIL CO., Bristow, Okla.; petroleum products; $100,000. Incorporators: E. H. Rollestone, Bristow, C. E. Strouvelle and C. P. Davis, both of Tulsa, Okla.

METASCALE PROCESS CO., Detroit, Mich., metal processing for scale removal; $50,000. Incorporators: Oscar M. Howard, Martin E. Ball and Joseph A. Hammer, 4301 Allendale St., Detroit. The last noted is representative.

CONTINENTAL CHEMICAL CO., Lakewood, O.; chemicals and chemical byproducts; $10,000. Incorporators: Harvey E. Miller and William H. Chapman, both of Lakewood.

WATERPROOFING, INC., Indianapolis, Ind.; waterproofing compounds, etc.; $100,000. Incorporators: James A. Walsh, Frank K. Bull and Lee R. Garber, all of Indianapolis.

C. H. A. SCHMITT CO., Boston, Mass.; chemicals and chemical byproducts; 400 shares of stock, no par values. Charles A. Schmitt, president; and Philip J. Kraft, Boston, treasurer.

INSULATING PRODUCTS CO., 412 North Western Ave., Chicago, Ill.; compounds; $40,000. Incorporators: Louis Weber, William J. Greer and Fred Ellzer.

MARR OIL CORP., 101 East Fayette St., Baltimore, Md.; refined petroleum products; 500,000 shares of stock, no par value. Incorporators: John J. Hopkins, Carl W. Painter and J. Donald Robb.

PROTECTION PAINT & PRODUCTS CORP., 8 South Dearborn St., Chicago, Ill.; paints, varnishes, oils, etc.; $25,000. Incorporators: Mortimer A. Sherick, A. B. Sherick, and Henry Rutz.

EX-OIL CHEMICAL PRODUCTS CO., Jersey City, N. J.; chemicals and chemical byproducts; $100,000. Incorporators: Francis I. Golden, Alexander Mannix and James H. Sharkey, 225 Claremont Ave., Jersey City. The last noted is representative.

FARMASTIC CO., Haverford, Pa.; paints, varnishes, etc.; $250,000. Incorporators: Frank A. Cabeen, Jr., Haverford; George G. Meade, Ambler, Pa.; and W. F. Diener, Collingswood, N. J. Representative: United States Corporation Co., Pennsylvania Bldg., Philadelphia, Pa.

CONSOLIDATED BOLL WEEVIL & INSECT DESTROYER CO., Blanchard, Okla.; chemical compounds; $25,000. Incorporators: John A. Stephenson, D. C. Morgan and T. C. Laws, all of Blanchard.

DALCO LUBRICANTS, INC., Wilmington, Del., oils and greases; $120,000. Representative: Corporation Service Co., Equitable Bldg., Wilmington.

FINDLAY-EAGLE OIL CO., Findlay, O.; oil products; $25,000. Incorporators: W. E. Stephenson and M. H. Shaffer, both of Findlay.

LASTIK PRODUCTS CO., Beaver, Pa., cements, paints, etc., now being organized, application for a state charter will be made June 6. Incorporators: E. A. Holland, J. deS. Freund and S. B. Myers. Representative: Hice, Morrison, May & Bradshaw, Beaver.

Industrial Notes

THE WHEELING STEEL PRODUCTS CO. (sales company for the La Belle Iron Works, Whitaker-Glessner Co. and Wheeling Steel & Iron Co.) discontinued May 1, and the Wheeling Steel Corp., from that date, has handled all sales. The Wheeling Steel Corp. will assume all existing sales obligations of the Wheeling Steel Products Co., Wheeling, W. Va., and of the three above named companies. This action will not affect the personnel of the sales division, which will remain unchanged at Wheeling and at district sales offices.

THE CONVEYORS CORP. OF AMERICA, Chicago, Ill., announces the appointment of the Pittsburgh Machine Products Co., Oliver Bldg., Pittsburgh, Pa., as district representative.

Since May 15 the firm of PETREE & DORR has occupied separate office from the Dorr Co. in the Munson Bldg., 67 Wall St., New York City, and has enlarged its staff. P. M. McHugh, until now vice-president and manager of sales of equipment for the Dorr Co., will become president and general manager of Petree & Dorr. C. G. Petree of Brisbane, Australia, will become vice-president and consulting engineer. J. V. N. Dorr, president of the Dorr Co., will be chairman of the board of directors. H. E. Haws, treasurer of the Dorr Co., will continue as treasurer for the present. G. C. Kaar will continue in charge of the office in Havana.

THE WEBSTER MFG. CO., Chicago, Ill., announces the appointment of Robert T. Pierce as manager of its New York sales office at 90 West St., succeeding Glen N. Porter, deceased.

Opportunities in the Foreign Trade

Parties interested in any of the following opportunities may obtain all available information from the Bureau of Foreign and Domestic Commerce at Washington or from any district office of the bureau. The number placed after the opportunity must be given for the purpose of identification.

LINSEED OIL, coconut oil and palm kernel oil, 10 to 50 tons of each, all of the best quality. Wurttemberg, Germany. Purchase.—6497.

EDIBLE OILS AND LARD. Vienna, Austria. Purchase.—6502.

VEGETABLE OILS AND LARD. Prague, Czechoslovakia. Purchase.—6517.

WINDOW GLASS AND CAUSTIC SODA. Rio Grande do Sul, Brazil. Manufacturers' agency.—6543.

VARNISHES AND PAINTS, hard aluminum. Madrid, Spain. Purchase.—6594.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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How Shall We Sell Our Research?

"WHAT kind of a report shall we turn in to the board of directors? Shall it be a simple statement of results achieved in terms of dollars and cents saved? Or shall it include the results aimed at, a perspective of the work in terms of the long-time problems with incidentally some mention of the ultimate goals?" This subject was the basis of a friendly discussion among the heads of the research department in one of the large industrial corporations. The question is fundamental. It involves the very basis for research and it is imperative that those of us who are trying to "sell" that commodity to industry should clear up in our own minds the proper basis for its sale.

The confusion arises probably from the habit of looking upon research as an investment that will pay dividends. Our attitude toward research must be more flexible. Investments carry with them a connotation of regular profits, of capital once invested which keeps turning itself over. These concepts are ingrained and are not easily shaken. Therefore when we speak of research as an investment we are unfair, for we tell only a part of our story. True, it is a "laying out of money from which profit is expected," but it does not yield regular profits, nor is it a single laying out of money. It is a repeated expenditure. It is an "investment" without the earmarks familiar to the layman. Hence there is danger in referring to it in terms of profits and dividends.

It is a fact well established that research will pay for itself many times over, and in that sense it is an investment. But it is much more than an investment. It is the insurance which every company should pay to make sure that its processes and its products are not obsolescent—a condition that cannot always be revealed by the cost system. It is furthermore the eyes of the corporation through which it may look into the future. Only through research can an industry, a corporation, or an individual anticipate conditions and turn them to advantage. On the other hand, only research can create conditions that will permit life and growth in industrial competition.

Is a board of directors to be informed solely of the dollars and cents which the research department has saved during the past fiscal year and to be given no insight into the aims for which it is striving? What will be the result? A demand for dollars and cents! A necessary abandoning of long-time research, fundamental study aimed at the future, to take up pot-boilers that will show an immediate profit. Instead of studying the possible utilization of low-grade phosphate rock in the manufacture of fertilizer it would be the analysis of samples to prove that the company was right in a single shipment. In place of the fundamental properties of portland cement, the research man would have to "trouble shoot" for an irate customer.

Sell research for what it is: Not a penny saver on the present budget, but a marvelous tool that will create conditions for an industry, new methods of production, products for a waiting market. Sell it as an economic force and an economic necessity. Sell it as a program that has vision and vitality. Sell it so that every board of directors shall come to know it not as an investment but as a searchlight into the unexplored future of the corporation.

Looking to the Future Of the Paper Industries

A PERIOD of unusual prosperity has recently been enjoyed by the paper and pulp industries. If such good times could be continued and upon the same basis of production as in the past, there would be but slight ground for the speech of HUGH P. BAKER, secretary of the American Pulp and Paper Association, before the recent convention of paper mill superintendents at Springfield, Mass. Unfortunately, such may not be the case.

The time is fast coming when keen foreign competition must be met. Our Canadian neighbors give promise of outstripping us in newsprint production within 2 years. Our own forests are rapidly being depleted and the need for adopting a sound policy of reforestation becomes not only advisable but vitally necessary. Even such a step, however, will not in itself fully prepare us for holding our production and markets.

Standardization must come in mill practice. Of 129 sulphite mills operating on this continent, no two have adopted a standard, common practice. Why? Simply because the mills cannot agree among themselves which method is best. Only sound, honest, co-operative study will solve this problem. Fortunately the oil and steel industries have set excellent examples of standardization which the pulp industry might well emulate.

In addition to the development of new sources of raw material and standardization of practice, the industry has other problems to face. Sewer drains and ventilators, smoke stacks and refuse piles must be cheated of their present harvest. The statement has been made that a 200-ton mill could be completely operated on the present-day waste of the industry—and there is evidence to lead us to believe that this estimate is conservative.

To meet foreign competition successfully the industry must produce at bedrock prices. To do this it must insure itself against lack of pulpwood, it must standardize, it must discover and prevent unnecessary losses. Otherwise the day may come in the not far distant future when the foreign producers succeed in dominating the paper market of the United States.

An Introduction to the Chemical Engineering Industries

THE student at the Chemical Exposition has always been a problem. Usually he has rambled around on his own and worn out the patience of exhibitors by his persistent questioning. Nor has he been as greatly benefited by the exposition as he might have been. He has merely gathered a series of random impressions, generally inaccurate and all uncorrelated. His sense of balance has often been entirely disarranged by a loquacious salesman or a taciturn one. So much for the problem.

The Ninth Exposition, next September, will have as one of its features a course of instruction for students. Already our news pages have carried the preliminary announcement. More than a hundred applications have been received and the final attendance will doubtless be treble that number. Distinguished engineers have accepted the task of conducting the various symposiums and the students will have a rare opportunity to get a feeling of the great industries which later on will furnish them their livelihood. The generous co-operation of Columbia University in offering rooms in its dormitories for the week at a nominal charge removes the expense bugbear with which the student is usually faced. It only remains for the student to take advantage of this progressive proposal and for the exhibitors to co-operate in making this introduction to industry a significant advance in chemical engineering education.

Curious Ideas of Conservation

IN A recent issue of *Science* we learn that an unknown donor has contributed $100,000 each to Harvard and Yale universities for the purpose of conducting experiments in silviculture in New England. This is a matter of real interest, especially to the pulp and paper, wood-distillation and other of our chemical engineering industries. On every hand come warnings that we are using up our timber supply and yet despite the good work of the Forestry Service and the Forest Products Laboratory, we are curiously unscientific in our attitude toward this problem. To make silviculture economically worth while will require research and thinking, and the university is an admirable place for this study.

It is reported that on the Canadian side of the imaginary line that separates Alaska from the dominion there is a large and thriving paper and pulp industry. For the most part it is in the hands of Americans who were forced out of Alaska by the peculiar conception of conservation that seems to have as its objective that there be no development anywhere—that water capable of developing power should continue to waste itself on the rocks of its stream bed and that trees should continue to grow to maturity and then fall down to rot and ruin.

Good business requires that we begin to connect up these long-distance subjects and predicates, these causes and effects that reach out over the passing years. We have no right to rob future generations of the resources they will most need, but we should not unnecessarily penalize industry by withholding raw materials that today are being dissipated because of the *laissez-faire* attitude and neglect. A scientific program of utilizing the growth of our forests is not inconsistent with the soundest policies of conservation.

Technology and the Raw Material Monopolies

AS A NATION the United States is dependent upon foreign countries for about fifteen essential raw materials. At least half and probably two-thirds of these commodities are of vital importance to the chemical engineering industries. We are, therefore, more than ordinarily concerned with the attempt that is being made to find out just what these monopolies really mean in the world economic structure. Secretary HOOVER and his associates in the Department of Commerce should be assured of our support for their investigation, not alone in moral encouragement but, if necessary, in aggressive technical effort.

It is perhaps a war heritage that practically all of these materials are dominated by combinations of companies or governments that control production or marketing and distribution. Potash, iodine, nitrates, quinine, rubber, sisal and tanning materials are chemical engineering products subject to just such control. And, as the Secretary well puts it, there is no "Sherman law of the world" to prevent combinations against the United States. There are at least four ways to meet these raw material monopolies: (1) By similar combinations of purchasers; (2) by development of new sources of the same raw materials; (3) by development of synthetic or substitute materials; (4) by measures of economy to reduce our dependence on foreign sources.

But the immediate technical problem presenting itself to our industries is that of developing synthetic supplies or the determination of adequate substitutes for the raw materials which are now available from single sources. In the case of nitrogen, for example, the fixing of atmospheric nitrogen affords the obvious measure of relief from the burdensome phases of Chilean nitrate control. But the very serious economic question is, Will it pay? Similarly in the case of rubber the preparation of synthetic rubber is at least a possibility, although nothing like the certainty which we have in the case of nitrogen fixation. In other cases the whole situation may turn on a very small and apparently insignificant bit of technology. This is actually what is likely to result in the case of sisal.

The story of sisal is a romantic one. It has always seemed to be the only cheap fiber suitable for making binder twine that would withstand the ravages of the grasshopper. Other fibers such as manila are eaten by this insect pest, with serious results to the farmer who must handle the sheaves of grain. But now a little investigation has shown that the honorable grasshopper has no more desire for manila than for sisal. His fastidious taste is simply for the salt that is left in the manila and other twine fibers because the fibers have always been washed in salt water. Other factors of importance may develop, but it now seems that the only measure required for relief against the sisal monopoly is to arrange that the producers of manila in the Philippines use fresh water in the cleaning of their fiber, thus eliminating the salt which savors the grasshoppers' meal.

It is not likely that as simple solution will be found for the fourteen other raw materials as now is promised for the binder twine situation, but the chemical engineer has in every one of these fields a distinct opportunity. Our industries cannot afford to remain dependent upon a single foreign source. Common sense and good economics forbid that our profession should sit idly by and allow the present condition to continue.

One Aspect of The Labor Shortage

A GREAT DEAL is heard lately of the effect which the current shortage of labor has on industry. The prosperous state of business leads many industries to seek to attain maximum production. It becomes immediately evident to such that there are no new laborers available and that it is necessary to make their present supply cover their needs. In consequence we note a loud clamor that the next Congress should let down the bars to an increased immigration, and, with this, a tendency to do nothing until such Congressional action occurs.

But there is every indication at present that the immigrant quotas will not be increased. This puts it squarely up to industry to find its own solution of the difficulty. From one point of view this may be a blessing in disguise. What is being done in some plants, and it is the logical thing for all at least to consider, is the substitution of labor-saving devices and material-handling equipment for unskilled labor and then training the men thus freed for the skilled jobs that are open. Such a plant is blessed with steadier and more economical operation. Its men enjoy better jobs at better pay. And dividends result to the industry which acts instead of waiting helplessly for the government to solve its difficulties for it.

Better Tools For Industry

AN ENGINEERING FRIEND of ours, whose principal work has been along metallurgical lines, recently made an excursion into the chemical field. He tells us he was amazed by the lack of authoritative fundamental data and the very abundant fund of misinformation concerning the products in which he was interested. He writes:

> Take a very commonplace chemical, epsom salt, for example; consult any number of solubility tables and you will find almost as many sources of conflicting information. You will learn that this salt is relatively soluble, 1 to 3 in cold water and 1 to 1 in hot water, but the particular table consulted will give you no information whatsoever as to the temperatures involved. Another source discloses that 258 grams are soluble in 1,000 cc. of water at 32 deg. F. and 1,000 grams at 212 deg. F. . . . Epsom salt melts in its own water of crystallization at 200 deg. F., but none of the ordinary tables so states. . . . Should not the chemist make it his business to publish the truth? Should not the chemists as a group make it their duty to separate out the misinformation existing in many of our technical books and conspicuously label it as "Obsolete"?

It is not our purpose to defend the engineer in his criticism of the chemist nor yet to point out the fallacy of his generalizations. His criticism may or may not be well taken, but it serves to emphasize the very urgent need for the compilation and critical study of the fundamental constants of industry. It also brings out another point and one that is common experience to most of us —viz., that when we get away from the very limited field of our own specialty we are incapable of judging and appraising conflicting values for these basic data.

What is needed is co-ordinated, critical study by specialists, each competent to judge the value of the data for his particular field. It is encouraging to learn that this is exactly what is being planned in connection with the great work now under way on the preparation of the International Critical Tables of Physical and Chemical Constants.

The Landolt-Börnstein-Roth Tabellen, on which many of our technical men are now forced to rely, are notably incomplete and inadequate. In them there is no recognition of the results of much of the scientific and industrial research conducted in the United States since 1914. Nor do the tables include essential data on the many new and useful technological materials. These obvious faults are to be corrected and many new and noteworthy features are to be included in the ambitious program outlined for the present undertaking. It is impossible here even to catalog the wide range of data that will make up the 2,000 pages of tables, but the briefest inspection of the preliminary plans brings convincing proof that practically every phase of industry will be benefited by these tabulations. The project is an enormous one, requiring whole-hearted co-operation as well as prompt and substantial financial support.

As the matter now stands, about fifty industrial units have pledged approximately $40,000 and the Carnegie Corporation has given $35,000 more for the project. An additional $125,000 must be raised in order to cover the entire expense of compilation, editing and publishing. But even an expense of $200,000 is only an inconsequential fraction of the value that will be derived once industry is supplied with these better tools for investigation and progress.

Chemical Engineering In Industry

OCCASIONALLY we hear of friends of ours, chemical engineers, who are holding responsible positions in a rubber plant, a cement factory, a soap works, a packing house, a baking plant, an enameling factory and so on *ad infinitum*. If we reflect upon it at all, we begin to realize to what far fields of service the chemical engineer is being called. Yet this realization is very vague, whereas both the true comprehensiveness of the field and the striking parallelism of the work of the chemical engineer in different fields are far from being appreciated by the chemical engineers themselves.

These two thoughts underlie a series of articles on the chemical engineering of many industries. Based on field inspection of modern progressive plants by members of *Chem. & Met.'s* editorial staff, these will give a series of glimpses into the work of the chemical engineer from which can be synthesized a composite picture of chemical engineering which no single article could possibly give.

The series starts in this issue with "Chemical Engineering in the Production of Coated Fabrics"—a study of the Duratex Corporation's plant at Newark, N. J. Other articles will follow at close intervals. The effort will be sustained and the program will extend over a period of years rather than weeks or months. Each article will focus on the important chemical engineering features of the industry and plant. Gradually the understanding that the unit processes of chemical engineering underlie all of the process industries will become part of the background of the chemical engineer himself, of the industries and of the industries' leaders. Toward this end these articles are frankly aimed. We commend them to your attention.

Milton C. Whitaker

Outstanding chemical engineering executive and pioneer in the fight for the legitimate use of alcohol in industry

"ETERNAL VIGILANCE is the price of liberty" in more than one line of human endeavor, but in no industry is this so strikingly apparent as in the production and lawful distribution of industrial alcohol. Notwithstanding the federal enforcement act's avowed purpose ". . . to insure an ample supply of alcohol and to promote its use in scientific research and in the development of fuel, dye and other lawful industries," the industrial alcohol manufacturer and the industries that depend upon him for their supply of this essential raw material have been consistently harassed and persecuted. Only by a constant wide-awake fight for their rights have the chemical industries been able to oppose the ill-advised and often unjust regulations forced upon them by a fanatical administration of the enforcement act.

A step forward for the alcohol manufacturer and a victory for the legitimate consuming industries were recently achieved by the appointment of the Trade Alcohol Advisory Committee. On June 1 the announcement was made that in the future all new regulations affecting industrial alcohol will be submitted to this committee by the Treasury Department in order that blundering rules may be corrected before they actually go into effect and do damage to legitimate industry.

Another development within the past few weeks has been the discovery that hidden away in the recently-repealed Mullan-Gage enforcement act in New York State was a definition of "intoxicating liquor" which if enforced would absolutely prevent the use of alcohol in any chemical, medicinal, varnish, motor-fuel or in fact in any product requiring more than ½ per cent of alcohol in its make-up.

A striking example of the industry's successful stand against ill-advised legislation was seen a year or more ago in the opposition to the Willis-Campbell ("Volstead, Jr.") bill before Congress. It will be recalled that the industrial alcohol committee of the American Chemical Society made a valiant presentation of the chemical industry's case against the bill. This was supplemented by the important though perhaps less prominent rôle played by Dr. Milton C. Whitaker, former professor of chemical engineering at Columbia and now vice-president of the U. S. Industrial Alcohol Co. and president of the U. S. Industrial Chemical Co. His clear, forceful testimony before the Congressional committees did much to swerve the radical prohibitionists from their fixed purpose of crippling lawful chemical industries.

Dr. Whitaker has said that his business is to make alcohol and other chemicals for industry and not for illegal purposes. He is constantly blocking the efforts of bootleggers and at the same time appealing to the authorities on behalf of legitimate industries in order to enable them to do business. And this eternal vigilance is necessary, for there are always enthusiasts in Congress who believe that alcohol is useless as well as dangerous and that carbon bisulphide, for instance, would be a proper substitute for it in medicinal extracts.

Chemical Engineering In the Production of Coated Fabrics

Manufacture of Artificial Leather and Rubberized Cloth at the Plant of the Duratex Corporation Involves Interesting Application of Engineering Principles

BY SIDNEY D. KIRKPATRICK
Assistant Editor, *Chem. & Met.*

WITHIN the last 10 years more than one of the chemical engineering industries has felt the stimulating influence of the quantity-production methods of the automobile manufacturer. Many recent significant advances in the technology of rubber, special alloys and steel, and paint and varnish, can be traced directly to the demands of the industry that in 1922 supplied us with 2,500,000 motor cars and trucks. But even more intimately connected with the automobile industry is the production of pyroxylin- and rubber-coated fabrics—artificial leather for upholstery, door linings and the tops of closed cars and rubberized cloth for the side curtains and tops of touring cars.

The artificial leather industry had its beginnings in England early in the nineteenth century, but it was not until about 1850 that it may be said to have taken root in the United States. At that time, the principal use for such material was in the manufacture of carriages, the predecessor of the automobile industry, which alone in 1922 consumed 50,000,000 yd. of artificial leather.

Certain of the firms now producing pyroxylin- and rubber-coated fabrics had their origin in the leather industry, which, in brief, is the history of the Duratex Corporation, of Newark, N. J. About 20 years ago the Johnson Leather Co., of Newark, began the manufacture of split leather and for many years supplied this material to the carriage trade. About 1916, however, the demand for increasing quantities of automobile upholstery material became so insistent that this firm started to produce artificial leather, which it marketed under the name of "Duratex." A year later the firm, now known as the Duratex Corporation, began to produce rubberized fabrics, and with the broadening demand for this material expanded its rubber department until it is now able to supply approximately a tenth of the consumption of the entire country.

The chief raw material common to both the pyroxylin and rubber departments is the fabric, or gray goods, as it is termed in the industry. Depending upon special requirements, this may be duck, twill, drill, sateen, moleskin, lawn or sheeting. The gray goods first go to the dye house, where they are dyed, stretched and, in some cases, napped and felted. From the dyed goods storage, they are taken to the makeup room, where the rolls of cloth are cut according to the orders of the planning department and are sent to the appropriate department for processing. If the goods are to be rubberized, they are taken either to the calender room or rubber-spreader room, depending upon which of the two methods is to be used for applying the rubber. If the cloth is to be made into artificial leather, it passes into the pyroxylin room, where the "dope" mixture of nitrocellulose, pigment, oils and solvent is applied. The heavy rolls of cloth are transported from one building to the other by hand trucks, although in the processing rooms they are more conveniently and efficiently handled on a monorail system installed by the Louden Machinery Co. (See Fig. 5.)

As will be observed in Fig. 1, the plant is housed in two 1½-story brick buildings, 60 ft. in width and approximately 500 ft. in depth. A third series provides for material storage and power generation.

Pyroxylin Department

The preparation of the coating mixture of nitrocellulose, solvent, oils and pigment is the first step in the manufacture of artificial leather. Many of the valuable properties of the finished product depend upon the composition and care used in the making of this coating solution, which is known in the industry as "dope."

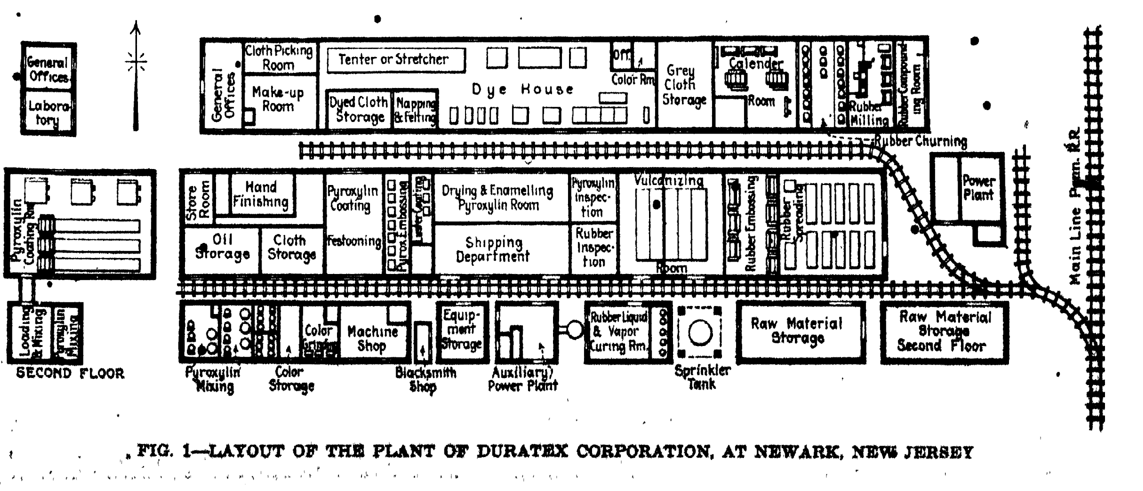


FIG. 1—LAYOUT OF THE PLANT OF DURATEX CORPORATION, AT NEWARK, NEW JERSEY

At the Duratex plant the pyroxylin is generally purchased in the form of a 12 per cent solution of nitrocellulose in a specified mixture of solvents. In general terms, this mixture consists of a diluent, a latent solvent and a true solvent. Because of its unusual solvent properties, ethyl acetate is almost universally used as the true solvent. Denatured alcohol is a common example of a latent solvent, while benzol and toluol are most often used as diluents.

Although the composition of the solvent mixture varies greatly with the coating requirements and other factors, such as atmospheric conditions, the true solvent generally represents 40 to 50 per cent of the total. Typical mixtures might be made up as follows:

	Ethyl Acetate Per Cent	Benzol Per Cent	Alcohol Per Cent
Solvent A...........	40	30	30
Solvent B...........	40	35	25

A difficulty which the artificial leather manufacturer shares with other pyroxylin industries is caused by the occasional precipitation of the nitrocellulose, resulting in what is known as a "blush" or "bloom" in the finished product. One of the reasons for this is the addition of moisture condensed from the atmosphere because of the low temperature of the evaporating solvents. In moist weather, therefore, it is necessary to add to the solvent mixture a small quantity of a higher boiling solvent, such as amyl or butyl acetate. A typical solvent mixture for use during periods of high humidity might consist of 10 per cent of amyl acetate, 30 per cent of ethyl acetate and 60 per cent of benzol.

Grinding, Mixing and Coating

The pigments mixed with the pyroxylin are all chemically inert colors—ochers, siennas, bone black, prussian and ultramarine blues, indian oxide and scarlet lakes being especially desirable. In this plant these are ground in a non-drying or semi-drying oil, such as castor oil, on three J. H. Day three-roller paint mills, one of which is shown in Fig. 2. The pigment-grinding room has a capacity of producing approximately 3,600 lb. of ground pigment in 24 hours.

Although varying, of course, with the specific gravity of the pigment and the color requirements for the finished stock, it is common practice to mix the ground pigment with the nitrocellulose solution in the proportion of two parts of pigment to three of nitrocellulose.

FIG. 2—PIGMENT GRINDING ON THREE-ROLLER MILL

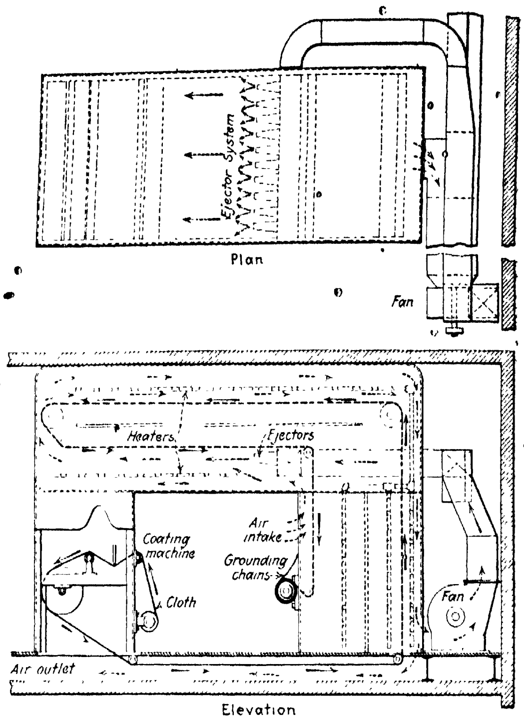


FIG. 3—PLAN AND ELEVATION OF DRYING EQUIPMENT FOR PYROXYLIN COATING MACHINES

Softening oils, such as castor, rapeseed or other non-drying or semi-drying vegetable oils, are then added to the mixture, generally in the proportion of about two parts of oil to one of nitrocellulose. This proportion, however, may be varied considerably depending on the pliability desired.

The pyroxylin mixing—that is, the incorporation of the various ingredients of the coating solution—is accomplished in large mixers made by the J. H. Day Co., of Cincinnati, and E. Ross & Son, of Brooklyn. In all, twenty-four such mixers are used, having individual capacities of 300, 500 and 800 gal. The ingredients are fed into the top of the mixers; in the case of the larger ones, from a second floor room directly above (marked "Loading and Mixing" in Fig. 1). The smaller mixers are loaded from overhead platforms to which the pigment and solution are brought by monorail and lifted by block and tackle.

It is significant that the mixers have been installed in three distinct rooms, carefully separated by fire walls. Necessary precautions are taken against the danger of ignition by static electricity. The mixers, belts and pulleys are carefully grounded and it has also been found necessary to ground the operators themselves, especially in cold, dry weather. This is done by having the men stand on zinc plates, properly grounded through the floor. The cloth is itself grounded to the coating machines by means of small brass chains that drag over the surface of the coated cloth during the final roll-up. (See Fig. 3.)

It was previously pointed out that the planning department routes the dyed cloth from the makeup room directly to the individual coating machines of the artificial leather department. Here the weight of the fabric

is ascertained and, also, by calculation, the amount of coating necessary to bring the finished product to its required weight.

The pyroxylin mixture is applied to the fabric on two types of coating machines, one of which is shown in Figs. 4 and 5. These are comparatively simple in principle, the thickness of the coat being regulated by the tension of the cloth against a knife edge over which it passes. The first and most difficult coat to apply is the anchorage coat, which is followed by the other coats necessary to give the required weight and the desired flexibility, finish and embossing surface.

As the fabric leaves the knife edge, it passes into a drying chamber, which is heated by means of steam coils. The temperature is regulated and recorded by standard recording instruments of the Foxboro and Bristol types.

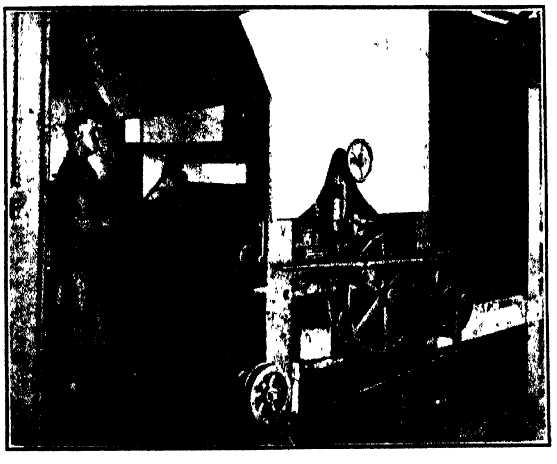
A Problem in Air Drying

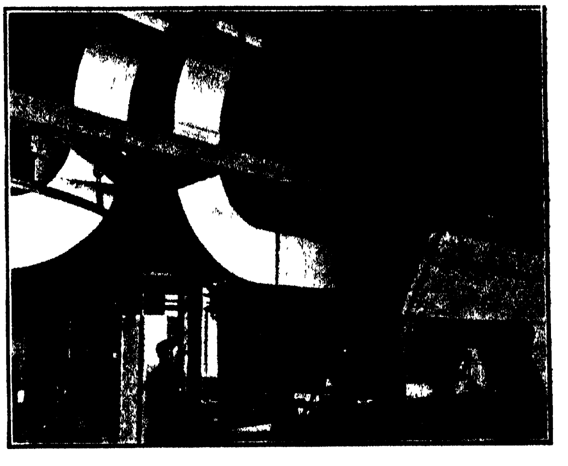
This drying equipment is an especially interesting application of air drying under rather unusual conditions. It is necessary to provide facilities for drying the base coating as rapidly as possible and, at the same time, to remove the solvent vapors effectively, in order to keep explosion and fire hazards at a minimum. The system was designed and installed by the Carrier Engineering Corporation and makes use of the ejector principle for efficient circulation of the air. As may be seen from the plan and elevation shown in Fig. 3, it is designed according to well-known counter-current principles. The air is delivered from the ejector nozzles at a velocity of approximately 1,000 ft. per minute, and passes over the driest cloth as it is on its way out of the drying chamber. In counter-direction the air then passes around the entire path covered by the cloth and is finally exhausted at an outlet directly beneath the coating head of the machine. At the base of the fan, the air current divides and a part of heated air is drawn into the fan to be recirculated directly by the ejector nozzles.

The apparatus handles about 2,500 cu.ft. of air per minute for each of the coating machines. The temperature is maintained at approximately 175 deg. F. depending upon the amount of air handled and how vigorously it is circulated. The drying chambers over the machines are connected with an exhaust system which removes a sufficient quantity of the fume-laden air, to prevent an explosive concentration. At the present time no provision is made for solvent recovery, although the drying and ventilating system is so designed that an installation might be made with a minimum of expense and inconvenience.

The second type of coating machine, known as the spool calender machine, coats at a much faster rate. The fabric from these machines is dried in a hanging room, suspended from the ceiling in festoons. The temperature in the festooning room is usually about 130 deg. F., but this too depends on the rate at which the cloth is drawn through the room. The time may be varied from 2 to 4 hours.

As the product comes from the coating machines, it has a smooth surface and looks very much like ordinary oilcloth. In order to give it the appearance of leather the coated fabric is grained or embossed under high pressure. The presses used are those of the T. W. & C. B. Sheridan Co., mechanically operated by means of a cam and triple toggle construction. On a surface 54x26 in., these presses are capable of giving a pressure of 600 tons. The embossers are of two types, a continuous press such as is shown in Fig. 6, in which the cloth is rewound automatically after each impression, and a non-continuous type, in which the leather is pulled through by hand or is rewound by the operator. The six presses in the leather embossing room have a total capacity of 30,000 to 40,000 yd. per 24 hours.





FIGS. 4 AND 5—PYROXYLIN COATING MACHINES SHOWING EXHAUSTING AND DRYING EQUIPMENT

The embossed leather receives a final coat of pyroxylin in order to give it the finish and luster desired in the finished product. This is done on coating machines somewhat similar to those already described. As will be seen in Fig. 8, these machines are provided with an ingenious exhaust system in order to remove the fumes which otherwise would diffuse throughout the room, becoming very objectionable to the workmen. The exhaust is through a duct extending along the sides of the path of the fabric and across and immediately above it, as it leaves the coating room. The vapors to be removed, being heavier than air, fall off the fabric and are drawn into the duct and through it are exhausted into the atmosphere. The quantity of air handled is simply sufficient to maintain the required suction at the duct openings.

From these machines the finished goods are drawn

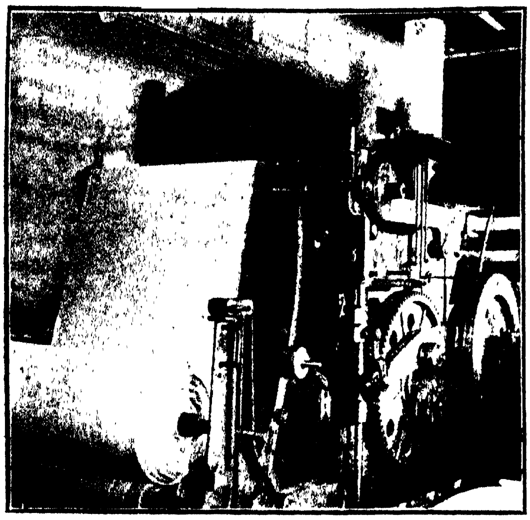


FIG. 6—LEATHER EMBOSSING PRESS SHOWING AUTOMATIC REWINDING ATTACHMENT

into another festoon drying room kept at a temperature of about 140 deg. F., from which they pass to the inspection room and shipping department.

Rubber Department

Many of the manufacturing processes in the production of rubber-coated fabrics are similar in principle to those described for artificial leather. The essential difference in the raw materials, however, and the characteristic properties of rubber itself require a very different procedure in certain steps in the manufacturing process.

The ingredients of the rubber mixes and the proportions in which they are used vary widely with the purpose for which the finished product is intended. In general, auto-top material requires the use of the following materials: para or plantation rubber (smoked sheets), reclaimed rubber, litharge, sulphur, whiting, and various softening agents, such as vulcanized oils, mineral rubber, etc. These are weighed out in charges of the proper volume to be handled in the rubber mixing machines or on the mills.

The mill room equipment consists of two Banbury internal mixers and three Wellman-Seaver-Morgan 60-in. mixing mills. The latter, which are similar to

FIG. 7—LABORATORY OF DURATEX CORPORATION

those shown in Fig. 9, are driven by a 300-hp. induction motor operating through reduction gears. Two of the mills are used for rubber mixing and the third sheets out the batches coming from the internal mixer. Directly above the rolls of each mill are safety bars electrically connected with the drive through a Cutler-Hammer magnetic clutch. In case of accident any mill can be stopped within a 6-in. travel simply by tripping this bar, thus minimizing the seriousness of the injury to the operator.

The Banbury mixer shown in Fig. 10 is unique in that it is practically automatic and accomplishes the mixing in an inclosed chamber. Essentially it consists of a trough, closed by a pneumatic ram which effectively holds the charge against the revolving blades that accomplish the actual mixing. The charge is raised on a small pneumatic elevator to a loading platform, and the batch is thrown into the feeding hopper while the machine is in operation. It is not touched then until the material is thoroughly mixed, at which time it is ejected, by means of compressed air, through a discharge gate at the bottom of the mixer. The rubber is discharged in large lumps which are worked into sheets on one of the 60-in. mills.

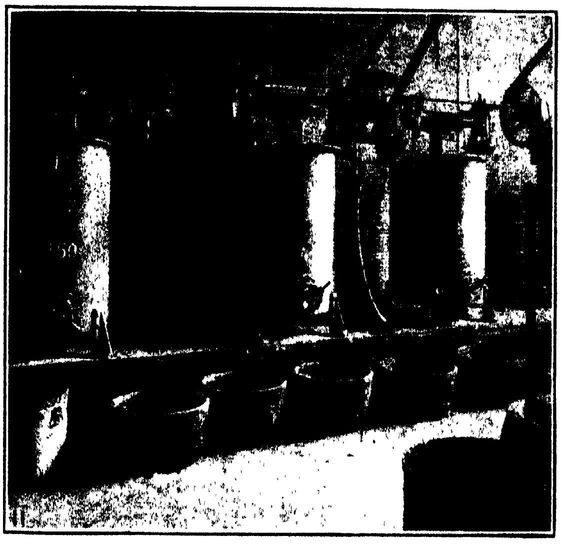
FIG. 8—LUSTER COATING ARTIFICIAL LEATHER

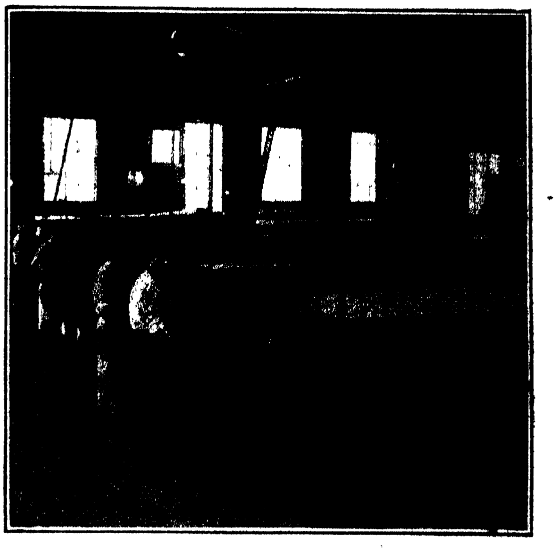
In this form the rubber is ready for the next step in the process, depending upon which of the two methods is to be used for applying it to the cloth. It may be sent to the churn room, where it is mixed with naphtha to make up a coating cement, or it may be sent to the calender room to be applied directly to the fabric.

How the Rubber Cement Is Made

The equipment of the churning room in which the sheeted rubber is dissolved or mixed with varnish makers and painters' (V. M. & P.) naphtha, consists of twenty-three multiple-operated Paragon mixers, made by the J. H. Day Co. (See Fig. 11.) The rubber and solvent introduced into the top of the mixers are churned until the product has the desired smoothness and viscosity and then the thick pasty rubber cement is drawn off at the bottom of the mixer. Smaller batches, particularly those for special colored stock, are mixed in pony mixers such as are used in paint mixing.

The rubber cement is discharged into steel or wood





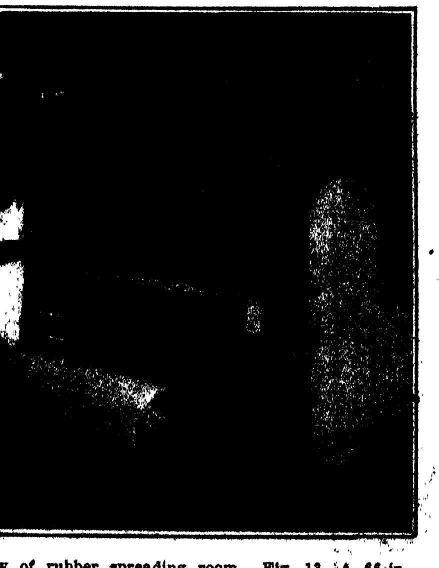


Fig. 9—Milling rubber. Fig. 10—Two Banbury internal rubber mixers. Fig. 11—Battery of mixers for rubber solution.

Fig. 12—A view of rubber spreading room. Fig. 13—A 66-in. rubber calender. Fig. 14—Rubber embossing machine.

tubs, such as are shown in Fig. 11, and these are carried by trucks to the rubber spreaders. These machines, which are to be seen in Fig. 12, operate on the same principle as the pyroxylin coaters—i.e., an adjustable knife edge pressing against a roller determines the thickness of the coat to be applied. The rubber-coated fabric moves out over a platen of steam coils heated by high-pressure steam, which serves to drive off the solvent. After the goods have received the proper weight of rubber coating, the rolls are transported to the embossing room.

For some rubber goods, such as auto-top materials, it is sometimes desirable to produce a double-texture cloth. This is accomplished on a machine known as a doubler, which merely presses together the coated surfaces of two pieces of cloth. Another machine in the same room is the starcher, which gives the silver luster finish usually associated with certain types of rubber goods, such as hospital sheeting, aprons, etc. This effect is obtained simply by dusting a mixture of potato and corn starches on the surface of the coated fabric.

Calender Room Operations

The other and more characteristic method of applying rubber to the fabric is by means of the calendering machine, one of which is shown in Fig. 13. The sheeted rubber must first be warmed, which is done by working or cracking it on a 50-in. rubber mill, such as the one in Fig. 9. Two mills are required for each of the two rubber calenders. The mills are of the same construction as those used for mixing, and they, too, are protected by the safety bars previously described.

The calenders, made by the Wellman-Seaver-Morgan Co., have three hollow chilled iron rolls, 24 in. in diameter and 66 in. wide. They are provided with steam and water connections for proper temperature control. The properly warmed rubber stock is fed into the calender between the two upper rolls and it forms a coat of predetermined thickness on the middle roll. This is then calendered onto the cloth fed in between the two lower rolls from the opposite side of the machine. The calender effect is obtained by gearing which permits the two lower rolls to turn at the same speed while the top roll moves at a slightly different rate.

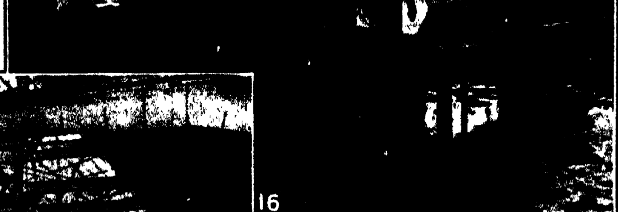
The calenders are driven by a variable speed 45-90 direct-current motor (230 volts, 175-230 amperes) operating through speed reduction gears. Two 240-volt, 165-kw. six-phase rotary converters supply the power to these motors.

As the rubberized cloth leaves the calenders, it is given a thin coat of a quick drying water varnish which prevents the coated surfaces from sticking to the cloth in the rolls and later from adhering to the graining roll during embossing—the next step in the manufacturing process.

Rubber Embossing and Vulcanizing

The fabric that has been coated on the calenders or in the rubber spreading room is taken to the embossing room. In contrast to artificial leather embossing, high pressures are not necessary. Rather a roller embosser is used consisting of an engraved steel roller turning between two paper or fiber covered rolls. The goods are fed in between the two lower rolls, follow around the engraved roll for about 180 deg. and pass out over the upper roll. The embossers are belt-driven through overhead countershafts. As shown in Fig. 14, the gearing and moving parts of these machines are covered for the purpose of protecting the operators.

The embossed material is now ready to be vulcanized. The rolls of cloth are taken to the vulcanizing room and as the goods are festooned into the ovens they receive a coat of varnish in order to give them the luster and finish desired. The vulcanizing ovens are long insulated chambers heated by steam coils. The temperature is automatically controlled and recorded by a Tycos "Thermo-Tyme" regulator. This instrument controls the steam supply so that the temperature is gradually increased for a predetermined period, until the vulcan-



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Two Views of Dye House

Fig. 15—Continuous dyeing machine with can drier in background.

Fig. 16—Jig dyers showing padder for direct dyes.

izing temperature (about 225 deg. F.) is reached. It is then held at this temperature for an hour or until vulcanization is complete.

Not all of the rubber goods, however, are vulcanized by dry heat. The single texture materials for hospital sheeting, raincoats, etc., are cured by means of sulphur chloride, either as a vapor or in a suitable solvent. The latter is known as the "liquid acid cure." The goods are passed over rolls which apply the sulphur chloride solution, the excess of which is later neutralized with ammonia.

Inspection and Testing

Careful inspection, both physical and chemical, is exercised over all the products of the Duratex Corporation. In the inspection room, a view of which is shown in Fig. 17, both the pyroxylin- and rubber-coated fabrics are examined for surface blemishes. Colors are checked and matched with company and buyers' standards. The material is weighed to see if it is up to standard.

In the chemical laboratory (Fig. 7) samples of all goods leaving the factory are tested for aging and weathering, for tensile strength, resistance to wear, stretching,[1] etc. Ultra-violet light from a Cooper-Hewitt mercury-arc lamp is used for determining color fastness and possible deterioration due to sunlight and exposure. The method and machine of the Bureau of Standards are used for strength determination.

The rubber-compounding ingredients, nitrocellulose, solvents—in fact, all raw materials—are evaluated according to standard physical and chemical tests. The fabrics are judged according to weight, weave and construction, thread count, etc.

Dyeing and Finishing

In addition to the inspection and laboratory testing, other operations common to both the pyroxylin and rubber departments include the dyeing and preparing of the fabrics as well as the power generation and distribution. Practically all of the gray goods used for the production of coated fabrics must first be dyed. Sulphur colors are used on top materials and other goods where it is desired that the product be fast to sunlight. For a considerable proportion of the artificial leather, fastness is not especially essential and direct dyes are used.

Oilcloth which is to be dyed with sulphur colors is first treated with diastase to render soluble the sizing material in the cloth. The removal of the size enables the dyer to obtain more uniform shades.

In the continuous dyeing machine shown in Fig. 15, seven separate baths are used in applying the sulphur colors. The cloth is wetted, passed into a dye bath in which the sulphur colors have been reduced by a sodium sulphide solution, and then into a chrome bath. After a thorough washing, the dyed goods are mangled and dried on the can driers, which may be seen in the background of Fig. 15.

Sulphur colors are also applied in the jig dyeing machines shown in Fig. 16. In this case it is necessary to change the bath for each of the dyeing, developing and washing operations. The cloth is dyed with direct dyes on a machine known as a padder, which consists essentially of a dye box with superimposed squeeze rolls. The cloth is passed through the padder as many

FIG. 17—VIEW OF INSPECTION ROOM

times as is required to obtain the shade desired. All of the dyed cloth must be stretched before it is coated, and a portion of it is napped and felted. The first operation takes place in a machine known as a tenter. This piece of equipment, which is 90 ft. in length, consists of two parallel traveling belts equipped with gripping devices which clutch the cloth and slowly spread it to the desired width as it is drawn through an oven heated by steam coils and forced hot-air draft to a temperature of around 190 deg. F.

The heavier dyed goods are napped on machines in which part the surface threads of the cloth are combed by wire teeth projections on steel drums revolving in opposite directions. There are several reasons for this operation. When the fabric is napped on the under side, it gives the artificial leather an additional pliability and plumpness as well as the soft feel that is often associated with leather. For certain grades, such as "Peelless" artificial leather, the cloth is napped on the side to be coated and then sheared to an even surface that allows the coating a better anchorage.

Unusual Features in Power Plant

The power plant contains a number of unique features that have attracted wide attention among engineers.[2] For its size and the kind of loads supplied, the plant is extremely simple, consisting of a single boiler of 3,330 sq.ft. of heating surface and one turbo-generator. Because of special equipment, including a new type of economizer installed by the Babcock & Wilcox Co., as well as forced and induced drafts, the boiler is operated, at times, up to 350 per cent of its normal rating. It is fired by an automatic Coxe chain-grate stoker. The turbo-generator is of the Rateau type, made by the Ridgeway Dynamo & Engine Co., and has a capacity of 625 kva., operating at 3,600 r.p.m. It generates 460 volt three-phase sixty-cycle power. When operating at 20 lb. back pressure and 500 kw. load, the turbo-generator requires 25,800 lb. of steam per hour.

Low-temperature steam requirements for heating and process work in the plant have been estimated to reach as high as 10,000,000 lb. per month during the winter. Figures for the steam consumed in the individual processes, however, are not immediately available.

The production of pyroxylin- and rubber-coated fabrics, although largely a specialized industry, involves the application of chemical engineering in most of the manufacturing processes. The writer is indebted to the officials of the company for their assistance in the preparation of this article.

[1] For an excellent article on "Testing Leather Substitutes and Top Materials," the reader is referred to J. B. Davis, *J. Soc. Automotive Eng.*, vol. 12, No. 3, pp. 276-82, March, 1923.

[2] "Power Plant of Duratex Company Has Many Interesting Features," *Power*, vol. 56, No. 10, pp. 358-62, Sept. 5, 1922.

Use of Pulverized Coal

The Methods That Have Been Perfected in Cement Mill Practice Form a Basis for Application in Other Industries

THE use of powdered coal as an industrial fuel has spread to such a large extent recently that the methods employed in the cement industry, which was the first industry to use this fuel, will be of interest to all. In *Power* for May 8, 1923, H. A. Schaffer, conservation engineer of the Portland Cement Association, has a paper on this subject. Mr. Schaffer says, in part:

When rotary kilns for cement manufacturers were introduced in this country about 30 years ago, a change was necessarily made from the coke burned in the old-style stationary, vertical kilns. The new fuel had to be one that could be blown into the revolving cylinder to produce instantaneously the intense temperature needed for clinkering the raw materials

At first crude oil was used with good results, but the increasing cost of this fuel in the East, where most of the early plants were located, led to trials of powdered coal. It was in 1897 that this finely ground material was first adopted as fuel for cement burning in several mills.

While crude oil and natural gas are today used in some localities where prices will permit, pulverized coal is the usual fuel. In fact, out of the 115 operating cement plants reporting to the United States Geological Survey in 1921, 92 burned powdered coal only and 6 more employed coal in conjunction with oil or gas. All but one of the remaining 17 burned oil; the exception utilized natural gas.

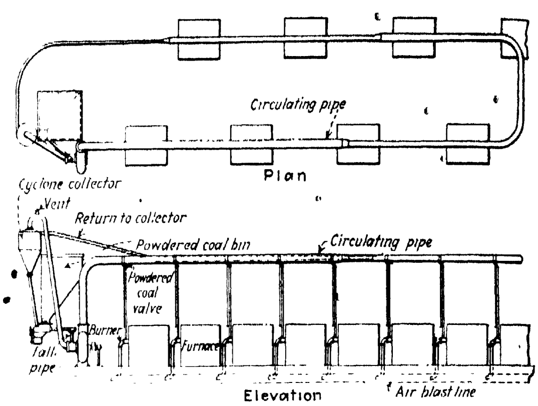
Kiln Fuel Requirements

Of course the fuel problems in the kilns of a cement mill are somewhat different from those met in power-plant practice. For instance, the great heat produced by a flame of pulverized coal is an advantage in cement manufacture. There the raw mix must be heated to a temperature of from 2,500 to 3,000 deg. F. in order to bring about the desired chemical reactions as the materials are burned into the clinker that is later ground into cement. But in a power plant this intense heat introduces difficulties, met to some extent by hollow furnace walls.

Ash, if reasonably constant and not too great in amount, offers no problem in the cement kiln, as allowance can be made for it in proportioning the mix. Apparatus for burning powdered coal in kilns is therefore simpler than that recommended for modern boiler installations, where arrangements for collecting ash must be made and attention directed to preventing injury to the furnace from heat.

In view of the long experience of the cement manufacturers with powdered coal in their kilns the question naturally arises as to why this fuel is not widely used in their power plants. The answer lies in the failures that met their early attempts to secure the advantages of pulverized coal as a boiler fuel, and in the recent advances in the utilization of the hot kiln gases for heating the power-plant boilers.

Various experiments were made in power plants with the crude apparatus early available for burning powdered coal, but none of these trials was altogether successful. Probably the gravest error made lay in the failure to proportion the furnaces to suit the fuel, with



TYPICAL PULVERIZED COAL-HANDLING SYSTEM FOR HEATING FURNACES

a resultant inability to make them stand up in the hard, continuous service demanded in cement-mill operation. As many more pressing problems arose to occupy the manufacturers' attention and the possibilities of waste-heat utilization came to the front, the development of workable methods for burning powdered coal under boilers was left to others more vitally interested in that phase of power-plant design.

Renewed Interest Now Shown

Powdered-coal installations have recently been made in a few cement mills, yet it is hardly probable that a great deal more will be done in this field, simply because the engineers of the industry are working on an even more economical plan.

In most plants the proper conservation of the hot gases leaving the kilns will provide all the heat needed for the boilers in a power station big enough to supply the entire plant. As the power needed to operate the heavy machinery in a cement mill is large, this means a marked saving in fuel. The installment of waste-heat boilers requires a very heavy investment, however, and involves many problems that must be solved for each plant.

In any cases where additional fuel must be bought to generate power, the possibility of utilizing a low grade of coal when powdered is especialy important, for a large quantity of fuel is required to make cement —about 200 lb. of coal to the barrel of 376 lb. when the waste heat is not utilized. Much more than half of this amount is now being pulverized for burning in the kilns, but a big total is still used without grinding to generate power.

In one case a cement plant has been able to burn anthracite silt, coke breeze and bituminous screenings in the same powdered-coal furnace, with satisfactory results. This furnace is equipped with both vertical and horizontal flare-type burners, for use with low- and high-volatile fuels, respectively. In the kilns it is difficult to use even a part anthracite, and the chemical composition of the coal must fall within certain limits.

Handling Powdered Coal

Especially in the field of safety the cement industry can offer valuable experience. In the early days coal dust was not generally recognized as a dangerous explosive, and inexperience resulted in a number of accidents. Since that time safe methods of handling this fuel have been worked out, and a campaign of education under the direction of the Accident Preven-

tion and Insurance Bureau of the Portland Cement Association has greatly reduced the hazard.

Many plants have never had an accident from this source, and with the installation of modern equipment the industry as a whole is making the coal room safe. In 1922 the cement manufacturers of the United States burned over 5,800,000 tons of powdered coal in about 100 separate plants.

Above all, the grinding and conveying equipment should be tight enough to prevent the escape of dust. The coal buildings should be well lighted so that attendants can work with facility, and well ventilated so that there is good circulation of air. Under no conditions should open lights be allowed in the coal house. Magnetic separators should remove all iron from the incoming coal to avoid sparks in the grinders. The coal driers should be separated from the grinding equipment by a fire wall, at least. Experience has shown that danger has been greater to life than to property where accidents have occurred, as the trouble has been caused more by "flares" that severely burn workmen than by explosions that wreck buildings. Employees must be made to understand the necessity of continuous observation of established precautions, and none but trustworthy men should be employed in the coal department. It is not enough to post accident-prevention rules—they must be observed.

For cement burning, finely ground coal has been found essential, as much heat is lost from incomplete combustion when coarser material is used. Eighty-five per cent passing a 200-mesh sieve is considered good. Fine grinding, however, tends to shorten the flame and to make it hotter, so that again the best boiler-room practice may differ from that cited.

In cement mills the procedure is first to dry the coal in rotary driers and then to pulverize it, usually in mills of the centrifugal type or in tube mills after any lumps have been broken up in small rolls or crushers. In a number of cases powdered coal is burned in the coal driers, but this is not such common practice as it is to use this fuel in drying the raw materials before they are ground to a fine powder. In at least one public-utility power plant the driers have been omitted entirely. The practice of pulverizing the material without drying is followed in one or more other cases when coal having a low moisture content is received.

Conservation of Molding Sand

For some years the New London Ship & Engine Co. has been reclaiming molding sand by mixing it with clay in a muller. A refractory clay having high plasticity is deflocculated with alkali and added in correct quantity to the used sand. In fact, merely mulling the sand increases the bond (as indicated by the Doty test on a 1-in. square prism described on p. 860 of our issue of May 14, and also by the dye adsorption test). This fact was reported to the recent meeting of the American Foundrymen's Association by metallurgists from the Hunt-Spiller Corporation, together with additional experiments indicating that a dried and remoistened sand is stronger than one possessing its original moisture. There will also be found a certain percentage of moisture, developing maximum cohesiveness. Other things being equal, the cohesiveness varies greatly with the grain size.

All these facts have considerable bearing on the reclamation of foundry sand—a problem of first importance today. A canvass of 145 plants showed a total of 1,000 tons rejected per working day—usually dumped at a cost of about \$1.50 per ton. This amount of sand equals about one-fifth the total in circulation in the foundries. H. M. Lane has worked on this problem for several years, and has come to the conclusion that not less than 60 per cent of the waste sand can be reclaimed at a profit and successfully re-used if the molders and core makers do not know they are getting it. Various hydraulic classifiers, well known to ore-dressing plants, can be used to separate fine particles from the burned sand, but on account of the expense of drying, Mr. Lane recommends the following procedure: Crush the sand in a ball mill, reclaim metal values by a magnetic pulley, and blow out the fine particles in a cascade separator. Then mix with the proper amount of a "fat" clay and water in a muller, and the sand is ready for re-use. If cores are to be made of it, a binder other than oil is necessary.

F. L. Wolf and A. A. Grubb also described methods in use at the Ohio Brass Co. Floor sweepings are screened, and the material which passes 8 mesh is now reclaimed, whereas it was formerly thrown away. Comparative tests follow:

	Satisfactory Sand	Refuse Sand
Average fineness	128.0	116.0
Dye adsorption	0.062	0.068
Moisture	7.5	5.2
Bond	163.0	144.0
Permeability	180.0	140.0

If the refuse sand is mulled to proper water content, it will produce good castings, but dries very rapidly in the pile. This tendency has been entirely eliminated by mulling the refuse with a calculated amount of fine Ohio sand having high dye adsorption. After this treatment the reclaimed sand has a fineness of 125 and dye adsorption of 0.073, moisture of 6.5 and permeability of 181. It works well in every respect.

Volatilization of Zinc Ores

Behavior of zinc in ores treated by the volatilization process depends largely on the arrangement of the mineral in the ore, also on the atmosphere that is maintained in the furnace during treatment. Experiments made by metallurgists of the Interior Department at the Salt Lake City experiment station of the Bureau of Mines have indicated that in a strictly oxidizing atmosphere little zinc is volatilized, especially in zinc carbonate ores. In zinc concentrates (zinc 30 to 40 per cent, the silver and lead 6 oz. and 6 per cent, respectively), the quality of silver and lead volatilized ranged from 50 to 80 per cent, whereas the amount of zinc volatilized generally averaged less than 1 per cent.

The behavior of zinc is very erratic, the conditions under which it is volatilized probably depending largely on the sulphur content in the ore, which causes a complicated series of chemical reactions. When crude ores high in sulphur content have been treated, most experiments indicated nearly complete volatilization of the zinc, but when the ore was given a preliminary roast to reduce the sulphur content, the amount of zinc volatilized varied considerably.

The presence of zinc in carbonate ores containing silver, lead and zinc indicates that by volatilization a clean-cut separation can be made between the lead and zinc. On the other hand, in treating complex sulphide ores much of the zinc was volatilized in nearly every experiment, and was precipitated in the Cottrell treaters as chloride with the other metal chlorides.

Strain and Fracture in Metals

Notes on Dr. Rosenhain's Recent Lecture Tour—Why Does Slip, Once Started, Stop?—Method for Distinguishing Shock Fractures—Cure for Season Cracking—How to Increase Endurance of Metal to Alternating Stress

STRAIN and fracture link up closely with the title of Dr. Rosenhain's first lecture on "Hardness and Hardening." (See *Chem. & Met.*, May 21, 1923, p. 899.) One way to harden a metal is to strain it. Furthermore, hardness might be regarded as the inherent capacity of the metal to resist strain and fracture. Again, plastic deformation in sound metal is accompanied by slip within the individual crystals comprising the aggregate—hardness is associated with the counter-phenomenon of "slip-interference."

Crystalline Structure of Metals

In view of the fundamental importance to any rational explanation of the experimental facts, it would be well to note briefly two pieces of strong evidence that the tiny granules making up a piece of metal are essentially crystalline in internal arrangement, despite the irregularity of their boundaries. A polished surface of substantially pure metal slightly etched shows these networks when examined under the microscope. Very deep etching of some alloys develops pits on the surfaces, these pits bounded by facets, oriented in a strictly parallel direction within each grain. (Fig. 1.) An easy way to show the essential and close parallelism of these facets is to illuminate the specimen obliquely at such an angle that rays are reflected from one set of planes up through the ocular. All the facets turned one way in one crystal flash bright at the same instant. A rather more striking proof of the similarity of the pitting action occurring on even slight etching—which merely gives adjacent grains different tones of gray—was given many years ago by Dr. Rosenhain. He illuminated such a specimen from two directions with red and green light, respectively. Individual grains stood out red or green in a dark background, as they reflected the corresponding light up the microscope tube or clear outside it, as the case might be.

Of course, the clinching proof is given by X-ray diffraction patterns. These show without doubt that the individual metallic grains are composed of atoms built up in a regular geometric pattern in space. (See, for instance, "Studies of Crystal Structure With X-Rays," by Edgar C. Bain, *Chem. & Met.*, Oct. 5, 1921, p. 657.) Auxiliary lines of evidence show that the atoms (which probably consist of a nucleus and an outer system of electrons) entirely dominate the space they occupy so tenuously. They act like they almost touch one another, they cannot wander about; they oscillate or gyrate slightly about a mean position; and there is in general no room for additional atoms in that closely packed space lattice. Many atoms crystallize in the face-centered cubic system, and in this it is easily shown that along three complementary planes (called the "octahedral planes" by crystallographers) the atoms are arranged with checkerboard regularity.

It is along these octahedral planes that cubic metals such as iron, copper, aluminum and lead slip under heavy load. Of course at low unit loads (within the proportional limit) the crystal deforms in an elastic manner—the whole lattice is pushed and pulled slightly out of square; its normal shape is almost instantly resumed on release of load. But when the load is too great and is applied fairly deliberately, the crystal appears to slip—to part into blocks which move past one another, yet quickly regain even greater stability than they had formerly.

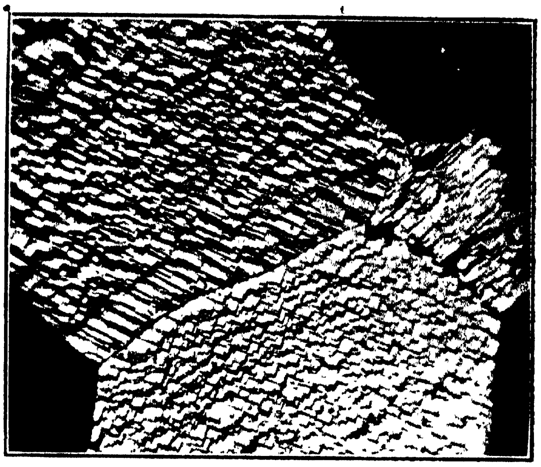


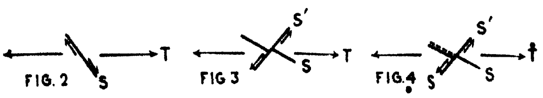
FIG. 1—CRYSTAL FACETS ON THE GRAINS OF SILICON STEEL. (STEAD)

Why Does Slip Stop?

It might be asked, Why does slip stop, once started? In many crystals it does not, especially if the stress is localized by a notch or if the load is suddenly applied with a great shock. Then the crystal does break across with a true cleavage fracture. But that is somewhat beside the point, for normal plastic flow is accompanied by intermittent slip. Dr. Rosenhain pointed out the fact that slip is a gliding motion, not a sliding one; movement involves an interchange of atomic bonds rather than a breaking of bonds. Therefore we find slip to occur along those planes where atoms are packed with greatest regularity and at shortest distances so that they may change partners like dancers in the "grand right-and-left," constantly changing yet never free. Indeed a test piece of brittle zinc made up of a single crystal the basal plane of which (where the atoms are regularly spaced) is set at about 45 deg. to the direction of pull, has been elongated several thousand per cent before fracture!

Furthermore, it is most probable that certain bonding actions occur between whole groups of atoms, and for that reason the atomic movements involved in crystalline slip involve a gradual transfer and not a simultaneous change. In other words, the first region is rapidly transferred or propagated to its next adjacent

layers—an action similar to that evidenced on a large scale by the drop of beam and its recovery in a tension test. But the atomic bonding is never destroyed completely; some regions of the disturbed surfaces take hold again in their exactly normal spacings with their neighbors, others never do. The latter constitute the disturbed atoms of the amorphous phase at the "surface" of slip—surface does not mean a definite plane, because slip occurs throughout a layer many atoms thick, and disturbs that layer profoundly. Such actions destroy the very mechanism of slip by disorganizing the crystallinity of the region, whereupon slip must stop. Crystallinity, slip and plastic flow are con-



FIGS. 2 TO 4—SLIP STOPS BY THE MOVEMENTS ALONG CONJUGATE PLANES

comitant phenomena, as is developed at length by a consideration of hardening.

Slip, therefore, looked at in this light, has a "self-stopping" tendency. Dr. Rosenhain is of the opinion that this tendency is not wholly sufficient, but is reinforced by the fact that a cubic crystal develops simultaneous slips on intersecting planes. Suppose, for instance, that by virtue of a tension T, slip occurs along a plane of maximum shear S. (Fig. 2.) Quickly thereafter—almost simultaneously—the same thing occurs on a conjugate plane S'. (Fig. 3.) This fractures the first plane, it becomes "stepped," as it were, and in order for further movement to occur along the first plane and direction, it would be necessary for new movement to be initiated in fresh material, as indicated by the dotted line in Fig. 4. Furthermore, the amorphous metal generated along S' would have to be broken through as well. Now consider the fact that not only two but three octahedral planes are simultaneously operating in a ferrite crystal, and that slip occurs not only in one but many planes along each direction, and it may be concluded that the various intersections will speedily lock each other.

In all such actions taking place in fine-grained metal, the influence of the crystalline boundaries in halting slip is evidently large. Not only is a certain amount of end support given, but it is necessary for the plane of movement to change in direction. Such factors are powerful preventives of rapid crystalline fracture by cleavage breaks. Therefore under steady, slow stress, the crystals are normally observed to slip, first here, then there; finally all of them have changed their shape and elongated to a noticeable extent. As deformation proceeds the crystals shred out gradually and finally the metal possesses every appearance of being "fibrous." (These "fibers," however, are much elongated crystals, highly intersected by surfaces of slip.) At last possibility for further slip has been exhausted and the individual crystals finally break across the altered layers, in a direction sharply inclined to the direction of strain. Even here it is important to remember that the crystals are broken across their body, not torn apart from one another. This can be demonstrated by microscopic examination (Fig. 5) if the broken surface is carefully protected by a thick copper-plate (electro-deposit).

However, there are instances when ductile crystals may be fractured by cleavage and with no apparent deformation. For instance, a thin sheet of very pure iron, if cold-rolled and properly heat-treated, will be made up of very large crystals, extending completely through the sheet from face to face. Now if this sheet is bent in a correct manner, so as to throw tension only along the octahedral planes of the single crystal, a brittle break with no extension will result. Pulled apart otherwise, the sheet as a whole necks down sharply and breaks after ductile flow.

Again, if a bar of tough wrought iron be notched sharply on all four sides, held in a vise and struck with a hammer it will snap off like a glass rod. If such a break is copper-plated and a normal section examined, it will be found that it follows long facets across large groups of crystals, passing from group to group with small change in direction. Crystals have not been torn apart, they have not even deformed, but apparently split open. A simultaneous development of Neumann bands in the ferrite crystals undergoing impact stress is an important side issue. Dr. Rosenhain regards them to be the "echo" of cleavage fractures by shock.

Path of Fracture in Mild Steel

So much for slip in pure metal, or in the uniform crystals of solid solution. How does mild steel behave, with its two constituents, soft ferrite and harder, less ductile pearlite?

Tested in tension, it might be expected that the fracture would occur in the softer ferrite, but actually it passes through pearlite volumes as well, although the ferrite crystals are shredded out. Apparently the less ductile pearlite does not develop brittle breaks until the last end—it is held up to its work on all sides by the surrounding meshes of ferrite. Finally, when the pearlitic masses must assume considerable extension, they break short across, throwing their loads into the surrounding ferrite, which in turn breaks, joining up to the cracks in the harder constituent. Thus it is that the surface of rupture passes indiscriminately across both. (Fig. 6.)

Fig. 5—Broken ends of elongated crystals; fracture copper-plated before sectioning. (Rosenhain).

Shock failures, on the contrary, follow the ferrite meshes exclusively or nearly so, simply because the cleavage planes developed by sudden impact are much more extensive and continuous in that constituent than in the laminated pearlite. This characteristic is a very good method of distinguishing whether a failure was caused by gradual or sudden overload.

Intergranular Cement

It is now interesting to inquire what kind of matter is present at the grain boundaries in normal metal, since these regions always hold together even when the metal is broken either after slow stressing or by shock.

Obviously when two crystalline bodies grow toward each other by adding on atom by atom, their junction will be filled with atoms which to an unknown depth

will be pulled both ways. It may be that the transition from one crystalline orientation to another may be gradual, accomplished step by step; it may be that there are a great number of little crystallites of colloidal size and with independent systems existing there; or it may be simply a heterogeneous mass of no order whatever. At any rate, there is evidence that a layer of considerable depth exists here, the properties of which differ from those of a sizable crysta

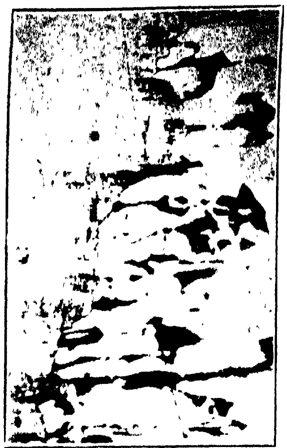


Fig. 6. Slow tension fracture, across both ferrite and pearlite in mild steel (Rosenhain)

Any of these suppositions as to the nature of the cementing material postulate a substance which cannot deform by slip. It can only move after a clear break which pulls atom from atom. No plane surfaces exist along which interatomic forces are of similar intensities, and along which slip can take place. It is known that breaking atom from atom requires vastly larger forces than does slip—the cohesion atom to atom is very large. The lecturer likened the two actions to this: Take two smooth plates; moisten each slightly with a few drops of liquid and rub them closely together. It requires comparatively little force to slide one past the other, but a very great force indeed to pull them directly apart.

Such great strength residing at the crystal boundaries at low temperatures suggests the presence of amorphous material. Non-crystalline metal is really a supercooled liquid like a glass; viscous, brittle and hard at ordinary temperatures but softer and weaker at higher temperatures.

While even the most drastic quenching of a fine spray of pure metal produces beads which when examined are seen to be made up of small crystals, it does not necessarily follow that *all* metal is crystalline. In fact, we can get alloys which, when compared to the same material after radically different heat-treatment, possess all the properties we would expect of amorphous material (arguing from analogy to solid substances known to contain no crystalline matter).

Thus it is known that the viscosity of a liquid is very low; if it can be undercooled like a slag without crystallizing, it has no definite "freezing" temperature or even temperature range; its viscosity increases at an increasing rate until, as indicated in Fig. 7, it reaches a very high value. In the liquid state, above the crystallizing temperature, the mass is composed of single atoms free to move; the viscosity and strength are quite low. As the mass cools the atoms aggregate into groups and ever larger particles and the mobility of each is greatly diminished, viscosity and strength multiply rapidly to millions of times those of the liquid until finally, past a "threshold temperature," the whole mass is as one group of helter-skelter atoms and viscous motion ceases. Below this temperature there must be an initial stress of appropriate magnitude before any motion occurs in the material at all.

If that same melt, instead of being undercooled, is allowed to crystallize, the viscosity and strength of the material enlarges greatly at the crystallization temperature, and on further cooling increases somewhat, but at nowhere near the rate which the amorphous material assumes. The viscosity-temperature (and inferentially the strength-temperature) curves intersect at a point dubbed the "equicohesive temperature" by Dr. Jeffries. (*E*, Fig. 7.) (See *Trans. Am. Inst. Metals*, 1917, p. 300.) Below *E* movement under stress must take place in the crystal by slip long before the amorphous material of its joints would break. Above *E* the opposite is the case. In fact, if the metal could be held at temperatures just below freezing, failure ought to occur at very low stresses and should be by pulling the grains apart—in other words, failure should be intercrystalline rather than transgranular.

Experimentally this has been verified beautifully. Lead—a very ductile metal—when tested in tension at room temperature draws down nearly to a knife edge before breaking. But hang up a bar long enough to give a stress near its support of say 4 lb. per sq.in., maintain it carefully 5 deg. below its melting point, and in a short time the bar will pull itself apart, with a brittle fracture having no extension or contraction in area. Other metals show the same phenomenon. Microscopic examination shows without question that such failure occurs by pulling the crystals apart at their boundaries. Likewise it has been proved that the trouble is not caused by the melting of an impurity occurring at the grain boundaries, first because intercrystalline fractures can be produced at successive temperatures (lower than the melting point of the most fusible phase, but above *E*) by imposing a higher stress or giving it a longer time to act. Second, gold with a certified purity of 99.999 is no exception to the rule.

Failure at Grain Boundaries

One very curious method of failure has been termed "season cracking." Such things as cartridge cases, tubing and utensils spun from thin metal of brass, aluminum, purest lead and even iron have at times developed cracks after years of use or storage, and for no apparent reason. When examined, failure is always found to be intergranular, and the metal always appears to contain internal stresses of considerable magnitude—either residual from the last manufacturing operation or imposed from outside sources during use. It springs apart after failure, or if small portions of the material be very carefully removed the two pieces deform somewhat so that they will not fit together again. If a test

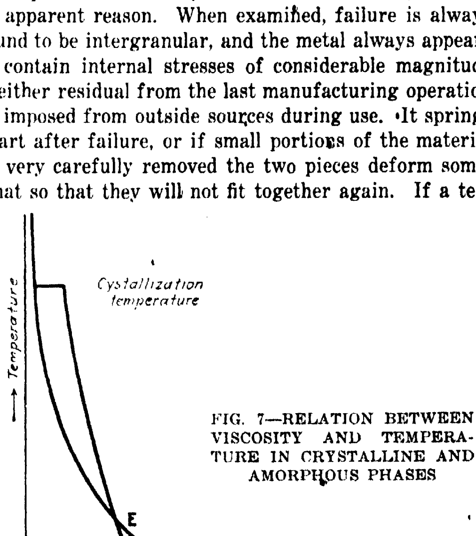


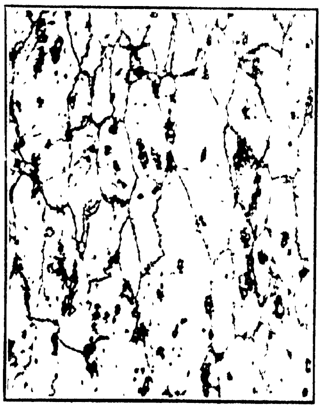
FIG. 7—RELATION BETWEEN VISCOSITY AND TEMPERATURE IN CRYSTALLINE AND AMORPHOUS PHASES

TABLE I

Stress, Lb. Per Sq.In.	Time to Produce Fracture	Nature of Break
54,000	2 min	Transcrystalline
36,000	9 min.	Partly intergranular
31,000	31 min.	Partly intergranular
29,000	56 min	Wholly intergranular
18,000	3 weeks	Wholly intergranular

piece be cut from such a defective article and broken in a testing machine, the bar will neck down and will show a perfectly normal transcrystalline rupture on slip-planes. Therefore there is no inherent weakness in the material. In this and other ways it has been proved that season-cracking is caused by a long-continued low stress.

These facts involve the movement of something in the metal which is unyielding against loads applied with moderate speeds, but yielding to loads applied with extreme slowness. Is not this a characteristic of amorphous material like pitch?—fragile to a blow but slowly engulfing a hammer laid upon it. This inference is fortified by experiments on a 3:20:77 Cu:Zn:Al alloy. Identical test pieces were made up and different loads hung on. Time for fracture was then recorded as given in Table I. If these results be plotted on semi-logarithmic paper, they locate a straight line, exactly as does a plot of the law of viscous flow. On long slow loads far below the elastic limit of the crystal the intergranular material in this alloy yields slowly and eventual fracture occurs by pulling the grains apart.



FIGS. 8 AND 9—ALLOY "A" (3.20·77 Cu Zn Al). × 150
Fig. 8—Intergranular crack in over-annealed piece.
Fig. 9—Stable metal after annealing at 250 deg. C.

Will any metal fail thus if given a long enough time under moderate stress? Dr. Rosenhain believes this depends upon the shape of the crystals; if they are very smooth, he would answer "Yes." If, on the other hand, the crystal boundaries are rough and interlock somewhat, "No." Under the latter circumstances a little yield in the boundary metal will alter the stress distribution—eventually nearly all the load will be carried by the interlocks on the crystals. This assumption is also verified by experiment. If the Cu:Zn:Al alloy mentioned above be tested in the rolled condition, it is free from intergranular rupture on prolonged loadings. This is true even if the metal is reheated to 450 deg. C. and a reduction of 50 per cent then given. However, if such safe material is annealed (1 hour at 425 deg. C.), the alloy will have the microstructure of Fig. 8 and intergranular breaks result. Annealing at temperatures below 250 deg. C. retains the rolled structure of Fig. 9, and the metal is immune from accelerated season-cracking. (See "Eleventh Alloys Research Report," p. 177.)

Many investigators have found that certain corrosive agents hasten season-cracking very much. In fact, immersion in mercurous nitrate is often specified for acceptance tests of cold-worked brass. If dangerous internal strains exist, the crystal boundaries are parted in a few seconds, probably by a selective corrosion of the amorphous metal at those places. Traces of ammonia gas in the atmosphere are accelerators of season-cracking. Dr. Rosenhain likened the action to two pieces of paper held together with soft gum. If the pieces were pulled apart quickly, the paper would tear, leaving the joint intact. If the pulling was very slow, the joint would slowly split, while if the joint were steamed slightly it would lose almost all its coherency. (However, chemical action is not necessary to explain the facts of Table I. That alloy while being stressed has been rigorously isolated from oxygen in a vacuum or in an atmosphere of hydrogen. Time of rupture is about twice as long as the periods noted, but intergranular rupture is still unquestioned.) Similar data have been noted in the action of caustic soda and molten nitrates on steel boilers. Bent boiler plate or cold-worked metal for such service should be normalized rather than given an anneal below the Ac range.

The so-called fatigue fractures constitute a last category which should be examined. If a metal is mildly overstrained once, and then allowed to rest, the amorphous metal generated at slip-planes and crystal boundaries may recrystallize to a certain extent—or at any rate the lesion appears to heal. If, however, the first overstrain is immediately reversed, and motion on the crystalline slip-planes is in great part reversed, the first lesions cannot heal, but actually extend themselves.

Experimentally this is observed as follows: If a piece of pure iron be given several thousand such alternate stresses, certain crystals will develop short markings which can be seen under the microscope. These markings, on continuing the experiment, grow endwise clear across the crystal, and gradually multiply into what are undoubtedly cracks. Finally the piece breaks—the fracture follows a succession of these fissures; if the stresses have been high, the final appearance is quite typical of coarse-crystalline metal broken under shock. In passing, it may be said that it is this appearance which has led to the mistaken idea that alternating stresses cause metal to crystallize.

The most important physical property for many classes of service like shafting and axles is the endurance limit of the metal—i.e., the stress which may be repeated an indefinite number of times without starting the first tiny internal fracture. This property is closely allied in magnitude to the stress which causes the first slip in the metallic crystals. Determining the proportional limit in tension does not register this value, since permanent deformation in individual crystals might have occurred long since. Furthermore, the metal may have previously been strained, and have acquired thereby a fictitiously high elastic limit. Consequently

an actual series of endurance tests is necessary to determine this important property, a matter which requires many long-continued experiments to determine satisfactorily, since it has been shown that specimens will break after 60 million alternations.

Many investigators have worked on this problem, notably Prof. Haigh at the Royal Naval College, C. E. Stromeyer at Manchester, D. J. McAdam at Annapolis (*Chem. & Met.*, Dec. 14, 1921, vol. 25, p. 1081) and Messrs. Moore and Kommers at Urbana (*Chem. & Met.*, vol. 24, p. 370; vol. 25, p. 1141), and at the present time a series of important tests are under way by the British Aëronautical Research Committee. Some striking results have already been published by Prof. C. F. Jenkin of Oxford. (*The Engineer*, Dec. 8, 1922, p. 612; *Chem. & Met.*, May 7, 1923, p. 811.) In these articles he interpreted or predicted many obscure fatigue phenomena by means of an ingenious model.

Such information has fortified Dr. Rosenhain in his belief that we have at present some short methods which give the true endurance limit of a metal. Stromeyer proposes that the evolution of a considerable amount of heat in a fatigue specimen should mark the load where alternating slips begin in the highest stressed crystals. An even neater and handier scheme has been devised by Gough in the National Physical Laboratory (see *The Engineer*, Aug. 12, 1921) and on experimentation checks known endurance limits to within 5 or 6 per cent.

In this method a Wohler test (rotating cantilever) is fitted with a mirror perpendicular to the axis and on the projecting end of the specimen. As the load is gradually applied, the deflection in the test piece causes the mirror to describe a conical surface. A reflected beam of light will therefore be broadened slightly with increasing bending, until presently the band of light suddenly expands. This marks a discontinuity in the load-deflection relationship, and as before noted, agrees with the endurance range very closely.

Raising the Endurance Limit

By means of such rapid tests many curious things have been discovered about the relation between elastic properties and endurance of various metals. Suffice it to say that it has been found possible to raise the endurance limit 20 per cent or more by the following procedure: First "normalize" the metal by a suitable heating followed by a fairly rapid cooling. Then, with a knowledge of the proper stress range for this material, "fatigue harden" it by a series of stress cycles, each run having a higher load applied, but each run separated from the next by a period of rest. After that, any further heat-treatment should be strictly avoided.

Such a method has been long utilized, without knowledge of its full significance. No marine engineer ever starts up a ship's engine at full load. He coaxes it up gradually. He may have had as a central idea to "run the bearings in"; the greatest advantage was that he raised the endurance limit of the entire machine.

It is also perhaps unnecessary to dilate about the effect of surface finish and internal soundness upon fatigue resistance. Failure starts at the highest stressed crystal. Notches, either scratches, dents or angles in the outer surface, or checks, inclusions or holes inside the metal, cause stress concentrations in their immediate vicinity several times the average. Perfect, even polished, surfaces on soundest metal must be had to insure best service under alternating stress.

The Future of Chemistry in the Iron and Steel Industry*

By Bradley Dewey
Dewey & Almy Chemical Co., Cambridge, Mass.

Every phase of steel-making development has been a triumph of organization. Today the progress of chemistry, applied theoretical physics and chemical engineering is usurping the place and leadership held during the last 40 years by the progress of mechanical engineering and electricity. With chemistry growing so fast, we now have the problem, How is the steel industry to organize this growth?

A generation ago a doctor was a doctor, and a chemist was a chemist. Just as medicine has grown so large that no one man can know it all, so chemistry has grown to a point where there are many distinct fields and where the problem of correlating and using the available information is becoming increasingly difficult. The specialized steel chemist will be the first to admit that he cannot give proper and adequate service to the daily operation and routine development of his organization and also correlate and apply the possibilities of these specialized fields. Consider a few examples.

Some men are obtaining an adequate visual picture of the makeup of an atom. Will this work help the technology of steel? Who is going to tell us why ¼ per cent of copper retards the atmospheric corrosion of steel? Is it going to be a physical chemist or a colloidal chemist? Will the answer open up new possibilities?

Lubrication has been considered a part of the field of the mechanical engineer, but the application of modern colloidal chemistry is opening up new vistas, and the problems incident to the lubrication of hot roll necks, bearings flooded with water, wire drawing and the like are well worthy of review by the best of the new school of chemists.

There are prospects that, through liquid air, we may obtain oxygen in the neighborhood of $5 per ton. The large use of this would, of course, bring with it a host of problems for the specialist in refractories, but would it not also bring with it problems for the best of our physicists and physical chemists? Some may dream that it would even make giant superpower gas producers of our blast furnaces, and make pig iron a byproduct.

The processing of all kinds of fuel, the complete gasification of coal and the structure of cokes made by newer processes call for imagination reinforced with up-to-date technical knowledge. The same is true of the problems incident to the possibilities of saving fuel through central station distribution of high-pressure gas made by new methods.

In short, the chemical organization of the steel and iron industry of the future must make use of specialists in physics, physical chemistry, radio-activity, metallography, special precision instruments, metallurgy, absorption of gases, electrochemistry, electric furnaces, heat-treatment, refractories, thermodynamics, phase rule diagrams, spectroscopy and also chemical engineers of both specialized and consulting experience in the great host of other process industries.

When planning the future of chemistry in the iron and steel industry, the steel executive must apply his best talents to the mechanism and organization which are to employ this ever-increasing mass of knowledge.

*Discussion of a paper on "The Value of Chemistry in the Iron and Steel Industry," read by W. A. Forbes before the recent meeting of the American Iron and Steel Institute.

Is the Sulphur Market Stable?

Healthy Competition in the Market and Production Greater Than Probable Requirements Indicate an Affirmative Answer

By Albert G. Wolf
Texas Gulf Sulphur Co., Gulf, Tex.

If THE history of the world's sulphur industry were plotted prior to the advent of the Frasch process in Louisiana, using time and relative prosperity as co-ordinates, the curve would show some rather violent swings. From that time on, however, we should have to consider the American and Italian industries separately. The two branches of the curve would then diverge, the Italian going downward and the American steadily upward. This increase in domestic prosperity is a reflection of the great increase in consumption due largely to the growing demand for sulphur in sulphuric acid manufacture and the increasing usefulness of this acid to mankind.

Brimstone in Industry

The use of sulphur in the manufacture of sulphuric acid has been the controlling factor in the prosperity of the industry in the past as at the present time. Italy, chiefly Sicily, was probably the first producer of sulphur in quantity, and supplied the European demand in the early days of acid manufacture. During the period from the middle of the eighteenth century to 1839 all the sulphuric acid of Europe, except Nordhausen acid, was made from brimstone. In 1838 the Neapolitan Government granted a monopoly on the exportation of sulphur to Taix & Co., of Marseilles, and that firm raised the price from $25 to $70 a ton. The following year pyrites was used commercially for the first time in the manufacture of sulphuric acid in England. This substitution was also made in all the continental plants, resulting in a permanent setback to Sicilian sulphur.[1]

Sulphur is now an absolutely essential commodity, no matter in what original form it may be produced. Through the recent replacement of pyrites by sulphur in many plants for the manufacture of sulphuric acid, it is now vastly more important to industry than it was a few years ago. But the question is asked: Is the market for sulphur sufficiently stable and the industry permanent enough to warrant manufacturers who require sulphur dioxide in their processes changing from pyrites to this source of supply? In this article the question has been answered in the affirmative.

To quote from a statement by Mr. Frasch regarding the condition of the Italian sulphur industry during the period preceding the introduction of his process in America: "The ups and downs of the Sicilian sulphur business are extraordinary. The people, a large percentage of whom are employed in the mines, are very poor and used to be in the hands of dealers and usurers, who manipulated the sulphur market to suit themselves, and extremely high prices and extremely low prices followed each other as suited their conveniences."[2]

Another sulphur crisis occurred in Sicily in 1894-95, after which the native sulphur sold below the cost of English sulphur recovered from the waste products of the Leblanc soda process. The Anglo-Sicilian Sulphur Co. was then formed by English capitalists, and handled most of the Sicilian output until 1906. During the first few years of its life this company made big profits, later it lost heavily, because of a misguided attempt to compete with Louisiana sulphur.

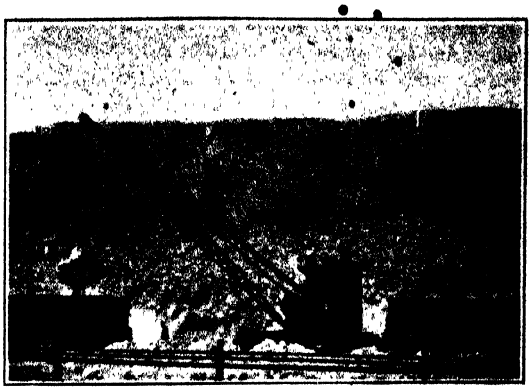


FIG. 1 LOADING CRUDE SULPHUR BY LOCOMOTIVE CRANE

When the English contract with the Sicilian producers expired there was 450,000 tons in stock piles at the mines, and the inroads on the business by the Union Sulphur Co., of Louisiana, were so serious that the Italian Government sent a commission to the United States to investigate the Frasch property and methods. Following the report of this commission, which was decidedly pessimistic regarding the Italian sulphur prospects, that government forced all the Sicilian producers into an obligatory trust or *Consorzio* for a period of 12 years. This occurred in August, 1906. The Italian Government then insisted that American sulphur keep out of European markets entirely, and tried to compel the Union Sulphur Co. to agree not to sell abroad. The refusal of the American company to accede to the Italian demands resulted in a price war in the United States, which soon eliminated foreign competition in this country.[3]

In America the sulphur industry may be said to date from the early part of the present century. Herman Frasch conceived the idea of his process for mining sulphur in 1890, and the first sulphur was produced in 1895. It was not until 1904, however, that the Union Sulphur Co. began making an appreciable output. From this time on the development was rapid. In 1903 nearly 200,000 tons was imported, but by 1913 imports had decreased to 20,000 tons. During this same year about 90,000 tons was exported.

Sulphur was discovered in 1901 at both Bryan Mound, Brazoria County, and Big Hill, Matagorda County, Texas. Mining at Bryan Mound was started by the Freeport Sulphur Co. in 1912, and at Big Hill by the

[1]"Recent Advances in the American Sulphur Industry," Raymond F. Bacon and Harold F. Davis, *Chem. & Met.*, vol. 24, No. 2, 1921, pp. 65-70.

[2]Perkin Medal Address of Acceptance, by Herman Frasch, *J. Ind. & Eng. Chem.*, February, 1912, pp. 134-140.

[3]The Union Sulphur Co. vs. Freeport Texas Co., U. S. D. C. Dist. of Del., vol. 1, No. 336 in Equity.

TABLE I—WORLD PRODUCTION AND CONSUMPTION OF SULPHUR[4]

	Production U. S. Long T.	Production Italy Met. T.	Production Japan Met. T.	U. S. Ship'ts. Long T.	U. S. Exports Long T.	U. S. Imports Long T.	Italy Exports Met. T.
1909...	273,983	402,353	36,317	258,283		26,914	364,953
1910.	247,060	397,808	43,848	250,919	3,742	28,647	395,944
1911...	205,066	376,161	52,064	253,795	28,103	24,250	456,227
1912..	787,735	356,555	55,005	305,390	57,736	26,885	447,590
1913..	491,080	345,548	59,481	319,333	89,221	14,636	414,716
1914.	417,690	334,974	75,308	341,985	98,163	22,810	338,308
1915...	520,582	319,260	73,369	293,803	37,271	24,647	359,806
1916...	649,683	233,835	108,100	766,835	128,755	21,510	396,035
1917...	1,134,412	177,453	117,990	1,120,378	152,736	973	162,971
1918..	1,353,525	194,585	64,697	1,266,709	131,092	55	230,769
1919...	1,190,575	181,744	67,384	678,257	224,712	77	147,286
1920...	1,255,249	224,247	21,147	1,517,625	477,450	44	189,878
1921..	1,879,150	240,089	25,000	954,434	285,762	4	105,063

Texas Gulf Sulphur Co. in 1919. The former, a relatively small producer when compared with the other two coastal mines now operating, did not begin to make its maximum output until it could be readily absorbed by the war demands. The Texas Gulf Sulphur Co. entered the market after the war and at what appeared to be a bad time to offer such an additional supply to the trade. But, by seeking new outlets for its products, and by reviving old ones, especially that in sulphuric acid manufacture, this company secured its share of the business without causing a ripple on the placid surface of the industry. Furthermore, because of its large potential supply, it aided greatly in stabilizing the market to the consumer.

The enormous increase in production of sulphur in the United States probably is not realized by many. Table I shows the great increase in consumption, the decrease of the United States imports to the vanishing point, and the gradual acquisition of the European market by American producers.

The effect on our foreign competitors is well shown in the declining production in both Italy and Japan.

The present price of sulphur is low, perhaps $6 per gross ton less than pre-war prices, whereas the present prices of most chemicals, as other commodities, are considerably higher than pre-war figures.

What Stabilizes the Sulphur Market?

Nearly all the factors influencing the price of sulphur are stabilizing. This is a favorable condition for the manufacturer using sulphur, because the stability of his business is affected by the accuracy with which he can estimate the prices of the raw materials that he will require. One of the chief factors in maintaining a relatively low price for sulphur is the price of pyrites, since sulphur is sold in direct competition with pyrites, both domestic and foreign, in the sulphuric acid industry of the United States.

[4]"Mineral Industry," vol 30 (1921), McGraw-Hill Book Co., New York.

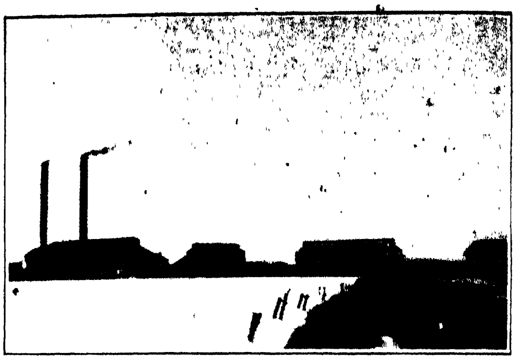
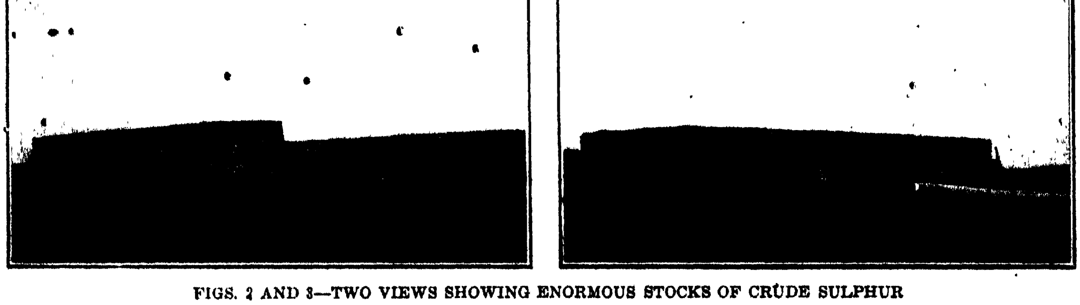


FIG 4—STEAM PLANT, MACHINE SHOP, WAREHOUSES AND RESERVOIR AT GULF, TEXAS

There are many other factors[5], however, tending to stabilize the price of sulphur. One of the most important is that there are three large producing companies in this country, with big ore reserves, all operating independently. This creates a state of healthy competition in the market. These mines are capable of producing in excess of two million tons a year, a quantity greater than the present yearly requirements or probable future demands for many years to come. This eliminates any likelihood of a shortage of raw material, even if the demand were to increase greatly. An excess of production over consumption is not likely to lead to a price war, because sulphur is easily stocked and does not deteriorate. Furthermore, a large stock on hand is desirable from the standpoints of both consumer and producer, for it readily takes care of yearly and seasonal variations in demand. Stocks at the mines are probably two million tons, and present production is about equal to consumption.

The market for sulphur is growing larger both at home and abroad; the normal annual increase has been estimated at 10 per cent. This permits the producer to make a large-tonnage production, which is reflected in his costs, and enables him to sell brimstone at a price that is attractive to the acid manufacturer as compared with that of sulphur in pyrites. Consequently, the price is reasonable to the rest of the trade. Furthermore, this market is not likely to shrink, any fluctuation in demand being due only to general economic changes. In fact, as new uses for sulphur are found, the total consumption will continue to increase.

[5]EDITOR'S NOTE Still another stabilizing influence on the sulphur market is the agreement between American and Italian producers, which was reported on page 828 of *Chem. & Met.* for May 7, 1923. By this compact prices are to be fixed from time to time with reference to economic conditions in the individual consuming countries. The world consumption has been apportioned between the two producing countries and arrangements have been made for settlement of disputes by arbitration. The duration of the agreement is fixed until Sept. 30, 1926.



FIGS. 2 AND 3—TWO VIEWS SHOWING ENORMOUS STOCKS OF CRUDE SULPHUR

Although the majority of the factors affecting the sulphur market tend to maintain its stability, there are certain influences at work, which are of minor importance to the market as a whole, but have their influence on the producer. In fairness to him and in order to complete this review, at least two of these should be mentioned here. They are taxes and freight rates. Recently the state legislatures of Texas and Louisiana considered the passage of certain tax bills, called severance taxes and gross-production taxes, on natural products. These taxes are in addition to the usual property and profit taxes. One such tax proposed is as high as 5 per cent of the gross returns. It is hoped that no such burden will be placed upon this comparatively young but extremely important industry. Freight rates in certain parts of the United States are in favor of pyrites, and are considered by many to be out of proportion to the relative values of pyrites and brimstone in the acid-making industry.

Sulphur Facts and Figures

At risk of repetition, a brief review of the main facts and figures affecting the sulphur situation is as follows:

Present Rate of Production—Probably equal to consumption.

Potential Production (By this is meant the tonnage capacity of the plants already installed, and the ability of the mines to produce up to that capacity)—In excess of 2,000,000 long tons per year, or nearly double the present requirements.

Stock Piles—Approximately 2,000,000 long tons—far more than enough to take care of yearly and seasonal variations in demand, and sufficient to fill orders for 2 years if all three mines were compelled to close down temporarily, a contingency not likely to arise.

Ore Reserves—The developed tonnage of sulphur cannot be stated with the same degree of positiveness as in the case of ore "blocked out" in a mine or quarry, but a reasonable estimate is 30,000,000 long tons. This does not take into consideration the possibility of other discoveries in the future. That such discoveries will be made is an almost assured fact, for the coastal saltdome area, incompletely tested for oil, is even less thoroughly prospected for sulphur.

Increased Demand—A greater demand would not tend to raise the price; on the contrary, it would permit the producers to operate at higher capacity and with greater efficiency, and, therefore, at lower cost. This would mean a continuance of low-priced sulphur.

Record Output of Pyrites, 1921

According to a recent report of the U. S. Geological Survey the domestic production of pyrites increased in 1921 by 49 per cent in quantity and by 55 per cent in value over the corresponding figures for 1920. The output reported was 157,118 tons, valued at $711,432. California contributed 63 per cent of the total and New York and Wisconsin supplied most of the remainder. The imports of pyrites, 216,229 tons, as compared with 332,606 tons in 1920, were the smallest recorded since 1896. This is striking evidence of the increasing competition offered by domestic sulphur.

As indicated in the preceding article, 1921 was also a record year for the sulphur producers. The output of 1,879,150 long tons was valued at approximately $17,000,000. Roughly, about one-half of the total was shipped and the remainder was held at the mines.

How to Improve Paper and Pulp Production

Mill Superintendents of the Paper Industries Discuss Problems at International Convention, Springfield, Mass., May 31-June 2

The recent convention of the American pulp and paper mill superintendents proved to be one of the best ever held by the association. Technical papers were presented covering the most modern phases of mill practice, including among many others the efficient use of logs in the woodroom, improved sulphite control and the prevention of losses in the sulphate practice. The general subject of waste attracted keen interest.

The technical sessions of the convention included papers by manufacturers of equipment and supplies. L. M. Booth, of the Booth Chemical Co., showed that by the addition of a dry coagulent to the white water from the machine, the loss of fiber can be almost completely eliminated. In mills where the water supply is limited, the waste water is made fit for use by the same process. The cost of fiber recovered is approximately 1 cent per pound.

The use of screen save-alls as a sure, cheap and reasonably efficient means of pulp recovery was discussed by A. W. Nason, of the Green Bay Foundry & Machine Co. He pointed out that with fine writings 100 per cent fiber recovery is often undesirable. To make complete recovery of white water fiber possible the use of a large settling tank taking care of all effluent was suggested. The settled suspension in the bottom is used again in the beaters, while the clearer liquid on top is used on the showers, etc. In this way very nearly a closed system results.

Pulp Superintendents Discuss Chips

Woodroom economy, although sacrificed in many mills to feed boiler fires with needless waste, is well worth while. Theodore Safford, of the Raquette River Paper Co., showed that careful attention to chipper knives consists in keeping them sharp, correctly adjusted as to angle depending on condition of wood fed, and provided against damage due to poorly gaged end thrust of the disk shaft. In the course of the discussion it was shown that the grading of chips according to size actually results in sufficient increase in pulp production to make the increased care worth while. The decreasing supply of pulpwood eventually makes the efficient operation of the woodroom absolutely necessary.

Use of Suction Rolls Increasing

Suction couch rolls are being used with increased success on paper machines following years of development work. Harold Bing, of the Sandusky Foundry & Machine Co., pointed out that the use of suction rolls in place of suction boxes results in greatly increased durability of cylinder felts due to reduction of friction and constant maintenance in clean condition. An analysis of the manner in which the water in the wet paper is removed by the suction roll shows that part is taken out by direct pressure (equal to difference between that in room and that in roll), part by atomization and part by absorption. On cylinder machines, the suction rolls usually work best in connection with a top press roll. This increases the pressure on the paper web, with corresponding increase of amount of water removed. On

many grades of paper the use of two felts may be reduced to the use of one by this means. The suction press on the Fourdrinier machine does away with breaks at the wet end by removing all excess water at the bite of the press rolls. In this way also by delivering a drier sheet to the drying rolls the speed of the machine may be increased—has been increased in many installations. The power consumption of these rolls, although considerable, is usually offset by the advantages mentioned, with the result that the net cost of production is diminished.

The sulphite mill presents so many problems that neither beginning nor end of standardized practice is in sight. Of 129 sulphite mills on this continent hardly two operate alike—that is, use the same size chips, same acid, same digester pressure and cooking time. It is only in control of these factors that improved operation can come. O. L. Berger, in his paper on this subject, makes the point that sulphite operation begins with getting good material at a fair price. The same spruce wood would vary more than 100 per cent in price, depending on size, length and condition of logs. An innovation in digester practice that is very promising has been made in Price Brothers' mill at Kenogame, Que. Hot liquor and gas from a digester being blown are passed into another digester just being brought up to pressure. Reports from the mill indicate greatly reduced use of steam, increased yield and a stronger and cleaner pulp. Patents on the process have already been taken out.

A paper by Edwin Sutermeister, chief chemist of the S. D. Warren Co., on losses in making soda fiber, dealt with many of the same factors that were considered in sulphite practice. Wood used must be uniform in size, quality and preparation for economical digester operation. Digesters must be properly lagged, otherwise a large preventable heat loss will occur. The successful operation of the soda process hinges on this material—i.e., on soda itself. Losses that must be held down are in the lime mud (where a loss as low as 2 per cent may be obtained by careful practice) in the black ash waste, in the burning of black ash, in washing the black stock (unwashed pulp from digesters) and in leaky pipes, valves, etc. The amount of soda that may be lost in washing the blackstock will not be allowed to exceed 1.5 per cent in good practice. A fiber loss of close to 15 per cent in cooking such a wood as poplar seems unavoidable in obtaining good grades of pulp.

B. T. McBain, of the Nekoosa Edwards Paper Co., who has made a careful study of waste at all stages of fabrication from woodlot to packing room, presented a paper covering briefly the entire industry. Every piece of apparatus used must be watched and frequently checked up for performance; by checking heat, power and raw material losses, profit is derived from waste. Pumps, piping, screens, save-alls, beaters—all must function efficiently if the sewer and ventilators are not to carry off valuable materials. Care in looking after details will make possible elimination of costly leaks.

Successful coloring of paper requires the prevention of mottled fiber, the use of uniform pulp and the cutting down of foaming. A special problem arises in preventing a two-sided effect. Mottled fiber can be prevented by proper control of beater furnish and of temperatures of furnish and dyestuff when brought together. Slow-cook sulphite pulp tends to take a much deeper shade than quick-cook pulp. Great variation in shade results when successive cooks are colored with same dye. Acid dyes cause foaming very frequently. Furnish which gives foam troubles often yields to treatment by alum, which leaves it slightly acidic in reaction. Two-sidedness may be reduced by beating stock as free as possible, by use of dyestuff having maximum affinity for the stock, and by seeking to combine the dye with the fiber rather than with the filler.

What does the paper industry need? Which are the weak links in its organization? What is the future to bring for it? Hugh P. Baker, executive secretary of the American Paper and Pulp Association, maintains that the industry in the United States must watch its step. Canada will outdistance us in the near future in newsprint production. Our forests are going fast. Foreign competition must be met. We have too many mills for profitable production except in times of prosperity. To maintain healthy growth, waste must be eliminated, overproduction guarded against and new markets constantly developed.

Cost of De-inked Newspaper

Mills located near cities capable of furnishing large quantities of old newspaper can produce pulp from de-inked news cheaper than they can buy new groundwood, according to cost data collected by the U. S. Forest Products Laboratory, Madison, Wis. A saving of $15 a ton has been effected at one mill through the use of de-inked news instead of groundwood pulp. Such a saving would bring in a large return on the $10,000 investment needed to equip an ordinary 30-ton mill with the additional washing equipment and a warehouse large enough to hold a 3 months' supply of old newspapers, and it would make possible the profitable operation of some mills now finding it difficult to make both ends meet.

To make the most out of the de-inking process, it is absolutely necessary that the mill be independent of the periodical manipulating of the waste-paper market. For mills situated near the larger cities such a course is very simple. In fact, a large part of a mill's supply might be collected by its own force from the neighboring territory, thereby cutting out the profits of at least three middlemen.

In stabilizing the supply of waste papers the publishers can be of enormous assistance, since the supply is *directly dependent upon the amount of paper saved by* the average householder. With proper newspaper campaigns, such as were carried on during the war, the supply of waste newspapers could be doubled without much effort; and if with proper warehouse facilities the demand were stabilized, the supply would continue.

When old newspapers are worth $20 per ton, it costs about $38, with the necessary addition of sulphite pulp, to produce a ton of newsprint from the converted stock.

Machinery and Appliances for Production and Control

Equipment News

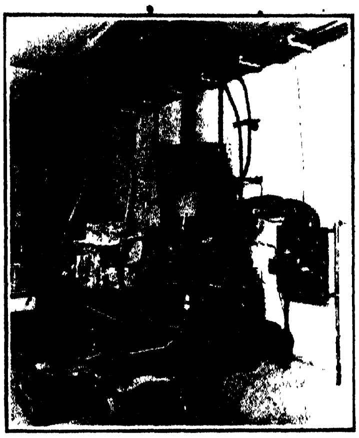
From Maker and User

Materials and Accessories for Chemical Industries

High-Temperature Metal Melting

In the center of industrial New York there has recently been completed and placed in operation a new rare alloy melting and refining plant which is unique in many ways. The entire output of the plant is restricted to the melting of what may be termed "Higher-Temperature Metals." This includes melting of chromium, nickel-vanadium, chromium-nickel-tungsten, palladium alloys and pure tungsten, which necessitates temperatures in the melting zone of from 3,600 to 4,300 deg. F. The plant referred to is that of the Bario Metals Corporation, 147 Varick St., New York City. The entire plant includes the departments of management, chemical analysis, melting and machining. All of the operations in the melting and casting plant are with the electric furnace and oven. The equipment includes three Ryan high-temperature melting units, one Northrup high-frequency furnace, one electric core and mold baking oven.

Of particular interest is the Ryan furnace, as it presents a new departure in the field of electric metal melting. The units in the Bario plant have a holding capacity of 125 lb. per heat and are capable of melting and refining alloy mixtures in from 30 to 40 minutes from the time the cold charge is placed in the furnace. The furnace is of the graphite resistor type—that is, the heat is developed by the passage of current at particular voltages and specific quantities through a stationary graphite electrode. No difficulty has developed in obtaining furnace temperatures up to 4,300 deg. F. While temperatures higher than those stated are obtainable in the arc furnace, the difference is that in this furnace there is an equal diffusion of the heat over the entire bath; and the temperature gradient between the melting and refining point of the metals and the heat at the electrode can be kept very close, eliminating superheating, which is detrimental in alloy melting operation.



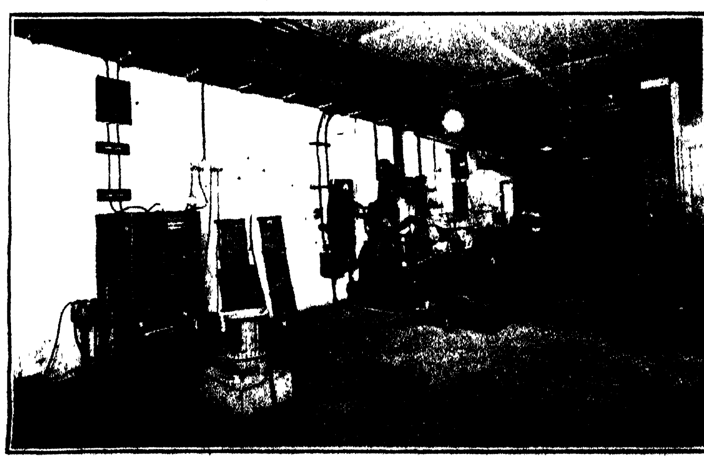
THE RYAN ELECTRIC FURNACE

As against this close temperature gradient, in the arc melting-furnace the heat is developed within very small areas at very much higher temperatures, as a result of which even distribution does not take place. This, of course, is not a detrimental factor in the melting of ordinary steel or even commercial alloy steels, but is particularly objectionable in the handling of rare alloys such as referred to because of the wide difference in the melting points during their amalgamation or melting, which if they are superheated causes considerable loss through oxidation. With reference to metallurgical operations, the furnace has sufficient door area and clearance to carry on any necessary slagging or charging operations.

The furnace is adapted for the melting of higher-temperature metals such as those named, and the manufacturers and developers of the furnace, F. J. Ryan & Co., Wesley Building, Philadelphia, do not believe that units over 500-lb. holding capacity will become practical owing to the restriction in size and length of electrodes and their placement throughout the furnace. However, in capacities from 50 lb. up to 500 lb. the arrangement and operation are extremely simple and present no new difficulties over present electric furnace practice.

The arrangement is, briefly, the connection of the furnace unit through the ends of the electrodes, which are in contact with water boxes attached to busbars running back to the transformer set directly in back of the furnace with tap arrangements connected with a radial type switch, by which a wide range of temperature control is secured. The furnace is lined with standard magnesite brick both in roof and hearth, and is of the stationary or nose tilt type, allowing for pouring directly from furnace into molds.

A novel arrangement of the fur-



ELECTRIC FURNACES IN PLANT OF BARIO METAL CORPORATION

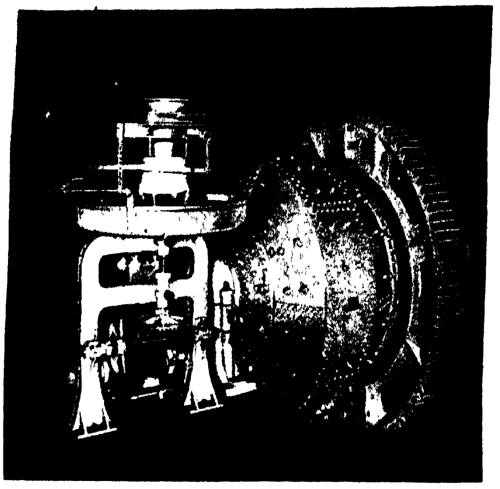
nace has been werked out to allow for maximum production. With each transformer setting there has been supplied two furnaces, each unit being set upon a truck. After the heat has been completed, by the loosening of two bolts the bus connections are disconnected, the furnace is moved from in front of the transformer, and a new furnace previously charged is moved in its place. The entire operation takes place within 5 minutes. This allows for maximum production in relation to horsepower connected load.

It is quite universal practice for power companies to charge for a connected load notwithstanding the percentage of producton in relation to the connected load. Therefore it is of advantage to the customer to be able to work his plant to the maximum point of that connected load, which is not possible where individual units are in operation a specified time and then shut down during pouring or casting periods. It is claimed by the manufacturers that the consumption of electrode and power is not in excess of that which now exists in the best electric melting practice.

Conical Mill Feed

The Hardinge Co., of New York City, has recently developed a new style of feeder for the Hardinge conical mill, which is applicable to both fairly fine and coarse materials. It is known as the table and screw feeder, and takes the place of the old style conical or drum feeder which was in use for so many years.

The feeder is capable of many times the capacity of the old style, as it actually forces the material into the mill. An arrangement of sealing ring is so designed that there is no back spill. There is also a device for taking care of any material which tends to work back of the feeder and cause wear. This method takes the material automatically and drops it into the upper part of the barrel in which the screw operates. The table is designed so that the feed may be regulated while the mill is operating. The table may also be stopped, or the feed cut off above the table while the mill is turning. This feeder has already had a number of successful applications. The cut shows one of the these feeders applied to a 7-ft. Hardinge mill for grinding cement clinker.



HARDINGE MILL FEEDER

Container Car Tanks

In many industries there is a distinct problem to be met in shipping various liquids by rail. The difficulty may be caused by corrosive action of the liquid on a metal container, or the liquid may be contaminated unless special containers or special precautions are taken. This difficulty has been solved in the past by using such containers as carboys or special cans or drums which were not subject to corrosion and could be easily cleaned. This solution of the problem did not, however, enable the shipper to realize the economy of bulk shipment. A new container which does offer this advantage has recently been placed on the market by the Pfaudler Co., of Rochester, N. Y. Developed primarily to solve the milk shipment problem, the equipment is also applicable for such fluids as light chemicals and oils.

It consists of a series of compartments, usually nine in number, which run transversely to the car. Each container houses a glass-lined tank, effectually insulated with cork, which is located between the double walls of the compartment. The containers are equipped with eyes or hooks at each top outside corner for handling by crane or hoist. The sides of the car are spaced to suit the width of the container, ½ in. clearance being allowed on each side. The glass-lined tank in the interior of the container compartment has a manhole for entrance of the liquid. Above this in the container shell (which is a metal and wood rectangular box) is a hatch provided with a lock. The outlet from the bottom of the tank is located opposite a small port in the container shell which can be closed and locked.

The containers are placed side by side in a specially designed car with low sides which come just above the ports in the container shells. This car is fitted with all the appliances needed to make it interchangeable with any standard railroad car. The capacity of the individual container is 600 gal. and of the loaded car 5,400 gal.

The makers of this car claim several advantages among which we mention that it eliminates handling of the cans, carboys or drums; it eliminates much waste time for unloading or loading box cars; it eliminates checking and rechecking at terminals; it makes sampling easier; and it lessens depreciation charges.

Catalogs Received

LEBANON BOILER WORKS, Lebanon, Pa.—Bulletin 23-A—A new bulletin describing the Lebanon line of return tubular boilers.

SOUTHWESTERN CONDENSER CO., Los Angeles, Calif.—Bulletin D-6. A new bulletin describing the Southwestern gasoline condenser and its application.

CONVEYORS CORPORATION OF AMERICA, Chicago, Ill.—Leaflet describing the "American" air-tight door for use in connection with boilers, coke ovens, oil stills, driers, retorts and various types of industrial furnaces.

LACLEDE-CHRISTY CO., St. Louis, Mo.—Bulletin dated April, 1923, describing various uses of Laclede-Christy firebrick.

DENVER FIRE CLAY CO., Denver, Colo.—Folder describing the different uses of the Hi-Fire bond, a cement for refractories.

DRIVER-HARRIS CO., Harrison, N. J.—Data Book R-23. A new book entitled "Alloys for Electrical Resistance," giving data in connection with various alloys used for heating elements in electric heaters of all kinds.

DETROIT RANGE BOILER & STEEL BARREL CO., Detroit, Mich.—May, 1923, bulletin on the metal barrel manufactured by this company.

ADAM HILGER, LTD., London, England—Catalog describing Professor Coker's apparatus for determining the distribution of stress in structural and machine members. Bulletin describing the Low-Hilger audiometer, an instrument designed to record the variations in pressure caused by sound waves.

F. J. STOKES MACHINE CO., Philadelphia, Pa.—Catalog 23. A new catalog on the well-known Stokes line of pharmaceutical and chemical machinery and apparatus.

ROLLER-SMITH CO., Bethlehem, Pa.—Bulletin 30. A descriptive bulletin on the Roller-Smith type of ammeter for three-phase a.c. circuit.

STEERE ENGINEERING CO., Detroit, Mich.—Pamphlet 243. A pamphlet on the Steere bellows type expansion drawing. Pamphlet 247, on the Steere system of backrun gas.

AUDUBON WIRE CLOTH CO., Audubon, N. J.—Folder on this company's new line of fine and extra fine brass cloth running up to 350 mesh.

Readers' Views and Comments

An Open Forum for Subscribers

The editors invite discussion of articles and editorials or other topics of interest

Testing of Glue and Gelatin Gels

To the Editor of Chem. & Met.:

SIR—In a recent article (*Chem. & Met.*, vol. 28, p. 55) W. D. Richardson described the Bloom gelometer as adopted by the National Association of Glue and Gelatin Manufacturers.

During the course of work on the hydrolysis of collagen to gelatin a reliable method of jelly testing has been required by the writer. An adaptation of the gelometer devised by E. S. Smith (U. S. Pat. 911,277 of 1909) and modified by Hulbert and later by Low has proved of value.

In the original tester and in previous modifications, a rubber membrane, fastened over the end of an inverted thistle tube, was placed over a jelly surface and air pressure applied just sufficient to force a definite volume of water into the thistle tube.

The greatest source of weakness in this design is the uncertainty involved in bringing the gel surface flush with the membrane and always to the same point. Fig. 1 shows an assembled gelometer as modified by the writer. The inverted thistle tube has been replaced by a machined brass head (Fig. 2), in which a thin unstretched rubber membrane is mounted by means of a ground bevel, flush with the flat lower surface of a ring or collar which surrounds it.

In operating, the platform 1 is forced up against the tester-head 3, leveling the membrane. The water level is then adjusted in the pipette 4 to reach the upper mark by means of stopcock S_1.

Then with stopcock S_2 open and S_1 closed a jelly is placed on the platform 1 and raised until its surface is flush with the lower surface of the tester-head. The meniscus will not rise again to the upper mark in the pipette, since the jelly surface will be slightly depressed by the slight pressure of a water column in the pipette.

Stopcock S_2 is then closed, S_4 is opened and pressure is applied by pumping the bulb 10. The oscillations of this pressure application are minimized by the capillary 8 and the reservoir 7. When the water level in the pipette 4 has been forced to the lower mark, indicating 5 cc., S_4 is closed and the pressure is read on the scale 6. From this pressure is subtracted that required to force the water into the membrane when no gel surface is beneath it and a small correction is added for a depression of the mercury surface in the large arm of the manometer.

Two hundred cc. of 10 per cent solutions of the glues was used in crystallizing dishes of uniform size, which are 100 mm. in diameter by 40 mm. deep, and readily obtainable. The complete

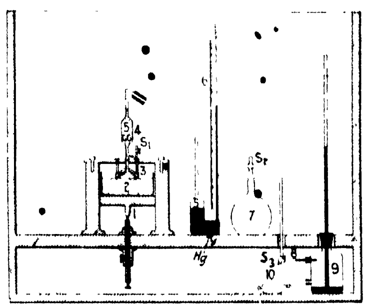


FIG. 1—NEW TYPE OF GELOMETER

gelometer was mounted in an air-bath kept in a refrigerated room and controlled thermostatically at 10 deg. C. to 0.2 deg.

Check determinations on a single gel after standing for 12 hours were concordant to within 2 per cent, while different gel samples of the same glue were found to check well within 10 per cent and generally to within 5 per cent. Due to ease and speed of manipulation, the device is applicable to routine tests.

A. M. HOWALD.

Mellon Institute of Industrial Research,
University of Pittsburgh,
Pittsburgh, Pa.

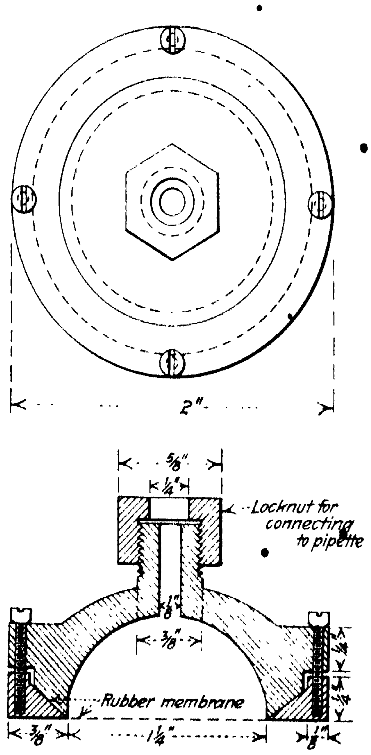


FIG. 2—MACHINED BRASS HEAD FOR GELOMETER

Bacchus Redivivus

To the Editor of Chem. & Met.:

SIR—From various circulars which reach us from our friends across the water, a valiant effort is being made to free us from the exactions of the peripatetic bootlegger. From a recent one:

> Something about
> Regenerated Beverages
>
> IT WILL not happen often that an offer of such solidity reaches you. Perhaps it is a chance that never comes again. Therefore, decide yourself.
>
> Here's your opportunity!
>
> What I am offering is no mixture of chemicals or other ingredients dangerous to health or one of the nowadays manifoldly offered powders, but a
>
> **dry substance**
>
> without a trace of alcohol, gained by concentration of guaranteed pure, natural alcoholic, original beverages. From this dry substance—by means of my formulas, which are so simple that a boy of 14 years can handle them—you can
>
> **regenerate the original beverage**
>
> guaranteed with all its primary characteristics such as bouquet, alcoholic content, etc.,
>
> **without being compelled to add even only one drop of alcohol.**
>
> The shipment is of course made immediately in an absolutely discreet way; material and formulas being sent separately.

So for one dollar (American currency, it is insisted), or 70,000 marks more or less, a package may be had from which 2½ gal. of tokay can be made. Or if your gullet prefers Münchener, merely say so, and a corresponding package will be received.

Possibly, Mr. Editor, you can name the branch of chemistry which developed this wonderful process. I nominate the originator to honorary membership in the Institute of Eye, Nose, and Throat Chemists. Will some one second it?

JAMES J. CURRAN.

Hartford, Conn.

What's Behind the Stock Dividend?

To the Editor of Chem. & Met.:

SIR—Your editorial in the Jan. 17 number, "What's Behind the Stock Dividend?" gleams forth from the mass of blatherskite amenities on this subject like a light amid the darkness. You bring out clearly that the injustice of the present non-taxability of stock dividends lies solely in the different treatment accorded to the earnings of enterprises not in the corporate form. It would be interesting to see a skilled protagonist of the corporation defend this discrimination. The writer is not such a one, but he would suggest that matters are evened up "if and when" the shareholder sells or transfers his

stock. You appear to regard this as a comparatively remote contingency. But it is at most no more remote than the demise of the stockholder, when his estate pays, and usually, too, pays in higher brackets of the income tax than does the accumulator of the same profits in the non-corporate form of business?

If the stockholder desires to cash in on the fruits of a wise and fortunate investment, the prospect of this big slice that the government takes from his "profits" often deters him from doing so, even thereby to his own disadvantage. This is foolish, I admit. But it is human. There is no doubt that this phase of the income tax affects the judicious manipulation of property.

Admitting, however, that fairness demands some such adjustment as you mention—namely, a lower rate on partnership profits passed to surplus, with the implied "penalizing" of wages—is there anything very immoral in stimulating thrift as against expenditure? Would not such a scheme have something of the advantages of a sales tax?

Right or wrong, however, to convince the public, as you say, is the dilemma.

CHARLES VAN BRUNT.

General Electric Co.,
Schenectady, N. Y.

Review of Recent Patents

Developments in the Equipment Field

Rubber-Lined Acid-Proof Containers That Are Free From Blisters

ONE of the principal troubles with rubber-lined containers has been the difficulty in pressing the rubber lining onto the base material. This has been overcome largely by using closed molds, but it can also be accomplished by the method described in this patent (1,454,687, J. E Perrault, assigned to the Hood Rubber Co., Watertown, Mass., issued May 15, 1923). The author uses a mandrel or core of a shape conforming with that of the desired article which is slightly tapered in construction toward the bottom end. Around this are placed the rolls of unvulcanized rubber for lining and then a layer of fibrous material or cloth. The presser is then inserted into the container to be rubber lined, and vulcanization is carried out in what is commonly known as an open heat. Experience shows that blisters occur only on the bottom and on the sides near the bottom, hence the presser member needs only to cover these parts of the vessel.

Burning Sulphur

It has been the experience in industrial work that much of the crude sulphur which comes from the Gulf States is not free burning. This means that

American Patents Issued May 29, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem & Met.* readers. They will be studied later by *Chem & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,456,504—Electrode Supporting Device. W. G Houskeeper, New York, N Y., assignor to Western Electric Co.

1,456,523—Method of and Apparatus for Treating Metals. R F Trimble, Elizabeth, N. J., assignor to Western Electric Co.

1,456,540—Regenerated Cellulose Material and Process of Making Same. N E Ditman, New York.

1,456,570—Method of Operation Employed in Extracting Liquid Vapor from a Gaseous Carrier. C C. Reed, Clarksburg, W. Va., assignor to Hope Construction & Refining Co., Pittsburgh, Pa.

1,456,590—Process of Making Halogenated Products. R E Eldred, New York, assignor, by mesne assignments, to Carbide & Carbon Chemicals Corp., New York.

1,456,592—Automatically Acting Lixiviation Apparatus. G. Haglund, Falun, Sweden.

1,456,594—Process of Making Sodium-Silico Fluoride. H Howard, Cleveland, Ohio, assignor to Grasselli Chemical Co., Cleveland.

1,456,615—Purifying Solutions of Iron and Recovering Metals From Such Solutions. D. Belcher, Boston, and F. A. Eustis, Milton, Mass., assignors of one-half to Charles Page Perin, New York, and one-half to said Eustis.

1,456,702—Process of Making Aldehyde Ammonia. H. W Matheson, Montreal, Que., Canada, assignor to Shawinigan Laboratories, Ltd., Montreal.

1,456,737—Centrifugal Separating Means. R. E. Lapham, Oakland, Calif.

1,456,781—Process of Recovering Cellulose Acetate From Solutions Thereof. J. M. Kessler, West Orange, and V. B. Sease, Newark, N. J., assignors to E. I. du Pont de Nemours & Co., Wilmington.

1,456,782—Cellulose-Ester Composition. J. M. Kessler, West Orange, N. J., assignor to E I. du Pont de Nemours & Co.

1,456,798—Process for the Extraction of Lead From Sulphide Ores. W H Hannay, Trail, B C., Canada, assignor to Consolidated Mining & Smelting Co of Canada, Ltd., Montreal.

1,456,809—Process for Treating Wood. G. F Lyon, Paris, France.

1,456,820—Conveyance of Highly Flammable Liquids. J. Muchka, Vienna, Austria.

1,456,834—Process for the Commercial Preparation of Potassium Phosphate. W H R and W. Hazen, Washington D C.

1,456,848—Process for Purifying Anthracene Press Cake. H. D. Gibbs, San Francisco, Calif., dedicated, by mesne assignment, to the people of the United States.

1,456,850—Process for Preparing a Concentrated Fertilizer. W. Hazen and W. H. Ross, Washington, D C.

1,456,855—Method of Joining Metals. T Midgley, Jr., Dayton, Ohio, assignor by mesne assignments, to General Motors Research Corp., Dayton.

1,456,871—Method of and Apparatus for Concentrating Liquids. I. Hechenbleikner and T C Oliver, Charlotte, N C., assignors to Chemical Construction Co., New York.

1,456,891—Electric Furnace Resistor. G M Little, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Co.

1,456,892—Protected Electrode for Electric Furnaces. G. M. Little, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Co.

1,456,893—Electric-Furnace Wall Construction. G M. Little, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Co.

1,456,916—Process of Making Chlorhydrins. G. O. Curme, Jr., Clendenin, W Va., and C O Young, Elmhurst, N. Y., assignors to Carbide & Carbon Chemicals Corp., New York.

1,456,934—Method and Apparatus for Separating Materials. J. A. Rice, San Francisco, Calif.

1,456,949—Process of Purifying Natural Barium Sulphate. A. I. A. Teillard, Paris, France.

1,456,953—Separation of Natural Gas and Distillation Gases Into Gasoline and Other Constituents. A. von Groeling, New York, assignor to National Refining Corp., Inc., New York.

1,456,959—Process of Making Chlorhydrins. C. O. Young, Elmhurst, N. Y., assignor to Carbide & Carbon Chemicals Corp., New York.

1,456,969—Process for the Manufacture of Aromatic Amino Compounds. Oliver W Brown and C O. Henke, Bloomington, Ind.

1,457,030—Method of Treating Sludge Acids and Separated Sludge Acids. I Hechenbleikner and F J Bartholomew, Charlotte, N C., assignors to Chemical Construction Co., New York.

1,457,068—Process of Refining Hydrocarbon Oils. H. M. Lasher, Kansas City, Kan., assignor to Kansas City Gasoline Co.

1,457,072—Process for Refining Vegetable Oils. C H. Hapgood, Nutley, and G F. Mayno, East Orange, N J., assignors to De Laval Separator Co., New York.

1,457,084—Pulverizing Apparatus. W L McLaughlin, Decatur, Ill.

1,457,087—Method and Apparatus for Cooling and Cleaning Air. J. J. Preble, Waltham, and L H. Parker, Boston Mass., assignors to Spray Engineering Co., Boston, Mass.

1,457,110—Air Separator. R M. Gay, Hanover, N. J.

1,457,114—Azo Dyestuffs and Process of Making Same. A. L. Laska and A Zitscher, Offenbach-on-the-Main, Germany, assignors to the corporation Chemische Fabrik Griesheim-Elektron, Frankfort-on-the-Main.

1,457,131—Cellulose Acetate. J. O Zdanowich, London, England.

1,457,164—Method and Apparatus for Manufacturing Sulphuric Acid. T. R Harney, Short Hills, N J., assignor to New Process Acid Co., Inc., New York.

1,457,217—Apparatus for Applying Paraffin to Soap Cakes. G A. Dostal, New York, assignor to Pictorial Soap Manufacturing Corp., New York.

1,457,235—Azo Dyestuffs. R. Stüsser, Dentz, Germany, assignor to Farbenfabrike vorm Friedr. Bayer & Co., Leverkusen, near Cologne-on-the-Rhine, Germany.

1,457,279—Liquid-Weighing Device. W. G Finch, Grand Rapids, and Leon R. Finch, Ionia, Mich.

1,457,288—Bronze Alloy and Process for Its Production. P. Ostendorf, Berndorf, Austria.

1,457,289—Copper and Zinc Alloy. P. Ostendorf, Berndorf, Austria.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

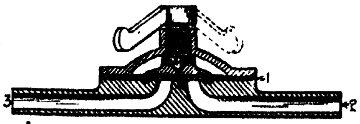
when ignited it is apt to go out. The reason for this is the fact that it contains small quantities of oil, and this oil spreads during the burning as a carbonaceous film, resembling asphalt in its consistency, over the surface. Eventually this extinguishes the sulphur flame, although the sulphur is only partly consumed. Traces of oil amounting to only 0.1 or 0.2 per cent are sufficient to render the sulphur non-free-burning. Harold S. Davis has patented (1,455,281, assigned to the Texas Gulf Sulphur Co., issued May 15, 1923) a method of making such sulphur free-burning. This consists essentially of mixing with the sulphur such substances as magnesia, asbestos and certain types of porous brick, and, to a lesser degree, magnesium carbonate, infusorial earth, fullers earth. These materials seem to act as a wick for the melted sulphur. The fibrous structure of some of the materials greatly aids in this action. They are also poor heat conductors, and therefore the heat generated in the burning surface is not conducted away rapidly enough to reduce the temperature below the ignition point.

This principle may be conveniently applied to both the cascade and the rotary burner, by lining the trays of the cascade burner and the drum of the rotary burner with asbestos or magnesia brick.

It is interesting to note that C. H. Weiskopf has patented (1,454,255, assigned to International Precipitation Co., issued May 8, 1923) an improved method for removing the precipitated material from the electrodes of an electric smoke precipitation apparatus. In such apparatus, the electrodes are of two kinds, so-called discharge and collecting electrodes. According to this new patent, the collecting electrodes are hung in such a manner that they may be shaken or jarred either by a balanced mechanism or by a small hammer. This dislodges the material from the electrodes and it falls down to a collecting hopper.

Valves for Corrosive Liquids

The main trouble with valves used in connection with corrosive liquids is, first, that the parts are rather difficult to replace and second, they are not inexpensive. These are the underlying principles in a patent (1,450,078, assigned one-half to T. Krug, issued March 17, 1923), issued to C. F. Hannz



of Buffalo. The accompanying diagram illustrates the construction and principle of operation. Liquid flow is shut off by depressing the flexible diaphragm 1, which is clamped over the two outlets 2 and 3. By releasing the pressor foot a shallow pocket is formed through which liquid may flow.

Tube Mill for Niter Cake

Everyone who has attempted to grind niter cake in a tube or ball mill realizes the very great trouble which arises from the caking of the product. This can be overcome, according to E. C. Soper, of Chattanooga, Tenn. (Pat. 1,454,491, May 8, 1923) by drawing a current of air through the tube mill to remove the water vapor and other gases and to prevent them from depositing on the surface of the mill and forming an undesirable cake. The apparatus needs very little explanation. The tube mill is of ordinary construction, with two chambers containing different sized balls. However, at the discharge end of the mill is an airtight chamber with two outlets. The solid material is discharged through a drop valve, and the gases and water vapor are carried up to a dust collector through a flue by the updraft created by air pressure.

Substantial Developments Heralded in Paper Industries

Bleaching, Deodorizing of Sulphate Pulp, Preparation of Lignin Pulp and Refinements in Use of Converted Fiber Attract Attention

THE BLEACHING of chemical pulp is an art only partly developed. As carried out in most practice today it is slow, expensive and difficult. Hence when such an engineer as R. B. Wolf patents a new improvement, the chances are that a fresh step has been made in progress. His present invention (1,454,610, issued May 8) embraces a bleaching tank of unusual design, preferably shaped like the frustum of a cone. This prevents the clinging of stock, which is circulated by means of a worm elevator in the center. A plow-paddle device revolves at the bottom to assist in working pulp toward the center. This form of apparatus makes possible the use of stock carrying 18 to 25 per cent pulp or even more. Ordinary bleaching tanks usually are limited to a concentration of 6 per cent of pulp. Working with this new vertical apparatus, time of bleaching is reduced, higher concentration of bleach may be used without injuring the fiber and the comparatively low temperature of 80 deg. F. may be employed to carry out the bleaching action.

Would Use Raw Material Completely

Not content with the loss of material involved in paper manufacture from straight cellulose, Carl Bache-Wiig has patented a process of treatment (1,455,471, issued May 15, 1923) which allows the utilization of lignin as well. Straw, cornstalks, wood or bagasse may be used. The material is first treated with 1 to 3 per cent sodium chloride at 70 to 110 deg. C. for from 12 to 72 hours. This procedure produces a greatly softened fiber. The successive treatment is a cook with a bisulphite liquor. By this process pulp suitable for a good newsprint may be obtained, according to the claims of the inventor.

Pulp Screen for Converted Stock

Hardly a month goes by without a new patent on a fresh wrinkle in paper stock treatment. F. P. Miller proposes to take unnecessary load off beaters by routing part of the digested stock directly to the paper machine and part only to the beaters. (1,455,594, issued May 15, 1923.) The stock is first digested and reduced in the usual manner, is then discharged onto a pile; the pile is reduced by a jet of water under pressure and the suspended stock conveyed to a screen. Here the coarse particles are separated from the fine; the fine material is then allowed to flow through a channel in which any heavy foreign material will collect. In this way the fine material is separated from the coarse, the latter being routed to the beaters, the former to the stuff chest.

To Kill the Odor of Sulphate Pulp

The odor of sulphate pulp has long characterized this process of manufacture. The odor is presumably due to the presence of mercaptans, higher sulphides or sulphur-lignin compounds. G. A. Richter, of the Brown Co., Berlin, N. H., has recently patented a method of treatment of sulphate pulp to remove its odor. (1,454,339, issued May 8, assigned the Brown Co.) The process consists in treating the wet pulp in a beater or washer with an oxidizing agent such as calcium hypochlorite at a concentration sufficiently low to prevent a bleaching action. In the method described approximately 2 per cent of hypochlorite is added on the basis of pulp weight. The reaction may be carried out simultaneously with the beating.

New Publications

THE NATIONAL RESEARCH COUNCIL has recently issued a Colloid Bibliography in mimeographed form. The author, Dr. Harry N. Holmes of Oberlin College, chairman of the National Research Council committee on the chemistry of colloids, intends this edition to be preliminary to a more comprehensive one. Yet it is a book of 135 pages containing 1,800 references on 106 topics. All the references are classified and many are accompanied by brief comment as an aid in deciding on their relative importance. This book may be purchased from the National Research Council, 1701 Massachusetts Ave., Washington, D. C., at $1.

AN ECONOMIC AND COMMERCIAL REVIEW OF THE ARTIFICIAL SILK INDUSTRY OF CANADA. Processes, raw materials, cost, tariff and other factors affecting the Canadian industry are considered. An appendix includes a survey of the industry in some of the principal producing countries. Compiled by the Natural Resources Intelligence Service, Department of the Interior, Ottawa, Canada.

Important Articles in Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem. & Met.* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. Those that are of unusual interest will be published later in abstract in this department; but since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage. The magazines reviewed have all been received within a fortnight of our publication date.

CONTACT SULPHURIC ACID. H. Braidy. Continuation of a series of articles. This one discusses drying towers. *L'Industrie Chimique*, May, 1923, pp. 194-7.

PRODUCTION AND USE OF LAMPBLACK. Rex Furness. Discussion of carbon black from natural gas and a criticism of process efficiency. *Chemical Age* (London), May 19, 1923, pp. 532-4.

EFFICIENCY AND COST COMPARISON IN BONE CHAR AND DECOLORIZING CARBON REFINERIES. G. Avot. An argument in favor of decolorizing carbons. *International Sugar Journal*, April, 1923, pp. 196-9.

ECONOMIC USE OF PHOSPHATE DEPOSITS. W. H. Waggaman. A word of caution from a careful student. *American Fertilizer*, May 19, 1923, p. 39.

EXPLOSIONS IN AIR COMPRESSORS. J. A. Vaughan et al. An exhaustive study of operating conditions and accidents in South African mines and plants. *J. So. African Inst. of Engrs.*, April, 1923, pp. 171-209.

SOME PRACTICAL NOTES on Oil Pumping. G. W. E. Gibson. Well illustrated article on design and present-day practice in operation. *J. Inst. of Petr. Technologists*, April, 1923, pp. 77-101.

FIRE HAZARDS AND FIRE EXTINCTION IN PETROLEUM INDUSTRY. Presidential address of Prof. J. S. S. Brame. *J. Inst. of Petr. Technologists*, April, 1923, pp. 113-128.

A METHOD FOR EXPRESSING THE VALUE OF MIXING AGENTS BETWEEN HYDROCARBONS AND 95 PER CENT ALCOHOL. W. R. Ormandy and E. C. Craven. *J. Inst. of Petr. Technologists*, April, 1923, pp. 129-133.

FREE SULPHUR IN MOTOR FUELS. W. R. Ormandy and E. C. Craven. *J. Inst. of Petr. Technologists*, April, 1923, pp. 133-139.

SUPER-DEODORIZATION AND THE NEUTRALIZATION AND BLEACHING OF VEGETABLE OILS UNDER VACUUM. Louis C. Whiton. An exposition of the Bataille process. *Cotton Oil Press*, June, 1923, pp. 30-33.

ORIFICE COEFFICIENTS—DATA AND RESULTS OF TESTS. J. M. Spitzglass. Tests to establish correct theory for orifice metering devices. *Mechanical Engineering*, June, 1923, pp. 342-48.

ACTION OF BACTERIA ON CELLULOSIC MATERIAL. A preliminary study of bacteria as affecting fermentation and decay. *Chemical Age* (London), May 12, 1923, pp. 510-511.

ACTION OF HEAT ON CHEMICAL PROPERTIES OF COTTON. J. Merritt Matthews. A general summary of the physical factors governing chemical changes in cellulose, with especial reference to heat. *Color Trade Journal*, June, 1923, pp. 255-258.

CLASSIFICATION AND DEFINITIONS OF PAPER. C. J. West. A comprehensive classification of different papers, with full definitions for use in manufacture and merchandizing. *Paper Trade Journal*, May 31, 1923, pp. 49-54.

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Men in the Profession

ALEXIS C. HOUGHTON has resigned as chief chemist of the Solvay Process and Semet-Solvay companies, Syracuse, N. Y., to take charge of the phenol plant of the Bakelite Co., New York City.

ERNST JOHANSEN has resigned his position as head of the research department of the Atlantic Refining Co., Philadelphia, to become chief chemist with the New England Oil Refining Co., Fall River, Mass.

CHARLES A. MAY, head of the Lamberton Works of the Maddock Pottery Co., Trenton, N. J., is recovering from a severe illness.

LEROY H. MINTON, general superintendent for the General Ceramics Co., Metuchen, N. J., has been elected vice-president of the local Chamber of Commerce.

DR. R. B. MOORE, retiring chief chemist of the Bureau of Mines, was guest of honor at a luncheon on May 29, which was attended by a large number of his associates at the bureau.

C. EDWARD MURRAY, JR., has been elected president and treasurer of the Murray Rubber Co., Trenton, N. J.

H. L. PRATT has been elected president of the Standard Oil Co. of New York, succeeding HENRY C. FOLGER, JR., who has been appointed chairman of the board of directors, a new office recently created. Mr. Pratt has been vice-president and will be succeeded in this office by CHARLES M. HIGGINS, formerly secretary. FREDERICK S. FALES has been elected secretary.

ERNST REINHARDT, ceramic engineer for the Chelsea China Co., New Cumberland, W. Va., has resigned to accept a similar position with the Hagar Potteries Co., Dundee, Ill.

H. R. SARGENT, formerly manager of the wiring supplies division of the Bridgeport Works of the General Electric Co., has been appointed managing engineer of this division under a development plan which will create several unit divisions at the Bridgeport factory.

L. I. SHAW, assistant chief chemist of the Bureau of Mines, delivered, on June 6, the dedication address at the new chemical building of the New York State School of Ceramics at Alfred University.

RICHARD STRATTON, manager of the Giant Powder Co., San Francisco, Calif., is on a visit to Eastern cities, including Wilmington, Del., where a conference has been held by company officials.

C. G. STUPP, formerly assistant chief chemist of the research department laboratory of The Barrett Co., New York City, and more recently with the National Aniline & Chemical Co., Buffalo, N. Y., has resigned to accept a position with Weiss & Downs, of New York City.

MALCOLM W. THOMPSON, secretary-treasurer of the Hall China Co., East Liverpool, Ohio, gave an interesting talk before the members of the local Rotary Club, May 29, on the subject of hotel chinaware.

W. M. WEIGEL, who has been working on non-metallics, particularly fillers, at the Tuscaloosa station of the Bureau of Mines, is to be transferred to the Washington office shortly as assistant to the chief chemist in charge of non-metallic matters. Mr. Weigel will take up his work in Washington some time before the first of July.

Obituary

WILLIAM M. BENNETT, vice-president of the Clinchfield Portland Cement Co., Kingsport, Tenn., died in that city on May 26, following an attack of acute indigestion. He was 56 years of age.

LUDOLPH OSCAR KOVEN, of L. O. Koven & Bro., Jersey City, N. J., died on May 17 in New York City.

CORNELIUS S. SWEETLAND, president of the Rumford Chemical Works, Providence, R. I., died at the Jane Brown Memorial Hospital in that city on May 30, in his seventy-eighth year. He was active in the organization up to the time of his death.

Calendar

AMERICAN CHEMICAL SOCIETY, fall meeting, Milwaukee, Wis., Sept. 10 to 14.

AMERICAN ELECTROCHEMICAL SOCIETY, forty-fourth meeting, Dayton, Ohio, Sept. 27 to 29 (dates provisional).

AMERICAN ELECTROPLATERS SOCIETY, eleventh annual meeting, Providence, R. I., July 2 to 5.

AMERICAN GAS ASSOCIATION, annual convention, Atlantic City, Oct. 15 to 20.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, summer meeting, Wilmington, Del., June 20 to 23.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS, iron and steel exposition, Buffalo, N. Y., Sept. 24 to 28.

AMERICAN SOCIETY FOR TESTING MATERIALS, twenty-sixth annual meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, June 25 to 30.

INSTITUTE OF MARGARIN MANUFACTURERS, fourth annual convention, Hotel Traymore, Atlantic City, June 14 and 15.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (NINTH), New York, Sept. 17-22.

NATIONAL FERTILIZER ASSOCIATION, thirtieth annual convention, White Sulphur Springs, W. Va., June 11 to 16.

NATIONAL LIME ASSOCIATION, fifth annual convention, Hotel Commodore, New York City, June 13 to 15.

SOCIETY FOR STEEL TREATING, Eastern sectional meeting, Bethlehem, Pa., June 14 and 15.

Industry and Trade

Current News and Market Developments

Summary of the Week

Revised alcohol regulations submitted to committee representing trade.

Government suit against Chemical Foundation begins at Wilmington, Del.

Federal Trade Commission starts hearing of case against naphtha soap products of Procter & Gamble.

Lower prices for tin have been followed by easier quotations for tin products.

Imported copper sulphate has been under selling pressure and sold at new lows for the movement.

Cottonseed oil strengthened on covering by shorts, following a rise in prices for cotton and lard.

Supreme Court holds that linseed companies violated Sherman act.

Importers will not be required to pay duty on merchandise lost while in government custody.

Weakness in chemical prices offset by rise in cottonseed oil and index number for the week shows gain.

Demand for arsenic and calcium arsenate remains slow and prices are tending downward.

Large silk dyeing companies in New Jersey merge into one of the largest establishments in the world.

Steadier seed markets checked the easier feeling in linseed oil market.

Prices for Chemicals Moving Downward

THE UPWARD SWING of prices for chemicals, which started last October, continued unbroken into April. A reaction which then set in was in evidence throughout May and gradual declines in various commodities brought about a lower average selling price.

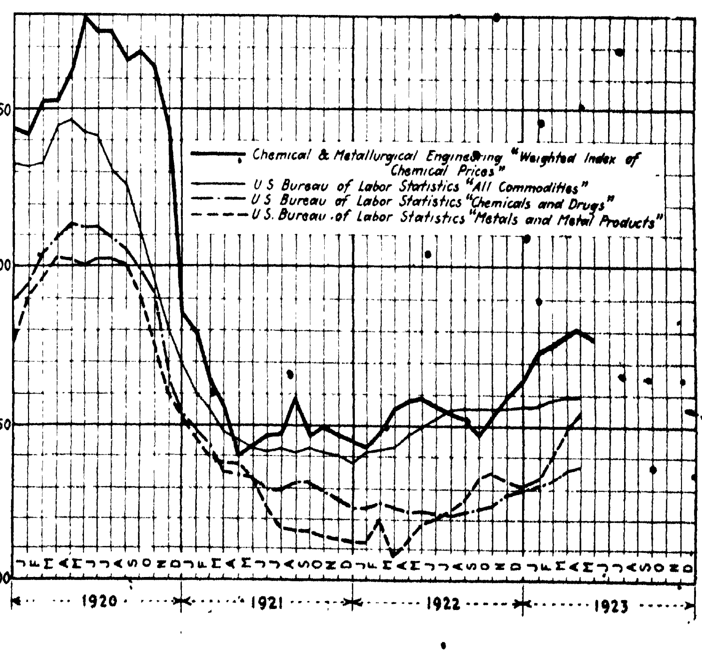
Chem. & Met.'s weighted index measures this decline in definite figures and reveals a high of 181.61 in April, as compared with 177.64 at the end of May. In other words, average prices for chemicals in April were more than 81 per cent higher than those that prevailed in 1913-14. While this percentage was decreased in the past month, the index number at the end of May shows a decline of less than 2¼ per cent from the high of the year.

To a very great extent, the steady rise in market values during the first 3 or 4 months of the year may be attributed to the unusually active condition of the various consuming industries and the correspondingly greater call for materials. Conversely, the softening of prices reflects a slowing up in general business activities and a less urgent call for supplies.

The influence of chemicals of foreign origin also has helped to depress values for different domestic selections. While consumers were in a position to take practically everything offered, importations were readily absorbed. When buying orders assumed smaller proportions, exporters in outside markets continued to ship heavily. As a consequence stocks began to pile up and holders began to offer price concessions as a stimulant to trading. This had the twofold effect of weakening confidence in values and of making buyers cautious in committing themselves on requirements for any period ahead.

In contrast to the depressing effect of selling pressure and slower consuming demand, the labor situation has been a steadying factor on values for chemicals. High labor costs are generally reported by domestic manufacturers and scarcity of labor also is given as a prime reason for the firm position held by certain chemicals. Uncertainty about the labor situation likewise casts its shadow about plans for future operations and undoubtedly this will be a price factor in the market for chemicals for some time to come.

The general level of wholesale prices as compiled by the Bureau of Labor is not yet available for the month of May. April figures of the bureau give the index number for "all commodities" as 159, which is a duplication of the figure for March, thus showing no change for the month. Chemicals and drugs made a slight gain, the number being 135 for March and 136 for April. Metals and metal products offer a comparison of 154 for April and 149 for March.



Trade Committee Will Pass on Revised Alcohol Regulations

Draft Now in Hands of Trade Alcohol Advisory Committee—Closer Co-operation Between Technical Users and Internal Revenue Department

THE draft of the revised Regulation 60 is in the hands of the Trade Alcohol Advisory Committee. It covers 250 typewritten pages. Copies will be sent to each member of the advisory committee for his criticism and suggestion. If need arises to correlate any of the changes suggested the advisory committee will be called together for that purpose.

The action of the Commissioner of Internal Revenue in turning over the draft of the regulation to the committee followed closely after the organization meeting of the committee. It is thought to indicate that he will do just what he has promised in co-operating closely with the legitimate producers and consumers of industrial alcohol. This is the first time since the enactment of the Volstead law that the technical industry has been called in formally.

Within 2 months after July 1 all holders of permits to withdraw beverage alcohol must renew them. For that reason every effort will be made to liberalize the regulation promptly so that it will not be so great a check on legitimate industry. One member of the advisory committee told Internal Revenue Commissioner Blair and Prohibition Commissioner Haynes that under existing regulations the cost of policing an alcohol plant equals the cost of fuel and adds a very large item to manufacturing costs. By adding this large item of cost to the long list of American products which make use of alcohol American goods are at great disadvantage in competing with the products of foreign manufacturers, who are spared all of that cost as well as others which the regulations are held to have heaped on trade alcohol.

The advisory committee at its initial meeting selected William M. Sailer as its chairman and H. E. Howe as its secretary. Mr. Sailer is the president of Sharp & Bohme and is the president of the American Drug Manufacturers' Association. Mr. Howe is editor of *Industrial and Engineering Chemistry*, the publication of the American Chemical Society. R. M. Cain, of the Swan-Meyers Co. of Indianapolis and president of the American Pharmaceutical Manufacturers' Association, was added to the membership of the advisory committee.

To Make Chilean Nitrate Survey

H. Foster Bain, Director of the Bureau of Mines, to Undertake the Task

Before making any recommendations in connection with the study being made of nitrogen supply, the Department of Commerce recognizes that additional accurate knowledge must be had as to the situation in Chile as it affects the production and distribution of nitrate of soda. It is recognized that the gathering of this information is a delicate task. For that reason it has been decided to send on this mission H. Foster Bain, the director of the Bureau of Mines, who, in addition to being the head of the government agency which represents the mining industry, is a mining engineer and mineral technologist who has had wide experience abroad. He will be accompanied by Harry S. Mulliken, technical assistant to the director of the Bureau of Mines.

The opinion has been expressed that neither the Chilean Government nor the nitrate producers in that country would welcome an emissary from the United States Government when the avowed intention of the law under which the visit would be made is to devise means of arousing competition for one of their great resources. It is believed, however, that by sending a high federal official to Chile he will be able to secure the necessary information, because both the Chilean Government and the nitrate producers probably prefer giving actual facts to a person of unquestioned responsibility, who could be relied upon to make only proper and accurate use of the data, rather than have the Secretary of Commerce predicate his recommendations on exaggerations. If the accurate information is withheld, the only recourse would be to secure the data from other sources. Inaccuracies would be certain to result. As a consequence, a distorted picture of the Chilean monopoly probably would be painted. The Chileans must recognize that the United States is in a position to make itself self-supporting, ultimately, in the matter of nitrogen. The only hope of preventing drastic action looking to that end would be to demonstrate that the cost of such a course would be too great to justify it.

Reduction in Sulphur Tax

The Senate Committee on State Affairs of the Texas Legislature is arranging for a reduction in the tax on sulphur from 2½ to 2 per cent. A bill is also being drafted to have the latter tax of 2 per cent apply on other natural products, including turpentine, iron ore, carbon black, salt, lime, cement, fullers earth, lignite, quicksilver or cinnabar. The committee is also considering a tax of ½ of 1 per cent on all oil refinery products.

Definite Chemicals Needed in Food, Says Mendel

Prof. Lafayette B. Mendel, of Yale University, addressed the members of the California Section of the American Chemical Society at San Francisco on June 1, the subject being "What Constitutes a Food." Dr. Mendel emphasized the importance of paying attention to the "little things" in diet. He described the regional incidence to goiter, and the need for minute amounts of iodine in food. The normal human being needed calcium, but most of the typical foods contain none. Vitamins, likewise, are essential; when omitted, a rapid decline in health takes place, in some cases due to an aversion to what formerly was considered a balanced diet, which aversion disappears after vitamins have been administered, even unknown to the patient. Professor Mendel deprecated generalizations in regard to the value of apparently similar foods and to the effect of heat on vitamins. All fats and oils were not of the same food value per unit of weight; in this connection the vitamin content of cod liver oil was emphasized. Cooking or heating does not necessarily destroy the vitamin in foods.

Swedish Industry Getting on Its Feet

In Sweden, according to a Reuter dispatch, the situation in the engineering industry has further improved and is, in fact, better than at any time since the middle of 1921. This is partly due to German competition having been checked by the occupation of the Ruhr. On the other hand, the Ruhr conflict and the Swedish labor dispute have made raw materials dearer and scarcer. The outlook is especially bright in paper industrial development. Orders for match-making machinery have fallen off. Mining prospects are good if they may be judged by demands for mining equipment.

Record Output of German Potash in 1922

The annual reports of the three producing potash companies of Germany—the Salzdetfurth, Aschersleben and Westeredeln—were made public on June 1 and revealed that production of potash in Germany in 1922 was the largest in the history of the trade. The total potash marketed was 12,955,433 double centners, as compared with 11,103,694 in 1913, the previous record year, and 9,211,814 in 1921. (A centner is slightly more than 110 lb.)

Foreign buyers took 25.6 per cent of last year's production, as against 16.6 per cent in 1921 and 45.6 in 1913. The American market is reported as particularly favorable.

The dividends declared by the three concerns were: Salzdetfurth, 350 per cent, as compared with 24 per cent in 1921; Westeredeln, 200 per cent, as compared with 20 per cent in 1921; Aschersleben, 150 per cent, as compared with 16.

Unfair Sales Methods Furnish Charge in Naptha Soap Dispute

Procter & Gamble Products Questioned by Federal Trade Commission—Company Doubts Government's Right to Specify Use of Certain Ingredients

CENTERED at the Engineering Club, New York City, at time of going to press, an interesting flurry exists in the soap industry. The Federal Trade Commission, following up the complaints of an unnamed party, charges Procter & Gamble with unfair sales methods. P. & G. White Naptha Soap and "Star Naptha Washing Powder" are furnishing the chief bones of contention. Although the identity of the complainant has not been revealed, evidence appearing in cross-examination of the witnesses indicates that the samples for analysis upon which the dispute rests were furnished by Fels & Co., of Philadelphia.

Examiner John W. Addison of the commission is hearing the case. Frank T. Dinsmore, counsel for Procter & Gamble, opposes W. C. Reeves, counsel for the commission. J. H. Bower, who has been in charge of soap chemistry for the Bureau of Standards since 1914, figures in the fray, as does Earl P. Stevenson, vice-president of the Arthur D. Little Co.

Naphtha Content Is Argued

Naphtha and sodium silicate are the ingredients about which the argument revolves. The complainant claims that there is an insufficient amount of distillate present in these products to be of use in enhancing the detergent value of the soap. Likewise in the instance of Procter & Gamble products that the amount of sodium silicate therein constitutes an adulteration in view of the advertisement of the respondents that only materials too good for ordinary laundry soap go into their products. Mr. Dinsmore contends that the government has no authority to fix the percentage of this ingredient or to say whether or not it is an adulterant in amounts therein present. Mr. Stevenson stated that while the use of silicate in amounts up to 10 per cent may contribute desirable characteristics to the soap, in excess of this amount it must be regarded as an adulterant. He said the chemical definition of soap is an alkali salt of fatty acid, and that sodium silicate is not soap, but in reply to further questions said he knew of only one soap which approached this definition very closely. That soap was not mentioned.

Whether or not the petroleum distillate used in P. & G. products may be classified as naphtha opened another question to dispute. The witness refused to admit that naphtha is a vague and variable term and defined naphtha as a light, volatile, flammable hydrocarbon which should have an initial boiling point ranging up to 300 deg. and an end point not in excess of 450 deg.

In speaking of the analysis of the P. & G. products made at the Arthur D. Little laboratories, Mr. Stevenson stated that it revealed the presence of only very small percentages of petroleum distillate which could not be classed as naphtha, and which, in his opinion, was not of sufficient quantity to enhance the cleansing power of value of these products. He also expressed the opinion that white laundry soap is not any better for washing purposes than yellow soap because of color.

Respondents' answer to the complaint claims that the amount of naphtha and silicate of soda used in their soap and washing powder do add to their efficiency.

For government experts in support of the testimony of the A. D. Little laboratories, Ivan M. Tull, general manager of the National Dyers and Cleaners Association, took the stand. R. F. Bacon, T. T. Gray and A. H. Gill have also given testimony. Other witnesses are still to be called.

Following the present hearing a postponement of the case until fall is expected when it will in all likelihood be reopened at Cincinnati for the purpose of hearing the defense of the respondents.

Manufacturing Chemists Hold Annual Election

Meeting at the Whitehall Club, New York, on June 6, the Manufacturing Chemists Association held its annual election. The annual report of the executive committee was also presented, covering the year's activities. These included work upon tariff, patent and waste disposal legislation, upon various phases of transportation and improvement of containers for chemical products.

The following officers were elected for the coming year: President, A. H. Hooker, Hooker Chemical Co.; vice-presidents, C. W. Miller, of the Davison company, and M. C. Whitaker, of the United States Industrial Alcohol Co.; treasurer, S. W. Wilder, Merrimac Chemical Co.; secretary, J. I. Tierney. The executive committee, headed by Chairman Henry Howard, Graselli Chemical Co., also includes the following six members: A. G. Rosengarten, Powers, Weightman, Rosengarten Co.; Lancaster Morgan, General Chemical Co.; H. H. Dow, Dow Chemical Co.; R. T. Baldwin, National Aniline & Chemical Co.; W. H. Bower, Henry Bower Chemical Manufacturing Co.; C. L. Reese, E. I. du Pont de Nemours & Co.

News Notes

The Beaver refining plant at Washington, Pa., burned on May 27. Only three gasoline tanks and a small office remained standing late in the morning. One hundred thousand gallons of gasoline had been burned and the damage was estimated at $225,000.

The University of West Virginia is planning to build a new chemistry building at Morgantown. The structure is to be four stories, with an extension of one story and basement.

The Alberta Clay Products Company has received orders for upwards of fifty carloads of clay products from two British Columbia points. Another large company is contemplating erecting a plant to utilize the clays of the district. The natural gas supply in that region is a valuable auxiliary to the clay product industry.

Western New York section elections of the American Chemical Society on May 29 were: chairman, G. P. Fuller, Niagara Falls; first vice-chairman, J. A. Handy, Buffalo; second vice-chairman, E. L. Koethen, Niagara Falls; secretary, R. W. Hess, Buffalo; treasurer, R. A. Nelson, La Salle; executive committee, M. J. Ahern, Buffalo; H. N. Gilbert, La Salle; J. R. MacMillan, Niagara Falls; councilors, C. G. Derick, Buffalo; Walter Wallace, Niagara Falls, A. M. Williamson, Niagara Falls.

The Mexican Petroleum Company is negotiating with the Davison Chemical Company for the silica gel process, according to a statement by an official of the company. Following this report the Mexican Petroleum Company declared at New York that it has been looking into the silica gel process of the Davison Chemical Company for about two years.

American Smelting & Refining Co. will close its tin smelter at Perth Amboy, N. J., July 1, owing to inability to get further supplies of Bolivian tin concentrates in competition with English tin smelters which are able to smelt at much lower cost because of cheaper labor and supplies. It is understood that the only other tin smelter still operating in the United States will close about July 31. All five smelters in the United States will then be down.

The twelve hour day in the steel industry is being widely condemned. Churches of all denominations are in accord with the views of the Federated American Engineering Societies. According to the report of the work periods committee of the latter society, profits need not suffer by the change from a twelve to an eight-hour day.

The Cottrell process is to be installed at the smelter of the Electrolytic Zinc Company of Australasia, Inc., Risdon, Tasmania. K. I. Marshall, of the Western Precipitation Company, has already sailed to do the work.

Washington News

Expansion of Chrome Ore Production in Rhodesia

In a report to the Department of Commerce, Consul C. I. Pisar of Cape Town says a feature of mineral production in Rhodesia during the later months of the year 1922 has been the expansion of the chrome-ore industry. The total production of chrome ore in 1921 was 50,188 tons, and in 1922 94,475 tons. The highest production for any single month was in November, 1922, when 24,814 tons were mined.

For some years past southern Rhodesia has been one of the principal chrome-ore producing countries in the world, and, as in the case of various other minerals, the demand occasioned by the European war resulted in a very marked increase in output. Between June, 1921, and May, 1922, the demand dropped to such an extent that practically all the mines in Rhodesia ceased producing. Since May, 1922, there has been a revival in the demand for chrome ore on a larger scale than ever.

The principal producers of chrome ore in Rhodesia are associated ventures styled "the Rhodesian Chrome Mines, Ltd., and the Rhodesian Metals Syndicate, Ltd. These companies hold claims in other parts of Rhodesia than the Selukwe district, where the principal deposits are located, and such is the variety of their deposits that they are able to supply almost any grade, both hard and "fines." The deposits are very extensive and mining costs are comparatively low. The present price of Rhodesian chrome ore (50 per cent) is from £5 to £6 per ton.

Albumen Containers Need Not Be Marked

Importers of egg albumen recently met and protested against a decision of customs appraisers officers to the effect that the immediate containers of albumen must be marked to show the country of origin. The importers decided to send a representative to Washington to protest against this ruling. After a conference with Assistant Secretary of the Treasury Moss, it was announced that the containers need not be marked. David Walker, who represented the importers, held that these containers were imported in an outside case which was the unit of sale, and that these cases went with the merchandise to the ultimate consumer.

Mr. Moss agreed that the importers were right in their contention that under the provisions of the 1922 act the actual containers of the albumen need not be marked, provided the outside case is properly labeled. A ruling to this effect, Mr. Walker said, will be handed down within the next few days.

Standardization Conference Dates Changed

Director George K. Burgess, of the Bureau of Standards, announces that several changes in date of conferences on standards have been necessary. The modified schedule for these conferences is as follows:

Preparation and unification of commodity standards, 10 a.m., June 11, conference room, Department of Commerce Building;

Conference on transverse fissures in rails, 9:30 a.m., June 15, room 30, South Building, Bureau of Standards;

Non-destructive testing of wire rope, 9:30 a.m., June 6, room 237, Industrial Building, Bureau of Standards;

Refractories used in steel industry, 10 a.m., June 18, room 704, Department of Commerce Building;

Standardization of paper, 10 a.m., June 19, Conference Room, East Building, Bureau of Standards;

Conference of tin plate manufacturers postponed to 9:30 a.m., Aug. 15, room 237, Industrial Building, Bureau of Standards.

Those desiring further information regarding the scope or progress of these conferences should address the Director Bureau of Standards, Washington, D. C.

Bureau Gas Chief to Direct California Research

Walter M. Berry, who has been chief of the gas engineering section of the Bureau of Standards, has resigned effective July 1 to become engineer in charge of research of the California Gas Research Council. The council is made up of representatives of California public utility companies interested in supply of manufactured gas and the utilization of it and natural gas. The work of the council will continue the research on gas utilization which has been in progress for several years. This has been carried on jointly by the utility companies and the California Railroad Commission. As a result of Mr. Berry's resignation, it is thought probable that the experimental studies of gas utilization at the bureau, which have been under his direction, will be transferred to the Chemical Division to be directed by E. R. Weaver.

Denatured Alcohol Formula

The Internal Revenue office of the Treasury Department has sent a notice to collectors, authorizing the use of specially denatured alcohol in the manufacture of bay rum and lotions for external use. The new denaturing process is called Formula No. 39-D and provides for the addition of 50 avoirdupois oz. of quinine sulphate and 1 gal. oil of bay N.F. to every 100 gal. of pure ethyl alcohol of not less than 190 deg. proof.

Netherland Chemical Trade in 1922

Chemical factories in the Netherlands, as a rule, did well during the year 1922. The export trade has increased materially in the past 2 years, with a considerable development of trade with the United States. The Dutch manufacturers also are finding it more nearly possible to supply their home market with many products that were formerly imported from other countries, this being the case especially with artificial fertilizers, which form an important item in the Netherlands. The manufacture of many varieties of drugs, formerly obtained mostly from Germany, is on the increase.

Turpentine and phosphate are the principal chemical products imported by the Netherlands from the United States. The following table shows the value of these and other important items imported from this country by the Netherlands in 1921 and 1922:

	1921	1922
Chilean nitrate	$105,916	$86,640
Phosphate	793,121	858,040
Caustic and other soda	47,996	96,900
Various chemical products	206,895	389,880
Dyes and colors	161,125	88,160
Turpentine	573,369	714,020

Delivered Weights to Govern Import Duties

Reports that importers would be granted an allowance in liquidating duties on imports where part of the goods were lost before passing into possession of the consignee have been confirmed. Hereafter duty will not be collected on merchandise which is lost while in government custody. Up to the present duty has been levied on the full shipments as indicated on the consular invoice. The collector's office in announcing the change stated: "The decision of the Customs Court is therefore controlling, and this office will modify its present practice and make due allowance, in liquidation, for all articles which the appraiser reports missing from the package under examination."

Italian Sulphur Production

Production from the sulphur mines of the Montecatini Co., near Rimini, Italy, amounts to about 40,000 tons a year. The last annual report of the company states that the 1923 output will be limited to this figure in order to enable Sicilian sulphur to find a market on the Italian mainland.

The Montecatini Co. has given up its interest in Sicilian sulphur companies and is interested at present only in the Gallitano Sulphur Mine and the Societa Solfifera Siciliana.

The 1922 annual report of this company states that the recent agreements between American producers and Sicilian sulphur consortiums can not improve the condition of the Sicilian sulphur industry, but that improvement in this industry can be obtained only by reducing the cost of production.

Government Reopens Suit Against Chemical Foundation

Preliminary Evidence Presented by Government and by Defence—Textile Alliance Cleared—Trial Likely to Be Long

THE suit of the government against the Chemical Foundation, Inc., is under way. The return of 4,500 patents seized and sold during the war by the Alien Party Custodian is being sought by the government. Judge H. M. Morris is presiding at the trial, which is being held at Wilmington, Del. Isador J. Kresel is chief counsel for the defence, while William D. Guthrie is also acting as counsel for the Foundation. Col. Henry W. Anderson, Assistant Attorney General, is pressing the case for the government.

Colonel Anderson endeavored to show that there had been some attempt on the part of chemical and dyestuff manufacturers in this country to combine. In connection with this he cited the formation of the American Dyes Institute, which has since been dissolved. He said, however:

Trial Not Under Sherman Law

"I want to make it quite clear that we are not here to try a monopoly case or a case under the Sherman anti-trust law in restraint of trade. I am avoiding in this case, and hope we can avoid throughout, any suggestion of international wrong. But I think it is pertinent to this case to show that there was a combination of bidders for the purchase of trust property. This is one of the elements to be considered in ascertaining the circumstances of the development of this combination and its heading up to the fact of getting control of these patents and bringing about a private sale thereof. This sale was brought about under terms which we will contend were ridiculous in the matter of consideration.

Colonel Anderson stated that those representing chemical interests, who were instrumental in bringing about the sale and who aided the alien property custodian in assembling information leading up to the sale of the patent, might, under the technical rulings of the law, be held guilty of a breach of trust in that they had induced officers of the United States government to bring about the sale of the patents.

Foundation Claims Justification

Kresel and Guthrie, in response to the government's charge, which occupied almost the entire first day of the trial, maintained that President Wilson and Mr. Polk favored the transaction, knowing all the facts; that the question of price was of secondary importance. Instead of being worth $100,000,000, as Attorney Anderson claimed, the actual value of the patents is, they claim, slight as far as workability is concerned. Actually less than 10 per cent of these have been used at all and of those used only a few have yielded profit. Kresel maintained that the books of the Foundation, which are open, prove that point. To return these patents to the government practically necessitates their return to Germany. such action, the Foundation counsel claims, would severely menace the American chemical industry, which is just now becoming thoroughly established.

Open to Reorganization

In reply to criticism of the Chemical Foundation made by counsel for the government, Mr. Kresel said the Foundation's managers were ready to have a complete reorganization, if necessary, in order to fully meet all objections that may justly be urged against its charter. It has administered its trust fairly, he added, issuing licenses to all persons applying for them for use in legitimate manufacturing purposes on fair and equal terms. It has scrupulously carried out the trust reposed in it. Its purpose was to promote the chemical industry and also to inform the people of its vast importance to national interests.

What is to be the outcome of the government's suit against the Chemical Foundation? The trial now under way at Wilmington, Del., is likely to cover a period of several weeks. The issue involved is of decided interest to the chemical industry in the United States. *Chem. & Met.* is following developments closely and during the period of the trial will present a weekly digest of its progress.

The charge was made by Kresel that there is an "invisible plaintiff" in the person of "the great German chemical trust." He drew a gloomy picture of a return of the German chemical monopoly in this country if the court upholds the government's demands.

Textile Alliance Cleared

One of the few positive developments in the early stages of the trial came in the clearing of the Textile Alliance of all charges of conspiracy in the seizure and sale of the patents. When Albert M. Paterson, president of the Textile Alliance, took the stand, he admitted his desire to have the Alliance combine with the Foundation. He stated that the purpose of both organizations is to prevent abuses in business. Moreover, he testified to the value of the Foundation's achievements, saying that today his industry finds it unnecessary to go outside of America for dyes. The reason for lack of a definite union between the two organizations developed to be the unwillingness of the executive committee of the Alliance to bring such a union about.

The trial will in all likelihood cover a period of several weeks. At present the opening guns have been fired, but the detailed arguments, the testimony of witnesses, the presentation of the case from other angles remain to be given.

National Lead Co. Negotiates for St. Louis Plant

E. J. Cornish, president of the National Lead Co., has confirmed reports that the Titanium Pigment Co., which is a subsidiary of the National Lead Co., is negotiating for the purchase of the plant of the Mineral Refining & Chemical Corporation, in St. Louis. The Titanium Pigment Co. manufactures "titanox," a new pigment composed of titanium oxide and blanc fixe. By securing a plant at St. Louis the company would be able to increase its output and also would be nearer the source of supply for barytes.

Dyeing Firms in Merger

Announcement was made last Wednesday that the United Piece Dye Works of Paterson, N. J., had obtained control of the Weidmann Silk Dyeing Co. It is stated that the companies will continue to operate as separate units, but will be conducted under the control of the United Piece Dye Works. This combination forms one of the largest silk-dyeing concerns in the country. In the announcement of the merger it was stated that the two have been merged under one management and control and the combined management will conduct these industries in their respective branches along the same lines as heretofore.

Match Industry in Poland

There are at present sixteen match factories in Poland, one having been established recently in former Russian Poland. Of this number, three are in former Austrian Poland, three in former German Poland, and the remaining ten in former Russian Poland. The matches are safety matches. About 50 per cent potassium chlorate is used in combination with antimony, sulphur and other substances. The principal wood is aspen, but pine and poplar are used occasionally. According to figures furnished by the Polish Ministry of Commerce, 84,706 cases, each case containing 5,000 boxes of 100 matches, were manufactured during the first 8 months of 1922. Exact figures for the last 4 months of the year are not available, but it is estimated that more than 50,000 cases were manufactured.

Supreme Court Holds Linseed Crushers Violated Sherman Act

Exchange of Prices and Other Information Through Armstrong Bureau Declared Unlawful—Reverses Decision of Lower Court and Orders Injunction

MANUFACTURERS in the same industry cannot exchange information as to sales and prices practically as a unit controlling the business of the industry without coming into conflict with the Sherman act, even though the information be cleared and distributed by an independent agency. So holds the United States Supreme Court in a decision June 4 reversing the action of the District Court for Northern Illinois in holding for the defendants in the government's suit against the American Linseed Oil Co. and eleven other crushers, and the Armstrong Bureau of Related Industries. The opinion, read by Associate Justice McReynolds, directed the District Court to grant the government the injunction it had sought.

The twelve linseed oil manufacturers were subscribers to the Armstrong Bureau. They controlled a large part of the business of their industry. They agreed to turn over to the bureau full reports of sales, quotations, offerings and other information. They were to receive through the bureau data on the market, trade and manufacturing conditions in the industry, economies in manufacture and sale, information regarding credit of buyers, uniform cost-accounting systems, fair freight rates, standardization of products and other information and help.

The District Court held that this agreement was not unlawful and denied the government's petition for an injunction against the practice as a violation of the Sherman act.

Lower Court Reversed

In concluding the Supreme Court decision reversing the lower court, Justice McReynolds, in his opinion, said:

"The obvious policy, indeed the declared purpose, of the arrangement was to submerge the competition theretofore existing among the subscribers and substitute 'intelligent competition,' or 'open competition'; to eliminate 'unintelligent selfishness' and establish '100 per cent confidence'--to the end that the members might 'stand out from the crowd as substantial co-workers under modern co-operative business methods.'

"In American Column & Lumber Co. vs. United States, we considered a combination of manufacturers got up to effectuate this new conception of confidence and competition and held it within the inhibition of the Sherman act because of inevitable tendency to destroy real competition, as long understood, and thereby restrain trade. Our conclusion there cannot be reconciled with the somewhat earlier opinion and judgment of the court below. They are in direct conflict.

"The Sherman act was intended to secure equality of opportunity and to protect the public against evils commonly incident to monopolies and those abnormal contracts and combinations which tend directly to suppress the conflict for advantage called competition--the play of the contending forces ordinarily engendered by an honest desire for gain.

"Certain it is that the defendants are associated in a new form of combination and are resorting to methods which are not normal. If, looking at the entire contract by which they are bound together, in the light of what has been done under it, the court can see that its necessary tendency is to suppress competition in trade between the states, the combination must be declared unlawful. That such is its tendency, we think, must be affirmed. To decide otherwise would be wholly inconsistent with the conclusion reached in American Column & Lumber Co. vs. United States, *supra*.

"The record discloses that defendants, large manufacturers and distributors powerful factors in the trade of commodities restricted by limited supplies of raw material (linseed), located at widely separated points and theretofore conducting independent enterprises along customary lines, suddenly became parties to an agreement which took away their freedom of action by requiring each to reveal to all the intimate details of its affairs. All subjected themselves to an autocratic bureau, which became organizer and general manager, paid it large fees and deposited funds to insure their obedience. Each subscriber agreed to furnish a schedule of prices and terms and adhere thereto—unless more onerous ones were obtained--until prepared to give immediate notice of departure therefrom for relay by the bureau. Each also agreed, under penalty of fine, to attend a monthly meeting and report upon matters of interest to be there discussed; to comply with all reasonable requirements of the bureau; and to divulge no secrets.

Not Bona Fide Competitors

"With intimate knowledge of the affairs of other producers and obligated as stated, but proclaiming themselves competitors, the subscribers went forth to deal with widely separated and unorganized customers necessarily ignorant of the true conditions. Obviously they were not bona fide competitors; their claim in that regard is at war with common experience and hardly compatible with fair dealing.

"We are not called upon to say just when or how far competitors may reveal to each other the details of their affairs. In the absence of a purpose to monopolize or the compulsion that results from contract or agreement, the individual certainly may exercise great freedom; but concerted action through combination presents a wholly different problem and is forbidden when the necessary tendency is to destroy the kind of competition to which the public has long looked for protection. The situation here questioned is wholly unlike an exchange where dealers assemble and buy and sell openly; and the ordinary practice of reporting statistics to collectors stops far short of the practice which defendants adopted. Their manifest purpose was to defeat the Sherman act without subjecting themselves to its penalties.

"The challenged plan is unlawful and an injunction should go against it as prayed in the original bill. The case will be remanded to the court below with instructions to issue such an injunction and promptly to take any further action necessary to carry this opinion into effect. Reversed."

Financial Notes

Parke Davis & Co. have declared a quarterly dividend of 50c. and an extra dividend of 75c. per share, both payable June 30. For the preceding quarter an extra dividend of $1.25 per share had been paid.

The United Zinc Smelting Corporation for the last calendar year shows total sales of $1,738,965 and operating profit, after costs and expenses, of $153,914. In 1921 the corporation reported an operating loss of $45,862.

The Owens Bottle Co. has declared a quarterly dividend of 75c. a share on the common stock and the regular quarterly dividend of $1.75 a share on the preferred, both payable July 2 to holders of record June 15.

The American Glue Co. has passed the regular quarterly dividend of $1 per share on common stock. Sales for the 4 months to April 30 were 28 per cent more than in corresponding period of 1922. Unsatisfactory trade conditions at present and undetermined questions of government taxes influenced action to pass the dividend.

The Goodyear Tire & Rubber Co. has declared a dividend of $2 on the prior preference voting trust certificates, payable July 1 to holders of record June 15.

At the annual meeting of the Pure Oil Co., President Dawes announced that he would recommend a reduction in the dividend rate on common stock from 8 per cent to 6 per cent.

The Lee Rubber & Tire Corporation will issue 65,000 shares of increased capital to acquire the assets of the Republic Rubber Co. The remainder of the stock will remain in the treasury.

United Kingdom Increases Imports of Chemicals in First Quarter of Year

Heavy Increase in Arrivals of Cream of Tartar—Decline in Glycerine Receipts—Small Imports of Coal-Tar Intermediates

IMPORTS of chemicals, other than drugs and dyestuffs, into the United Kingdom in the first quarter of 1923 increased in quantity, with the exception of glycerine, compared with the same periods in 1921 and 1922, according to a report received by the Department of Commerce from the office of the consulate-general in London. The increase over 1922 figures in some cases was nearly 200 per cent, and in the case of cream of tartar the increase was more than 9,400 per cent.

In the drugs sections, the returns for the first quarter indicated substantial increases in imports over 1922 figures, but did not reach the 1921 volume.

In dyes and dyestuffs, there were renewed imports of coal-tar intermediates and of synthetic indigo during the first 3 months of 1923, there having been no receipts of either in the corresponding period of 1922. But compared with 1921, intermediates totaled 58,000 lb., against 488,700 lb. in the same period of 1921, while imports of synthetic indigo increased to 804,400 lb., compared with 702,100 lb. 2 years ago. Imports of alizarin were 522,300 lb. in the first quarter of 1923, compared with 635,500 lb. in the corresponding period of 1922, while imports of "all other sorts" of finished coal-tar dyes, not enumerated, increased to 915,400 lb. in the 1923 period, compared with 875,000 lb. in the first quarter of 1922. Imports of natural indigo were 15,200 lb., compared with 40,200 lb. in the first quarter of 1922. Of extracts for dyeing, cutch increased to 1,284,600 lb. in the first 3 months of 1923, compared with 948,800 lb. in the corresponding period last year, while "all other sorts" declined slightly, being 2,234,200 lb., compared with 2,276,300 in the first quarter of 1922. Prices paid for alizarin averaged higher than in 1922, and prices for unenumerated coal-tar dyes averaged lower. Average prices for natural indigo were higher and prices for cutch and other extracts for dyeing averaged lower.

Comparative figures of quantity imports of chemicals and drugs during the first quarter of 1923 contrasted with the corresponding period of 1922 included: acetic acid, 1,645 tons—799 tons; tartaric acid, 6,223 cwt.—2,223 cwt.; bleaching materials, 8,696 cwt.—7,688 cwt.; borax, 17,606 cwt.—6,977 cwt.; calcium carbide, 175,028 cwt.—162,861 cwt.; glycerin, crude, 2,688 cwt.—9,376 cwt.; glycerin, distilled, 1,009 cwt.—2,288 cwt.; red lead and orange lead, 9,294 cwt.—4,444 cwt.; nickel oxide, 6,366 cwt. (no 1922 figures); potassium nitrate, 42,906 cwt.—26,775 cwt.; other potassium compounds, 1,246,487 cwt.—964,794 cwt.; sodium nitrate, 551,869 cwt.—238,814 cwt.; other sodium compounds, 85,374 cwt. — 35,439 cwt.; cream of tartar, 13,644 cwt.—143 cwt.; zinc oxide, 1,906 tons—1,161 tons; quinine and quinine salts, 324,219 oz.—139,368 oz.; bark, cinchona (bark Peruvian, etc.) 1,218 cwt.—618 cwt.

Export figures of chemicals and drugs for the first quarter of 1923 show increases in the majority of products as compared with the same period of 1922, but in the latter period there were a number of decreases as compared with 1921 which have not been fully recovered this year. The present trend, however, is toward higher exports in 1923.

Imports of Coal-Tar Dyes Increase in May

Imports of coal-tar dyes through the port of New York during May totaled 254,327 lb., with an invoice value of $292,340, according to the monthly report issued by the Chemical Division of the Department of Commerce and the Chemical Section of the Tariff Commission. This compares with 179,309 lb., valued at $185,344, in January; 191,709 lb., valued at $199,640, in February; 312,809 lb., valued at $301,436, in March, and 242,022 lb., valued at $256,751, in April.

The largest quantity importations of dyes in May were Ciba Scarlet, Ciba Bordeaux B, Alizarin Blue Black, Xylene Light Yellow 2 G, and Trisulphon Brown B. Of the total in May, 39 per cent was shipped from Switzerland, 39 per cent from Germany, 13 per cent from Italy, 5 per cent from England, 3 per cent from France and 1 per cent from Canada. In April, 42 per cent came from Switzerland, 37 per cent from Germany, 18 per cent from Italy, 2 per cent from Canada and 1 per cent from England.

The May report includes for the first time imports for consumption of synthetic aromatic chemicals, medicinals, photographic chemicals, intermediates and other coal-tar products which appear in the tariff act of 1922 in paragraphs 27 and 28. The aggregate of this imported during the month was 191,496 lb., with an invoice value of $90,524. Color lakes and bacteriological stains are not included.

German Soap Trade Depressed

The erratic and continued downward trend of the mark, the cost of basic oils which must be obtained abroad and the inability of the German people to absorb the output of the factories under prevailing prices has brought the soap industry of Germany to a rather discouraging pass, according to advices received by the Department of Commerce.

Trade Notes

R. B. French, of the New York office of Harshaw, Fuller & Goodwin Co., has left on a business trip to New England.

H. S. Chatfield, of the Kasebier-Chatfield Shellac Co., returned last week from a trip in Western territory.

The Oil Trades Association of New York will hold its annual outing at Massapequa Inn, Massapequa, L. I., on June 21. Albert J. Squier is chairman of the entertainment committee.

Sales of crystalline graphite in 1922 amounted to 1,849,776 lb. This was an increase of 56 per cent as compared with 1921. The amount of amorphous graphite sold was 2,200 short tons, or an increase of 19 per cent over 1921.

The Endicott-Johnson Co. has purchased land in St. Louis for the purpose of erecting a distributing warehouse in the Middle West and Southwest.

Following the recent acquisition of the California Chemical Co., San Diego, Calif., by Stanley H. Barrows, president of the National Kellastone Co., Porterville, Calif., plans are being perfected for the dissolution of the purchased company and the organization of the California Chemical Corp., to take over the plant, leaseholds and other properties. Mr. Barrows will head the new company. The plant is now being operated as the San Diego division of the Sierra Magnesite Co., of which Mr. Barrows also is president. Extensions and improvements will be made in the present works for increased output of flake magnesium chloride, potash and epsom salts.

Recent statistics show that rich deposits of clay are now to be found in seventeen counties in the state of Indiana. What is said to be the first pottery established in the state was located at Bloomingdale in 1840.

With the installation of automatic machinery, the Whitall-Tatum Co., Millville, N. J., manufacturer of bottles, vials, etc., is planning for the early discontinuance of its caster department. It is likely that the change will be made at the close of the present blast.

Directors and officers of the Standard Oil Co. of New Jersey have been re-elected.

Nearly 36 per cent of the record crude oil production of 1,937,767 bbl. per day in April was the result of operations in California. Daily output in California was 689,865 bbl.

The price of foreign dyes in Swatow, China, in 1922 declined gradually and the importation of aniline dyes showed an increase in value of 22,051 haikwan taels ($18,247), as compared with the figures for the same quarter of last year, according to a memorandum prepared by the commissioner of customs in Swatow, describing the trade of that port for the quarter ended Dec. 31, 1922.

Facts and Figures That Influence Trade in Chemical Products

Market Conditions

Current Prices Imports and Exports The Trend of Business

Quiet Trading Movement Gives Easy Tone to Prices Throughout Chemical List

Imported Offerings Are Still Under Selling Pressure and Large Consuming Industries Are Well Covered for Nearby Needs

THE weighted index for the past week indicates a higher average sales price for chemicals. This is due to advances in cottonseed oil, which is the basic oil in the vegetable oil group. As far as the price tendency of chemicals is concerned, the trend was more toward lower than higher levels.

Consuming trades continue to take large amounts of chemicals but new orders from this source have fallen off in volume and curtailed production as promised for the summer months has been anticipated in the markets for raw materials and there is a natural reaction from the active trading which characterized domestic markets in the first quarter of the year. Such a condition naturally has a direct bearing on prices and well informed members of the trade say values for chemicals may hold an easy position until indications of fall requirements are more clearly understood. There is a tendency on the part of manufacturers to carry only limited stocks of raw materials and trust to future developments as a guide for placing orders later on.

Stocks of different foreign chemicals are held in the local market and it is difficult to hold prices steady when buyers are apathetic. Most importers have figured in arsenic transactions and stocks have been held awaiting a heavy call for calcium arsenate. No improvement has yet taken place and arsenic prices are hard to maintain. Among other imported materials which are selling in buyers' favor are carbonate of potash, caustic potash, oxalic acid, permanganate of potash, cyanide of soda, prussiate of soda, sulphide of soda, and copper sulphate.

The easy position of some metals is reflected in lower prices for metal salts. This is noticeable in the case of tin products, some of which were lowered at the beginning of the month. Copper oxide and copper carbonate have been unusually active this season and they are in a strong position as a result of limited offerings. Copper sulphate, however, has not sold up to expectations and the influx of low priced foreign goods has depressed the market.

Acids

Citric Acid.—A better tone was noted in the market and inquiry for moderate sized lots was more regular. Some reports credited small-lot sales of imported at 53@53½c. per lb. The lowest price named for imported was 52c. per lb. and this figure was said to be below replacement costs. Domestic grades are pretty well sold up with first hands holding quotations at 49@50c. per lb.

Formic Acid.—Demand is of fair proportions but stocks on hand have been ample and there has been no change in market conditions. Imported grades are commanding the most attention because of price considerations. The quotation for 85 per cent acid is held at 14@15c. per lb. Domestic offerings are generally held at an inside figure of 16c. per lb.

Arsenic Still Declining — Imported Copper Sulphate Sells at New Low—Prussiate of Potash Neglected — Permanganate of Potash Weak—Caustic Potash Quiet and Easy—Fusel Oil Sold Up—Methyl-Acetone Advances.

Muriatic Acid. — The movement against old orders is still in evidence and producers are not carrying any surplus stocks, so that offerings for new account are restricted. Consumers, however, seem pretty well covered. Prices are steady at 90c.@$1 per 100 lb. for 18 deg. and $1.75@$2 for 22 deg. in tanks.

Nitric Acid.—Prices are holding on an unchanged basis but there was little else in the current market to distinguish trading. Demand is seasonable and regular deliveries are passing to the several consuming industries but new business is running light. Sellers quote 36 deg. at $4.50@$5 per 100 lb. and 42 deg. at $5.25@$5.75 per 100 lb.

Oxalic Acid.—There has been very little if any improvement in demand and this is reflected in the easy tone to prices. Offerings of imported were available throughout the week at 13@13½c. per lb. Stocks are fairly large and with consumers taking hold only in a hand to mouth fashion, there is not much in sight on which to base hopes of a consistently higher market.

Sulphuric Acid.—Consuming interest is less keen but consumption is reported to be above normal standards. Resale lots have not figured to any extent in recent transactions and with producers in control of the market and not carrying surplus stocks, prices are well established with sellers' views at $9.50@$12 per ton for 60 deg. and $15@$16 per ton for 66 deg.

Tartaric Acid.—Offerings of foreign makes have been free and with prices easy a fair volume of business was put through during the week. Some reports credit sales of imported at 36c. per lb. but 36½c. per lb. was asked in many directions. Makers of domestic tartaric are finding a good call for contract deliveries and are holding quotations at 37½c. per lb.

Potash

Bichromate of Potash.—First hands are quoting 11½c. per lb. as an inside price and in some cases there is no desire to accept much business at that figure. However, it is possible to locate material at 11¼c. per lb. Some producers are poorly supplied and prices depend upon seller. Trading is not featured in any way either for home or export account.

Caustic Potash.—Interest centers in imported grades with no new developments during the week. Different importers hold stocks in the local market. In some cases they are not trying to force sales while others are eager to turn over holdings. The lowest price heard was 7½c. per lb. and there is a range upward according to seller. For domestic caustic 9c. per lb., f.o.b. works, is quoted.

Carbonate of Potash.—Importers are not finding a ready outlet and a slow week was generally reported. On 90-95 per cent there were offerings at 6¾c. per lb. Moderate buying in the 80-85 per cent variety was reported on a basis of 6½c. per lb. Hydrated 80-85 per cent is easy with quotations at 7½c. per lb. and very little demand from consumers.

Chlorate of Potash.—Some round lots of imported have recently passed to consumers with different reports about the prices at which this material was sold. It is stated that the buyers in question generally are giving the lowest prices obtainable. In the spot market holders of stocks are quoting 7½c. per lb. as the inside price. Domestic makes are also steady with 8½c. per lb. works the asking price.

Permanganate of Potash.—This material has been irregular in price. A

short time ago cables from primary points abroad quoted shipments of permanganate at higher prices. In anticipation of an advance in the spot market, different holders of stocks put up their prices to 19c. per lb. and many have continued to quote at that level. A few holders, however, have accepted bids at relatively low prices and sales are said to have been made at 17½c. per lb. At present spot goods may be quoted at 17½c. to 19c. per lb., according to seller. It is stated that this material is included in the list on which government surveys are being made and some members of the trade believe that tariff changes are not improbable.

Prussiate of Potash.—The market for red prussiate was practically neglected and prices are nominally repeated at 65@68c. per lb., according to seller. Yellow prussiate also is finding a restricted outlet and competition from other materials undoubtedly has cut down demand for this chemical in recent months. Prices for yellow prussiate are 35@36c. per lb. for spot material with shipments as low as 34c. per lb.

Sodas

Bichromate of Soda.—Prices for bichromate of soda are largely a matter of seller. Some prominent factors are quoting 9c. per lb. as their inside price. Others offer at 8½c. per lb. and independent sellers say that sales have been made at the inside figure, and it is believed that fairly large lots can be obtained at that level. Competition, however, is not very keen and it seems probable that stocks in some sellers' hands are not very large.

Caustic Soda.—A very dull period is reported for this commodity. The export situation has not changed for the better and foreign markets are not interested at present price levels. The f.a.s. quotation for standard brands is reported to be easy at 3.35c. per lb. On outside brands 3.22½c. per lb. is still quoted but firm bids might find sellers at lower figures. Domestic consumers are taking regular deliveries and that side of the business is regarded as satisfactory. Prices for domestic delivery are holding at 2½c. per lb. works, for car lots, basis 60 per cent. Dealers also hold spot goods on a steady level of 3½c. per lb. and upward on a quantity basis.

Cyanide of Soda.—A fairly wide range in prices, according to seller, is noted. Imported material has sold as low as 20c. per lb. and in some quarters it was stated that this price still could be done. In other directions 21½@22c. per lb. was given as the market price for imported. Domestic cyanide is generally held at 22@23c. per lb.

Nitrate of Soda.—Demand for spot material has been quiet in all consuming markets and holders of stocks have been willing to shade prices in order to interest buyers. There is no definite spot price for the time being as buyers have heard prices ranging from $2.40 to $2.50 per 100 lb. Shipment prices are holding at the schedule recently announced. Reports from primary points say that exports of nitrate from Chile for first half of May were only 25,000 metric tons, partly explained by the fact that sales in April were small pending announcement of new prices.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	**178.17**
Last week	177.64
June, 1918	272.00
June, 1919	229.00
June, 1920	274.00
June, 1921	147.00
June, 1922	157.00

Cottonseed oil occupies an important position in the weighted index and the advance in this commodity more than offset declines in copper sulphate, barium, chloride and formaldehyde.

Nitrite of Soda.—Buyers have remained out of the market and prices are very weak with considerable competition between domestic and imported offerings. There were imported stocks on the market last week at 7¾c. per lb. Domestic makes were generally held at 8c. per lb. but it was stated that some sellers of domestic would meet foreign competition.

Prussiate of Soda.—There was not much trading to test prices but sellers say that values already are very low and many hold that further declines are improbable. Imported material is openly quoted at 15½c. per lb. but this might be shaded on actual transactions. Domestic prussiate is offered at 16c. per lb. by prominent producers.

Sulphide of Soda.—Greater competition from imported sulphide gave an easier feeling to the market for domestic. This was further intensified by a very slow trading period. Prices for domestic, however, show no change and fused is quoted at 4½c. per lb. and broken at 5½c. per lb. Crystals especially are reported as steady with 2¾c. per lb. as the lowest price heard. Imported fused was offered at 3½c. per lb. for spot and shipment.

Miscellaneous Chemicals

Arsenic—The fact that buying orders were light held the market in an easier position. For some time certain holders have been willing to shade the quoted prices. On that account it is difficult to report the market weaker, but some factors who were quoting 14c. per lb. in the previous week were offering at 13¾c. per lb. and it is probable that 13½c. per lb. could have been done. There was some interest in futures, but this did not result in any business as far as could be learned. June-July shipments were offered by producers at 12½c. per lb. and the latter held shipments over the last half of the year at 11c. per lb.

Calcium Arsenate—There was no change of importance in the local market. Demand is very quiet and stocks have not been reduced to any extent. A little better call was reported for deliveries against old orders, but new business failed to make any gain. Prices are largely nominal, but are admitted to be easy at 16@16½c. per lb.

Copper Oxide—Grinders have been taking large amounts and producers have been pretty well sold up for some time. Imported material has been selling freely. Prices are quoted at 20@21c. per lb., depending on quantity and seller.

Copper Sulphate—Some good sized quantities of domestic sulphate have been taken out of the market, but new business is not large enough to stiffen prices and the market is easy in tone. Quotations for domestic large crystals are 5.75c. per lb. Imported sulphate has been a drug on the market and some round lots sold during the week at private terms, but below the quoted levels. The quoted prices were subject to sharp reductions and offerings were free at 4¾c. per lb., although some holders ask up to 5½c. per lb.

Formaldehyde—A few scattered lots are held by second hands and these goods can be bought at 14½c. per lb. With that exception the market is holding a steady course with first hands asking 14½@15c. per lb.

Fusel Oil—Prices for fusel oil are almost wholly nominal. A few lots of crude have reached the market and sales are reported at prices ranging from $3.30 to $3.60 per gal. Refined is difficult to locate and no prices are heard in any direction for prompt delivery. Production in Europe has been light for some months and imports have been very small. Competing materials which had cut down demand for fusel oil are in small supply and some uncertainty is felt about future supplies.

Tin Products—Tin crystals are now offered at 34½c. per lb. for June delivery and tin bichloride at 12½c. per lb. Tin oxide was unchanged at 48c. per lb. Lower prices for the metal are responsible for the easier position of the salts.

Methyl-Acetone—First-hands announced a 10c. advance in prices, reflecting higher producing costs. The revised trading basis, in 100-gal. drums, is 92@95c. per gal., the inside figure obtaining on carload lots. For tank car deliveries 90c. is asked.

Alcohol

No price changes occurred in the market for alcohol. The call for denatured was up to expectations and a steady undertone was reported from nearly all quarters. The special, No. 1 formula, was traded in on the basis of 35c. per gal. in drums. On the completely denatured, formula No. 1, the quotations ranged from 43@49c. per gal., as to style of container, etc. Ethyl alcohol. U. S. P., 190 proof, was offered at $4.70 per gal. Producers' agents offered methanol, 95 per cent, at $1.1[illegible] per gal., and the 97 per cent at $1.2[illegible] per gal.

Coal Tar Products

First Hands Report Steady Market on Phenol—Better Call for Naphthalene—Benzene Offered Freely

Actual offerings of phenol for immediate delivery were limited to odd lots here and there and no real selling pressure was in evidence. While traders admit that several lots of U.S.P goods sold down to 45c. per lb., quotations for resale parcels at the close stood nearer 50c. In any event spot prices on outside material were wholly nominal. Leading producers talked firmer prices on contract deliveries, and it was doubtful whether 30c. per lb. could have been shaded on nearby stuff. The "new production" is not yet a market factor. The past week witnessed improvement in the demand for naphthalene, both flake and ball, but prices underwent little if any change. Solvent naphtha was firmly maintained on moderate stocks, production being well sold up in most directions. Benzene was offered freely at the recently reduced level of prices. Cresylic acid on spot was unsettled. Salicylic acid was inactive and barely steady in certain quarters of the trade. Benzoic acid was firmer. Xylene, pure, met with a fair call and with little offering on spot the situation favors sellers.

Benzidine Base—Some irregularity was reported in prices and the market settled at 80@85c. per lb. The sulphate was neglected and prices of 70@75c. per lb. were considered nominal.

Benzoic Acid—Inquiry showed improvement and some traders entertained firmer views. It was reported that sales on spot went through at 77c. Quotations at the close, covering the U.S.P grade, ranged from 75@80c. per lb.

Beta-Naphthol—There were offerings on the ordinary grade at 22c. per lb., with intimation that this figure could be shaded on a firm bid. Several producers, however, continued asking 22½@23c. per lb.

Cresylic Acid—Importations have let up of late, but with the demand slow prices failed to improve. There were sellers on spot at $1.10@$1.15 per gal., the outside figure obtaining on the 97 per cent grade. Leading domestic producers have nothing to offer.

Alpha-Naphthylamine—Producers reported a steady market and prices of 35@37c. were maintained, the inside figure holding on round lots, ex-works.

Aniline Oil—Scattered business was put through at 16½c. per lb., less than carload lots. The inside price on carload business held at 16c. per lb. The undertone was steady.

Benzene—Most of the benzene moving into motor-fuel channels is traded in on a contract basis which assures a steady outlet for production. The recent drop in prices was the outcome of lower prices for gasoline. The market for the pure was quiet, leading interests asking 27@32c. per gal., the price depending upon the quantity, style of package, etc. On the 90 per cent grade 25c. was the nominal price for tank car shipments, f.o.b. works.

Naphthalene—Demand for spot goods was better and prices seemed to steady a little. Sales of flake again went through at 8¼c. It develops that some transactions in prompt shipment from works were placed at 8c. per lb. On ball naphthalene prices were wholly nominal at 9@9½c. per lb. Crude was unsettled abroad and based on cables received here late in the week fair quality merchandise could have been secured at 3@3¼c. per lb., c.i.f. basis. Intermediate makers showed only passing interest in crude.

Ortho-Toluidine — First-hands continue to quote from 14@15c. per lb., round-lot basis. A fair inquiry was reported from abroad.

Paranitraniline—The spot market was unsettled and closing prices ranged from 70@75c. per lb. It was reported that scattered business went through at a shade under 70c.

Phenol—The market was largely nominal so far as second-hand offerings were concerned, but late in the week most holders were asking around 50c. for spot material. Leading interests took a firmer view of the nearby situation based on reports that new production could not be reckoned with for some months to come. On contract business 30c. was the nominal closing price.

Salicylic Acid—Business was slow and while the undertone was barely steady prices showed no change.

Solvent Naphtha—The market was in a strong position in view of the soldup condition of leading producers. Demand was good. Quotations for contract deliveries ranged from 27@32c. per gal., f.o.b. works.

Xylol—There were offerings of spot material in the pure grade at $1 per gal. On contract 75c. represented the market. The demand was fair.

Chemical Salesmen to Hold Outing June 23

A. J. Binder, chairman of the entertainment committee of the Salesmen's Association of the American Chemical Industry, announces that the annual chicken-lobster dinner and games will be held at Pleasure Bay, N. J., on Saturday, June 23. An invitation is extended to members of the trade not affiliated with the association and a large attendance is expected. The "party" will leave New York at 10:30 a.m., by boat, from West 42nd St., but members located in the downtown section may connect with the steamer at the foot of Cedar St.

Lower Cable Rates

Lower cable rates to Central American points have been made by the All-America Cables. The announcement of the cable company quotes rates at 35c. a word to San Jose, Guatemala; La Libertad, Salvador; San Juan del Sur, Nicaragua; San Jose and Port Limon, Costa Rica; and to 40c. a word to all other places in Guatemala, Salvador, Nicaragua and all Spanish Honduras; and to 42c. a word to all other places in Costa Rica. Deferred service is at one-half rate.

Rubber Consumption in Germany Falls Off Sharply

The rubber trade in Germany has suffered materially as a result of the Ruhr situation, decline in marks and loss of export business in rubber goods. Consumption of rubber in Germany was 3,000,000 lb. in January and only 1,000,000 lb. in April. Exports have been aided somewhat by the withdrawal of high export taxes and the changing of regulations which made it difficult to obtain permits. Holland is the largest buyer of German rubber goods.

Latest Quotations on Industrial Stocks

	Last Week	This Week
Air Reduction	64½	65
Allied Chem & Dye	71	71
Allied Chem. & Dye pfd	110	109½
Am Ag Chem.	19½	18¾
Am. Ag. Chem. pfd	42½	45
American Cotton Oil	8	8
American Cotton Oil, pfd	17½	17
Am Drug Synd.	5½	5¼
Am. Linseed Co.	26⅝	25
Am. Linseed Co., pfd	44	47
Am. Smelting & Refining	61½	62
Am. Smelting & Refining, pfd	98	97⅞
Archer-Daniels Mid. Co., w i	36½	33½
Atlas Powder	*170	170
Atlas Powder, pfd.	*90	*90
Casein Co of Am.	*60	*60
Certain-Teed Products	*40	38
Commercial Solvents	28	28
Corn Products	131½	132½
Corn Products, pfd	118	118
Davison Chem.	24¼	30
Dow Chem. Co.	46	46
Du Pont de Nemours	126⅝	128
Du Pont de Nemours, db	85	87½
Freeport-Texas Sulphur	14½	13⅞
Glidden Co.	8½	8
Grasselli Chem.	133	133
Grasselli Chem., pfd.	104	104½
Hercules Powder	105	105
Hercules Powder, pfd.	105	105
Heyden Chem.	2	1⅞
Int'l Ag. Chem. Co.	5½	4⅝
Int'l Ag. Chem. Co., pfd	17	15⅞
Int'l Nickel	14	15
Int'l Nickel, pfd	78½	80½
Int'l Salt	*90	*90
Mathieson Alkali	49	49
Merck & Co.	87	87
National Lead	124	123½
National Lead, pfd.	112½	112
New Jersey Zinc	162	162
Parke, Davis & Co.	*81	77½
Pennsylvania Salt	88	88
Procter & Gamble	*140	*140
Sherwin-Williams	*29	*29
Sherwin-Williams, pfd.	*101	*101
Tenn. Copper & Chem.	9⅞	*9⅝
Texas Gulf Sulphur	62⅝	60⅞
Union Carbide	58½	59⅝
United Drug	80	81⅝
U. S. Industrial Alcohol	56	56½
U. S. Industrial Alcohol, pfd	98	98
Va.-Car. Chem. Co.	10	10
Va.-Car. Chem. Co., pfd	27½	27⅝

*Nominal. Other quotations based on last sale.

Vegetable Oils and Fats

Imported Linseed on Spot Lower—Crude Cottonseed Up—Good Call for China Wood—Tallow Declines

A BETTER feeling prevailed in the market for vegetable oils toward the close, but, with the exception of china wood oil, few round-lot transactions could be located. Shorts ran to cover in old crop cottonseed oil options, the advance in lard and grains causing some uneasiness in speculative quarters. Coconut oil steadied just a trifle on moderate offerings of copra. Buying interest in crude soya bean oil for shipment was lacking. The palm oils were dull and rather easy, reflecting the drop in tallow.

Linseed Oil—The market was steadier at the close on a moderate recovery in seed. Early last week domestic oil was traded in at $1.04 per gal. in cooperage, carload lots, July shipment, but later it was doubtful whether $1.05 could have been shaded. Spot oil of domestic make settled at $1.12@$1.14 per gal. August forward was nominal at $1.02 per gal. At one time a price of $1.00 was named on August-September-October business. Inquiry in the forward positions improved slightly, but the market, taken as a whole, was a rather dull affair. Imported linseed oil was unsettled and business went through ex-dock at lower prices. It was reported that distressed oil actually sold down to 95c. per gal., duty paid. Foreign linseed oil markets were inactive and slightly lower. Private estimates on the new domestic crop have not yet taken definite form, but most "experts" expect a fair increase in the acreage. Developments in Canada were not so favorable. Argentine offerings continue large. The Indian crop is moving freely and the exports for the past week reached the total of 784,000 bushels, nearly all of which was shipped to the United Kingdom. Shipments of flaxseed from the Argentine to the United States since the first of the year amounted to approximately 15,500,000 bu., while receipts of domestic seed at Minneapolis and Duluth, from September 1, 1922, to date, amounted to 8,900,000 bu. The stocks of seed at Minneapolis last week were placed at 28,852 bu., which compares with 19,136 bu. the week previous. Export demand for linseed cake was quiet, but crushers continued to quote around $34 per ton, f.a.s. New York.

Cottonseed Oil—The second half of the week brought with it a little more activity in cottonseed oil options and prices steadied. The advance in lard, together with higher markets for cotton and grains, caused shorts in July and September oil to run to cover. The fact that September oil has been at a discount for no apparent reason brought out support from traders who believe that a strong statistical situation in July could only mean an even stronger situation for September. The new cotton crop has not been doing well and, according to the Department of Agriculture, the condition as of May 25 was 71 per cent of normal. The average for the past 10 years was 73.6 per cent. Taking the condition as a basis operators do not look for much more than 11,000,000 bales from the 1923 crop. In view of the fact that we raised two short crops in succession a moderate increase for this season would hardly create a bearish situation. Cash demand for cottonseed oil and compound was fair. May consumption figures will not be available for another week or so, but private estimates on the disappearance range from 125,000 to 150,000 bbl. Crude oil sold in the southeast at 10c. per lb, tank cars, f.o.b. mills, an advance of ½c. for the week. Bleachable oil settled at 10½c. per lb. buyers' tanks, f.o.b. Texas common points. Lard compound closed at 13@13¼c. per lb., carload lots, f.o.b. New York.

China Wood Oil—Considerable interest was reported in August forward deliveries. At one time a price of 17½c. per lb. was named for August oil, but a flood of inquiries caused importers to withdraw offerings and the market steadied. Later business was placed in August forward at 19½c. per lb., and by the close of the week asking prices covering this position ranged from 21½@22c. per lb.

Coconut Oil—The coast market was dull, but no selling pressure was apparent and the quotations held at 8@8¼c. per lb., sellers' tanks, nearby and forward positions. In New York Ceylon type oil settled at 8⅜@8½c. per lb., sellers' tanks, prompt and nearby delivery. The steadiness in copra tends to support values. Copra held at 4⅞@5c. per lb., c.i.f. New York.

Soya Bean Oil—There were offerings of crude soya bean oil for forward shipment from the Pacific coast at 9⅞c. per lb., sellers' tanks, duty paid. Buying interest was lacking.

Fish Oils—It was reported that 4,000,000 menhaden were landed in the first week of the new season, which compares with 13,000,000 fish a year ago. Offerings of oil were limited and producers continued to quote 50c. per gal., tank car basis, f.o.b. works. No new business came to light. Newfoundland tanked cod oil was unchanged at 70c. per gal., in bbl., f.o.b. New York. Demand was slow.

Tallow and Greases—The sale of 300 drums of extra tallow at 7¼c. per lb., ex-plant, was reported last week, which compares with previous business at 7⅝c. per lb. The market was easy at the close. Oleo stearine was unchanged at 9c. per lb., carload basis. Yellow grease was lowered ¼c. to the basis of 6⅜c. per lb. on fairly low acid material.

Miscellaneous Materials

Glycerine. — Refiners continued to quote 17c. on the C. P. grade, in drums, spot and nearby delivery. Demand was fair and with no important change in crude sentiment in the market appeared firmer. C. P. was offered in the middle-west at 16½c., in drums, carload basis. In dynamite the trading was extremely slow and prices named were considered nominal, ranging from 15¾@16c. per lb., in drums, carload basis. Buyers' ideas were ½c. under the market. Crude glycerine was unsettled. The soap-lye, basis 80 per cent, held at 10½@11c. per lb., loose. On saponification, 88 per cent, nominal prices ranged from 12@12¼c. per lb., loose, carload lots.

Naval Stores.—The market went off on quiet business and at the close nominal quotations ranged from $1.03@$1.05 per gal., which compares with $1.06@$1.09 per gal a week ago. Southern markets were unsettled on limited domestic buying and virtually no export inquiry. The belief is growing that paint manufacturers are using substitutes to a greater extent than ever before. In rosins prices held about steady, although business in this field also was inactive. The lower grades held at $5.90@$6.20 per bbl. Pitch closed unchanged.

Shellac.—Prices steadied in some quarters on reports of slightly higher cables from Calcutta, but traders seemed to have little confidence in the "bull" side. Arrivals last week were small and with no additional pressure on ex-dock goods the spot quotations held at 58@60c. on T. N., 63c. on superfine orange and 70@71c. on bleached bonedry. Demand was routine only.

Lithophone.—A little imported material was around at concessions, but domestic producers continued to quote the market firm at 7@7¼c. per lb., carload lots, nearby positions.

White Lead, Etc.—The market for pig lead was a shade easier, but with no change in the "official" price the pigments were left unchanged. The metal was offered at 7¼c. per lb., New York. Deliveries of white lead against existing contracts are large enough to keep stocks down and corroders regard the market as fairly steady, notwithstanding the recent reduction in prices for pig lead. Standard dry white lead, basic carbonate, held at 9¾c. per lb. in casks, carload lots. Red lead, dry, was, offered by producers at 11¾c. per lb. Litharge closed at 10¾@11c. per lb.

Zinc Oxide—Domestic production is well sold up and with no important price changes in the metal the market held at 8@8¼c. per lb. on the American process, lead free. French process, red seal, closed at 9¾c. per lb.

London Tallow Auction

At the weekly auction in London, held June 6, 1,795 casks of tallow were offered for sale, but only 960 casks were sold. Prices went off 6 pence per cwt.

Imports at the Port of New York

June 1 to June 6

ACIDS—200 pkg. tartaric, Hamburg, W Benkert & Co , 129 csk tartaric, Rotterdam Order, 5 dr cresylic, Liverpool, Order, 20 keg tartartic, Liverpool, Kachurin Drug Co.; 12 dr cresylic, Glasgow, Guaranty Trust Co , 25 dr cresylic, Glasgow, Order 3 cs. benzoic, London, H. J. Baker & Bros , 67 csk oxalic, Christiania, Roessler & Hasslacher Chem Co.

AMMONIUM—215 csk nitrate, Hamburg, Kuttroff, Pickhardt & Co , 20 csk perchlorate, Marseilles, Order, 20 cs. chloride, Liverpool, Wing & Evans

ALCOHOL—80 bbl., Arecibo, C Esteva

ARSENIC — 100 csk , Hamburg, A J Marcus, Inc , 28 csk , Rotterdam, Lunham & Moore, 264 cs., Kobe, J D Lewis, 200 cs, Kobe, McKenzie & Foster, 17 cs, Kobe, Collinge, Dawson & Co., 125 cs, Kobe, Taiyo Trading Co.; 250 cs., Kobe, Guaranty Trust Co ; 350 cs , Kobe, Order, 350 cs, Osaka, Asano Bussan Kaisha, 310 cs, Yokohama, Chipman Chem Eng Co

ARSENIC ORE—141 bbl , Piraeus Comptoir Agricole & Comm , 117 bbl , Piraeus T. C. Hoelzer & Co , 720 bbl., Piraeus, Blandeis Goldsmith

ANTIMONY OXIDE—250 bg , Shanghai, Asia Banking Corp.

ASBESTOS—1,875 bg., Southampton, W D. Crumpton & Co

BARIUM—28 csk chloride, Hamburg, Order.

BARYTES—250 bg , Bremen E L Bullock & Sons, 1,459 bg , Genoa, Bankers Trust Co.

BORATE OF LIME—6,589 bg., Valparaiso, Pacific Coast Borax Co

CASEIN—2,119 bg., Buenos Aires, Order , 20 pkg., Southampton, A Hurst & Co , 67 bg., Havre, Brown Bros & Co , 302 bg , Hamburg, Nat'l City Bank

CALCIUM—30 csk permanganate, Hamburg, Bengol Trading Co

CAMPHOR — 500 cs crude, Shanghai, Asia Banking Corp , 200 cs , Shanghai, Irving Bank Col Trust Co., 100 cs , Shanghai, Order, 100 cs., Kobe, Irving Bank-Col. Trust Co

CHEMICALS—17 pkg , Hamburg, Hensel, Bruckmann & Lorbacher, 42 csk , Bremen, Hummel & Robinson Corp , 561 pkg , Rotterdam, Order , 103 pkg., Hamburg, Roessler & Hasslacher Chem Co , 10 cs , Hamburg, Hummel & Robinson Corp , 223 pkg , Hamburg, Jungmann & Co , 80 bbl , Hamburg, A Murphy & Co.

CHALK—500 tons, Dunkirk J W. Higman & Co , 500 tons, London, Baring Bros & Co.

CHROMIUM FLUORIDE—10 csk , Hamburg, Pfaltz & Bauer

CINCHONIDINE — 10 cs., Rotterdam, Mallinckrodt Chem Works; 1 cs , Rotterdam R. W Greeff & Co.

COLORS — 77 csk., Hamburg, C W Campbell Chem. Co , 21 bbl. aniline, Hamburg, Order , 350 bg. earth, Leghorn, Reichard-Coulston, Inc , 22 csk dry, Bremen, M G Lange & Co , 150 csk. lampblack, Rotterdam, P. Van Gelsten , 11 dr aniline, Liverpool, Order 11 bbl aniline, Genoa, Bachmeier & Co ; 30 bbl. do., Genoa, B Bernard, Inc 6 pkg aniline, Genoa, Ladenburg, Thalmann & Co , 10 bbl aniline, Genoa, Organic Products Co.; 17 bbl do., Genoa, Ackermann Color Co.; 5 bbl , Genoa, American Exchange Nat'l Bank; 4 bbl , Genoa, Order ; 7 csk. aniline, Havre, Carbic Color & Chem Co , 175 csk., Havre, Ciba Co , 74 pkg , Havre Sandoz Chem Works; 16 bbl earth, Hamburg, Int'l Ultramarine Works , 17 bbl earth, Hamburg, A. Murphy & Co

COPRA—21 bg., Arroyo, Franklin Baker Co ; 111 bg San Juan, Hutcheson & Henderson , 44 bg , San Juan, Franklin Baker Co ; 100 bg., Port Antonio, Atlantic Fruit Co., 340 bg , Jamaican ports, Franklin Baker Co

DEGRAS—30 bbl , Liverpool, Am Trust Co

DEXTRINE — 1,000 bg., Copenhagen, Stein, Hall & Co.

DYESTUFFS — 6 csk , Southampton, Irving Bank-Col Trust Co.; 4 csk. alizarine , Liverpool, A Klipstein & Co.; 68 bbl., Genoa, Ackermann Color Co.; 39 pkg , Genoa, Wetterwald & Pfister Co.; 5 pkg., Hamburg, Kuttroff, Pickhardt & Co.

EPSOM SALT—4,434 bg., Hamburg, Order.

FULLERS EARTH—500 bg , Bristol L. A Salomon & Bros.

FUSEL OIL—18 dr , Hamburg, Order , 10 bbl , Naples, Atlantic Fwdy Co

GLAUBER SALT — 500 bg., Hamburg, Order

GLYCERINE—160 csk , Marseilles, Order , 122 dr , London, Wm. Rawol.

GRAPHITE—500 bg., Genoa, Order , 20 bg , Marseilles, Order

GUMS—3 cs. kauri London, Glidden Co , 10 cs tragacanth, Constantinople, American Levant Trading Co , 9 cs do., Constantinople, Order, 100 cs damar and 190 bg copal, Singapore, L C Gillespie & Sons , 115 bg do., Singapore, Brown Bros. & Co , 100 cs damar and 70 bg copal chips, Singapore, Bingham & Co., 200 cs damar, Singapore, Mech & Metals Nat'l Bank, 870 pkg Singapore, Order, 200 cs damar, Batavia, Kidder, Peabody Acceptance Co , 100 cs do , Batavia, Chem. Nat'l Bank , 100 cs damar, Batavia, W Schall & Co , 100 cs do , Batavia, W H Muller & Co , 900 cs do , Batavia, Order, 567 bg copal, Macassar, L C Gillespie & Sons , 1,390 bskt and 13 cs copal, Macassar, France, Campbell & Darling ; 860 bskt. copal, Macassar, Paterson, Boardman & Knapp , 290 bskt copal, Macassar, M. L. Van Norden , 130 bskt do , Macassar, S. Winterbourne & Co , 2,063 bskt., 300 bg and 171 cs do , Macassar, Innes & Co , 163 bskt. do , Macassar, A Klipstein & Co., 287 bskt. do , Macassar, Kidder, Peabody Acceptance Corp , 280 bg copal and 70 bg damar, Singapore, Irving Bank Col Trust Co , 70 bg copal and 50 cs damar, Singapore, Baring Bros. & Co , 350 bg damar and 140 bg copal, Singapore, Kidder, Peabody Acceptance Co.

IRON OXIDE—10 csk , Liverpool, Order , 60 bbl , Malaga, J L Smith & Co.; 50 bbl , Malaga, Hummel & Robinson Corp ; 7 bbl., Malaga, Order, 10 csk , Liverpool, E. M. & F Waldo

KIESELGHUR—1,000 bg , Oran, Janovici & Co

LOGWOOD EXTRACT—217 bbl , Cape Haitian; Logwood Mfg Co

MANGROVE BARK—10 bg., Belawan, Neuss, Hesslein & Co.

MAGNESITE—106 bbl , Rotterdam, Speiden-Whitfield Corp., 350 bg. calcined, Glasgow, Brown Bros & Co.

MAGNESIUM — 200 cs. citrate, Genoa, Order

MENTHOL — 25 cs , Kobe, Nat'l City Bank , 10 cs , Kobe, Mech & Metals Nat'l Bank , 25 cs , Kobe, Bankers Trust Co.

NAPHTHALENE—453 bg., Rotterdam, Lunham & Moore , 200 bg , Glasgow, Order , 571 bg., Bristol, Order.

OCHER—1,013 csk , Marseilles, Reichard-Coulston, Inc , 159 csk , Marseilles, Am Exchange Nat'l Bank , 263 bg., Genoa, Order , 225 bbl , Marseilles, F. B. Vandegrift & Co

OILS—China Wood—50 dr., Hong Kong, Irving Bank-Col Trust Co., 59 bbl., Liverpool, Order, Quantity in bulk, Hankow, L C Gillespie & Sons. **Coconut**—200 bbl , Manila California Barrel Co.; 869 tons (bulk) Manila, Philippine Refining Corp **Cod**—30 csk , St Johns, R Badcock & Co.; 160 csk., Bergen, Fidelity Union Trust Co., 200 bbl , Kobe, Cook & Swan Co **Linseed**—100 bbl , Southampton, Nat'l City Bank; 798 tons (bulk) London, Archer-Daniels Linseed Co. **Olive Foots**—50 bbl , Naples, Banca Comm. Ital.; 400 bbl., Naples, Mechanics & Metals Nat'l Bank ; 500 bbl , Bari, Irving Bank-Col. Trust Co ; 130 bbl., Bari, Order ; 200 bbl., Sevilla, Banca Comm Italiana , 100 bbl., Sevilla, Nat'l City Bank ; 100 bbl , Sevilla, W Schall & Co.; 200 bbl., Catania, Order; 200 bbl., Messina, Order. **Olive Oil** (denatured)—725 bbl , Bari, National City Bank ; **Palm**—950 csk., Lagos, Order ; 600 csk., Port Harcourt, African & Eastern Trading Corp.; 750 csk., Calabar, African & Eastern Trading Corp. **Peanut**—330 cs , Hong Kong, Kewong Yuen Shing. **Seal**—200 bbl., St Johns, Bowring & Co **Sesame**—250 bbl., Marseilles, Order ; 294 bbl., Rotterdam, National City Bank ; 294 csk., Rotterdam, Order ; 288 bbl. Rotterdam, Order **Soya Bean**—500 bbl., Dairen, I. R. Boody & Co.; 300 bbl , Dairen, Balfour, Williamson & Co.

OIL SEEDS—Linseed—65,838 bg., Rosario, Order ; 4,200 bg., Tientsin, Northwestern Nat'l Bank of Minn.; 35,471 bg., Santa Fe, L. Dreyfus & Co.; 19833 bg. and 3,240,-647 kilos in bulk, Rosario, American Linseed Co ; 15,065 bg , Buenos Aires, Order ; 17,408 bg Buenos Aires, Order.

PHOSPHATE—914 bg. bone, Rotterdam, H J Baker & Bro.

POTASSIUM SALTS—60 dr. permanganate, Hamburg, National City Bank ; 181 dr permanganate, Hamburg, A. Klipstein & Co., 100 bbl chlorate, Hamburg, Innis, Speiden & Co , 200 cks and 200 dr. chlorate, Marseilles, Asia Banking Corp ; 300 csk chlorate, Marseilles, Order ; 200 csk. perchlorate, Marseilles, Order ; 6,000 bg muriate and 500 bg. sulphate, Bremen, Potash Importing Corp of Am.; 75 dr caustic, Hamburg, Peters, White & Co., 250 bg. chlorate, Marseilles, Meteor Products Co., 250 bg chlorate, Marseilles, Order

PYRIDINE—6 dr , Rotterdam, Lunham & Moore.

QUEBRACHO—7,840 bg., Buenos Aires, Fourth Atlantic Nat'l Bank of Boston ; 1,710 bg , Buenos Aires, First Nat'l Bank , 2,067 bg , Buenos Aires, Guaranty Trust Co., 285 bg., Buenos Aires, Order

QUICKSILVER—1,000 fl., Seville, Order ; 1,000 fl., Alicante, National City Bank ; 50 fl , Vera Cruz, Poillon & Poirier , 5,000 fl , London, Order

QUININE—2 cs , Rotterdam, R. W. Greeff & Co , 20 cs , Rotterdam, Mallinckrodt Chem Works , 4 cs., Rotterdam, Order.

SHELLAC—43 cs , Rotterdam, A. Hurst & Co , 30 bg garnet, Hamburg, Kasebier-Chatfield Shellac Co.

SIENNA—50 csk., Leghorn, J. L Smith & Co

STARCH—150 bg potato, Stein, Hall & Co., 1,000 bg potato, Catz American Co.

SODIUM SALTS—10,930 bg. nitrate, Iquique, Du Pont de Nemours & Co ; 120 bbl hyposulphate, Marseilles, Order , 168 cs cyanide, Marseilles, Nat'l City Bank , 187 cs. cyanide, Havre, Asia Banking Corp , 13,916 bg nitrate, W. R Grace & Co , 2,191 bg nitrate, Valparaiso, W R Grace & Co ; 100 dr sulphite, Bristol, R F. Downing & Co ; 125 bg. fluoride, Marseilles, Nat'l City Bank , 112 cs cyanide, Marseilles, Asia Banking Corp.; 100 bbl. hyposulphite, Marseilles, E M Sergeant & Co., 120 bg do , Marseilles, Order

STRONTIUM NITRATE—39 csk , Hamburg, A Klipstein & Co

SUMAC—700 bg , Barcelona, Order , 10 bg , Marseilles, Order , 1,250 bg., Palermo, Order

TALC—200 bg , Genoa, Order , 600 bg Bordeaux, L. A. Salomon & Bros.; 700 bg , Genoa, L A Salomon & Bros , 750 bg , Genoa, Ital. Disc & Trust Co., 300 bg., Genoa, C. B Chrystal & Co., 200 bg. Genoa, Hammill & Gillespie

TARTAR—42 csk , Naples, Tartar Chemical Works; 150 sk , Marseilles, Tartar Chemical Works , 128 sk , Marseilles, C. Pfizer & Co.; 426 bg., Marseilles, Royal Baking Powder Co , 280 bg , Marseilles, C. Pfizer & Co.; 60 csk , Marseilles, Tartar Chemical Works , 765 sk., Oran, Tartar Chemical Works , 339 sk , Oran, C Pfizer & Co ; 11 sk., Valparaiso, C Pfizer & Co., 320 bg., Marseilles, Royal Baking Powder Co ; 80 bbl Marseilles, Tartar Chemical Works; 122 csk crude, Palermo, Royal Baking Powder Co

TARTRATE OF LIME—110 bg , Marseilles, Order ; 110 bg., Marseilles, C. Pfizer & Co.

VERMILION—16 csk., London, Pomeroy & Fischer

WAXES—22 bg bees, Aden, Order ; 900 bg. montan, Bremen, Order ; 67 bg carnauba, Para, International Acceptance Bank ; 110 cs. bees, Havre, Strohmeyer & Arpe ; 11 bg bees, Coquimbo, W. R. Grace & Co.; 32 bg., do., Talcahnano, Duncan Fox & Co.; 47 sk., Valparaiso, W R. Grace & Co.; 50 cs bees, Hamburg, Innis, Speiden & Co.

WHITING—101 bbl., Hamburg, Order

WHITE PIGMENT—224 bbl Christiania, Titanium Pigment Co.

ZINC CHLORIDE—169 csk , Hamburg, Pfaltz & Bauer.

ZINC OXIDE—330 bbl., Marseilles, Order.

ZINC WHITE—33 csk., Bristol, Reichard-Coulston, Inc.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available. In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb.	$0 38 –	
Acetone, drums	lb	.25 –	25½
Acid, acetic, 28%, bbl.	100 lb	3 38 –	3 50
Acetic, 56%, bbl.	100 lb.	6 75 –	7 00
Glacial, 99½%, bbl.	100 lb	12 00 –	12 50
Boric, bbl.	lb	10½–	
Citric, kegs	lb	49 –	52
Formic, 85%	lb	.14 –	16
Gallic, tech.	lb.	45 –	50
Hydrofluoric, 52%, carboys	lb	.12 –	12½
Lactic, 44%, tech., light, bbl.	lb.	.11½–	12
22% tech., light, bbl.	lb	.05½–	06
Muriatic, 18° tanks	100 lb.	90 –	1 00
Muriatic, 20°, tanks,	100 lb.	1.00 –	1 10
Nitric, 36°, carboys	lb	04½–	.05
Nitric, 42°, carboys	lb.	06 –	.06½
Oleum, 20%, tanks	ton	18 50 –	19 00
Oxalic, crystals, bbl.	lb.	.13 –	13½
Phosphoric, 50% carboys	lb.	07½–	08½
Pyrogallic, resublimed	lb	1 50 –	1 60
Sulphuric, 60°, tanks	ton	9 50 –	11 00
Sulphuric, 60°, drums	ton	13 00 –	14 00
Sulphuric, 66°, tanks	ton	16 00 –	16 50
Sulphuric, 66° drums	ton	20 00 –	21 00
Tannic, U.S.P., bbl.	lb.	.65 –	.70
Tannic, tech., bbl	lb.	.45 –	.50
Tartaric, imp., powd., bbl.	lb	.36½–	
Tartaric, domestic, bbl.	lb.	.37½–	
Tungstic, per lb.	lb.	1.10 –	1 20
Alcohol, butyl, drums, f.o.b. works.	lb	.26 –	.28
Alcohol ethyl (Cologne spirit), bbl	gal	4 75 –	4 95
Ethyl, 190 p'f U.S.P., bbl	gal	4 70 –	
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 190 proof			
No. 1, special bbl	gal	41 –	
No. 1, 190 proof, special, dr	gal.	35	
No. 1, 188 proof, bbl	gal	42 –	
No. 1, 188 proof, dr	gal	36 –	
No. 5, 188 proof, bbl	gal	40 –	
No. 5, 188 proof, dr	gal	.34 –	
Alum, ammonia, lump, bbl	lb.	03½–	03¾
Potash, lump, bbl	lb	02¾–	03½
Chrome, lump, potash, bbl.	lb.	.05¼–	06
Aluminum sulphate, com., bags	100 lb.	1 50 –	1 65
Iron free bags	lb	.02½–	.02¾
Aqua ammonia, 26°, drums.	lb	.06¼–	.07¼
Ammonia, anhydrous, cyl	lb.	.30 –	30½
Ammonium carbonate, powd casks, imported	lb.	.09½–	.10
Ammonium carbonate, powd domestic, bbl	lb	.13 –	.14
Ammonium nitrate, tech., casks	lb	.10 –	11
Amyl acetate tech., drums	gal	3 50 –	3 75
Arsenic, white, powd., bbl	lb	13½–	14¼
Arsenic, red, powd., kegs	lb	14½	
Barium carbonate, bbl.	ton	70 00 –	75 00
Barium chloride, bbl	ton	83 00 –	85 00
Barium dioxide, drums	lb	.18 –	18½
Barium nitrate, casks		.08 –	08½
Barium sulphate, bbl.	lb	04 –	.04½
Blanc fixe, dry, bbl.	lb	.04 –	.04½
Bleaching powder, f.o.b. wks., drums	100 lb	1 90 –	
Spot N. Y. drums	100 lb	2 40 –	
Borax, bbl	lb	.05¼–	05½
Bromine, cases	lb.	28 –	30
Calcium acetate, bags	100 lb	4 00 –	4 05
Calcium arsenate, dr.	lb	16 –	16½
Calcium carbide, drums	lb	05¼–	05½
Calcium chloride, fused, drums	ton	22 00 –	23 00
Gran. drums.	ton	28 00 –	30 00
Calcium phosphate, mono, bbl.	lb	.06½–	.07
Camphor, cases	lb	.86 –	.88
Carbon bisulphide, drums	lb.	07 –	07½
Carbon tetrachloride, drums	lb.	09½–	10
Chalk, precip.—domestic, light, bbl	lb.	.04½–	.04½
Domestic, heavy, bbl.	lb.	.03½–	.03½
Imported, light, bbl	lb.	.04½–	.05
Chlorine, liquid, tanks, wks	lb	.05½–	.05½
Cylinders, 100 lb., wks	lb.	06 –	06½
Cylinders, 100 lb., spot	lb.	.09 –	
Chloroform, tech., drums	lb.	.35 –	38
Cobalt oxide, bbl.	lb.	2 10 –	2 25
Copperas, bulk, f.o.b. wks.	ton	20 00 –	21 00
Copper carbonate, bbl.	lb.	19 –	.20
Copper cyanide, drums	lb	47 –	50
Coppersulphate, dom., bbl.	100 lb.	5 75 –	
Imp. bbl.	100 lb.	4 75	5 00
Cream of tartar, bbl.	lb.	.25½–	26½
Epsom salt, dom., tech., bbl.	100 lb.	1.90 –	2.15
Epsom salt, imp., tech., bags	100 lb.	.90 –	1 00
Epsom salt, U.S.P., dom., bbl.	100 lb.	2.50 –	2.60
Ether, U.S.P., drums	lb.	.13 –	.15
Ethyl acetate, 85%, drums	gal.	.80 –	.81
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 –	1.00
Formaldehyde, 40%, bbl	lb	$0 14½–	$0 15
Fullers earth—imp., powd., net	ton	30 00 –	32 00
Fusel oil, ref., drums	gal	–	
Fusel oil, crude, drums	gal.	3 30 –	3 60
Glaubers salt, wks., bags	100 lb	1 20	1 40
Glaubers salt, imp., bags	100 lb	90 –	95
Glycerine, c.p., drums extra	lb	17 –	.17½
Glycerine, dynamite, drums	lb	15¾	16¼
Glycerine, crude 80%, loose	lb	10½–	11
Iodine, resublimed	lb	4 55 –	4 65
Iron oxide, red, casks	lb.	12 –	18
Lead:			
White, basic carbonate, dry, casks	lb	.09¾–	10
White, basic sulphate, casks	lb	09½–	
White, in oil, kegs.	lb.	12½–	.14
Red, dry, casks	lb	11½–	.12
Red, in oil, kegs	lb	13½–	.15
Lead acetate, white crys., bbl.	lb	14 –	14½
Brown, broken, casks	lb	13	13½
Lead arsenate, powd., bbl	lb	23 –	24
Lime-Hydrated, bbl	per ton	16 80 –	17 00
Lime, Lump, bbl	280 lb	3 63 –	3 65
Litharge, comm., casks	lb	10¾	11
Lithophone, bags	lb	07 –	07½
in bbl	lb	07	07¾
Magnesium carb., tech., bags	lb	08 –	08½
Methanol, 95%, bbl	gal	1 18 –	1 20
Methanol, 97%, bbl	gal	1 20 –	1 22
Nickel salt, double, bbl.	lb	10½–	
Nickel salts, single, bbl.	lb	11½	
Phosgene		60 –	75
Phosphorus, red, cases	lb	–	
Phosphorus, yellow, cases	lb	35 –	40
Potassium bichromate, casks	lb	11½–	12
Potassium bromide, gran., bbl	lb	19 –	.20
Potassium carbonate, 80-85%, calcined, casks	lb	.06¼–	06½
Potassium chlorate, powd	lb	07½–	.08
Potassium cyanide, drums	lb	.45 –	.50
Potassium, first sorts, cask	lb.	.08¼	.08½
Potassium hydroxide (caustic potash) drums	lb	07½–	09
Potassium iodide, cases	lb	3 65 –	3 75
Potassium nitrate, bbl.	lb	.06¼–	.07¼
Potassium permanganate, drums	lb.	.17½–	19
Potassium prussiate, red, casks	lb.	.65 –	67
Potassium prussiate, yellow, casks	lb.	35 –	35½
Salammoniac, white, gran., casks, imported	lb.	.06 –	06½
Salammoniac, white, gran., bbl., domestic	lb	.07½–	.07½
Gray, gran., casks	lb	08 –	.09
Salsoda, bbl	100 lb	1 20	1 40
Salt cake (bulk)	ton	26 00 –	28 00
Soda ash, light, 58% flat, bags, contract	100 lb	1.60 –	1 67
Soda ash, light, basis, 48%, bags, contract, f.o.b. wks.	100 lb.	1.20 –	1 30
Soda ash, light, 58%, flat, bags, resale	100 lb	1 75 –	1 80
Soda ash, dense, bags, contract, basis 48%.	100 lb	1 17½–	1 20
Soda ash, dense, in bags, resale	100 lb	1 85 –	1.90
Soda, caustic, 76%, solid, drums, f.a.s.	100 lb.	3 22½–	3 35
Soda, caustic, basis 60%, wks., contract.	100 lb.	2 50 –	2.60
Soda, caustic, ground and flake, contracts	100 lb.	3 80 –	3.90
Soda, caustic, ground and flake, resale.	100 lb.	3.92½–	...
Sodium acetate, works, bags.	lb	05½–	.06½
Sodium bicarbonate, bbl	100 lb.	2 00 –	2 50
Sodium bichromate, casks.	lb.	.08½–	.09
Sodium bisulphate (niter cake)	ton	6.00 –	7.00
Sodium bisulphite, powd., U.S.P., bbl.	lb.	.04½–	.04½
Sodium chlorate, kegs	lb.	.06½–	.07
Sodium chloride	long ton	12.00 –	13.00
Sodium cyanide, cases	lb.	.20 –	.23
Sodium fluoride, bbl.	lb.	$0 09 –	$0 10½
Sodium hyposulphite, bbl.	lb.	$02½–	.03
Sodium nitrite, casks	lb	07½–	08½
Sodium peroxide, powd., cases	lb.	.28 –	.30
Sodium phosphate, dibasic, bbl	lb.	.03½–	.04
Sodium prussiate, yel. drums	lb.	.15 –	.16
Sodium salicylic, drums	lb.	.47 –	52
Sodium silicate (40°, drums)	100 lb.	.80 –	1.25
Sodium silicate (60°, drums)	100 lb.	2.00 –	2.25
Sodium sulphide, fused, 60-62% drums	lb.	.04½–	.04½
Sodium sulphite, crys., bbl	lb	03½–	03¾
Strontium nitrate, powd., bbl.	lb	.12½–	.13
Sulphur chloride, yel. drums	lb	04½–	05
Sulphur, crude	ton	18 00 –	20 00
At mine, bulk	ton	16 00 –	18 00
Sulphur, flour, bag	100 lb	2 25 –	2 35
Sulphur, roll, bag	100 lb.	2 00 –	2.10
Sulphur dioxide, liquid, cyl.	lb	08 –	08½
Talc—imported, bags	ton	30 00 –	40.00
Talc—domestic powd., bags.	ton	18.00 –	25.00
Tin bichloride, bbl.	lb.	.12½–	.13
Tin oxide, bbl	lb.	.48 –	
Tin crystals, bbl	lb.	.34½–	.35
Zinc carbonate, bags	lb.	.14 –	.14½
Zinc chloride, gran, bbl.	lb.	.06½–	.06¾
Zinc cyanide, drums.	lb.	.37 –	.38
Zinc oxide, lead free, bbl.	lb.	.08 –	.08½
5% lead sulphate, bags	lb	.07½–	...
10 to 35% lead sulphate, bags	lb.	.07 –	...
French, red seal, bags	lb.	.09¾–	...
French, green seal, bags	lb.	.10¾–	...
French, white seal, bbl	lb.	.12 –	...
Zinc sulphate, bbl.	100 lb.	2.50 –	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb.	$0.65 –	$0.80
Alpha-naphthol, ref., bbl	lb.	.75 –	.90
Alpha-naphthylamine, bbl	lb.	.35 –	37
Aniline oil, drums	lb.	.16½–	.16½
Aniline salts, bbl.	lb.	.23 –	.24
Anthracene, 80%, drums	lb.	.75 –	1.00
Anthracene, 80%, imp., drums, duty paid.	lb.	.70 –	.75
Anthraquinone, 25%, paste, drums	lb.	.70 –	.75
Benzaldehyde U.S.P., carboys	lb.	1.40 –	1.45
tech., drums	lb	.75	80
Benzene, pure, water-white, tanks and drums	gal.	.27 –	.32
Benzene, 90%, tanks & drums	gal.	.25 –	.30
Benzene, 90%, drums, resale.	gal.	.28 –	.32
Benzidine base, bbl.	lb.	.80 –	.85
Benzidine sulphate, bbl	lb.	.70 –	.75
Benzoic acid, U.S.P., kegs	lb.	.75 –	80
Benzoate of soda, U.S.P., bbl.	lb.	.57 –	.65
Benzyl chloride, 95-97%, ref., drums	lb.	.45 –	...
Benzyl chloride, tech., drums	lb.	.30 –	.35
Beta-naphthol, tech., bbl	lb.	.22 –	.23
Beta-naphthylamine, tech.	lb.	.80 –	.90
Cresol, U.S.P., drums.	lb.	.25 –	.29
Ortho-cresol, drums	lb.	.26 –	.30
Cresylic acid, 97%, resale, drums	gal.	1 15 –	1.20
95-97%, drums, resale	gal.	1.10 –	
Dichlorbenzene, drums	lb.	.07 –	.09
Diethylaniline, drums	lb.	.50 –	.60
Dimethylaniline, drums	lb.	.42 –	.43
Dinitrobenzene, bbl.	lb.	.19 –	.20
Dinitroclorbenzene bbl	lb	.22 –	.23
Dinitronaphthalen, bbl.	lb.	.30 –	.32
Dinitrophenol, bbl	lb.	.35 –	.40
Dinitrotoluene, bbl	lb.	.20 –	.22
Dip oil, 25%, drums	gal.	.25 –	.30
Diphenylamine, bbl.	lb.	.50 –	.52
H-acid, bbl.	lb.	.80 –	.85
Meta-phenylenediamine, bbl.	lb	1.00 –	1.05
Michlers ketone, bbl	lb	3.00 –	3.50
Monochlorbenzene, drums	lb	.08 –	.10
Monoethylaniline, drums	lb.	.95 –	1.10
Naphthalene, flake, bbl.	lb.	.08¼–	.08¾
Naphthalene, balls, bbl.	lb.	.09 –	.09½
Naphthionate of soda, bbl.	lb.	.58 –	.65
Naphthionic acid, crude, bbl.	lb.	.55 –	.60
Nitrobenzene, drums	lb.	.10 –	.12
Nitro-naphthalene, bbl.	lb.	.30 –	.35
Nitro-toluene, drums	lb.	.15 –	.17
N-W acid, bbl.	lb.	1.25 –	1.30
Ortho-amidophenol, kegs	lb.	2.30 –	2.35
Ortho-dichlorbenzene, drums	lb.	.17 –	.20
Ortho-nitrophenol, bbl.	lb.	.90 –	.92
Ortho-nitrotoluene, drums	lb.	.10 –	.12
Ortho-toluidine, bbl.	lb.	.14 –	.15
Para-amidophenol, base, kegs	lb.	1.20 –	1.30
Para-amidophenol, HCl, kegs	lb.	1.25 –	1.35
Para-dichlorbenzene, bbl.	lb.	.17 –	.20
Paranitroaniline, bbl.	lb.	.70 –	.75
Para-nitrotoluene, bbl.	lb.	.60 –	.65
Para-phenylenediamine, bbl.	lb.	1.45 –	1.50
Para-toluidine, bbl	lb.	.95 –	.98
Phthalic anhydride, bbl.	lb.	.35 –	.38
Phenol, U.S.P., drums	lb.	.48 –	.50
Picric acid, bbl.	lb.	.20 –	.22
Pyridine, dom., drums	gal.	nominal	

Pyridine, imp., drums	gal.	$2.50 - $2.75
Resorcinol, tech., kegs	lb.	1.50 - 1.60
Resorcinol, pure, kegs	lb.	2.25 - ...
R-salt, bbl.	lb.	.55 - .60
Salicylic acid, tech., bbl.	lb.	.37 - .42
Salicylic acid, U.S.P., bbl.	lb.	.40 - .45
Solvent naphtha, water-white, drums	gal.	.27 - .32
Crude, drums	gal.	.24 -
Sulphanilic acid, crude, bbl.	lb.	.18 - .20
Thiocarbanilide, kegs	lb.	.35 - .38
Toluidine, kegs	lb.	1.20 - 1.30
Toluidine, mixed, kegs	lb.	.30 - .35
Toluene, tank cars	gal.	.30 - .35
Toluene, drums	gal.	.35 - .40
Xylidines, drums	lb.	.47 - .49
Xylene, pure, drums	gal.	.75 - 1.00
Xylene, com., drums	gal.	.37 -
Xylene, com., tanks	gal.	.32

Naval Stores

Rosin B-D, bbl.	280 lb.	$5.90 -
Rosin E-I, bbl.	280 lb.	6.00 -
Rosin K-N, bbl.	280 lb.	6.20 -
Rosin W.G.-W.W., bbl.	280 lb.	6.50 - 7.50
Wood rosin, bbl.	280 lb.	6.00 - 6.10
Turpentine, spirits of, bbl.	gal.	1.03 - 1.04
Wood, steam dist., bbl.	gal.	.96 -
Wood, dest. dist., bbl.	gal.	.65 - .67
Pine tar pitch, bbl.	200 lb.	6.00
Tar, kiln burned, bbl.	500 lb.	- 13.00
Retort tar, bbl.	500 lb.	- 12.00
Rosin oil, first run, bbl.	gal.	.45 -
Rosin oil, second run, bbl.	gal.	.48 -
Rosin oil, third run, bbl.	gal.	.52 -
Pine oil, steam dist.	gal.	.75 -
Pine oil, pure, dest. dist.	gal.	.70
Pine tar oil, ref.	gal.	.48 -
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal.	.32 - .32½
Pine tar oil, double ref., bbl.	gal.	- .75
Pine tar, ref., thin, bbl.	gal.	- .25
Pinewood creosote, ref., bbl.	gal.	- .52

Animal Oils and Fats

Degras, bbl.	lb.	$0.03½ - $0.04½
Grease, yellow, bbl.	lb.	.06½ - .06½
Lard oil, Extra No. 1, bbl.	gal.	.90 - .92
Neatsfoot oil, 20 deg. bbl.	gal.	1.30 -
No. 1, bbl.	gal.	.92 - .94
Oleo Stearine		.09 -
Red oil, distilled, d.p. bbl.	lb.	.10½ - .10½
Saponified, bbl.	lb.	.10½ - .10½
Tallow, extra, loose	lb.	.07½
Tallow oil, acidless, bbl.	gal.	.94 - .96

Vegetable Oils

Castor oil, No. 3, bbl.	lb.	$0.14 -
Castor oil, No. 1, bbl.	lb.	.14½
Chinawood oil, bbl.	lb.	.26 - .28
Coconut oil, Ceylon, bbl.	lb.	.09½
Ceylon, tanks, N.Y.	lb.	.08½
Coconut oil, Cochin, bbl.	lb.	.09½ - .10
Corn oil, crude, bbl.	lb.	.12½
Crude, tanks, (f.o.b. mill)	lb.	.09½
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.10
Summer yellow, bbl.	lb.	.12½ - .13
Winter yellow, bbl.	lb.	.13½ - .13½
Linseed oil, raw, car lots, bbl.	gal.	1.12 -
Raw, tank cars (dom.)	gal.	1.07
Boiled, cars, bbl. (dom.)	gal.	1.14
Olive oil, denatured, bbl.	gal.	1.10
Sulphur, (foots) bbl.	lb.	.08½ - .09
Palm, Lagos, casks	lb.	.07½ - .07½
Niger, casks	lb.	.07 - .07½
Palm kernel, bbl.	lb.	.08½ - .08½
Peanut oil, crude, tanks (mill)	lb.	.13 - .13½
Peanut oil, refined, bbl.	lb.	.16½ -
Perilla, bbl.	lb.	.15½ - .16
Rapeseed oil, refined, bbl.	gal.	.83 - .84
Rapeseed oil, blown, bbl.	gal.	.88 - .89
Sesame, bbl.	lb.	.11½ - .12
Soya bean (Manchurian), bbl.	lb.	.12½ - .12½
Tank, f.o.b. Pacific coast	lb.	.09½ - .10
Tank, (f.o.b. N.Y.)	lb.	.10½ - .10½

Fish Oils

Cod, Newfoundland, bbl.	gal.	$0.70 - $0.72
Menhaden, light pressed, bbl.	gal.	.76 -
White bleached, bbl.	gal.	.78 -
Blown, bbl.	gal.	.82 -
Crude, tanks (f.o.b. factory)	gal.	.50 -
Whale No. 1 crude, tanks, coast	lb.	
Winter, natural, bbl.	gal.	.76 - .78
Winter, bleached, bbl.	gal.	.79 - .80

Oil Cake and Meal

Coconut cake, bags	ton	$30.00 - $31.00
Copra, sun dried, bags, (c.i.f.)	lb.	.04½ - .05
Sun dried Pacific coast	lb.	.04½ - .04½
Cottonseed meal, f.o.b. mills	ton	38.00 -
Linseed cake, bags	ton	34.00 -
Linseed meal, bags	ton	36.00 -

Dye & Tanning Materials

Albumen, blood, bbl.	lb.	$0.45 - $0.50
Albumen, egg, tech., keg	lb.	.90 - .95
Cochineal, bags	lb.	.33 - .35
Cutch, Borneo, bales	lb.	.04½ - .05
Cutch, Rangoon, bales	lb.	.13 - .13½
Dextrine, corn, bags	100 lb.	3.69 - 4.01
Dextrine gum, bags	100 lb.	3.99 - 4.09
Divi-divi, bags	ton	38.00 - 39.00
Fustic, sticks	ton	30.00 - 35.00
Fustic, chips, bags	lb.	.04 - .05
Logwood, sticks	ton	26.00 - 30.00
Logwood, chips, bags	lb.	.02½ - .03½
Sumac, leaves, Sicily, bags	ton	70.00 - 72.00
Sumac, ground, bags	ton	$65.00 - $67.00
Sumac, domestic, bags	ton	40.00 - 42.00
Starch, corn, bags	100 lb.	2.97 - 3.07
Tapioca flour, bags	lb.	.06 - .06½

Extracts

Archil, conc., bbl.	lb.	$0.17 - $0.18
Chestnut, 25% tannin, tanks	lb.	.02 - .03
Divi-divi, 25% tannin, bbl.	lb.	.04 - .05
Fustic, crystals, bbl.	lb.	.20 - .22
Fustic, liquid, 42°, bbl.	lb.	.08 - .09
Gambier, liq., 25% tannin, bbl.	lb.	.08 - .09
Hematine crys., bbl.	lb.	.14 - .18
Hemlock, 25% tannin, bbl.	lb.	.04 - .05
Hypernic, solid, drums	lb.	.24 - .26
Hypernic, liquid, 51°, bbl.	lb.	.10 - .12
Logwood, crys., bbl.	lb.	.18 - .20
Logwood, liq., 51°, bbl.	lb.	.09 - .10
Quebracho, solid, 65% tannin, bbl.	lb.	.04½ - .05
Sumac, dom., 51°, bbl.	lb.	.06½ - .07

Dry Colors

Blacks—Carbongas, bags, f.o.b. works	lb.	$0.20 - $0.24
Lampblack, bbl.	lb.	.12 - .40
Mineral, bulk	ton	35.00 - 45.00
Blues—Bronze, bbl.	lb.	.55 - .60
Prussian, bbl.	lb.	.55 - .60
Ultramarine, bbl.	lb.	.08 - .35
Browns, Sienna, Ital., bbl.	lb.	.06 - .14
Sienna, Domestic, bbl.	lb.	.03½ - .04
Umber, Turkey, bbl.	lb.	.04 - .04½
Greens—Chrome, C.P. Light, bbl.	lb.	.32 - .34
Chrome, commercial, bbl.	lb.	.12 - .12½
Paris, bulk	lb.	.30 - .35
Reds, Carmine No. 40, tins	lb.	4.50 - 4.70
Oxide red, casks	lb.	.10 - .14
Para toner, kegs	lb.	1.00 - 1.10
Vermilion, English, bbl.	lb.	1.30 - 1.32
Yellow, Chrome, C.P. bbls.	lb.	.20 - .21
Ocher, French, casks	lb.	.02½ - .03

Waxes

Bayberry, bbl.	lb.	$0.30 - $0.32
Beeswax, crude, bags	lb.	.20 - .21
Beeswax, refined, light, bags	lb.	.32 - .34
Beeswax, pure white, cases	lb.	.40 - .41
Candelilla, bags	lb.	.20½ - .21½
Carnauba, No. 1, bags	lb.	.42 - .43
No. 2, North Country, bags	lb.	.23 - .23½
No. 3, North Country, bags	lb.	.18½ - .19
Japan, cases	lb.	.16 - .16½
Montan, crude, bags	lb.	.04½ - .04½
Paraffine, crude, match, 105-110 m.p.	lb.	.04 - .04½
Crude, scale 124-126 m.p., bags	lb.	.02½ - .03
Ref., 118-120 m.p., bags	lb.	.03 - .03½
Ref., 125 m.p., bags	lb.	.03½ - .03½
Ref., 128-130 m.p., bags	lb.	.03½ - .03½
Ref., 133-135 m.p., bags	lb.	.04½ - .04½
Ref., 135-137 m.p., bags	lb.	.05 - .05½
Stearic acid, sgle pressed, bags	lb.	.12½ - .12½
Double pressed, bags	lb.	.13 - .13½
Triple pressed, bags	lb.	.14½ - .14½

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb.	$3.25 - $3.30
F.a.s. double bags	100 lb.	3.85 - 3.90
Blood, dried, bulk	unit	4.00 -
Bone, raw, 3 and 50, ground	ton	27.00 - 30.00
Fish scrap, dom., dried, wks.	unit	3.75 -
Nitrate of soda, bags	100 lb.	2.45 - 2.52½
Tankage, high grade, f.o.b. Chicago	unit	3.60 - 3.70
Phosphate rock, f.o.b. mines, Florida pebble 68-72%	ton	$4.00 - $4.50
Tennessee, 78-80%	ton	8.00 - 8.25
Potassium muriate, 80%, bags	ton	34.55 -
Potassium sulphate, bags basis 90%	ton	43.67 -
Double manure salt	ton	25.72 -
Kainit	ton	7.22 -

Crude Rubber

Para—Upriver fine	lb.	$0.28½ - $0.28½
Upriver coarse	lb.	.26 -
Upriver caucho ball	lb.	.26½ -
Plantation—First latex crepe	lb.	.28½ - .28½
Ribbed smoked sheets	lb.	.28½ - .28½
Brown crepe, thin, clean	lb.	.27 -
Amber crepe No. 1	lb.	.28 -

Gums

Copal, Congo, amber, bags	lb.	$0.12 - $0.13
East Indian, bold, bags	lb.	.23 - .23½
Manila, pale, bags	lb.	.20 - .20½
Pontinak, No. 1 bags	lb.	.20 - .20½
Damar, Batavia, cases	lb.	.27½ - .28½
Singapore, No. 1, cases	lb.	.34 - .35
Singapore, No. 2, cases	lb.	.22 - .23
Kauri, No. 1, cases	lb.	.65 - .67
Ordinary chips, cases	lb.	.20 - .22
Manjak, Barbados, bags	lb.	.09 - .09½

Shellac

Shellac, orange fine, bags	lb.	$0.61 -
Orange superfine, bags	lb.	.63 -
A. C. garnet, bags	lb.	nominal
Bleached, bonedry	lb.	.70 - .71
Bleached, fresh	lb.	.58 -
T. N., bags	lb.	.58 -

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh. ton	$500.00 -
Asbestos, shingle, f.o.b., Quebec	sh. ton	$65.00 - $85.00
Asbestos, cement, f.o.b., Quebec	sh. ton	20.00 - 25.00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	16.00 - 20.00
Barytes, grd., off-color, f.o.b. mills bulk	net ton	13.00 - 15.00
Barytes, floated, f.o.b. St. Louis, bbl.	net ton	28.00 -
Barytes, crude f.o.b. mines, bulk	net ton	10.00 - 11.00
Casein, bbl., tech.	lb.	.17½ - .18½
China clay (kaolin) crude, f.o.b. Ga.	net ton	7.00 - 9.00
Washed, f.o.b. Ga.	net ton	8.00 - 9.00
Powd., f.o.b. Ga.	net ton	14.00 - 20.00
Crude f.o.b. Va.	net ton	8.00 - 12.00
Ground, f.o.b. Va.	net ton	14.00 - 20.00
Imp., lump, bulk	net ton	15.00 - 20.00
Imp., powd.	net ton	45.00 - 50.00
Feldspar, No. 1 pottery	long ton	6.00 - 7.00
No. 2 pottery	long ton	4.00 - 5.50
No. 1 soap	long ton	7.00 - 7.50
No. 1 Canadian, f.o.b. mill	long ton	20.00 - 22.00
Graphite, Ceylon, lump, first quality, bbl.	lb.	.06½ -
Ceylon, chip, bbl.	lb.	.05½ -
High grade amorphous crude	ton	15.00 - 35.00
Gum arabic, amber, sorts, bags	lb.	.14½ - .15
Gum tragacanth, sorts, bags	lb.	.48 - .56
No. 1, bags	lb.	1.50 - 1.60
Kieselguhr, f.o.b. Cal.	ton	40.00 - 42.00
F.o.b. N.Y.	ton	50.00 - 55.00
Magnesite, crude, f.o.b. Cal.	ton	14.00 - 15.00
Pumice stone, imp., casks	lb.	.03 - .05½
Dom., lump, bbl.	lb.	.05 - .05½
Dom., ground, bbl.	lb.	.06 - .07
Silica, glass sand, f.o.b. Ind.	ton	2.00 - 2.50
Silica, sand blast, f.o.b. Ind.	ton	2.50 - 5.00
Silica, amorphous, 250-mesh, f.o.b. Ill.	ton	17.00 - 17.50
Silica, bldg. sand, f.o.b. Pa.	ton	2.00 - 2.75
Soapstone, coarse, f.o.b. Vt., bags	ton	7.00 - 8.00
Talc, 200 mesh, f.o.b. Vt., bags	ton	6.50 - 9.00
Talc, 200 mesh, f.o.b. Ga., bags	ton	7.00 - 9.00
Talc, 200 mesh, f.o.b. Los Angeles, bags	ton	16.00 - 20.00

Mineral Oils

Crude, at Wells

Pennsylvania	bbl.	$3.25 - 3.50
Corning	bbl.	1.85 -
Cabell	bbl.	1.91 -
Somerset	bbl.	1.75 -
Illinois	bbl.	1.97 -
Indiana	bbl.	1.98 -
Kansas and Oklahoma, 28 deg.	bbl.	1.30 -
California, 35 deg. and up	bbl.	1.04 -

Gasoline, Etc.

Motor gasoline, steel bbls.	gal.	$0.21½ -
Naphtha, V. M. & P. deod., steel bbls.	gal.	.20½ -
Kerosene, ref. tank wagon	gal.	.14 -
Bulk, W. W. export	gal.	.07 -
Lubricating oils:		
Cylinder, Penn., dark	gal.	.22 - .25
Bloomless, 30@31 grav.	gal.	.18½ - .20½
Paraffin, pale	gal.	.24 - .26
Spindle, 200, pale	gal.	.22 - .24
Petrolatum, amber, bbls.	lb.	.05 - .05½
Paraffine wax (see waxes)		

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	ton	$45-50
Chrome brick, f.o.b. Eastern shipping points	ton	50-52
Chrome cement, 40-50% Cr_2O_3	ton	23-27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	40-46
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	36-41
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65-68
9-in arches, wedges and keys	ton	80-85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48-50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	48-50
F.o.b. Mt. Union, Pa.	1,000	42-44
Silicon carbide refract. brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N.Y.	ton	$200.00 - $225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11½ - .11½
4-6% C	lb.	.12 - .13
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	125.00 -
Spiegeleisen, 19-21% Mn	gr. ton	40.00 -
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb.	2.00 - 2.50
Ferrosilicon, 10-15%	gr. ton	48.00 - 50.00
50%	gr. ton	95.00 -
75%	gr. ton	150.00 - 160.00

Ferrotungsten, 70-80%, per lb. of W	lb.	\$0.90 - \$0.95
Ferro-uranium, 35-50% of U, per lb. of U	lb.	6.00 - ....
Ferrovanadium, 30-40%, per lb. of V	lb.	3.50 - 3.75

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	\$6.00 - \$9.00
Chrome ore Calif. concentrates, 50% min. Cr_2O_3	ton	22 00 - 23 00
C i f. Atlantic seaboard	ton	20 50 - 24 00
Coke, fdry., f.o b. ovens	ton	7 00 - 7 50
Coke, furnace, f o b ovens	ton	6 00 - 6.50
Fluorspar, gravel, f.o.b. mines' Illinois	ton	20 00 - 21 50
Ilmenite, 52% TiO_2	lb.	.01½ - .01¾
Manganese ore, 50% Mn, c i f. Atlantic seaport	unit	.33 - ....
Manganese ore, chemical (MnO_2)	ton	75 00 - 80 00
Molybdenite, 85% MoS_2, per lb. MoS_2, N Y.	lb	.65 - .70
Monazite, per unit of ThO_2, c i f, Atl. seaport	lb.	.06 - 08
Pyrites, Span., fines, c.i f. Atl seaport	unit	.11½ - .12
Pyrites, Span., furnace size, c i f. Atl seaport	unit	.11½ - .12
Pyrites, dom fines, f o b mines, Ga.	unit	12
Rutile, 95% TiO_2	lb.	.12 - ....
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8 50 - 8.75
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	8 00 - 8 25
Uranium ore (carnotite) per lb of U_3O_8	lb.	3 50 3 75
Uranium oxide, 96% per lb. U_3O_8	lb	2 25 2 50
Vanadium pentoxide, 99%	lb.	12 00 - 14 00
Vanadium ore, per lb V_2O_5	lb	1 00 - ......
Zircon, washed, iron free, f o.b. Pablo, Fla	lb.	.04½ - 13

Non-Ferrous Materials

	Cents per Lb
Copper, electrolytic	15 15½
Aluminum, 98 to 99%	25 26
Antimony, wholesale, Chinese and Japanese	7½ 7¾
Nickel, virgin metal	28 30
Nickel, ingot and shot	30
Monel metal, shot and blocks	32.00
Monel metal, ingots	38 00
Monel metal, sheet bars	45 00
Tin, 5-ton lots, Straits	42 50
Lead, New York, spot	7 25
Lead, E St Louis, spot	7 00
Zinc, spot, New York	6 65
Zinc, spot, E St Louis	6 30

Other Metals

Silver (commercial)	oz	\$0 65
Cadmium	lb.	1.00
Bismuth (500 lb lots)	lb	2 55
Cobalt	lb.	2 65@2 85
Magnesium, ingots, 99%	lb.	1.25-
Platinum	oz.	114 00
Iridium	oz.	260 00@275 00
Palladium	oz	80 00
Mercury	75 lb.	67 00

Finished Metal Products

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	24 25
Copper bottoms	29 75
Copper rods	25 25
High brass wire	19 37½
High brass rods	17 00
Low brass wire	21.10
Low brass rods	22 00
Brazed brass tubing	24.25
Brazed bronze tubing	29 00
Seamless copper tubing	25.25
Seamless high brass tubing	23 50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.60@11 8
Copper, heavy and wire	11 50@11 6
Copper, light and bottoms	10 00@10 1
Lead, heavy	5.75@6 0
Lead, tea	3 50@3 7
Brass, heavy	6 50@6 7
Brass, light	5 75@6 0
No. 1 yellow brass turnings	6 75@ .70
Zinc	3.75@4.2

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	\$3 29	\$3.14
Soft steel bars	3.19	3.04
Soft steel bar shapes	3.19	3.04
Soft steel bands	3.29	3.19
Plates, ¼ to 1 in. thick	3.29	3.14

Industrial

Financial, Construction and Manufacturing News

Construction and Operation

Alabama

BIRMINGHAM—The Naphthalene Products Co., recently organized with a capital of \$250,000, has tentative plans under consideration for the construction of a new plant for the production of naphthalene and other chemical specialties. W P. Badham and C. P Herty head the company

California

WATSONVILLE—The Ferro Paint & Pigment Co, operating a plant near Watsonville for the production of red oxide of iron, etc, has plans for the installation of additional equipment at its plant for considerable increase in output

VENTURA The A F Gilmore Co., 210 West 7th St, Los Angeles, oil products is arranging for the purchase of a local site for the construction of a new oil refinery estimated to cost about \$60,000

SAN FRANCISCO - The J. D and A B Spreckels Securities Co, operating the Western Sugar Refinery, 2 Pine St, will commence the construction of a new 1-story concrete building at the plant to cost approximately \$245,000

WATSONVILLE - K T Romie, Salinas, Calif., has acquired property at Main and Ford Sts, as a site for a new plant for the manufacture of hollow concrete products and other cement specialties

LINCOLN — Gladding, McBean & Co, Crocker Bldg, San Francisco, have commenced the installation of a continuous tunnel kiln at their local pottery, 365 ft long, and will make other additions and improvements for the production of roofing tile products

SAN DIEGO—The Vitrified Products Corp has awarded a contract to Lange & Bergstrom, Timken Bldg., for the erection of the initial buildings for its proposed new plant at Old Town, near San Diego, estimated to cost about \$75,000 The equipment installation will be arranged at an early date George W Kummer is general manager

Florida

TAMPA—A fertilizer manufacturing company, represented by the Chemical Construction Co, Charlotte, N C., Peter S Gilchrist, president, has plans in preparation for the construction of a new phosphate plant on site along the Hillsborough River It will consist of a number of buildings, with power house, and equipped for the manufacture of superphosphate, about 41 to 17 per cent pure The plant with machinery will cost in excess of \$1,000 000 The local Board of Trade is interested in the project

Illinois

DECATUR—The A E Staley Mfg Co Geddis Lane, manufacturer of corn starch, etc, is having plans prepared for the erection of a 3-story addition, 70x126 ft., on 7th St, estimated to cost about \$55,000

FAYVILLE—Fire, May 29, destroyed two buildings at the plant of the Hercules Powder Co. An official estimate of loss has not been made It is planned to rebuild

CHICAGO—The Chin Chin Chemical Co., comprising a recent reorganization of the National Chemical Co., 719 North Wells St., has plans under way for the erection of a new plant on 10-acre tract of land acquired at Ingleside Ave. and 138th St., Dolton district. It will be 2-story, estimated to cost about \$350,000, with machinery. Bids will be asked at an early date Josepn T. Hutton is president.

CHICAGO — The Archer-Daniels-Midland Co., comprising a recent consolidation of the Archer-Daniels Linseed Co., Minneapolis. Minn., and the Midland Linseed Products Co., Chicago, has taken over the plant of the last noted company at Kingsbury and Blackhawk Sts., 200x400 ft., for a consideration of \$150,000. The factory will be improved and developed to maximum production.

Louisiana

ELIZABETH The Calcasieu Mfg. Co., manufacturer of pulp and paper products, is planning for enlargements in its plant to increase the capacity from 10 to 20 tons per day The company recently increased its capital from \$250,000 to \$350,000 for expansion

Maryland

BALTIMORE -The Bethlehem Steel Corp., Bethlehem, Pa, is perfecting plans for the installation of a new silica gel plant at its Sparrows Point works, for the recovery of benzol from coke-oven gas. The equipment will include a department for the refining of benzol

Massachusetts

BOSTON The Boston Pottery Co., 152 Condar St, has filed plans for the erection of a new addition to its plant to cost about \$17,000 It is purposed to install additional equipment

WOBURN—Fire, May 28, destroyed a portion of the plant of the Crescent Tanning Co, with loss estimated at about \$150,000. including machinery. It is planned to rebuild.

CAMBRIDGE The Essex Brass Foundry, University, Boston, has acquired property at Main and 6th Sts., Cambridge, totaling about 20,000 sq ft., as a site for a new foundry, for which plans will soon be prepared

Michigan

BATTLE CREEK- The Sinclair Oil Refining Co, 111 West Washington St, Chicago, Ill., is planning for the construction of a new oil storage and distributing plant on local site, estimated to cost about \$75,000, including equipment

GRAND RAPIDS - The La Mar Pipe & Tile Co, recently organized with capital of \$200,000, has construction under way on a new plant in the La Mar section for the manufacture of cement tile, pipe and kindred products It is estimated to cost in excess of \$80,000 with machinery. J. Kent Wilson is general manager.

MUSKEGON HEIGHTS—The Stroh Aluminum Co., 232 Chene St., Detroit, has tentative plans under consideration for a new local plant. Application has been made to the Muskegon Board of Commerce for a suitable site The company is allied with the Stroh Castings Co

Missouri

ST LOUIS The Warren Steel Casting Co, 3400 Maury Ave, has preliminary plans under consideration for the rebuilding of the portion of its foundry destroyed by fire, May 23, with loss estimated at about \$42,000, including equipment.

New Hampshire

NASHUA - The Boston & Maine Railroad Co, North Station, Boston, Mass., will have plans prepared at once for the construction of a new chemical tie-treating plant on local site, comprising about 80 acres of land, recently acquired. Complete machinery will be installed for creosoting and kindred operations. The plant is estimated to cost close to \$100,000, with equipment.

New Jersey

TRENTON- The Trenton Flint & Spar Co., Academy and North Montgomery Sts., has filed plans for the erection of a new 1-story plant on Marian St., to be equipped for pulverizing, sorting, etc.

PHILLIPSBURG—Fire, May 29, destroyed a portion of the plant of the J. T. Baker Chemical Co. An official estimate of loss has not been announced It is planned to rebuild at an early date.

JERSEY CITY—Robert Griffin & Co., 151 West Side Ave., manufacturers of wall paper, have awarded a contract to W. H.

& F. W. Crane, Journal Square, for the erection of a new 2-story plant addition, 50x300 ft., on West Side Ave., estimated to cost approximately $100,000, including equipment. C. H. Ziegler, 75 Montgomery St., is architect.

NEWARK—The May Chemical Co., 204 Niagara St., manufacturer of chemicals, colors, etc., has acquired through the Bernard Trading Co., a holding company, property adjoining its plant at 200-202 Niagara St., 50x100 ft. It is planned to build an addition to the plant in the near future. Dr. Otto May is president.

New York

ROCHESTER—The F. B. Rae Co., foot of Ambrose St., manufacturer of oils, paints, etc., has preliminary plans under consideration for the rebuilding of the portion of its plant destroyed by fire, May 25, with loss estimated at $350,000, including buildings, equipment and stock.

TROY—The Manning Abrasive Co., Inc., 20 Murray St., New York, is considering the construction of a new plant in the vicinity of Troy for the manufacture of sandpaper and other abrasive products, estimated to cost close to $150,000, with machinery. The company is now operating a plant at Watervliet, N. Y.

Ohio

CHILLICOTHE—The Buckeye Tile Co., recently organized under Delaware laws with capital of $250,000, has plans for the construction of a new local plant for the manufacture of tile and kindred ceramic products. Seven kilns will be installed. The works will cost close to $75,000, including equipment. John C. Strayer, York, Pa., is president, and J. J. Carter, formerly connected with the Wheeling Tile Co., Wheeling, W. Va., plant superintendent.

CLEVELAND—The Master Builders Co., Union Bldg., Cleveland, manufacturer of special chemical-iron material for use in concrete reinforcement, has preliminary plans under consideration for the rebuilding of the portion of its plant destroyed by fire, May 22, with loss estimated at $100,000, including buildings and equipment.

SEBRING—The French China Co. is perfecting plans for enlargements in its plant, including the construction of new decorating kilns and the installation of additional equipment.

Pennsylvania

BENTLEY SPRINGS—New interests have acquired the plant and property of the Eagle Paper Mill, Bentley Springs, near Freeland. Plans are in progress for remodeling and improving the mill for considerable increase in production.

WASHINGTON—Fire, May 26, destroyed a portion of the plant of the Beaver Refining Co., Henderson Ave., manufacturer of refined petroleum products, with loss estimated at close to $500,000, including equipment. It is planned to rebuild at an early date.

NEW CASTLE—The Seiberling Rubber Co. has tentative plans under consideration for enlargements at its local plant to increase the capacity from 800 to about 2,500 tires per day. It is purposed to install additional equipment.

PHILADELPHIA—The Leather Products Co., 1150 Adams St., Frankford, has arranged for the removal of its plant to a new factory at Wayne Junction, where additional equipment will be provided for considerable increase in the manufacture of chemical leather products. A. S. Hull is president.

JENKINTOWN—The Farmastic Co., recently formed under Delaware laws with capital of $250,000, has construction in progress on a new local plant for the manufacture of paint and affiliated products. It is purposed to commence operations early in July. Martin R. Jacobs is president and J. D. Farber, secretary and treasurer.

NEW CASTLE—The Shenango Pottery Co. will make enlargements in its plant and install additional equipment for considerable increase in production. Three additional kilns will be built. The company has arranged for an increase in capital from $230,000 to $750,000 for expansion.

South Carolina

HONEA PATH—The Honea Path Oil Mill Co. has plans under consideration for the construction of a new cottonseed oil mill.

Tennessee

SIGNAL MOUNTAIN—The Signal Mountain Portland Cement Co. has work nearing completion on its new local cement manufacturing plant and plans to finish the machinery installation during July. The plant will represent an investment of close to $2,000,000. It will have a capacity for handling 12,000 bbl. of material a day.

COLORADO CITY—The Tubbock Cotton Oil Co. has work in progress on a new cottonseed oil mill, four-press type, estimated to cost about $200,000, including machinery. At a later date it is planned to increase the plant to an eight-press mill, doubling the initial output.

RANGER—The Baltic Gas Co. has plans nearing completion for the construction of a new gasoline-refining plant, estimated to cost close to $90,000, with equipment. R. W. Thomas, E. D. Finney and Charles Terrell head the company.

DALLAS—The Dallas Pottery Co. has acquired a tract of about 7½ acres of land in the Love Industrial Field, and plans for the erection of a new plant to cost about $75,000, including equipment. Work will be commenced at an early date. Taylor Jackson is general manager.

Virginia

CHINCOTEAGUE—The Assateague Fish, Oil & Fertilizer Co. has been reorganized and will succeed to the plant and business of the company of the same name. The new organization is capitalized at $560,000; it will make extensions and improvements at the fertilizer mill and plans to commence operations at an early date. William J. Highfield, Wilmington, Del., is president, and Edward W. Pyle, secretary and treasurer.

Washington

SEATTLE—The Campbell Oil Co., Shelby, Mont., represented by Ray M. Wardall and Winter S. Martin, L. C. Smith Bldg., Seattle, has tentative plans under consideration for the erection of a new oil-refining plant on site now being selected at Seattle, to be equipped for an initial daily output of about 1,000 bbl. per day.

West Virginia

WHEELING—The West Virginia Match Co., recently formed with a capital of $300,000, has plans nearing completion for the construction of a new local plant estimated to cost in excess of $100,000 including machinery. A site has been selected.

New Companies

ST. LOUIS LITHOPONE CO., St. Louis, Mo., lithopone and chemical products, $350,000. Incorporators: Emmet C. Carter and E. A. Giblin, both of St. Louis.

FULTON CHEMICAL WORKS, INC., Brooklyn, N. Y., chemicals and chemical byproducts, $50,000. Incorporators: R. E. Slayton, F. S. Johnson and M. W. Lennon. Representative: Caldwell & Polhemus, 50 Church St., New York.

CHAPMAN OIL & REFINING CO., Room 1121, 29 South La Salle St., Chicago, Ill., refined oil products, $10,000. Incorporators: Ray C. Chapman, W. I. Power and Theodore C. Kretzman.

JOHN M. CARRECABE, INC., Chelsea, Mass.; fiberboard, leatherboard and kindred products, $70,000. A. L. Carrecabe, Swampscott, Mass., president and treasurer, and John A. Carrecabe, vice-president.

GUMITE CO., INC., Jersey City, N. J.; paints and varnishes, $100,000. Incorporators: Alfred O. Kellogg, Frank B. Vermilya, and John J. Field, 3d, 1 Union St., Jersey City. The last noted is representative.

AMALGAMATED RUBBER CO., Akron, O., rubber products, $10,000. Incorporators: Arthur L. and Edwin C. Abt, both of Akron.

PINKHAM CHEMICAL CORP., Brooklyn, N. Y.; chemicals and chemical byproducts, $10,000. Incorporators: M. M. Siegel, S. M. Louis and A. E. Rosenberg. Representative: G. H. Curtis, Jr., 51 Chambers St., New York.

RICHARD HAWORTH, INC., Providence, R. I., chemicals and chemical byproducts; $25,000. Incorporators: Harold A. Weaver, Edward C. Stiness and Richard Haworth, 130 Fountain St., Providence. The last noted is representative.

MOTORKOOL OIL CO., Wilmington, Del.; refined petroleum products; $500,000. The company is represented by the Colonial Charter Co., Ford Bldg., Wilmington.

LETTERMAN RUBBER WORKS, INC., San Antonio, Tex.; rubber products; $30,000. Incorporators: J. H. and M. W. Letterman, and J. T. Meyers, all of San Antonio.

NEWMAN OIL CO., Okmulgee, Okla.; refined oil products; $600,000. Incorporators: William C. and Thomas A. Newman, and Dwight Richardson, all of Okmulgee.

LARKRESEN CHEMICAL WORKS, INC., Wilmington, Del.; chemicals and chemical byproducts; $300,000. Representative: Colonial Charter Co., Ford Bldg., Wilmington.

GORDON CHEMICAL CO., INC., Foxboro, Mass.; chemicals and chemical byproducts; $250,000. Lewis Marks is president; and Nathan Haffer, 80 Green St., Boston, Mass., treasurer and representative.

J. M. HUBER, INC., West 2nd St. and the Hudson Boulevard, Jersey City, N. J.; printing and other inks, etc.; $500,000. Incorporators: Joseph M. Huber, Hans W. Huber and Walter Gundlach.

INDUSTRIAL OIL CO., INC., East Providence, R. I.; refined oils; $50,000. Incorporators: W. S. Canton, Simon Norman and John W. Canton, Jr., 80 Ivy St., Providence. The last noted is representative.

LLOYD & KLAPP, INC., Philadelphia, Pa.; soap products; $10,000. Edward M. K. Klapp, 1716 Spruce St., Philadelphia, is treasurer and representative.

PITTSBURGH POWDER & SUPPLY CO., Pittsburgh, Pa.; explosives and powder, being organized under state laws, application for a charter will be made on June 11. Incorporators: Charles G. Lane, Jr., John B. Nicklas, Jr., and Leonard Balter. Representative: Roland A. McCrady, 1130 Park Bldg., Pittsburgh.

RUBBERSTONE FLOORING CORP., New York, N. Y.; composition rubber products; $50,000. Incorporators: J. Schede and G. C. Hannam. Representative: J. J. Nolan, 25 Broad St.

BASTROP GLASS CO., Winchester, Ind.; glass products; $100,000. Incorporators: Charles W. Bowman, Stuart Pierce and James H. Moroney, all of Winchester.

CHAMELEON CO., New York, N. Y.; paints and varnishes, $10,000. Incorporators: R. W. Cramer, W. J. Labhardt and W. J. Shore. Representative: Olney & Comstock, 68 William St., New York.

BRILLIANT GLASS CO., Paterson, N. J.; glass products; $25,000. Incorporators: John E. O'Connor, Franklin L. and Leroy F. Duke, 193 Ellison St., Paterson. The last noted is representative.

Opportunities in the Foreign Trade

Parties interested in any of the following opportunities may obtain all available information from the Bureau of Foreign and Domestic Commerce at Washington or from any district office of the bureau. The number placed after the opportunity must be given for the purpose of identification.

ACIDS, SEBACIC. Stuttgart, Germany. Purchase.—6603.

AMMONIA, ANHYDROUS. Progreso, Mexico. Agency.—6637.

BORAX. Berlin, Germany. Purchase.—6596.

CHEMICALS. Goteborg, Sweden. Agency.—6598.

CHEMICALS. Progreso, Mexico. Purchase and Agency.—6599.

BLEACHING CHEMICALS. Bilbao, Spain. Purchase.—6606.

CHLORINE. Goteborg, Sweden. Agency.—6708.

DYESTUFFS. Goteborg, Sweden. Agency.—6598.

GLUE, BONE AND LEATHER. Basel, Switzerland. Agency.—6638.

INSECTICIDES. Bordeaux, France. Agency.—6605.

PAINTS, MOTOR CAR. East London, South Africa. Purchase.—6595.

PARAFFIN. Stuttgart, Germany. Purchase.—6601.

ROSIN. Stuttgart, Germany. Agency.—6598.

ROSIN. Ruzomberok, Czechoslovakia. Purchase.—6604.

SODAS. Goteborg, Sweden. Agency.—6598.

SODAS, caustic, bichromate of potassium, bichromate of soda, and chrome alum. Berlin, Germany. Purchase.—6708.

SODIUM SULPHATE. Goteborg, Sweden. Agency.—6598.

SULPHUR. Goteborg, Sweden. Agency.—6598.

TAR AND PITCH. Bordeaux, France. Agency.—6622.

CHEMICAL & METALLURGICAL ENGINEERING

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H. C. PARMELEE, Editor

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Skating on Thin Ice

SLIGHTLY more than a year ago the correspondence between Secretary HOOVER and the Attorney-General resulted in a list of permissible and legal trade association activities. One statement therein, which later developments have served to emphasize, might have been liberally interpreted as follows: "Beware of the open-price scheme! On the surface it may seem legally feasible, but potentially it's dangerous business." That warning still holds. And another pillar was added to its support when the Supreme Court in its decision on June 4 against the linseed oil associates held that "their manifest purpose was to defeat the Sherman act without subjecting themselves to its penalties." If there has been any shadow of doubt in the mind of the conscientious trade association executive regarding the ethics of the open-price plan, this decision should forever dispel it.

It is significant that the warning in the Hoover-Daugherty correspondence was sounded in spite of the fact that Judge CARPENTER in the District Court at Chicago had already refused the government's request for an injunction against the Armstrong Bureau of Related Industries. The lower tribunal held that there was no actual restraint of trade and therefore no violation of the Sherman act, but the decision indicated the illegal potentialities of the organization. Apparently Mr. HOOVER either judged this opinion too frail to support a legitimate trade association activity or even at that time he saw how clearly the linseed decision was foreshadowed by the Supreme Court's stand against the open prices of the Hardwood Manufacturers' Association. It has since been pointed out that only a very small but conspicuous minority of the trade associations has fostered the open-price scheme. Probably 98 per cent of the commercial organizations of the country have acted in the public interest, while a meager 2 per cent have brought the whole into disrepute. We should not lose sight, however, of the fact that the trade organization is not the only guilty party.

The operations of the linseed associates, as far as the original bill of complaint shows, were always free and above board. Their strict rules for adherence to the "open competition plan" were obviously framed for the single purpose of maintaining uniform prices and a stable market, but at no time was there evidence of connivance or secret conspiracy at price fixing. That supposedly competing firms in more than one line of industry are actually fixing prices under cover is a matter of general belief, if not common knowledge. Nearly everyone has observed the fact that price changes may be announced simultaneously by all of the firms in a single industry. Sometimes even the wording of these announcements is strikingly similar; once we noted the peculiar coincidence that two of them received in the same mail included the same typographical error. The fact that many of these practices have been carried on unmolested for so long may have given some of these firms a false idea of security. They should recognize, however, that they are skating on thin ice and that sooner or later their schemes are certain to meet with disaster.

Once the friends of honest business and the supporters of the many constructive and useful activities of the trade association are aroused they are going to see that the government's continued warnings do not longer go unheeded.

Messrs. Gary et Al. Are Misinformed

A GREAT AMOUNT of public interest—judging from newspaper and magazine comment—has been excited by the report of the American Iron and Steel Institute committee on the proposed total elimination of the 12-hour day. It has even been asserted that the gentlemen who signed the report, Messrs. GARY, BLOCK, BURDEN, CAMPBELL, DINKEY, FARREL, GRACE, KING and TOPPINGS, do not believe what they signed when they say that the 12-hour day has not of itself been an injury to the employees, either physically, mentally or morally.

Now we haven't any sympathy for the 12-hour day. We have worked the long turn in the hottest part of a steel mill in the hottest of summer. In the remembrance of those days and nights, we are quite sure we should never have signed that report, even in the interest of harmony. However, that is no reason for doubting that the gentlemen who did sign it are absolutely sincere and believe what it sets forth. Furthermore, we do not hesitate to say that before the present situation can be remedied, it is absolutely necessary for the "reformers" to recognize the fact that the real men in the industry would not tolerate any condition which they knew was sapping their workers—no matter what the dividend situation or profit and loss account might be.

The trouble is they do not know! They get the basis for their opinion from officials, welfare worker, industrial investigators, or common spies, all "insiders." Little of this so-called "information" is in turn based on sincere, impartial investigation by a person who has risen from the ranks of the night shift, or even capable of imagining himself in the worker's job or herself in the wife's shoes. Outside investigators, strangely enough, are resented as meddling busybodies. And for this reason it is obviously impossible to convert the Iron and Steel Institute committee to the 8-hour day until

its members actually get the real information and from the inside.

How this may be done is difficult to say. Perhaps it would not be too much to suggest that Mr. GARY, for instance, should choose some rising young executive in the Carnegie Steel Co. of strapping physique who could stand the gaff, give him the job of furnace man's helper, require him to lose his identity for 6 months and live on his wages among his fellow workmen.

Then Mr. GARY would get a new basis for opinion—and from the inside!

An Integrated Society Convention

THE recent spring meeting of the Taylor Society was one of the most enjoyable affairs of this nature that it has ever been our fortune to attend. One came away from this convention stimulated—with a feeling that something of true worth had taken place in which it was a privilege to participate. Comparing this feeling with the reactions caused by many gatherings of a like nature, one is moved to question wherein the difference lay. The usual feeling one takes away from such a meeting is of a mind in chaos, overcrowded with a heterogeneous mass of ill-digested facts.

The difference is just this, and it is one that many other technical societies could well mark: The Taylor Society's program was a unit. It was composed of different subjects—true; but each of these subjects was so chosen that it threw a searchlight beam on the main topic. By the discussion of a series of closely coordinated parts of the management problem its significance to industry was placed in a clearer and better light for all who attended.

Turning Refuse Into Money

THE FORWARD MARCH of technology prompts an occasional stock-taking of current terms. In the Chicago packing plants, we are told, all but the squeal is utilized; there is no waste. The refuse of today is the raw material of tomorrow. Hence one is forced to admit that the term "utilization of waste" is a misnomer, because the process or processes involved have become an integral part of industrial operation. The ideal manufacturing plant discards nothing; there is no refuse to throw away.

The scientist and his confrère, the expert technologist, delight to "make a job" of anything; and in this respect it is pertinent to review the profound influence of chemical engineering in recent years on the completeness of utilization of raw material or the byproducts of industry, no matter of what kind. The field for invention and initiative has been extensive, and advantage has been taken of its potentialities by a Californian corporation, headed by STANLEY HILLER, who appears to have an unusually keen sense of the economics of industrial effort and the latent value of what is usually considered as refuse. His researches and the practical application of his ideas on the manufacture of valuable byproducts from fruit pits during the war led to the establishment of an industry of no small proportions in the West. Concurrently, a study of conditions in the canning industry suggested an investigation into the losses of valuable liquors, with the result that he developed a unit plant, which collects and treats and clarifies what was previously thrown away, thus adding appreciably to the profits of the undertaking.

Fish curing and marketing has assumed immense proportions, especially in the Pacific Coast region. An idea of its importance may be gathered by considering the potential value of the material that has been discarded as valueless—the heads, tails and entrails—amounting to about 35 per cent of the weight of the catch. Mr. HILLER has developed a neat and compact treater, in which such refuse is chopped, cooked, deprived of oil, dried and ground. It is then sold as a chicken feed or fertilizer material. The oil recovered finds a ready market for a large number of purposes.

It's the little things that count. The scientifically complete utilization of all the raw material that Nature has provided, as well as of the residues and byproducts of normal manufacturing processes, indicates that we may be entering a new phase of industrial efficiency. The ability to apply such refinements in a practicable manner emphasizes the importance of large-scale operations and the value of technical control of the highest standard. Mr. HILLER'S successful work on the coast suggests another grouping of engineers—those who specialize in the work of turning waste products into assets of dividend value.

The Technical Man And His Job

NOTHING strikes nearer home to the technical man than a discussion of his job and his good relations with his employer. While he may be concerned primarily with his own efforts to improve his individual status, nevertheless anything that affects the standing of his profession is bound to have his attention. It is, therefore, to a peculiarly receptive audience that one of our readers has addressed the letter on page 1081 of this issue, which bears the title: "Is There an Agreement Against Technology?" He describes a condition which, if at all prevalent, would have a most unfavorable reaction on the chemical profession.

We believe it safe to say, however, that fortunately only a small minority of our manufacturers are a party to this "gentlemen's agreement" not to engage a technical expert who has left the employ of a competitor. The apparent effect of such a vicious practice would be to enable the manufacturer to carry on research up to a point where he has improved his product and established economic production and then to sit safely by and take his profits without fear of competition. A short-sighted policy, to be sure, but one likely to attract the opportunist. The effect on the technical man, on the other hand, would be to enslave him in his present position, or, if he loses that, force him into a different line of work in order to gain his livelihood. By thus narrowing the market in which the technical man can sell his special abilities, this practice takes away the incentive that makes for really worth-while research.

A somewhat parallel situation exists in the case of the unfair contracts which a few employers still exact from their technical men. These coercive contracts, entirely unilateral in character, would claim as the manufacturer's property all of the knowledge and experience gained by the technical man during the term of his employment. In spite of the fact that the courts have been called upon to iron out some of these difficulties and have succeeded in establishing some fairly definite

precedents, the practice still persists and these oppressive compacts are constantly held over the heads of some of our technical men.

The contract evil as well as the employing agreements stressed by our correspondent will not be corrected as long as the technical men submit to these injustices. There must be a more general recognition of the chemical and engineering professions and the chemist and engineer must win for themselves the same respect and trust that are now accorded the legal and medical professions. The responsibility for bringing about these changes is in the hands of the technical men themselves. Our reader's protest is a step in that direction.

The Flat Tire Of Industry

NOT LONG AGO an acquaintance said that finance was the flat tire of industry. This may sound like a rather flippant thought, but it was really a headline to call attention to the very sound truths lined up beneath it. It is perhaps too often the case that those industries with banking control are the most poorly managed and the least integrated.

This was the thought in our acquaintance's mind when he made that remark. He, like most of us, had seen the operating and the distribution departments of a manufacturing plant formulate the best of plans, more often than not with the full cognizance of the banking control, only to have the whole structure overturned at some later date for a purely financial reason. And he knew that in plants where the control lay in the plant and not in the bank, plans were made and carried through with respect to industrial, not financial, considerations.

But this wrecking of plans need not occur. Does not all modern industry base its plans on the plant budget? Suppose, then, that the banking control sits in on the budget making and then holds to the budget made. That's good financial practice as well as good industrial practice. And if such a course is followed, don't you think that the one-time flat tire will be reinflated—a sound wheel once again for our industrial machine?

Sizing Up The New Graduate

INDUSTRY has little concern with the "sweet girl graduate" of June, but in the large group of technical and scientific men now leaving our colleges and universities the chemical engineering industries do find each year a new source of inspiration and an ever new set of problems.

The young man upon graduation often feels that his scholastic record will of itself mean much. In a sense this is true, although industry also has other bases of judgment. And even the professors who have for 4 years consistently drilled into the young man the importance of high scholastic standing appreciate how many other factors must enter into the appraisal of his service value. This view is conspicuously apparent in an employment qualification record used by the department of chemistry at the University of Wisconsin. This record serves to assist the department head in answering requests from industry for young men of promise and in turn aids the graduates in obtaining work for which they are particularly qualified.

This record of qualifications cites twelve factors which form the background for the confidential estimate made by the faculty committee for each individual graduate. Integrity, quite properly, is the first requirement. It is followed in turn by personality, application, initiative, personal appearance, health, habits, attitude toward work, and co-operative spirit. Not until the tenth item in this estimate does one find the entry "scholastic record"; and it is followed only by two items of rather doubtful value—namely, "probable success" and "experience." This should be a most striking evidence to the young man that many factors enter into his rating as a prospective member of the profession in addition to the class standing, on which so much emphasis is placed during his collegiate experience.

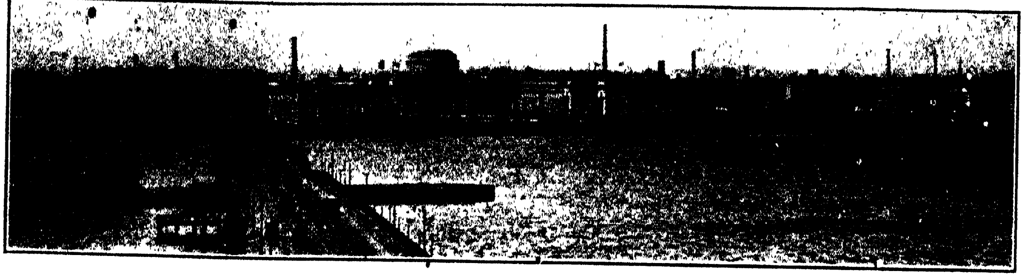
Breaking Him In

BUT there is another side to the case. Industry is confronted with a responsibility to the young men that come to it fresh from college filled with enthusiasm and ambition. Many if not most of them are ambitious beyond their powers of immediate accomplishment. It is of greatest importance that this ambition be curbed and this enthusiasm be directed into useful channels, although, of course, without the destruction of either.

One employer of our acquaintance has a course of cadet training for the young men whom he employs fresh from college. For a time at least most firms must use these youngsters in more or less routine fashion as aids in the various branches of the business. Moreover, it is commonly if not generally necessary to try them out in several departments before final judgment can be reached as to their place of greatest promise and usefulness.

In this post-graduate service the manager who is responsible for supervision of the young men must be peculiarly tactful or he will unwittingly destroy a most valuable asset—that of loyalty and enthusiasm for the organization as a whole. One instance, where serious results almost came to pass through misunderstanding, affords excellent warning to all employers. In that case a young man splendidly trained and of fine personality was made a cadet engineer in a large corporation of national scope. He was moved about from one department to another at frequent intervals and finally he became thoroughly discouraged. This happened because, as he puts it, he was never left alone long enough to do anything by himself. As soon as he found out what the particular job meant he was moved on to something else. The whole trouble lay in the fact that the young man did not understand the purpose of the movements. He thought they resulted from dissatisfaction with the service that he rendered, whereas, as a matter of fact, the very frequency with which he was moved was the best evidence he could get of the appreciation of the promptness with which he grasped each new situation. He was simply being given an opportunity to learn many phases of the business before being assigned his own particular niche to fill.

Industry has a responsibility in the training of these new hands. If by co-operation and understanding the management and the inexperienced apprentice can work together during this trying period, the results are bound to be of mutual value and satisfaction.



An Engineering Inaugural

Memorable in Itself, but Even More Memorable Because of the Great Composite Expression of the Faith of the Engineer

THE inauguration of Samuel Wesley Stratton as president of the Massachusetts Institute of Technology was more than an important academic event. It had greater significance than the induction of a strong proper leader as head of a great engineering school. It marked the expression of a faith that was vigorous, indomitable, inspiring. It was the challenge of the engineer for progress and peace.

This keynote found expression from many tongues. Dr. Stratton himself in his inaugural address selected as his text the famous line from Pliny's "Natural History, "*Alia initia e fine*. This he translated most happily, "Every finish marks a fresh start." The phrase, most appropriately carved in the office of the president at the Institute, represents perfectly the progress of science in general, and with it as a pointer Dr. Stratton painted a vivid picture of the effect of science on the evolution of the great industries of today steam transportation, electric power, the automobile, aeronautics, electric communication. Step by step the engineer has forged ahead from the beginnings that now seem ludicrous, aided by the chemist, the physicist and the mathematician, until the present industrial perfection has been achieved. And this perfection is but a beginning, for *alia initia e fine* is not a mere catch phrase. It is in the blood of the engineer.

Before Dr. Stratton's inaugural address many distinguished men, representing many phases of contact between the president and the Institute and commemorating his achievements as creator and head of the Bureau of Standards, brought messages of greeting. Through them all rang a note of confidence confidence that with men like Stratton in schools like the Institute the engineers of the future will be equipped to lead this nation and the world through paths of safety and progress.

A distinguished engineer, Prof. C.-E. A. Winslow of Yale, speaking for the alumni of the Institute, has given inspiring expression. "To us alumni of the Institute, the essential thing about the Institute, the thing that we hold so dear, is the spirit of science.

We want that spirit to have, through the work of the Institute and its alumni, the widest possible fruition. The problems of the purely material universe have been very largely solved during the past century. The great problems of the next century are of a different nature. They are problems of human relationship.

"The things that are wrong in the world today are the relationships between classes and the relationships between nations, and those difficulties are, I believe, to be solved by the spirit of applied science. That spirit means, first of all, honesty—intellectual honesty in facing the facts of any given situation. We do not build bridges by the methods of Coué. We calculate the stresses and the strains, and we attempt, as closely as possible, to visualize the load that bridge will have to bear. We need that spirit in dealing with these less tangible things. And when we have faced the facts as they are, we need then the courage and the confidence with which the engineer deals with his problems.

"If, as representing the alumni this morning, I have any wish for this Institute which Dr. Stratton is to carry on, it is that the young men who come here may fully realize the potency of this talisman of the scientific spirit, that they may not be merely engineers but citizens, and citizens not merely of America but of the world. And thus the torch which Dr. Stratton takes up today from the unseen hands of Maclaurin and Walker and Rogers may illumine all the dark places along that difficult road which leads onward—a world of order and of progress and of peace."

One more message to round out the picture! John Campbell Merriam, president of the Carnegie Institution of Washington, brought clearly to the front the responsibility of educators to develop in men a type of thinking that shall be free from prejudice and illusion and that shall be satisfied only with truth—truth, which, Swinburn says, "looks into the pit of hell and is not afraid."

"If this great country is to succeed in the continuing organization of its economic and political relations, it will be on the basis of clearly substantiated facts interpreted by a philosophy that expresses the true laws operating in human conduct. It is only by education in the kind of straight, clear, fearless thinking that characterizes the work of the scholar and investigator—plus the unselfish determination to accept facts where we find them—that we can keep on the upward path."

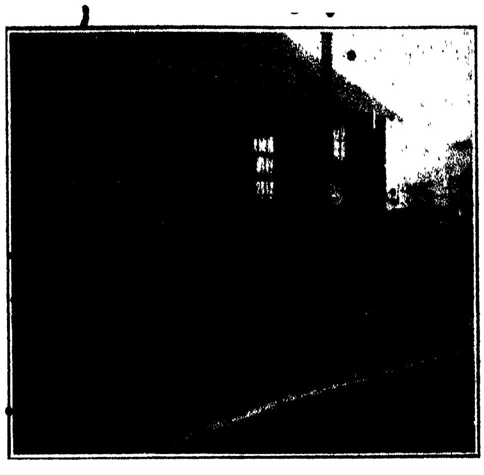
Samuel Wesley Stratton

Inaugurated as president of the Massachusetts Institute of Technology on June 11. As creator and head of the national Bureau of Standards, Dr. Stratton has won for himself an enviable position among the technologists and scientists of the world.

How the Railless Railroad *Solves the Unskilled Labor Problem*

BY MATTHEW WILLIAM POTTS
Consulting Engineer, New York City

Tractor and trailer transportation eliminates man-handling around the plant. It gives the advantage of hauling long trains without the necessity of following any given path.



Hauling barrels loaded on trailers over wooden runways. Concrete runways are a better investment, as they eliminate considerable maintenance troubles

IN the daily newspapers and technical publications of the country we read about the present shortage of cheap labor needed to perform the manual work of handling materials in various industries. Executives seem to agree that the 3 per cent immigration law must be raised in order to supply more manual laborers. How many of these same executives have given serious consideration to the use of material-handling equipment as a means of providing the necessary power to move materials in industries?

Man-power is a deceptively expensive luxury. Chinese coolies laboring for a few cents a day cannot develop power as cheaply as the American motor of either electric or gasoline drive. American mechanical power costs only a fraction of Chinese coolie-power. In addition, the use of this mechanical power increases the efficiency of the plant, because it is not subject to labor turnover.

In spite of this truth, there are still thousands of individual companies whose executives extravagantly employ man-power for the internal handling of incoming and outgoing freight, raw materials, parts and finished products. In addition to wasting needed man-power, these companies, almost without exception, are showing too high operating cost and too narrow profit margin.

The man on the hand or push truck and the gang carrying a load by hand—whether in industrial plant, storage yard, warehouse, freight platform, passenger-terminal or pier-shed—are heavy penalties on profits. Power does the job more cheaply.

The shrewd executive, seeking economy or cheap labor, can adopt few better tactics than to work out a way to apply tractors and trailers to his material-handling problems. Haulage is the backbone of virtually every industry. Unless raw materials, parts, finished products, supplies and freight move smoothly and on schedule to the point of need, the whole operating schedule breaks down, with an expensive waste due to labor time, idle equipment and all the far-reaching effects resulting from any upset of routine.

Is the solution of this labor shortage to be found in allowing more immigrants to enter the country? No. Why? Because the second generation of these immigrants are not satisfied to be common laborers; they have been educated in our public schools and they imbibe the same ideas that our own native children do and they desire to be in the skilled and not the unskilled labor class. Even the newcomers won't stay unskilled long.

HOW THE TRACTOR HELPS

The answer to the labor shortage is not a change in the laws that will mean only a temporary solution, but more extensive use of labor-saving devices (a better name would be labor-conserving devices) and machines to do the work of common labor. When we had a shortage in the field of skilled mechanics the development of automatic machines to do the work was speeded up. The same is true of the farm labor shortage, which was met by a more extensive use of farm machinery.

To make a mere play of words and to offer no concrete evidence in any discussion, especially in one so important as the present immigration question, is not productive of constructive improvements. For this reason I have taken the subject of tractors and trailers to illustrate the results that can be obtained by the more extensive use of material-handling equipment in industries and to point out how common labor can be obtained cheaper, quicker and better by installing this equipment than by changing the present 3 per cent immigration law.

Assuming 10 tons as a tractor load, a single machine replaces 40 hand-truckers handling 500 lb. each. By proper routing, with a drop-and-pick-up system of trailer-trains, a tractor can be kept almost continuously in action under load. Given the proper application, the tractor is the greatest labor conserver in the industrial vehicle family. Each tractor may be provided with three trains of trailers, ranging from five to ten trailers in length; thus all idle time in loading and unloading is consumed by the trailers only, the tractor uncoupling and passing on to the next job.

The tractor-trailer methods are frequently called "railless railroads" in order to differentiate between the original industrial railroad, which required rails on which to operate, and the present system of industrial railroads, which operate without rails. The feature of operating without being confined to one set line of travel has done much to bring about the great savings in money, time and space that can be effected by installing tractors and trailers. The constant changes in

methods of production make it imperative for the industrial transportation system to be adaptable quickly to new routes and conditions without incurring loss of time or additional money expenditure. As the electric or the gasoline tractor and its train of trailers can change its route at a moment's notice, it has all the advantages obtained by hauling long trains of materials, but none of the disadvantages caused by being confined to a given track or route which cannot be deviated from at will.

The term "railroad" is retained because the tractor-trailer equipment is in many ways similar to the equipment used on the steam railroads. First, we have the tractor, which is really the locomotive. Second, we have the trailers, which represent the cars and of which there are many styles and types to meet the need of the materials to be handled and the road conditions. Third, if the system is to operate successfully in any large plant, it is necessary to have a dispatch system and a centralized control of all equipment. Installing an industrial transportation system is not a hit-or-miss proposition, but is one that requires considerable thought on the original installation and close attention to the operating details.

Advantages of Using Tractors

Some of the advantages obtained by the use of a tractor-trailer system of industrial transportation, when compared to manual-handling, are:

1. Reduced number of men on the payroll.
2. Cheaper operating costs.
3. Quicker and better deliveries of materials between operations.
4. Complete co-operation between departments.
5. Increased production.
6. Reduction of labor troubles.
7. Reduction in labor turnover.
8. Reduction in amount of materials and parts damaged in transfer from operation to operation.
9. Better working conditions.
10. There are numerous others, such as assisting in distributing costs of handling by departments instead of placing it as an overhead item, providing a means of checking up the weak spots in the organization, etc.

The number of advantages depends upon the amount of attention paid to the system and the human element which operates it. By this I mean that if the system is operated with a common laborer as its directing head the results will not be as gratifying as if an intelligent and able man were placed in charge. Few railroads are operated by their common labor, and this same rule should apply to the tractor-trailer railroad in industry.

The writer has often analyzed the transportation problems of plants, with a view to improving the present methods of handling materials. Quite often it has been recommended that a tractor-trailer system be installed. If no equipment but common stevedore hand trucks are being used in the plant, it frequently necessitates the purchase of considerable new equipment. Many times the recommendation has been turned down because the executive did not know what it was costing him to handle materials with his present equipment and he did not take sufficient interest to have his own force find out the cost or wish to permit an outsider to determine it for him.

In other instances the present costs have been determined, but the initial investment has appeared too large; and the difficulty of obtaining such a large appropriation has deferred the installation of the system. It is now my practice, and I strongly recommend this method of procedure to salesmen and executives, to take one step of the problem at a time and segregate it so that after its successful solution it will be possible to take the next step without having to alter the first.

This method necessitates making a complete study of the problem and laying down a definite program. Gradual development will always prove the soundness of the complete system. The first step is to make a layout of the plant, showing all the points where it is necessary to deliver and pick up materials. The second step should be to analyze this layout to determine where the strategic points really are—in other words, where the natural flow of materials comes together. In this way it is often possible to make slight alterations in the delivery and pick-up points so as to save considerable time on each tractor trip and to cut down the length of haul. This new layout can immediately be put into service with the present equipment and it will automatically prove itself.

It is often necessary when first installing tractor-trailer systems to build up a "right of way" for the trains. This leads to the formation of a "maintenance of way" crew which will later form the nucleus of the transportation department. The building of

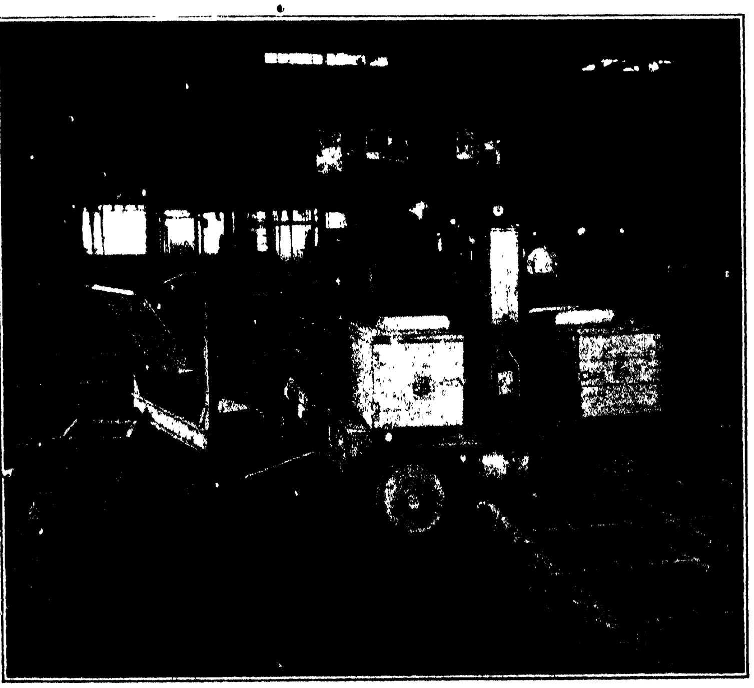


Fig. 1—Electric tractor hauling fifth wheel trailer over rough earth floor of foundry.

the right of way frequently saves money by making immediate improvements in the general yard condition, eliminating delays due to the truckers getting stuck and other familiar causes that lead to expense.

After the "right of way" is established one tractor and twelve trailers will form a good combination for the first purchase of equipment. This equipment in actual operation will decide what additional equipment should be purchased. Again the similarity of the tractor-trailer system to the common freight-handling railroad becomes apparent. Each tractor unit must be supplied with at least a 12 to 1 ratio of trailers if it is to be operated economically and efficiently. This is like supplying the railroad locomotive with cars. The type of trailers should be standardized as to wheels, bearings and connecting hitch; but the superstructure or frame can be made to suit the materials to be handled. There is so much lining up of trainloads, cutting out of cars (trailers) here and there, backing and hauling about that anything but a universal coupler would be a serious drawback. By standardizing the wheels and bearings it is possible to carry a small stock for making minor repairs without tying up the trailer entirely. Thus a bearing can be removed from any wheel and a new one slipped into place while the old one is being repaired. The same is true about repair to wheels.

As the system is put into actual operating practice it will slowly enlarge until the entire handling is taken care of. At this point the dispatching of the equipment will have reached such proportions that it will be necessary to have a superintendent of transportation, whose duty it will be to keep a general oversight of everything connected with the transfer of materials—the men, trucks, paperwork, pavements, all costs. To him is also relegated the duty of devising or passing upon proposed improvements. Minor changes for the betterment of the system should be constantly presenting themselves.

If records have been kept from the beginning of the study of plant transportation, it will be seen that each step pays for itself and the profits made will carry the initial investment. In order to illustrate what can be done, by showing what has been done, the writer will cite a few instances of successful tractor-trailer installations that have paid for themselves and are still continuing to show a large profit over the old methods.

In the Minneapolis Steel & Machinery Co., Minneapolis, Minn., it was found that with the old method of horse-and-wagon intraplant transportation, the cost of handling materials was $1.50 per ton, and it required forty-seven men plus fourteen teams and wagons to perform the operation—which was none too good. In 1917, the company investigated and started to install a tractor-trailer system of transportation. In 1919, the installation had been completed and it was found that fourteen men, three storage battery tractors, fifty-three small trailers, four 4-ton trailers, and two of 2½-ton capacity, a motor truck popularly known as the "jitney" and power-lift transfer trucks, which handled materials in the shops, could handle all the company's materials. The cost had been reduced to 30 cents per ton, and from 50 to 100 per cent more tonnage was handled by the new equipment. This saving of $1.20 per ton handled make an aggregate saving of $200 per day in handling cost alone. It did not require many days' operation to pay for the installation.

In order to show how these fourteen men were distributed, I will give a brief description of the transportation organization. There is a superintendent of transportation, a chief dispatcher, an assistant chief dispatcher, five division dispatchers, four tractor drivers and two men to operate the "jitney" service.

When we consider that forty-seven men were originally required to do the work of these fourteen, it is amazing, and the result of this saving of man-power effected a release of thirty-three men for other work that could not be performed by machine equipment. It will be noted that eight of the fourteen men are required to direct the system. This means that all the heavy work is taken out of the transportation department.

In addition to handling the materials within the plant, these fourteen men, or rather the eight men that direct the department, also keep all records of cost for handling materials, and furnish a complete record of when

Fig. 2 (above)—Old method of handling raw material at Armour Glue Works in Chicago. How would you like to push one of these trucks for an 8-hour day?

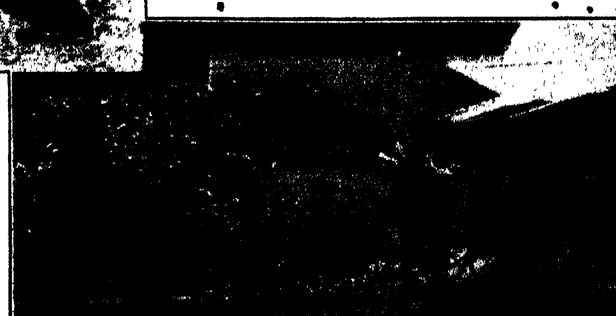


Fig. 3 (below)—Present method of handling raw material at Armour Glue Works in Chicago by tractor-trailer system, handling three times the amount at one-third the expense, with better working conditions for all.

and how the materials were delivered to each department. This information proves very valuable in establishing cost figures.

Tractors in a Chemical Plant

In the plant of a large chemical industry, the use of a tractor-trailer train for handling refuse to the dump pile, for handling salt among the departments, for handling ground sulphur, ice, etc., effected a material saving in time and money, as well as speeding up the production schedule.

There is a tendency on the part of chemical plant executives to feel that their continual change in processes and the use of the same apparatus for making different products make it impossible for them to lay out a route for a tractor-trailer system. This is not correct, because the tractor-trailer system is very flexible. Its line of travel can be changed at a moment's notice, and it is not limited to any one path, as it will negotiate all turns and straight runs that are as wide as the widest part of the train.

This is clearly illustrated in Fig. 1, where the tractor is operated on the dirt floor of a foundry, pulling a train of trailers.

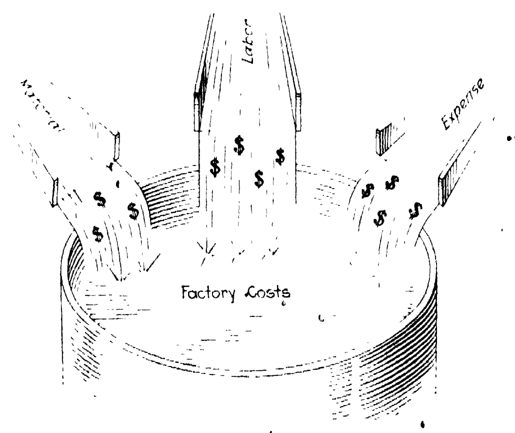
The chemical plant executives also feel that their present hand equipment would have to be scrapped if they were to install the tractor-trailer methods. In the plant of the Armour Glue Works, at Chicago, the raw material used to be handled in hand "buggies" as shown in Fig. 2, and it required two husky men to propel these buggies when loaded. After a tractor had been installed for other purposes it was decided that this operation could be more profitably performed by using a tractor-trailer system. With the slight change in design as shown in Fig. 3, the old equipment became a part of the new tractor-trailer methods, and now one man and a tractor will handle from three to five loaded buggies in one train, with ease.

The method of placing barrels on trailers is shown in the headpiece, and it is often profitable to use wooden runways, provided no heavier trucking than the tractor-trailer trucking is done over them.

Now is the time, during the present labor shortage, to make the greatest use of material-handling equipment, and the tractor-trailer methods should prove of interest to chemical plant executives. They will find that by investigating these methods and installing them in their plants, they will not only overcome the labor shortage but they will also reduce their operating expenses, thereby increasing the profits on their goods.

A Gage of Purchasing Efficiency

An Accounting Method That Enables Executives to Judge the Purchasing Agent and His Judgment of Markets



TWO important factors indicating effective control of manufacturing cost systems are frequently neglected in the design and subsequently in the installation of otherwise excellent systems. The first is the provision for that control which will unquestionably reflect the ability of the purchaser of materials used in the process of manufacture. Is he foreseeing rising and declining markets? And if so, to what extent is the concern benefiting thereby? Considering the large element of material costs entering into the manufacture of most products, it is a continual surprise that more manufacturers do not avail themselves of effective means to control such an important phase of their business.

The features enumerated in the following paragraphs are selected from a system in use by a concern the sales of which run into the millions, and which has branches all over the world and an annual turnover of raw materials of well over twenty. It is easy to see the disastrous results of unwise purchases made repeatedly as is the case when turnovers average more than one per month. The three elements of factory costs—material, labor and factory expense or burden—are thrown together into a factory much as cement, sand and stone are thrown into a concrete mixer.

After a definite length of time, due to effective management, certain products may be expected from the factory in sufficient quantities and of the required quality, ready for distribution to the customer direct or to the branches, as the case may be. These are the facts common to every manufacturer. The recording of the facts in such form as to be of the greatest assistance to the manufacturer varies, however, in nearly every plant. Some are good and some are not. There are certain well-known methods used by the accounting department to collect the three elements of cost and then to differentiate them to the various classifications under each element.* If the voucher register is used, a column may be headed "Factory Ledger," into which all the elements of cost are thrown. This account in the general ledger is the factory control account. It is debited or charged with the total amount of material, labor and factory expense going in to make up the product and is credited with the finished product which is shipped or transferred from the factory. The balance of this account represents the value of the material, labor and factory expense still in the factory either in the form of raw material, work in process or finished goods and therefore is an inventory account.

The factory ledger, a subsidiary ledger, will further classify material, labor and factory expense into additional accounts depending upon the refinement and detail required. It will also contain the following accounts: Factory Inventory, General Stores Adjustment, Manufactured Goods, Cost of Factory Shipments.

Physical inventories should be taken at the factory periodically and should always be priced at cost or market, whichever is lower.

Under the material classification the General Stores account and the Material Used account should be set up as separate accounts, the latter subdivided into the different departments. When the cost of all raw material purchased plus transportation charges have been debited to the General Stores account at the end of the period, the account will have the following appearance:

Debit	Credit
Jan. 31—Purchases ...1000	

The materials used in process of manufacture are collected and classified by products and departments. The totals for the departments are the basis for postings to the debit of the Manufactured Goods account and to the credit of the Materials Used accounts. In pricing materials used, always use *current market prices.*

Every manufacturing department is held up to a back-breaking efficiency because it is easy to calculate the production that should be obtained and compare it with actual accomplishments. Here is a way of doing the same thing with the purchasing department and no one will welcome it more than the efficient purchasing agent.

The balance of each of the Materials Used Accounts are closed at end of period by transfer to the General debited) the General Stores account will be shown thus:

Debit	Credit
Jan. 31—Purchases ...1000	Jan. 31—Used 800

If the amount of inventory on hand at the beginning of the period is now transferred from the Inventory account and the amount of inventory at close of period is credited to this account (Inventory account being debited) the General Stores account will be shown thus:

Debit	Credit
Jan. 31—Purchases ...1000	Jan. 31—Used 800
Jan. 1—Inv. beginning 600	Jan. 31—Inv. close 900

If cost and market price remained the same the above 800, indicating materials used, instead of this amount would be 700, with the result that the account would balance. However, in purchasing materials, a rise in market value was foreseen so that when the materials used were priced, it was found that the market was 800 on what had been purchased at 700, or that a profit of 100 had been made.

It is not the major purpose, of course, for the factory to make profits on material purchases. If such is the purpose, the term "factory" is a misnomer and should be relegated for that of "Jobber." On the other hand, the factory should not incur a loss in its material purchases.

The above credit balance of 100 at the end of the first month's operations should not be used as a basis for immediately formulating any judgment relative to the efficiency of the purchasing department. It will be only after 3 or more months, in which time the balance may alternate from credit to debit, that this account will indicate a positive trend. It is advisable to set up an account to which this balance can be transferred monthly. This account may be called Inventory Adjustment account or General Stores Adjustment account or some similar name. It is, however, a Profit and Loss account and must be treated as such at the end of the year.

The above brings out the first point under discussion. *A credit balance in the General Stores Adjustment account after a certain period will clearly indicate, if inventory and materials used are properly priced, that the purchaser of materials is skillfully making his purchases, while a continued debit balance will just as surely indicate the reverse condition.* With large turnovers it doesn't require much of a loss per turnover to run the accumulated totals into a considerable debit balance. The method of collecting labor and expense and subsequently transferring them to the Manufactured Goods account is only a matter of routine. The balance of the Manufactured Goods account, after inventories have been considered, is transferred to the Cost of Factory Shipments account in the factory ledger, which in turn is transferred as a credit to the Factory Ledger account in the general ledger. When the Factory Ledger account is credited with the actual cost of factory shipments or transfers an account called Manufacturing account in the general ledger is debited therewith.

Impurities in Battery Electrolytes

The importance of obtaining information concerning the action of impurities in storage battery electrolytes arises from the detrimental effects which many of them produce on the operating characteristics and life of the storage battery. Such information is necessary as a basis for the preparation of specifications covering sulphuric acid for use in batteries. A new method of measuring the rate of sulphation of storage battery plates was recently devised at the Bureau of Standards.

It was found that the presence of 1 part in 10,000,000 of platinum in the electrolyte increases the local action at the negative plates 50 per cent; the effect of copper is much less, while the effect of iron is of unusual interest because of its accelerating action at the negative plates. Manganese deposits upon the positive plates in the form of manganese dioxide which covers the active material, closes the pores and causes a large waste of current.

Cooling of Steel Gages

A recent progress report to the gage steel committee, Bureau of Standards, notes that the temperature distribution in a round bar of metal in the quenching bath has been studied.

It has been demonstrated by experiment that in water cooling, the surface is cooled to below 100 deg. C. in 2 seconds, while the center of a 1-in. bar has cooled less than 20 deg. C. In 10 seconds the center has cooled half way, but it is evident that gage specimens cannot be hardened in water and withdrawn before cold for slower cooling through the transformation, without the surface region having already passed that change.

In oil, the center cools half way in 17 seconds with a large temperature gradient which decreases rapidly thereafter, so that the specimen can be withdrawn from the bath when entirely above the hardening change without danger of softening.

The Air Slaking of Lime

The Rate of Deterioration as Well as the Kind of Deterioration of Siliceous, Magnesium and High-Calcium Lime When Exposed to Air Has Been Studied and Is Discussed in This Paper

BY F. H. RHODES,* W. H. JONES AND W. R. DOUGAN

IT IS well known that the essential reactions involved in the slaking of quicklime in air are:

a. The absorption of water vapor by the calcium oxide, with the formation of calcium hydroxide, and

b. The absorption of carbon dioxide by the calcium hydroxide (or oxide) with the formation of calcium carbonate.

Gray[1] and Levi and Orthmann[2] state that the absorption of moisture by quicklime proceeds much more rapidly than does the absorption of carbon dioxide. Whetzel[3] found that high-calcium limes take up moisture more rapidly than do magnesium limes; while the carbonation of magnesium limes takes place more rapidly at first and then more slowly than does the carbonation of the high-calcium limes.

The work described in this present article was undertaken for the purpose of obtaining more exact information as to the relative rates of the reactions which take place when quicklime is exposed to air, and as to the manner and extent to which these reactions are influenced by the impurities normally present in commercial limes.

The samples of lime used in these experiments were obtained through the courtesy of Dr. M. E. Holmes of the National Lime Association. These samples analyzed as shown in Table I.

The calcium oxide, magnesium oxide, silica, alumina, ferric oxide and carbon dioxide were determined by No. C 25-22 T of the American Society for Testing Materials. The water content was calculated as the difference between the percentage of loss on ignition and the percentage of carbon dioxide. The available calcium oxide was determined by the sucrose method.

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[1] "Influence of Moist Air on Quicklime." *Jour Chem Met Soc. S Africa*, vol 9, p 396

[2] "The Action of Air on Lime," *Jour Am Leather Chemists' Assoc.*, vol 6, p. 593.

[3] "Effect of Exposure on Commercial Limes," *Jour. Ind. Eng Chem.*, vol. 9, p 287 (1917)

TABLE I—ANALYSES OF LIMES USED

Sample No.	% CaO	% MgO	% SiO_2	% Al_2O_3	% Fe_2O_3	% CO_2	% H_2O	% Avail Lime	Remarks
5	96.97	1.10	0.41	0.11		0.00	1.37	94.06	....
44	98.36	0.22	0.11	0.21		0.22	1.01	94.28	High-calcium lime from oölitic limestone.
111	53.92	45.01	2.42	0.61		0.00	0.42	30.19	High-magnesia lime from dolomitic stone.
65	55.84	41.22	1.08	0.48	0.52	0.22	0.64	45.17	High-magnesia lime from dolomitic stone.
34	88.22	6.19	2.31	0.42	1.14	1.12	0.42	70.10	...
53	93.18	1.22	1.84	0.91	0.24	1.40	1.01	68.21	......
63	97.22	0.51	0.14	0.56		0.14	1.20	95.11	High-calcium lime

A preliminary experiment was made to determine the rate of slaking of relatively pure lime. About 2 lb. of lime No. 5 (96.97 per cent CaO) was broken to lumps about 2 in. in diameter, while a second sample was ground to pass a 50-mesh sieve. Each portion was spread out in a large porcelain dish and exposed to circulating outdoor air, under sufficient cover to keep off rain and snow. Each lot was stirred frequently to expose fresh surface. At intervals, samples were taken from each lot, care being observed to obtain samples which were as nearly as possible representative of the average mass of the material. In each such sample carbon dioxide, water and active calcium oxide were determined. These results are shown graphically in Figs. 1 and 2. These figures also show the mean temperatures and mean relative humidities of the air, in 5-day periods, for the times during which the samples were exposed.

The results obtained for the rate of change of water content are rather interesting. In each case the moisture content increased rapidly at first until substan-

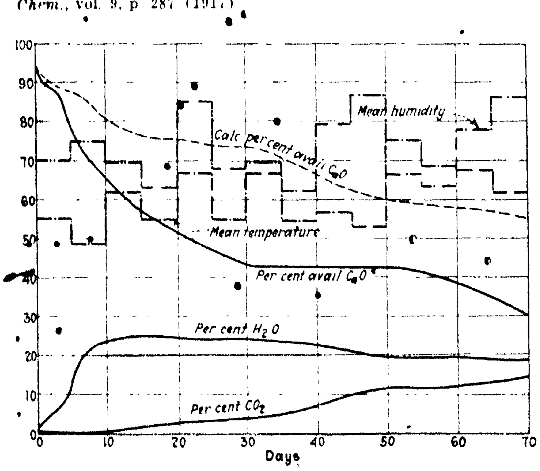

FIG. 1—AIR SLAKING OF LUMP LIME (SAMPLE 5)

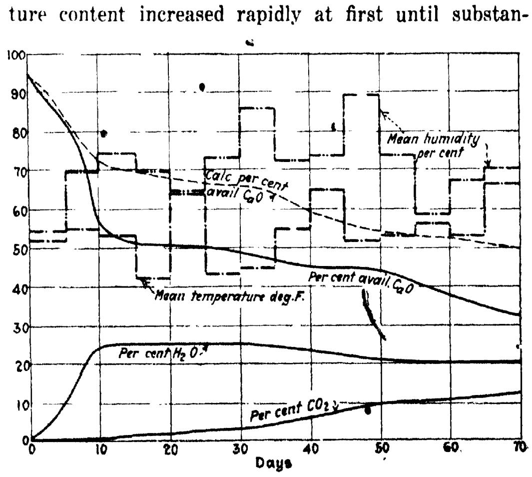

FIG. 2—AIR SLAKING OF POWDERED LIME, SAME SAMPLE

TABLE II—WATER CONTENT

Days Exposure	Lump Lime Obs.	Lump Lime Calc.	Lump Lime Diff.	Powdered Lime Obs.	Powdered Lime Calc.	Powdered Lime Diff.
0	1.37	....	...	1.37	..	...
1	2.26	....	...	3.68	.	...
2	3.61	....	...	4.79	...	...
3	5.35	....	...	6.08	.	...
6	13.92	...	..	18.11	....	...
10	24.34	23.7	0.6	23.44		..
15	24.89	23.3	1.6	25.61	23.2	2.4
20	24.92	23.1	1.8	24.90	22.8	2.1
25	24.78	22.7	2.1	24.54	22.3	2.2
30	24.98	22.8	2.2	24.40	22.1	2.3
40	23.03	20.9	2.1	22.95	20.1	2.8
50	20.73	19.3	1.4	19.47	17.6	1.9
60	20.33	18.4	1.9	19.80	17.4	2.4
70	19.93	17.6	2.3	18.50	16.2	2.3

TABLE III—CONTENTS OF AVAILABLE CALCIUM OXIDE

Days Exposure	Lump Lime Obs.	Lump Lime Calc.	Lump Lime Diff.	Powdered Lime Obs.	Powdered Lime Calc.	Powdered Lime Diff.
0	94.06	..	...	94.6		
1	91.6	92.8	1.2	89.9	91.5	0.6
2	89.5	91.5	2.0	88.7	90.1	1.4
3	89.4	89.6	0.2	87.0	88.6	1.6
6	80.2	81.1	0.9	74.1	76.7	2.6
10	56.7	70.1	13.4	66.0	70.3	4.3
15	51.5	69.4	17.9	57.2	66.7	9.5
20	52.9	66.7	13.8	54.4	65.7	11.3
25	44.8	66.7	21.9	47.7	64.0	16.3
30	48.7	66.7	18.0	43.3	63.4	20.1
40	45.1	59.6	14.5	43.2	56.4	13.2
50	44.3	54.9	10.4	43.0	50.0	7.0
60	37.6	52.0	14.4	38.9	48.5	9.6
70	32.0	49.9	17.9	30.5	45.4	14.9

TABLE IV—SLAKING OF HIGH-CALCIUM LIMES

Days Exp	% Avail CaO	% H_2O	% CO_2	% Avail CaO	% H_2O	% CO_2
0	94.28	1.01	0.22	95.11	1.20	0.14
1	93.5	1.11	0.21	94.3	1.53	0.20
3	90.2	1.71	0.25	92.0	3.22	0.18
5	87.5	2.3	0.20	90.0	4.01	0.55
10	81.0	4.0	0.23	84.7	8.8	0.73
15	75.5	6.1	0.33	79.8	14.2	0.82
20	71.0	8.4	0.42	74.7	20.5	1.01
30	62.7	13.6	0.37	60.4	26.0	1.05
40	56.5	18.8	1.21	62.3	25.6	1.50
50	52.7	24.4	2.10	48.6	23.3	2.80
60	50.7	25.0	3.45	47.5	20.9	3.76
70	49.0	24.5	4.48	47.5	18.2	6.00
80	48.2	22.9	5.70	46.0	16.1	9.80
90	45.8	20.0	8.11	43.1	15.0	12.6
100	42.4	18.7	12.00	39.0	14.3	15.4
110	38.8	18.5	12.75	33.7	13.3	18.5
120	36.0	18.3	14.20	27.1	12.5	21.1

tially all of the calcium oxide was converted into calcium hydroxide, and then decreased slowly as the hydroxide was changed to the carbonate. In both cases the maximum amount of moisture actually taken up by the sample was greater than the calculated amount required to combine with the calcium oxide; and after the conversion to the hydroxide was complete there was present always an approximately constant excess of moisture above that required theoretically to combine with the uncarbonated oxide. Table II shows the changes which took place in the moisture content during the period of exposure.

Apparently the presence of this "excess moisture" is due to the adsorption of water vapor on the surface of the very fine particles of hydrated and carbonated lime.

Absorption of Carbon Dioxide

The rate of absorption of the carbon dioxide was relatively much slower than the rate of absorption of moisture. This would be expected from the fact that the concentration of carbon dioxide in the air is relatively much lower than the concentration of water vapor. It is interesting to note that in each case the rate of absorption of carbon dioxide was greater between the thirtieth and fiftieth day than at any other time. That this was not due to any accidental variation in the concentration of carbon dioxide in the air above the samples is shown by the fact that the increase appeared at the same period in both cases, although the two experiments were not started at the same time, and by the fact that in other samples exposed subsequently similar periods of increased rates of absorption of carbon dioxide were observed at about the same stage in the slaking. Apparently at the end of about the first 30 days the hydrated lime undergoes a slight change in physical structure which results in making the mass more porous and thus facilitating the diffusion of air through the lime; while at the end of about the first 50 days the formation of carbonate films on the hydroxide particles again begins to decrease the rate of carbonation.

The percentage of available calcium oxide in the samples decreases very rapidly at first, during the rapid absorption of water, and then more slowly as carbonation progresses. In every case the amount of active calcium oxide as determined by analysis was less than the theoretical amount as calculated from the percentage of active calcium oxide in the original lime and the amount of water and carbon dioxide which had been absorbed. This discrepancy is slight at first, but increases rapidly as hydration progresses and appears to reach a maximum value several days after the conversion to the hydroxide is complete. The writers are inclined to regard this difference between the observed and the calculated values of the percentages of active calcium oxide as being due to a change in the physical structure of the hydrated lime—probably a conversion of the amorphous and very reactive calcium hydroxide first formed by the hydration into a finely crystalline and less reactive modification.

The values for the contents of available calcium oxide are shown in Table III.

Following these preliminary experiments, portions of limes of various types were ground to pass a 50-mesh sieve and were then exposed to the air for 120 days. Samples taken at frequent intervals were analyzed as described above.

Limes 63 and 44 were relatively pure high-calcium lime. The former was relatively soft and quick-slaking, while the latter was a very hard, dense, slow-slaking lime from oölithic limestone. The changes which took place during the air-slaking of these high-calcium limes are given in Table IV, and are shown graphically by Fig. 3.

In general, the curves showing the change in water content, carbon dioxide content and percentage of available calcium oxide are similar to the corresponding curves obtained in the preliminary experiments.

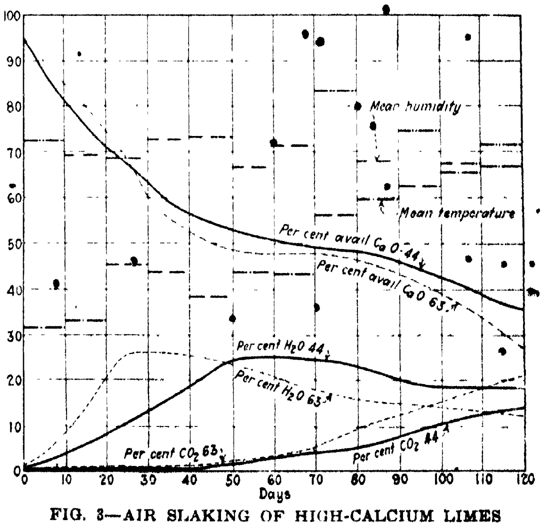

FIG. 3—AIR SLAKING OF HIGH-CALCIUM LIMES

TABLE V—SLAKING OF MAGNESIUM LIMES

Days Exp.	Lime No. 65 — % Avail. CaO	% H_2O	% CO_2	Lime No. 111 — % Avail. CaO	% H_2O	% CO_2
0	45.17	0.64	0.22	20.19	0.42	0.00
1	44.0	1.20	0.51	30.0	1.10	0.00
3	42.2	2.73	1.71	28.[illegible]	2.21	0.3
5	40.9	3.61	2.02	28.0	3.06	0.42
10	38.1	6.33	2.81	26.2	4.08	1.01
15	35.0	8.92	3.72	24.4	5.42	1.41
20	32.5	11.1	4.50	23.3	6.50	1.71
30	28.9	14.7	5.89	21.0	8.21	2.20
40	26.8	16.8	7.04	19.2	9.50	2.67
50	25.0	18.0	7.72	18.6	11.1	3.06
60	24.2	18.4	8.23	18.4	11.3	3.72
70	23.5	18.6	8.34	18.2	11.7	4.01
80	22.9	18.6	8.51	18.0	11.5	4.37
90	22.2	18.7	8.74	18.0	12.0	4.74
100	21.7	18.8	8.84	17.7	12.3	6.04
110	21.1	19.0	8.86	18.1	12.0	6.22
120	20.6	18.7	9.11	17.5	13.2	5.51

There was a distinct difference between the rates of slaking of the two limes. Sample 63 slaked rapidly, the hydration being complete at the end of about the fifteenth day and carbonation being about 42 per cent complete at the end of the one hundred and twentieth day. Sample 44—the dense, hard lime from oölitic stone—slaked much more slowly, hydration being complete only after about 50 days' exposure and carbonation being only about 29 per cent complete at the end of the one hundred and twentieth day.

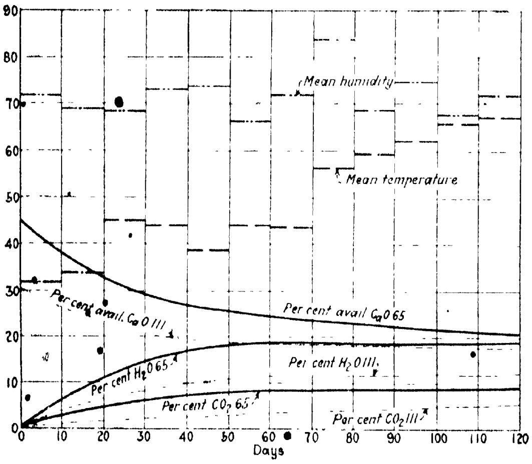

FIG. 4—AIR SLAKING OF MAGNESIUM LIMES

The changes which took place during the slaking of the magnesium limes - samples 65 and 111—are presented in Table V and are shown graphically in Fig. 4.

The hydration of the magnesium limes took place much more slowly than did the hydration of the high-calcium limes. Moreover, the water content did not, within the time covered by the experiments, attain a maximum value. In each of the magnesium limes the amount of moisture increased rather slowly at first and then remained almost constant. Apparently the calcium oxide reacted with the atmospheric moisture to form hydroxide, and the water liberated by the carbonation of this hydroxide reacted with and was retained by the magnesium oxide.

During the earlier stages of the slaking the magnesium limes carbonated more rapidly than did the high-calcium limes. The rate of carbonation decreased, however, during the latter part of the period of observation, so that the amount of carbonation was ultimately less than that obtained with the purer limes.

The available calcium oxide content decreased regularly as slaking progressed. The rate of decrease of active calcium oxide was much slower than that observed with the high-calcium limes. The writers assume that the slower decrease in available calcium oxide was caused by the fact that the magnesia inhibits the conversion of the very reactive amorphous calcium hydroxide into the less reactive crystalline modification.

The observed differences between the rates of slaking of the two magnesium limes correspond to an observed difference in the physical properties of the limes. Sample 65 was rather soft and light, and apparently had been burned at a relatively low temperature. Lime 111 was dense and hard and appeared to be slightly overburned.

The results obtained in the slaking of two typical siliceous limes are shown by Table VI and Fig. 5.

It will be observed that these two samples behaved very differently. Lime 53 acted very much like a typical high-calcium lime. The water content increased rapidly to a maximum value of 20.8 per cent and then again decreased. The percentage of carbon dioxide increased very slowly during the first 100 days, and then began to increase rather rapidly. The percentage of calcium oxide decreased rapidly at first, and then more slowly;

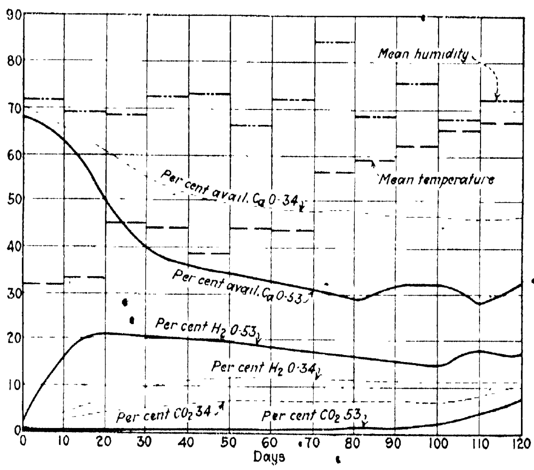

FIG. 5—AIR SLAKING OF SILICEOUS LIMES

and the decrease in the content of active calcium oxide was much greater than would be expected from the amount of carbon dioxide and water which were absorbed.

On the other hand, Lime 34 behaved much like the magnesium limes. The water content increased rather slowly to about 12 per cent and then remained almost constant throughout the remainder of the period of observation. The percentage of carbon dioxide in-

TABLE VI—SLAKING OF SILICEOUS LIMES

Days Exp.	Lime No. 34 — % Avail. CaO	% H_2O	% CO_2	Lime No. 53 — % Avail CaO	% H_2O	% CO_2
0	70.10	0.42	1.12	68.21	1.20	0.14
1	69.5	1.20	1.21	67.7	3.81	0.13
3	69.0	2.01	1.37	67.1	7.44	0.21
5	68.3	2.52	1.94	66.2	10.01	0.17
10	66.1	2.62	2.75	63.0	16.2	0.20
15	63.7	5.71	3.41	57.1	20.0	0.36
20	60.8	7.18	4.26	50.5	20.8	0.45
30	55.4	9.97	5.43	40.0	20.4	0.42
40	51.6	11.20	6.12	36.2	20.0	0.61
50	49.6	11.6	6.64	34.5	19.3	0.91
60	48.2	12.1	6.59	32.7	18.4	1.12
70	47.5	11.8	6.62	30.8	17.7	1.42
80	47.6	11.4	7.00	28.9	16.4	1.57
90	46.9	11.5	7.00	32.0	15.5	1.64
100	46.5	11.2	6.98	32.3	14.7	2.31
110	46.0	11.3	8.21	28.0	17.6	4.46
120	46.4	11.2	10.16	32.6	16.7	7.28

creased slowly at first, remained almost constant for about 50 days, and then began to increase again. The percentage of available calcium oxide decreased rapidly during the first 50 days, and more slowly thereafter, but the decrease was much less than the decrease observed with lime 53.

A comparison of the analyses of the two original limes shows no evident reason for this difference in slaking. Lime 34 contained considerably more magnesia than did lime 53, but the amount of magnesia was hardly sufficient to explain the anomalous behavior.

SUMMARY

In the slaking of lime in air, the essential reactions are (1) the absorption of moisture with the formation of calcium hydroxide, and (2) the absorption of carbon dioxide with the formation of calcium carbonate.

With relatively pure high-calcium limes, hydration takes place much more rapidly than does carbonation. The amount of water actually taken up by the lime is greater than that theoretically required to convert the oxide into hydroxide. This excess water is probably moisture adsorbed on the surface of the particles of hydroxide and carbonate. The percentage of "active calcium oxide" in the material decreases very rapidly as hydration and carbonation proceed, the decrease in active calcium oxide being much greater than would be expected from the amount of water and carbon dioxide absorbed during slaking. This abnormal rate of decrease of "active calcium oxide" is probably due to the crystallization of the very reactive amorphous hydrate and the formation of relatively inert crystalline hydrate. It should be noted, however, that the slaking is accompanied by an increase in weight, so that the decrease in the *weight* of available calcium in the partially slaked lime from a given original portion of quicklime is considerably less than the decrease in the *percentage* of available calcium oxide.

With magnesium limes there is a more regular and more gradual increase in the percentages of water and carbon dioxide, and a more uniform and less rapid decrease in "active calcium oxide." Some siliceous limes behave very much like pure high-calcium limes; others act very much like magnesium lines.

The data obtained for the rate of hydration and carbonation in these experiments cannot be applied directly to the slaking of lime under all conditions, for in any case the rate of slaking will depend on the size of the heap, the method of piling, the amount of moisture in the air, and other external and independent factors. These results do serve, however, to throw some light on the general progress of the slaking reactions with different types of limes.

Gases in Metals

Tests conducted at the Bureau of Standards on the completeness of recovery of oxygen from oxides of iron and silicon in the vacuum fusion method for gases and metals have indicated complete reduction and recovery in both cases. Other oxides which may be present in steels are now being tested. Through the co-operation of a manufacturer of malleable cast iron, some tests have recently been made which indicate that results for oxygen by the Ledebur method on white cast iron are of little value because of the surface oxidation of the sample during its reduction to a finely divided form.

Annual Meeting of Manufacturing Chemists Assn.

Report of Executive Committee Presents Significant Sidelights on Important Problems Affecting the Industry

THE EXPANDING ACTIVITY of the Manufacturing Chemists Association for the year ended May 31, 1923, follows the curve of increasing industrial production very closely. With gathering momentum in business activity many calls arose for change and readjustment of standard practices, and increased use of the association facilities was made by member companies.

The policy of the association in regard to the tariff has always been to prepare in advance for a change and to aid the committees of the government to the limit in giving information with regard to the chemical industry. The association commends President Harding's attitude with regard to changes in accordance with the flexible provisions of the tariff. The President has announced his unwillingness to make any changes unless the facts show conclusively that they are absolutely necessary. Higher rates than are essential to protect against lower labor and production costs abroad are not advocated by the association.

FAVOR WORKING CLAUSE IN PATENT LAW

At the invitation of Senator Stanley, who introduced the patent bill, Henry Howard, as chairman of the executive committee, prepared a form incorporating a working requirement. This form embraced the modifications required to meet the objections raised by the American Patent Attorneys' Association and certain industrialists. Senator Stanley adopted this draft, and this was among the many measures pending when Congress adjourned on March 4 last. Lack of success in the last Congress to obtain this legislation does not mean that the effort has been abandoned. The introduction of the same or of a similar bill in the next session is expected.

INDUSTRIAL WASTE LEGISLATION COMING

Although the original bills introduced into Congress with regard to industrial waste were aimed at prevention of pollution of the waters of the Atlantic seaboard, later these were enlarged to cover the country generally. Fearing that a blanket law applied without careful investigation would work undue hardships upon chemical manufacturers, the association opposed its passage.

Many other important matters have received attention from the executive committee. It has supported the bill to define and prohibit commercial bribery. It has opposed drastic prohibition enforcement bills which would have crippled chemical industries. It has supported the chemical division of the Bureau of Foreign and Domestic Commerce.

In addition a number of special committees have carried out important investigations. The work of the carboy committee has already been referred to in *Chem. & Met.* Other committees have worked on the multiple unit tank cars, the standardization of laboratory apparatus, the best practice in handling and unloading acid tank cars, the formulation of standards for steel drums and the shipment of acid less than 65 deg. Bé. in steel drums.

Unemployment and the Sales Machine

How the Spring Meeting of the Taylor Society at Syracuse Considered This Subject in Its Various Aspects

EDITORIAL STAFF REPORT

TAKING as a subject the report of Secretary Hoover's committee on business cycles and unemployment, this meeting of the Taylor Society was held on June 7, 8 and 9, for the purpose of studying the effect of unemployment on industry and to bring out the factors that would tend to stabilize employment. With this information in hand, a study was made of other departments of industry, such as the sales department and the planning division, noting what these could do in eliminating the causes that have resulted in unemployment in the past.

Dr. Willford I. King, of the Bureau of Economic Research, New York City, was instrumental in furthering the work of this Hoover committee. It was Dr. King's bureau which provided the statistical background upon which its findings were based. Dr. King spoke on the general subject of "Safeguarding Industry by Stabilizing Employment." In this talk the factors leading to unemployment were pointed out, by means of a study of the business cycles and various industrial statistics.

One of the first facts noted in this statistical research was that the lay-off of labor at the last depression occurred primarily in construction, factory and mines. There was no commensurate falling off of employment in retail business. The next factor studied was the interrelation between farm labor and industrial labor, and it was found that there was no appreciable shift, back and forth, between the farm and the factory. Another factor brought out was that the lay-offs occurred chiefly in large plants, and that the plants employing up to 100 workers showed no appreciable diminution in employment.

WHAT CAUSES THE BUSINESS CYCLE

This leads one to the possibility of there being some connection between large units in industry and the business cycle. From a careful study of the factors, Dr. King pointed out that this is probably not the case, but that the business cycle is caused by the action of retail business. Because the small manufacturer more generally meets his final customer direct and does not trade through the large retailers, his business is not affected, while the business of the large manufacturer, who deals through retail stores largely, is immediately affected by the behavior of the retailer.

The real cause then of the business cycle, as determined by this study, is the failure of the retailer to sell the consumer a sufficient amount of merchandise. The first result of this is lower orders from the retailer to the manufacturer. These lower orders to the manufacturer immediately result in unemployment in the manufacturer's plant, while the retailer's store, having its shelves full, must keep its employees in an endeavor to empty the shelves. By the time the business has caught up with itself again, the demand is good and the retailer needs all his employees for business purposes, while the manufacturer again builds up his employment.

Dr. King suggested several ways in which this trouble could be eliminated. His remedies were to scrutinize carefully all orders received, keep a fair reserve of cash, in boom times be very slow to raise wages and increase the working force, at all times keep a trained force in the plant, and finally keep a careful watch on the stock of unworked materials that they do not represent too much frozen capital.

From this paper of Dr. King and his remarks on the subject of the failure to sell goods to the consumer, we are led directly to the paper read by Prof. H. R. Wellman, of Dartmouth University, on the subject of the sales machine. Dr. Wellman opened his paper with several precautions to manufacturers, pointing out the possibility of sales saturation existing at any given moment, although it could not exist in the long run; and suggesting the possibility that business might be urged beyond the point of profit. He further pointed out that, at the present time, the average cost of marketing commodities is 68 per cent of the cost of production. These figures seem to him to be out of all reason, and the time is ripe for a reduction of these costs.

SOME REMEDIES SUGGESTED

Coming down to the main remedy for the failure of the sales departments and retail organizations to sell the goods produced by manufacturers, Dr. Wellman pointed out the absolute necessity of a well-thought-out and rationally based sales plan. In Dr. Wellman's words, "the sales plan must be based on the facts and not on theory; on the present and not on the past."

In forming a sales plan the essential elements are simple, although in following them out one may be led into a quite detailed study. These elements are: (*a*) study what has been done by means of the company's records; (*b*) study what can be done from market analysis; (*c*) determine what, from the two elements (*a*) and (*b*), shall be done. It is in this last that the essential factor of executive ability enters, in that judgment must be used.

Having made the analysis suggested above and determined the line of operation for the sales department, it is then possible to establish definite sales quotas, to determine the proper compensation for sales effort and to budget the total business along with the production department budget.

It is from the necessity of making this budget in order to control sales and thus stabilize the business that one is led directly to a study of the planning department of a business. In this connection, Keppele Hall, of the Joseph & Feiss Co., of Cleveland, gave before the society a description of what an ideal planning department was. It was pointed out by Colonel Hall that the planning department was, in reality, a service department for the whole business. It is its duty to study all phases of a business—finance, production, purchasing and sales. From the results of this study the mangement must be provided with proper figures and information upon which can be based the scientific, systematic and rational conduct of industry.

Having been led from a study of the question of unemployment to the heart of scientifically managed business—the planning department—the rest of the time of the convention was taken up by the study of some good examples.

An extremely interesting trip was taken to the plant

of the Corona Typewriter Co. at Groton, N. Y. This plant has been well known for many years for the perfection of its management system. The feature of its system lies in the fact that a careful study is made of the sales possibilities, and the manufacturing necessity is determined from this study. The planning department then organizes for a long period ahead, on the basis of this study, and employment conditions are in this way maintained at a stable point.

Following this inspection a visit was made to the plant of the H. H. Franklin Manufacturing Co., maker of the well-known Franklin automobile. This plant was one of the first to establish the Taylor system. By means of careful and efficient planning, it has information on hand many months in advance of the number of cars which it desires to make to meet its sales demands. In this way the company is able to order its stock at least 6 months in advance, and to work on this stock far in advance. The result is the flattening out of variations in the employment curve and a general stabilization of the industry, which results in efficient management and good employment conditions.

British Chemical Industries

Nitrogen Fixation Again to the Fore—Developments in Blast-Furnace Construction and Alcohol Production

FROM OUR LONDON CORRESPONDENT

LONDON, May 19, 1923.

THERE is nothing of importance to report in regard to chemical markets during the past month, the position having remained stable and prices firm with low stocks. The continental situation is still a dominating factor, and its effect has been substantially that anticipated by the trade. It is felt that even if a solution to the present impasse should be found, there can be no revival of serious competition from Germany for a considerable time to come. The political situation is a little obscure, several sections of the press are predicting the resignation of Bonar Law, and people are gloomy or optimistic according to their own fancy in regard to his possible successor as Prime Minister.

INTEREST REVIVED IN NITROGEN FIXATION

During the war about twenty secret patents were filed by the government, based on investigations carried out at the research laboratory established during the war under the auspices of the Nitrogen Products Committee, and in many cases corresponding patents were taken out in foreign countries and British possessions covering ammonia synthesis, manufacture and purification of industrial gases, oxidation of ammonia and the manufacture of nitrates. Subject to the right of Brunner Mond & Co. to non-exclusive licenses, the Disposal Board has invited offers for these patents, but as tenders must be received not later than May 25, it seems doubtful if any serious or definite proposals can materialize from interests other than British. One of the most interesting of these patents was that of an explosion compressor evolved by H. A. Humphrey somewhat on the lines of his well-known pump. Humphrey had in mind the combination of the Häusser explosion process with an air compressor operating as one unit with a free piston, and it was calculated that for an output of 2 tons of nitric acid per day about 3,000 kw. could be generated continuously, part of which would, of course, be required for working the process. The wisdom of combining a power unit with the nitric acid explosion unit is open to the great objection that when acting efficiently as a compressor, the nitric acid yield is probably low and, conversely, an apparatus designed primarily for nitrogen fixation is likely to prove an inferior compressor. Additional interest in the Häusser process for combining oxygen and nitrogen when coke-oven gas is exploded has been aroused by two recent papers of Prof. W. A. Bone, read before the Royal Society and the Royal Institution. Professor Bone claims that the elimination of hydrogen as a component of the flammable mixture so as to leave substantially carbon monoxide as the sole combustible constituent gives rise to conditions under which the nitrogen assumes abnormal activity with increased yields of nitric oxides. As a matter of fact, a process covering the removal of hydrogen from coke-oven gas for this purpose is already being developed, so the way to practical results is, to some extent, prepared. It is open to question whether Professor Bone is right in using the word "activation" in describing this phenomenon, which is apparently feasible only when there is less than about 2 per cent of hydrogen present, but to the industrial world the chief interest lies in a complete thermodynamic solution and practical results.

PROGRESS IN BLAST-FURNACE FUEL ECONOMY

Sutcliffe & Evans have again done something revolutionary on the basis of their previous researches and if their claims are substantiated, the quantity of fuel per ton of pig iron may be reduced to something like 12 cwt. The investigations have shown that the chief factor in the blast-furnace process is the "combustibility," or, let us say, the chemical reactivity with oxygen of the coke used, which depends largely on its physical condition and especially on its porosity. The desirable properties of a good blast-furnace coke are well known, and Sutcliffe & Evans claim to have produced a smokeless fuel made by carbonizing briquets composed of 80 per cent coal and 20 per cent coke breeze, which is harder than metallurgical coke, is in fine granular condition and has a porosity practically equal to charcoal. It is understood that the process is to be tested on a commercial scale soon.

PROCESS FOR UTILIZATION OF WASTE CELLULOSE

Messrs. Lynn and Langwell have given an account of their process for transforming cellulose directly into alcohol, fatty acids, etc., by means of bacteria and without the use of considerable quantities of relatively expensive chemicals. The basic British patents are Nos. 134,265 and 161,294 and the basic discovery is that of a bacillus which rapidly attacks almost every form of cellulose under either anaërobic or aërobic conditions. This organism thrives and does its work at the extraordinary temperature of 68 deg. C., at which any ordinary form of vegetable fiber (excepting wood or cork) is decomposed, forming carbon dioxide and, in addition, alcohol, acetic acid, butyric acid, methane and hydrogen or varying mixtures of these according to the conditions. The process is being worked on a large scale at the works of Power Spirit, Ltd., Epsom, and in view of the large amount of inedible waste vegetable fiber annually produced, it seems possible that this process may be of considerable economical and technical importance.

Production of Hydrogen by the Thermal Decomposition of Oil

The Concluding Article of a Series Describing Government Experiments in Producing Pure Gas for Air Service Requirements—Arrangement and Operation of Plant for Thermal Efficiency—Cost Considerations

BY E. R. WEAVER
Chemist, Bureau of Standards

THERE are two reasons for the excessive heat losses in blast gas and by radiation: (1) The great difficulty, in a two-shell plant, of burning the finely divided carbon deposited in the vaporizer to CO_2 or of utilizing any considerable portion of the heat produced from it; and (2) the long blasting period required to get the plant up to a sufficiently high temperature at the beginning of the run. Most of the difficulty occurs in the last 100 or 200 degrees; if the blasting period can be shortened, by the use of preheated air or otherwise, considerable economy must result.

BURNING CARBON DEPOSIT

The carbon deposited in the vaporizer is so finely divided that it is particularly difficult to get anything but carbon monoxide while burning off the checker brick. If air is introduced only at the bottom of the checkerwork, all the carbon will be burned off at the bottom and the bricks subjected to the cooling action of the air stream before the top of the column is cleared. At the same time the upper part of the tower is subjected only to the temperature of carbon monoxide production, and a large part of the fuel escapes as unburned carbon monoxide. If any considerable benefit is to be derived from the deposited carbon, it will be necessary so to arrange the air inlets that the carbon is burned off in all parts of the tower at about the same time. Practically it is impossible to do more than introduce air at four or five levels in approximately the right proportion. After the carbon is removed from the checker brick the blast gas from the generator can be burned completely in the tower and its fuel value utilized to the utmost; while carbon is present, blast gas from the generator is entirely wasted. For this reason, and because it is desirable to blast the generator strongly just before a run in order to have a maximum temperature in the coke bed, much better results are obtained by burning the carbon from the brick before starting to blast the generator than by blasting the two simultaneously.

It was found in practice that more time is required to burn the carbon from the checker brick than to make a run. It should therefore be possible to save much time and a considerable amount of radiation from the generator by employing two vaporizers with one generator, the carbon being burned from one while a run is being made with the other.

The use of regenerators for preheating the air used in the generator should also effect a considerable eco omy. Just how much fuel can be saved by means these improvements is uncertain. It may be qui possible to reduce the consumption of coke in the ge erator to the small amount of compact solid unavoidab burned while burning out the deposited carbon to pr vent the clogging of the gas passages.

Figs. 18 and 18A show semi-diagrammatically th arrangement believed to be most economical for a pla of large capacity. Each vaporizer is here divided be tween two shells called the vaporizer and superheate This permits the oil to be introduced at the top an coolest part of the checkerwork; it places the hottes part of the checkerwork and linings under minimu load; and on account of the shorter connections, th two shells should cost but little more to construct tha a single shell of equivalent capacity connected to permi the blast to enter the bottom.

REFRACTORIES REQUIRED

Probably the most difficult problem encountered i connection with the process is that of obtaining suitabl refractories for linings and checkerwork. Followin the plant experiments, load tests were made at hig temperature in the ceramic laboratories of the Burea of Standards for the purpose of ascertaining the mos suitable materials for the purpose. Including the hal dozen materials which had already been eliminated b use in the plant, every refractory known to be com mercially available and which it was believed migh meet the requirements of the plant was tested. O these materials, two were found to have propertie

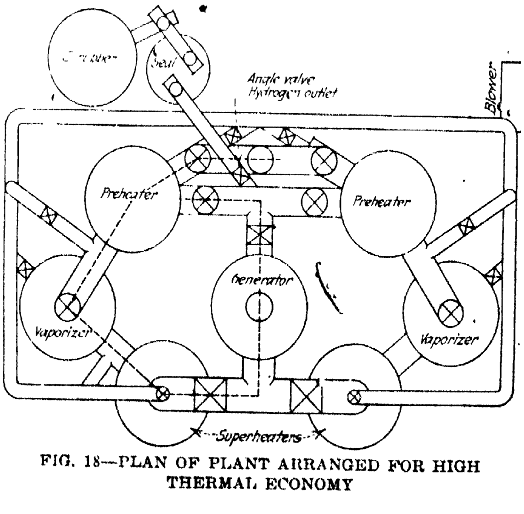

FIG. 18—PLAN OF PLANT ARRANGED FOR HIGH THERMAL ECONOMY

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which should make them of the greatest value. They were self-bonded silicon carbide and a kaolin product made by a recently developed process, the details of which have not been made public. Both refractories were tested under a load equal to the weight of a 15-ft. column of the same material.

The kaolin brick showed only a small contraction under the load at a temperature as high as 1,600 deg. C. and did not fail decisively until 1,675 deg. C. was reached. The silicon carbide brick showed no signs of injury at a temperature of 1,725 deg. C., which was the highest obtainable in the furnace used.

A comparison with some of the refractories used in the plant indicated that had kaolin brick been used there would have been but little if any injury at the temperature obtained during the experimental runs, and that a temperature at least 200 deg. C. in excess of those employed would not have seriously affected silicon carbide linings and checkerwork. The silicon carbide was also free from reducible iron compounds. The kaolin was not, but it is believed that a similar material practically free from iron can be obtained at a price considerably below that of silicon carbide. No serious difficulty should be encountered with refractories in a plant having an inner lining and checkerwork of silicon carbide. For purposes of economy the kaolin refractories should be used in the cooler parts of the plant. If a preheater for air is employed, there is no necessity for using in it any refractory of a quality superior to that of the average firebrick.

If a single vaporizer is used with the generator and preheating the air is not resorted to, there is no need for any valve subjected to high temperature except the stack valve. If, however, two vaporizers and preheaters are used with a single generator, a number of hot valves are required. Experience with the experimental plant indicated that a great deal of difficulty would be encountered in keeping a steel or iron valve in condition under such severe service even if water-cooled, and that the heat lost in such a valve during the producing period is far from a negligible factor in determining the capacity of the plant.

It has been found that machined surfaces of the nickel-chromium alloy Nichrome will remain in good condition at a temperature at least 500 deg. C. hotter than will machined steel surfaces. The valve heads and seats should therefore be made of this alloy. For economical reasons, however, the Nichrome parts should be as small as possible. The valves between vaporizer and generator and vaporizer and preheater may reach a temperature higher than the softening point of Nichrome, hence the castings made of it should be in contact with water-cooled steel supports in order that the exposed parts may be cooled below the danger point by conduction. The Nichrome parts of other hot valves in the plant will be in no danger of injury from the heat, but the valve stems must be water-cooled to prevent carbonization of the packing. The valves between the vaporizers and the generator should be of the double-gate type with a vent between the gates in order to indicate at once any failure of the gates to seat tightly and to prevent contamination of the hydrogen in case such a failure occurs. The valve mechanism indicated in the drawings of the proposed plant is merely suggestive. Several of the ordinary types of valve mechanism could be employed successfully in hot valves of the character described. Fig. 19 shows details of some of the valves and refractories proposed.

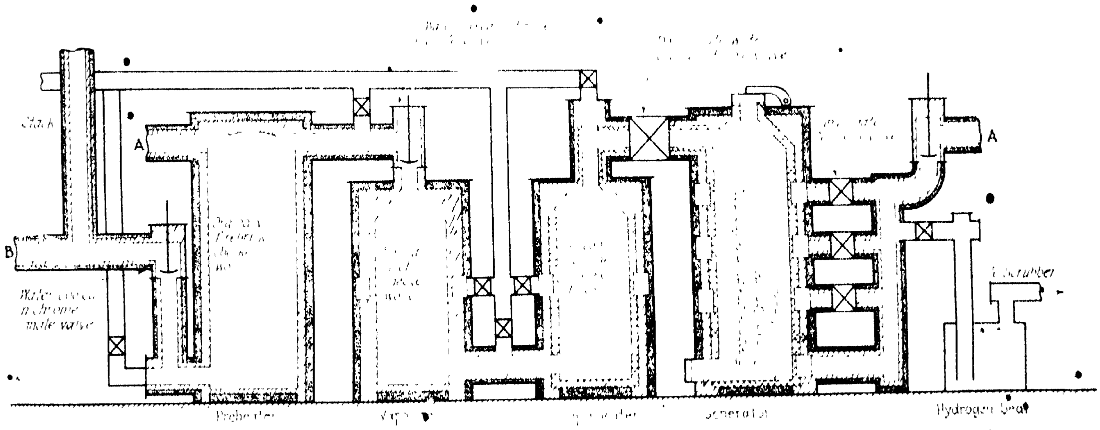


FIG. 18A. DIAGRAMMATIC SECTIONAL ELEVATION DEVELOPED ALONG LINE DOTTED ON PLAN

It is certainly desirable if not absolutely essential to use in the generator a solid fuel practically free from ash-forming constituents. The fuel may be either pure carbon or carbon containing a considerable quantity of heavy hydrocarbons, in which case some hydrogen will be recovered from the solid fuel.

Coke—If an ordinary coke is used, it is impossible to obtain a sufficiently high temperature without completely fusing the ash and producing a clinker very difficult to handle. This difficulty would be serious enough if air were blown in only at the bottom, but when secondary air is used in large quantity and clinker is produced throughout the fuel bed, the operation of the plant is almost impossible. The fused clinker also attacks the generator linings, which present a sufficiently serious problem without this complication. Even if the clinker could be handled in the ordinary way, at least two men would have to be employed to remove the clinker at frequent intervals, interrupting the operation of the plant and permitting it to cool off. The amount of solid fuel used is not large, and the amount of labor, interruption to service and deterioration of refractories involved in the use of an ordinary coke are out of all proportion to the saving in the cost of the fuel at the present time.

Retort Carbon—Retort carbon is an ideal fuel for use in the process, both because it is free from ash- and clinker-forming constituents and because its high density and heat capacity permit long runs.

The only serious objection to the use of retort carbon

is the limited supply available. It is an unimportant byproduct of a coking process which is being supplanted by other methods, and no increase in the demand for the material is likely greatly to increase the supply. The present production in this country is only about 1,000 tons annually and probably half that amount is used by the carbon companies in the manufacture of their varied products.

Petroleum Coke—Petroleum coke is commercially available in sufficient quantity and burns practically without residue; but as ordinarily produced, the material is so porous and has such low heat capacity that only comparatively short runs are possible. The porosity of the material is no doubt of advantage in presenting a larger surface to the oil vapors; it is probably a disadvantage in blasting, because it shortens the zone of carbon dioxide formation in which alone the temperature necessary for complete decomposition of the hydrocarbon can be attained.

The most satisfactory solution of the fuel problem would appear to be the manufacture of petroleum coke briquets of high density. Similar briquets have been made cheaply and in large quantity from the lampblack produced by the oil-gas process on the Pacific Coast. These have been used successfully in water-gas manufacture in which the requirements are substantially the same as in the present process. Petroleum coke appears to be a more suitable raw material than lampblack; coal-tar pitch is probably the most suitable binder.

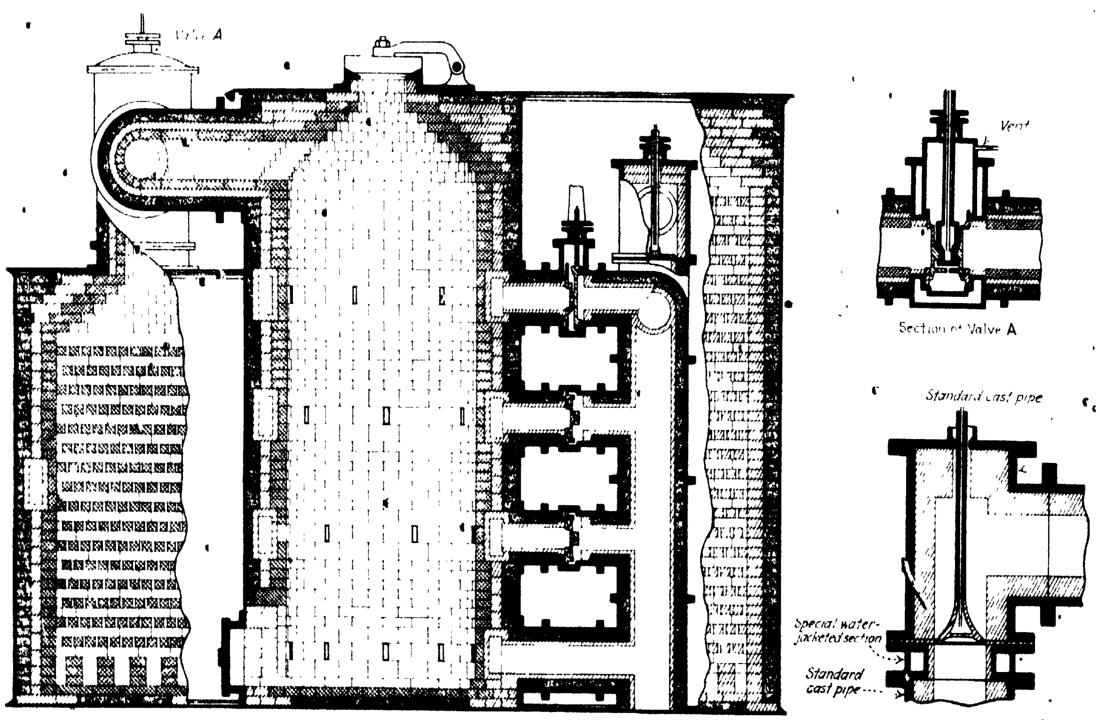
If this process were to be employed on a sufficiently large scale, it would certainly be most advantageous to purchase the residue from petroleum refining at such a stage that it would produce oil and carbon in proper proportion and to complete the distillation at the hydrogen plant under conditions which would yield a dense residue. In this case the abundant waste heat of the hydrogen plant would be employed for the distillation and the hydrocarbon vapors conducted to the hydrogen generator without condensation. The cost of hydrogen produced on a large scale by this process should rival that of the cheapest methods for producing hydrogen from water-gas so extensively employed in Europe for the synthesis of ammonia. It is probable that a hydrogen plant operated as an integral part of an oil refinery utilizing hydrocarbon gases and residues of every kind which could not be otherwise disposed of to greater advantage, supplying waste heat for the operation of the oil stills and consuming a part or all of the coke produced by the refinery, would yield hydrogen at lower net cost than any other known process.

The first cost of a plant combining distillation with hydrogen production, and the skilled operation it would require, make it unsuitable for intermittent operation and therefore out of the question for an aviation field. It is therefore beyond the scope of this investigation, and the possibilities of such future developments are merely suggested.

Probable Cost of Hydrogen

The following cost estimates are intended to serve as a guide in determining the probable cost of producing hydrogen under a variety of conditions. The quantities of fuel required and the capacities of the various plants are conservatively estimated from the results of the experiments with a 4.5-ft. generator and a single vaporizer, assuming that the amount of gas produced per run will be proportional to grate area.

The unit costs of materials, investment, labor and repairs vary so much under different circumstances that the reader should regard the figures given as merely illustrative of the manner in which these factors affect the cost of the product. The estimates are made for hydrogen containing not more than 1 per cent of methane; the exclusion of carbon monoxide depends



Detail of Generator and Part of Superheater and Preheater

Section of Water cooled Angle Valve Between Vaporizer and Preheater

FIG. 19—DETAILS OF REFRACTORIES AND VALVES

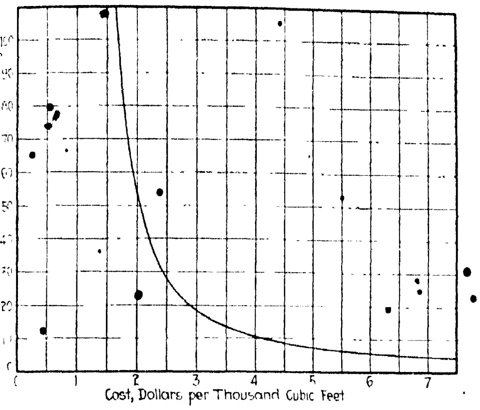


FIG. 20—APPROXIMATE RELATION BETWEEN DAILY PRODUCTION AND COST OF HYDROGEN

entirely upon the extent to which it is possible to eliminate iron oxide from the plant.

The experimental plant made about 13,000 cu.ft. per run under favorable working conditions with a coke consumption of not over 30 lb. per 1,000 cu.ft. Three runs are easily made per 10-hour day. Fuel oil actually cost 8.25c. per gallon delivered in Trenton, and retort carbon cost $15 per ton at point of origin, to which $8 freight and hauling charges had to be added. One man should be able to operate a well-equipped plant under normal conditions provided other workmen are at hand to assist him in case of emergency. The air blower consumes practically all the power used. Twenty horsepower is sufficient for this purpose for a 4.5-ft. generator and is assumed proportional to grate area for larger installations. The cost of repairs will depend principally upon the frequency of replacement and cost of refractories. Other repairs should not be expensive.

Cost estimates are tabulated in Table III for the conditions stated in the following several paragraphs. The column of the table headed by a certain letter contains the figures corresponding to the conditions stated in the paragraph marked with the same letter. The estimated cost of the plant does not include housing or hydrogen storage.

A. Plant—A 4.5-ft. generator with a single vaporizer. Estimated cost of plant, $35,000. Average production, 10,000 cu.ft. per run; one run per day on 300 days per year.

B. Plant—Same as in paragraph *A*. Average production, 10,000 cu.ft. per run. Three runs per day on 300 days per year.

C. Plant—A 6-ft. generator with a single vaporizer. Estimated cost of plant, $45,000. Average production, 25,000 cu.ft. per run; three runs per day on 300 days per year.

D. Plant—Same as in paragraph *C*. Average production, 25,000 cu.ft. per run; nine runs per 24-hour day on 360 days per year.

E. Plant—A 6-ft. generator with two vaporizers and two preheaters. Estimated cost, $70,000. Average production, 25,000 cu.ft. per run; five runs per day on 300 days per year.

F. Plant—Same as in paragraph *E* with an additional briquetting plant for making a dense fuel from petroleum coke. Estimated cost of plant, $85,000. Average production, 25,000 cu.ft. per run; fifteen runs per 24-hour day on 360 days per year.

G. Plant—Two 8-ft. generators, preheaters and superheaters equipped for distilling petroleum residues to supply both hydrocarbons and contact carbon. Estimated cost of plant, $150,000. Average production, 55,000 cu.ft. per run; thirty runs per 24-hour day on 360 days per year.

TABLE III—ESTIMATED COST OF HYDROGEN

	Plant *A*	Plant *B*	Plant *C*	Plant *D*	Plant *E*	Plant *F*	Plant *G*
Average daily production. Thousands of cu.ft.	8 2	25	62	225	100	375	1,650
Costs, Cents per 1,000 cu.ft							
Fuel oil at 8 cents per gal.	43	43	43	43	43	43	..
Dense carbon fuel at $35 per ton	88	61	61	52	52	.	
Petroleum coke at $20 per ton				.		25	
Petroleum residues, 30 per cent free carbon at $8 per ton						..	17
Labor and superintendence	80	44	18	9	11	8	3
Electric power at 2 cents per kw.-hr	20	13	13	10	12	10	8
Repairs and miscellaneous operating expenses	30	25	20	15	20	15	10
Eight per cent of investment for interest, taxes, etc	94	31	16	5	15	4	2
Amortization (full value in 10 years)	117	39	20	6	19	5	3
Total	$4 62	$2 56	$1 91	$1 40	$1.72	$1 10	$0.43

The estimated costs given in Table III are plotted against the assumed daily production in Fig. 20.

The experimental work described in this paper was carried out by S. F. Pickering, P. G. Ledig, C. P. Larrabee, A. H. Graham and F. W. Trapp, under the direction of the author, who wishes to acknowledge the loyal co-operation of the whole group. It is a pleasure also to acknowledge the interest taken in the investigation and the assistance rendered by F. E. Crowell, engineer of the Gas Engineering Co.

Crystallization or Poor Heat-Treatment?

British engineering papers during the early part of May gave much attention to the report of an accident which occurred last December on the London & Northwestern R.R. While traveling at about 60 miles an hour, a locomotive driving axle broke short off, just inside the wheel hub. An investigator for the Ministry of Transport reported that the various tests on the broken part showed that it was made from a badly segregated heat of steel. He also said that the fractured surface had the appearance common to a failure due to "fatigue."

On the other hand, a report from the National Physical Laboratory, which was consulted on the case, said specifically that the test pieces were coarsely crystalline, and the break was a type of fracture typical of *overheated* steel.

In England as well as in America there is a lack of understanding between modern metallurgical investigators and the older school of mechanical engineers engaged by railroads and other large consumers. As a matter of fact, it seems increasingly clear that a vast majority of the breaks that are commonly called "crystallization breaks" or "fatigue fractures" are due to improper refinement of the grain by heat-treatment after the forging operations.

The failure in question is one extremely difficult to have been detected at any time subsequent to the steel-making process. Segregation and piping occurred toward the axis of the piece, and the outside material, which was sampled, showed correct chemical analysis and good physical properties.

It is to be emphasized, of course, that eternal vigilance is the price of safety. The total stress on the part which failed was not much more than 6,000 lb. per sq.in. over the whole area, which allows a factor of safety of nearly 12 for the particular steel used. This margin would certainly appear to be adequate for all purposes, and it is suggested by *The Engineer*, in its issue of May 4, 1923, that there was either an original flaw existing near the surface of the axle or that it was scratched during machining or at some other time before the wheel was pressed on. Such surface scratches are known to be very damaging.

Legal Notes

By Wellington Gustin
Of the Chicago Bar

Fixing Profits of Infringing Machine

Plaintiff Loses Claim for Damages Through Failure to Establish Proper Standard of Comparison

What is the proper measure of damages for infringement is involved in the suit of the DeLaski & Thropp Circular Woven Wire Co. against the Empire Rubber & Tire Co., involving the DeLaski & Tropp patent, No. 1,011,450, for a machine for wrapping automobile tires before vulcanization. In another case the U. S. Court of Appeals held the patent valid and the U. S. District Court in this case held the patent valid and infringed and awarded the plaintiff damages, but declined to award it profits and to treble the damages. Both parties appealed from this judgment, 287 Federal 1

The question of profits turned on the question of what constitutes a proper standard by which to compare the gains and savings made by the use of the infringing machines over other means available at the time for doing the same work.

Another machine, known as the Williams machine, was also used by the defendant for the same purpose as the infringing device. These machines the court regarded as the proper standard of comparison The plaintiff, however, insisted that original hand wrapping as done before the invention was the proper standard But since the Williams machine and other machines, though not of the utility of the machine infringed, were not only available but used by the defendant, they became the proper standard of comparison

As the plaintiff built its case upon hand wrapping as a proper standard of comparison, which was rejected by the court below, the Court of Appeals said there had not been any evidence given as to gains and savings in the use of the infringing device measured by the proper standard as adopted by the lower court, and therefore there was nothing in the record to support the plaintiff's claims for profits, therefore its claims must fail.

Sales Agreement Proves Unenforceable

No Valid Contract When One Party Reserves the Right to Cancel at His Pleasure

The Federal District Court has said that an agreement by defendant to purchase a stated quantity of a product per week so long as it was made by plaintiff and conformed to sample, and for plaintiff to deliver such quantity "every week thereafter," does not constitute a contract binding on the defendant, since the plaintiff might cease manufacture at will, without violation of the agreement. This is laid down in an action on a contract brought by Edward J. McCaffrey against B. B. & R. Knight, Inc., 282 Federal 334.

The seller did not agree to manufacture goods of the kind or quality for any particular period, and if he should cease to manufacture goods of that kind, or goods which conform to the sample, he would not be liable for a breach of any obligation which he had assumed or which was imposed upon him by the contract, says the court.

The seller rested his case on a decision in McMullan vs. Dickinson Co., 63 Minn. 405. Here the defendant had agreed to keep the plaintiff in its employ so long as he retained the ownership of a substantial number of shares in the corporation and it continued in business. In this case the court said: "The expressions of a contingency whereby the contract might be terminated by the act of either party expressly excluded the idea that each was at liberty to terminate it at any time without regard to the happening of either contingency."

In the case at bar the court points out that the contract is substantially different in terms from the one in the cited case. Further, there is no reference to any subject matter extraneous to the contract that excludes the idea that the seller was at liberty to cease his manufacture, regardless of the wishes of the buyer.

Hence the judgment that the contract was unenforceable.

Famous Trademark Case Reversed

Highest Court Rules Foreign Maker Cannot Compete With Assignee of His Mark

In the now famous trademark case of A. Bourjois & Co., Inc. vs. Katzel, the United States Supreme Court has reversed the decree of the Circuit Court of Appeals (43 Sup. Ct. 245).[1] The facts of this case are briefly set out as follows: In 1913 A. Bourjois & Cie., E. Wertheimer & Cie., Successeurs, doing business in France and also in the United States, sold to the plaintiff their business in this country, with their good will and their trademark registered in the Patent Office. The plaintiff since its purchase has registered them again and goes on with the business that it bought, using substantially the same form of box and label as its predecessor and importing its face powder from France.

The defendant bought a large quantity of the same powder in France and sold it here in the French boxes, which closely resemble those used by the plaintiff. The court said there was no question that the defendant infringed the rights of plaintiff unless the fact that defendant's boxes and powder are the genuine product of the French concern gives her a right to sell them in the present form.

In giving its reasons for holding that plaintiff's rights were infringed by the transactions of the defendant the court says that after the sale of their business good will and trademarks in the United States the French manufacturers could not come into the United States and use their old marks in competition with the plaintiff. That proposition is founded on the trademark act of Feb. 20, 1905, section 10, authorizing assignments. Further, it says that if for the purpose of evading the effect of the transfer it had arranged with the defendant that she should sell with the old label, it would be plain that the arrangement must fail, but there was no such conspiracy in this case. "The vendors," the court says, "could not convey their goods free from the restriction to which the vendors were subject. Ownership of the goods does not carry the right to sell them with a specific mark. It does not necessarily carry the right to sell them at all in a given place."

[1]See Wellington Gustin, "What's in a Name?" *Chem. & Met.*, vol. 27, p. 342, Aug. 23, 1922.

The Plant Notebook

Hints That Cut Cost.
Management Puzzles

An Exchange for Operating Men

Practical
Problems of
Plant Operation

Removal of Carbon From Liquids

BY J. BENNETT HILL
The Barrett Co.

In the use of decolorizing carbons in the recovery of gasoline used in dry-cleaning it is often desirable to remove the carbon by settling alone and so avoid filtration. While the bulk of the carbon settles readily, there is a small amount of very fine material that settles only very slowly. This can be removed conveniently by making use of the dirty soap in the gasoline to carry it down. Where the gasoline is not distilled, this soap is normally removed by a treatment with a solution of caustic soda which precipitates it out. If the treatment with decolorizing carbon is given before this soap removal, the bulk of the carbon settled out, and the settled liquid treated with caustic soda, the fine carbon is carried down by the gelatinous soap precipitate, leaving a perfectly clear gasoline.

Possibly this same general idea might be of value in other industries.

Stirrer Efficiency

Who Said Paddle Stirrers Were Not Efficient?—Read This

The article by W. L. Badger and his two co-workers which appeared in the Dec. 13 issue of *Chem. & Met.* was exceedingly interesting to me. The subject "Stirrer Efficiency" has received very scanty study throughout the industry and the amount of misinformation on the subject is great. I recall one incident from personal experience which may be of interest.

Some time ago it was essential for purposes of experimentation to have a wooden tank stirred somewhat rapidly. There was in the plant a tank with an ordinary type of paddle stirrer. It was not even shaved off at an angle of 5 deg., as was the case with Professor Badger's tank, but consisted of a 4x4 tapered slightly to the end and bolted to an upright shaft. Two such arms pointing in opposite directions at the bottom, and two more arms at a 90 deg. angle from the other two, situated 18 in. above the lower arms, made up the whole stirrer. The tank happened to be filled at the time with a finely divided white precipitate suspended in water, and since there was considerable doubt as to the efficiency of the stirrer in question, it was decided to make some tests on the tank as it was. To do this the stirrer was started and when the tank was apparently in full equilibrium 12 gal. of strong solution of victoria blue was dumped in. Six samples of the charge were taken at various parts of the tank, three immediately after dumping in the dye and three at the end of 3 minutes' stirring. The dyestuff gave the liquid a distinct blue color and there was no difficulty whatever in distinguishing the samples which had been in contact with the dye from those which had not. The first samples showed very varying colors from white to very deep blue. The second set of samples were uniform both as to appearance of the unfiltered samples and examination of the filtered solutions. In other words, the tank was stirred completely within 2 minutes. Doubtless if we had started to stir at moment of adding the dye the time would have been longer. This seems to confirm Professor Badger's interesting conclusion that paddle stirrers are surprisingly efficient.

To the Operating Man, Be He Executive or Subforeman

This department will depend for its healthy growth upon your contributions. No man or group of men can supply the raw material adequately. It must represent the experience of all of the men in our industries. If you will contribute one short item from your operating or management experience, you will help to build an invaluable, interesting storehouse of material which will help you, your company and the industry. For every idea you give, you'll get a thousand.

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Chem. & Met.
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The Great k_0 Mystery

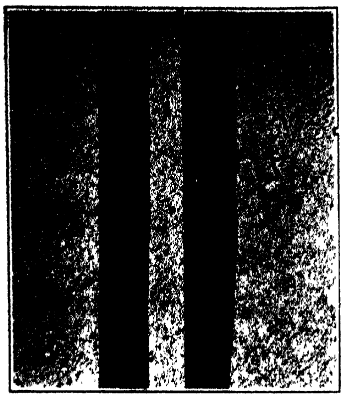
Errors in the Calculation of the Rate of Heat Transfer

Everyone who has had to do with the installation of evaporators or stills or cooling coils has undoubtedly used the following formula:

$$A = \frac{Q}{k_0 h t_m}$$

By this it is possible to calculat the heating or cooling surface neces sary for the particular piece of equip ment in question. A, of course stand for the area or surface required, is the coefficient of heat transfer, is the total heat lost or gained durin the operation, h is the number hours which is required for carr ing out the operation, t_m is the me temperature difference or the te perature gradient in degrees Fahre heit.

The calculation or estimation of is a somewhat inaccurate perfor ance, as it depends on a number rather indeterminate quantities. C ductivity is the reciprocal of res ance and the resistance to heat f in the case of a liquid to liquid tra fer through a pipe would be ec to the resistance of the water film the metal pipe plus the resistance the metal itself, plus the resista of the liquid film on the outside the pipe. Of course the total re ance varies with the rate of flo cooling water, the thickness of metal, surface films or deposit the metal pipe and many other th In other words, the value of k_0 i



Gypsum coated (on left) and clean copper tubing. Why k_o varies

a mathematical certainty, even though it is a so-called constant.

All this serves as an introduction to a specific example of a variation in k_o which has come to the writer's attention. Upon calculating k_o from the best data possible, a value of 230 was obtained, and from this was estimated a total area of heating surface which amounted to about 72.4 sq.ft. A recheck of these figures by another engineer taking into account some experience which he had had with the liquid in question gave an estimated value of 30 for k_o and a consequent value of 555 sq.ft. There followed a series of tests in the plant and in it conditions were developed from which a value for k_o was calculated. This value was found to be in the neighborhood of 60.

The photograph herewith, presented illustrates as well as anything can the reason why any calculation of the rate of heat transfer is practically impossible unless some previous experience with the solution can be relied on, or unless the liquid remains clear and does not deposit on the pipes.

Restoring Steel Barrels

How the Welding Outfit Can Be Utilized to Keep the Scrap Pile Empty

The use of oxy-acetylene welding for reclaiming leaking and damaged steel barrels is recommended. Slightly defective containers that would otherwise soon become worthless scrap can be reclaimed so that they may be re-used or resold by a few minutes' skillful application of the welding torch.

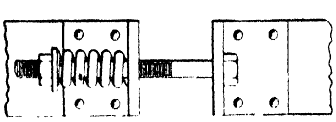
Used metal barrels that are not obviously beyond repair are first steamed and thoroughly cleaned inside and out, an essential operation to prevent possible ignition of explosive gas mixtures when containers have been used for oils, etc. They are then tested under pressure to locate any damaged sections, and those in need of repair are segregated, while the rest are painted and finished for resale.

Welding the damaged barrels is comparatively simple. The testers mark the leaky sections for the oxy-acetylene operator, who welds on an average of 40 barrels and drums a day. Some, of course, require more work than others, but it is only rarely that the damage cannot be repaired with the blowpipe. It has been found that rather than using drawn iron welding rods, ordinarily used on light sheet iron, better results can be obtained by using a bronze filler rod. Quicker, cheaper and better work can be done with the bronze rod, since bronze has a lower melting point and can be more easily handled than drawn iron. As the repaired barrels are painted, the initial bright color of the bronze weld is no objection.

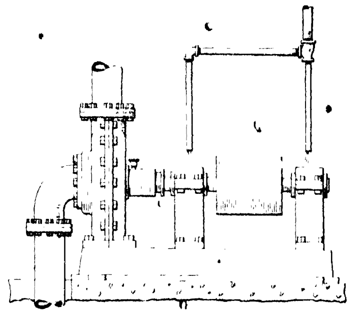
Regardless of whether the damage consists of a split seam or crack, the barrels are restored through oxy-acetylene welding to as serviceable a condition as those which are received undamaged. Even if a section of the side is missing, it may be satisfactorily patched with a piece of scrap steel sheet. After welding, the repaired barrels are tested a second time before they are painted and stored for future sale.

Spring Kiln Hoops

The alternative contraction and expansion of brickwork in kilns, chimneys and flues exposed to intense heat at intervals necessitates adequate provision against loosening and collapse. This provision usually takes the form of steel hoop bands, held together by bolts. During periods of high temperature, these are placed under considerable strain; when low temperatures are reached again, the contraction of the brickwork is likely to result in the slippage of the hoops and the collapse of the structure. To minimize danger from this cause it has been found an advantage in some instances to equip the loops with heavy springs, as shown in the accompanying cut. If desirable, each band may be provided with two bolts and two springs, to equalize the strain.



SPRING KILN HOOP



Water pipes in position to protect bearings from corrosion

Bearing Corrosion

A Simple Method of Preventing Corrosion of Centrifugal Pump Bearings

Centrifugal pumps are very frequently used to pump materials which are distinctly corrosive to the rotor and shell, but more particularly to the bearings. Stuffing boxes do not seem to keep the bearings of even the overhung type of pump from being chewed up with certain types of liquids.

A crude but effective method was worked out to eliminate to some extent the excessive corrosion which in the case of one strongly alkaline liquor was very great. It meant daily attention to the bearings and frequent recasting. A small stream of water was allowed to flow on the outside casing of the bearing. This does two things. In the first place, it keeps the bearings cool and thus cuts down chemical action (on the principle that the rate of reaction is halved for every 10 degrees of temperature drop). In the second place, and more important, the water dilutes the corrosive liquid to an extent that makes it innocuous and non-corrosive.

The accompanying diagram shows the way it is done. Small water pipes are run down to a point just a few inches above the bearings and hardly more than a dribble of water is needed.

In actual, traceable results this stunt was convincing. The life of the bearing was increased by from three to four times and with the alkaline liquor which had to be handled that made a very appreciable difference—a difference which showed upon the mechanics' payroll.

Machinery and Appliances for Production and Control

Equipment News

From Maker and User

Materials and Accessories for Chemical Industries

Pump Valves

Users of pumps will be interested to know that some improvements in pump valve construction are announced by the Worthington Pump & Machinery Corporation, of New York. An entirely different form of valve has been perfected which, when applied to service conditions that have been hard for the older standard valves by causing them to cut and to leak, will eliminate the difficulties. It therefore increases the average pump efficiency, decreases the cost of pumping, and continually maintains the capacity of the pump at its maximum point.

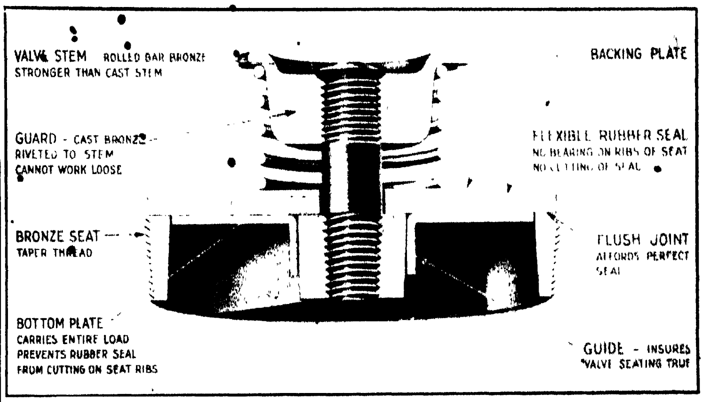


FIG. 1—NEW WORTHINGTON VALVE

Every user of pumps knows of the money loss taking place every day due to leakage through the pump valves when used for severe service conditions. This has led one prominent manufacturer who makes pump valve rubbers as well as other mechanical rubber goods to say in one of his pieces of advertising literature:

"It is a fact that there is more real economy—more actual saving of money—in the use of a first-quality pump valve than in any other one item in the entire mechanical rubber line. We are absolutely sure that this is true."

After many years of building and operating pumps the Worthington engineers now claim that the principal cause of leakage is traceable to the excessive wear on the rubber, which while negligible in some cases is often quite bad. Thus, Fig. 2 shows a photograph of a hard rubber valve after 3 months of particularly hard service. Cracks and cuts caused by the valve seat and by the radiating ribs are plainly visible. Fig. 3 shows a medium rubber also after 3 months of unusually difficult service. It is plain that the only way positively to prevent leakage with valves in this condition is to remove the rubbers and replace them with new.

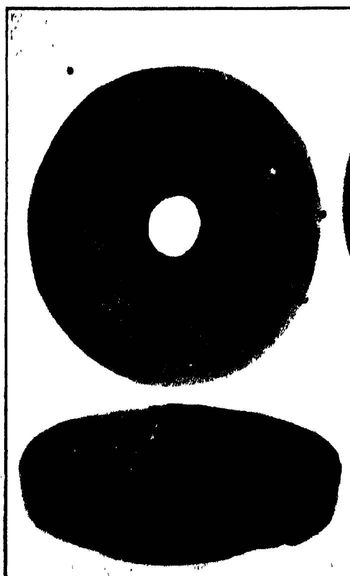


FIG. 2—HARD RUBBER VALVE AFTER 3 MONTHS' HARD USE

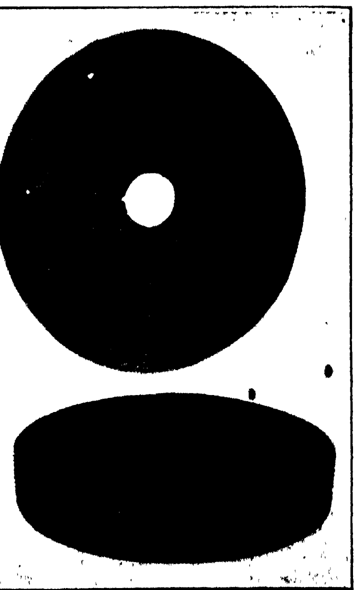


FIG. 3—MEDIUM RUBBER VALVE AFTER 3 MONTHS' HARD USE

To overcome this rapid and costly wearing, cutting and cracking action, there has been evolved the new type of valve shown in Fig. 1, known as the Worthington "Seal" valve for use when the conditions are too hard for the ordinary form of valves now in standard use.

This new valve assures absolute tightness when closed, because, as will be noted, the rubber used is flexible and will always seat perfectly both at the hub and outer rim, its inner and outer seats, and so keep tight. Age and continuous usage do not cut grooves or cause cracks, as demonstrated in Fig. 4, which shows a flexible rubber seal used for a year in this new type of valve. At the end of the year there was no visible wear; there was no leakage; renewal was of course unnecessary; and there was no cost for repairs.

The simplicity of this valve is evident on inspecting Fig. 1. There are no screws, no bolts, no rubber rings, no nuts, no bushings, no rotating elements. The special new feature that makes this valve good for hard service is the rubber valve proper. When the valve is closed the middle seat carries the entire

load and prevents the rubber seal from cutting on the seats or ribs. This bottom plate moves up and down with the rubber, and so not only acts as a middle seat but helps to keep the rubber valve in shape even when open. Thus all mechanical functions requiring strength and wear resistance are cared for by metal parts. The flexible rubber acts only as a seal against leakage. It will be noticed that the top of the rubber seal is protected by a thin "backing plate," which keeps the rubber seal flat and prevents any possibility of wear from contact with the spring.

All moving parts are light but made amply rigid. The lightness assures a smooth, quiet-running pump. The rigidity prevents the distortion that results in leakage. It is not expected that repairs or replacements will be often required, but the construction makes this easy when it does become necessary, and the cost of any possible repairs will be low because of the simplicity and inexpensiveness of all parts.

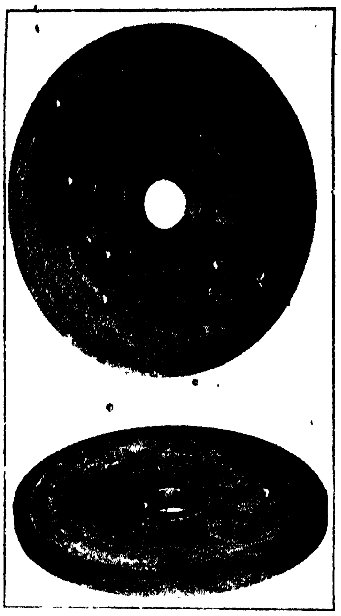


FIG. 4—NEW VALVE AFTER A YEAR'S USE

Requirements of a Refractory Mortar

By Robert F. Lindsay
Research Department, Denver Fire Clay Co.

The apparent need of a better refractory mortar for laying fireclay refractories has resulted in the introduction of a number of so-called refractory cements of varying worth. After 2 years' study of refractory mortars under furnace conditions, the Denver Fire Clay Co., in perfecting its Hi-Fire Bond, found there were certain requirements necessary to the production of a satisfactory bond. A discussion of these essential qualities will be of interest to every user of refractories.

The first specification of a refractory mortar, to be used within the temperature range of a No. 1 firebrick, is that it should be refractory—in other words, having a melting point close to that of the brick with which it is used. Fireclay mortar will stand this test, unless it has been mixed with materials such as the low fusing loams to reduce its shrinkage or cause it to fuse to the bricks; then its value as a refractory mortar is lost. This same fault is found in many of the trademarked cements. To eliminate shrinkage and obtain a cold bonding strength, large quantities of foreign materials are added, and as a result the most important requirement—refractoriness is sacrificed.

Hardening in the cold is of no especial advantage, and should be avoided unless it can be accomplished without eliminating some of the more necessary qualities. Gross misstatements as to the melting points of some of the specially prepared refractory mortars has led to the distrust by many users of all refractory mortars. One refractory cement tested recommended by the manufacturer for use up to 3,300 deg. F. melted at 2,300 deg. F. Unless a mortar has the necessary high melting point the bond it forms is caused by a slag forming between the brick. The result is that under a continued high heat the mortar will flow from the joints, scoring the wall and leaving the joints open to the action of the flames. Ashes and clinkers will readily cling to the slag, further reducing the resistance of the wall. Settling and distortion of the wall under continued heat will also result and in arch construction or where there is a shearing action on the joint the brick will slip out of place. A mortar that is refractory and will sinter into a mass similar in properties to the brick itself is the desired one. It is not a strong, hard joint in the cold that is wanted, but a hard, refractory bond under heat.

A good milled fireclay, although of the same refractoriness as the firebrick, loses its value because of its high shrinkage. This causes the joints to become loose and all the ill effects of a loose setting will result. A satisfactory mortar should have a low shrinkage so that it will stay put. Again, this should not be accomplished by the formation of a slag, for refractoriness must be maintained.

The expansion and contraction of the mortar in relation to the brick are important. They should be the same or approximately those of the firebrick at varying temperatures, otherwise conditions nearly as bad as those obtained from using a mortar with a large shrinkage will occur. When silica is used as a base for the mortar, spalling and loose joints usually result, because its expansion and contraction are not the same as the brick. One of the methods used to correct this fault (and silica is used a great deal as a base because of its low cost) is to use basic fluxes, but here again the slag method of bonding is wrongly introduced.

Not only should the physical properties of the bonding material be like that of the brick but the chemical properties should be similar, having the same resistance to the furnace gases, ashes, etc., with which the brick might come in contact. A mortar that fires to a body similar in structure to the refractory bodies with which it is used and of similar chemical qualities will best meet this requirement.

In attempting to reduce shrinkage and maintain refractoriness we had difficulty at first in producing a mortar that possessed workability. A cement, though otherwise good—that is, sandy in nature—lacks plasticity and with it the desirable thin well-filled joint cannot be made. Uneven laying and waste of material also result. The wet prepared cements can be easily used in making thin joints, and they usually harden in the cold, but this hardening takes place not only in the joint but in the mortar box, on the workman's hands and clothes and often in the containers, causing loss of material and dissatisfied workmen. Although a thin joint is recommended, it is at times necessary to use heavy layers of mortar, and a wet prepared mortar, if suited for making thin joints, often cannot be used for the heavier joint unless some foreign material is used to thicken it. Good foreign material to add is not always available, and if the wrong material is used another deleterious factor is introduced.

Good working qualities not only assure a better brick-laying job but a considerable saving of material.

Readers' Views and Comments

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The editors invite discussion of articles and editorials or other topics of interest

A "Gentlemen's Agreement" Against Technology?

To the Editor of Chem. & Met.:

SIR—There are many members of the chemical profession whose careers are threatened today by a certain vicious practice that appears to be growing in American industry. This practice consists in what is called a "gentlemen's agreement" among manufacturers in a certain industry not to employ a technical expert who has left the employ of a concern engaged in the production of the same or a similar product or at least not without the permission of the last employer. I believe there is just such an agreement in existence among certain manufacturers of artificial silk, certain dyes, abrasives, caustic soda, etc. It probably originated in the idea once entertained by many that valuable trade secrets would be carried away by the technical expert who would then sell them to a competitor and thus enable him to produce a better or cheaper article.

The probable effect on the manufacturer has been for him to increase research to a certain point, and then stop and wait for his competitor, in the meantime enjoying a feeling of security in the possession of the results of this research. The effect on the chemical profession, however, has been literally to enslave many individuals in positions at salaries frequently far incommensurate with the profitable results they achieve. They cannot help themselves, because their experience is specialized and cannot be sold on the open market due to the "gentlemen's agreement" among the possible employers. The technical man is thus often penalized for having given meritorious service and he has no alternative but to continue the drudgery or to leave and enter work in a different line—work in which his experience will probably be of little use. Actually in this event the original employer has locked up the expert's experience where it will be of practically no value to himself or to the public.

Any solution to this vital problem in ethics which has not the good of the public and justice at heart would, of course, be wrong. On one hand we have increased the desire of the manufacturer for research, and on the other we have killed or limited the incentive of the man who does the research through a highly arbitrary agreement that may limit his rewards, his success and his career. Notwithstanding the fact that genius exacts its own reward, the majority of even so learned a profession as ours are not geniuses. And the effect on the public is indirectly, if you wish, to pay the bill for research, which, if it has been done at all, has not been as fruitful in benefits to mankind as it would have been were a proper incentive given the researcher. Such a stimulus would follow only from an opportunity to sell his special abilities on a free and open market.

It is all right to have trade secrets. It would be well if there were more real ones and less imagined ones. But when trade secrets limit the progress of the men who have created them, they limit the public good that comes from such progress; and any agreement, gentlemanly or ungentlemanly, is vicious which allows this state to exist.

MILTON J. SHOEMAKER.

Buffalo, N. Y.

Corrosion of Rust-Proofed Iron and Steel

To the Editor of Chem. & Met.:

SIR—The article by W. P. Wood on "Corrosion of Rust-Proofed Iron and Steel" in your April 30 issue contains conclusions which I feel are hardly justified by the data furnished. I refer to the statements made regarding chlorine in tap water, particularly to the assertion that the tap water he used contained dissolved chlorine. In determining the chlorine-consuming capacity of sewages for the city of Cleveland, done by the city's engineering department in 1919-1921, controls were always used of tap water and distilled water. We invariably found that tap water (which had been previously chlorinated by the city's water department) has a chlorine-consuming capacity as great as and usually greater than its oxygen-consuming capacity, given the same time and equal molecular amounts at the start. Our data indicated a fairly close relationship between the two. The tap water he cites had an oxygen-consuming capacity of 2.7 parts per million when he received it; therefore I feel quite sure that any chlorine which had been introduced at his local water plant was completely and chemically dead by the time it reached him, for we found that organic matter oxidized by chlorine is exceedingly stable. Furthermore, a dosage of chlorine sufficient to saturate the consuming power of the water and leave an analyzable excess at the consumer's tap is indeed a rarity.

It is quite likely that the "chlorine" which he lists under "constituents" refers to combined chlorine as chlorides, because a dosage of 7.6 p.p.m. is considerably more than twice as much as is necessary to give a very pronounced taste to water and is probably close to ten times the average dosage. That amount would accomplish 75 per cent disinfection or better in an ordinary city sewage.

Before rightly ascribing to chlorine the differences found in corrosion there should be run another set of samples in an unchlorinated water having the same constituents. When that is done, it is probable that the mineral salt content of the water will be blamed rather than a little chlorine long since dead.

GLENN GREEN.

Pathological Laboratory,
Lakeside Hospital,
Cleveland, Ohio.

To the Editor of Chem. & Met.:

SIR—The writer wishes to point out that his conclusion in connection with the corrosiveness of tap water was reached as a result of the tendency of this water to cause pits in the metal. The importance of this was definitely mentioned in the article. A rigid comparison of weight losses would not lead to this conclusion in all cases, but the pitting was quite evident.

Always granting the possibility of analytical errors and the fact that the figures for chlorine are considerably higher than the average, the case in question is somewhat unusual in that the samples were taken at a point not far from the purification plant. There is admittedly a considerable variation in chlorine content at this point. Further, the nitrogen content of the raw water is very low, and while the chlorine which has been added to the water might be, as it were, "bacteriologically dead," it is very questionable whether it is "chemically dead." The writer has been informed by a member of the laboratory whose duty it was to check this water regularly that positive tests for free chlorine by the orthotoluidin method were obtained within a radius of several miles from the purification plant. There is also on many occasions a pronounced taste to the water.

In conclusion, it might be well to point out that the mineral salt content of this particular water would be practically a negligible factor as far as corrosion of metals is concerned.

WILLIAM P. WOOD,

Assistant Professor of Metallurgical Engineering.
University of Michigan,
Ann Arbor, Mich.

Was It an Impurity?

To the Editor of Chem. & Met.:

Sir—Back in 1880-81 Dr. Edward G. Acheson was at work in the Edison laboratories, pegging away at carbon filaments. In his search for new modifications he undertook to break up carbon compounds by electrolysis. He chose carbon bisulphide, which he put into a test tube, and in this inserted two platinum wires. But the CS_2 would not conduct the current until he had shaken it up with water; then it became a partial conductor, its conductivity increasing as the current passed through it.

While no carbon appeared, he observed occasionally the deposit of small white granules at the bottom of the carbon bisulphide. What were they?

He separated them until he had about half a gram. They were very hard; they made scratches on sapphire.

Another curious feature was that when a granule of the substance at the bottom of the test tube containing CS_2 was brought between the platinum electrodes there developed a flash of light—and then the substance turned black.

The next step was to call, in company with his friend Dr. Edward L. Nichols, on the late Mr. Tiffany at his great jewelry establishment, then on Union Square. Hailing from Menlo Park, they obtained an audience without delay. Mr. Tiffany sent for his diamond expert, who proved to be a tall young man named Kunz - none other than our old friend Dr. George F. Kunz. He said if they would return in a couple of hours he would tell them what they had. But when they returned young Mr. Kunz admitted that he did not know. "It is not carbon," he said, "because it dissolves readily in hydrofluoric acid. But if you can make it in quantity and at a low cost it will be of great use to the world as an abrasive!" This was just 10 years before Dr. Acheson made carborundum.

But what were those granules? Mr. Acheson became assistant chief engineer for the Edison interests in Europe in 1881. In Paris he met an eminent German chemist whose identity has passed into the limbo of forgotten names. He described the experiments to him.

"Hah," exclaimed the eminent German chemist, "here you have another proof that sulphur is not an element. You have obtained, sir, a decomposition product of sulphur itself, which I have long claimed cannot be an element!"

Now we meet another difficulty. The voltage was 104, reduced by lamps in series and the current increased until the lamps glowed a dull red. But 20 years afterward Dr. Acheson tried to produce those same granules from carbon bisulphide in his laboratory. He used all the diligence and all the strategems at his command, without getting a sign of them in a single instance! What was the stuff?

ELLWOOD HENDRICK.

New York City

Review of Recent Patents

Developments in the Manufactured Gas Field

Attention of Inventors Indicates the Industrial Importance of This Fuel

THE NORMAL PROCEDURE in manufacuring water gas or similar gas is to keep the CO at a maximum and the CO_2 at a minimum, because CO_2 is an incombustible. However, if the carbon were all changed to CO_2, the increased yield in hydrogen would give the gas a higher thermal value, as a study of the thermal reactions will show. In the usual method of water-gas manufacture, a certain per cent of CO will always be formed, however. In this invention of Harold R. Berry of Wilmington, the object is to supply a means for oxidizing all the CO and freeing all the hydrogen. The simplest form is an ordinary water-gas set, to which has been added, directly over the generator, through which the make must pass, a chamber containing a grate. On this grate are placed shavings, strips and borings of, say, steel and iron, or any other suitable substance.

These substances react with the steam to form an oxide, thus releasing all the hydrogen. In its turn, in the presence of CO, the oxide releases oxygen, which reacts with the CO to form CO_2, the scrap being rejuvenated. The chief requirement of this scrap is that it have a relatively large surface

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American Patents Issued June 5, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met* readers They will be studied later by *Chem & Met 's* staff, and those which, in our judgment, are most worthy will be published in abstract It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis

1,457,339 Kiln and Burner Therefor. M Bassler, Milwaukee, Wis.

1,457,343—Rubber Mixer or Like Machine. D R Bowen, Ansonia, Conn., assignor to Farrel Foundry & Machine Co., Ansonia.

1,457,351—Air Filter L L Dollinger, Rochester, N Y

1,457,406—Depth and Specific-Gravity Measuring Apparatus C W. Stancliffe, New York assignor to Pneumercator Co, New York

1,457,413—Machine for Treating or Processing Fabrics and Other Goods A Wilson, Elizabeth, N J, assignor to Duratex Corp, Newark, N J

1,457,436—Process of Making Metal Sulphides Henry Howard and E. B. Alvord, Cleveland, Ohio, assignors to Grasselli Chemical Co, Cleveland.

1,457,484—Method of Purifying Acid Liquor. F. C. Atkinson, Indianapolis, Ind.

1,457,498—Process of Making Phosgene. D. B. Bradner, Edgewood, Md.

1,457,503—Method of and Apparatus for the Purification of Water W. M. Cross, Kansas City, Mo

1,457,514—Filtration Chamber. J W. Flower, Detroit Mich., assignor to Michigan Valve Foundry & Engineering Co., Detroit

1,457,521—Powdered-Coal Apparatus A J. Grindle, Chicago, Ill., assignor to Grindle Fuel Equipment Co

1,457,522—Powdered-Coal Apparatus A J Grindle, Chicago, Ill, assignor to Grindle Fuel Equipment Co

1,457,543—Nitrating Aromatic Hydrocarbon S. P. Miller and J. R. Hess, Philadelphia, Pa, assignors to The Barrett Co

1,457,656—Process of Desulphurizing Petroleum and Petroleum Distillates A E Dunstan and E B Thole, Sanbury-on-Thames, England

1,457,676—Process of Making Sulphuric Acid and Apparatus Therefor. F G Stantial, Melrose, Mass, assignor to Merrimac Chemical Co., Woburn, Mass

1,457,709—Explosive C. J Startsböll Lundsgaard, Vejen Denmark

1,457,718—Electric Furnace. I. R Valentine, Erie, Pa, assignor to General Electric Co.

1,457,780—Gas-Fired Melting Furnace. H O Loebell, New York, assignor to Doherty Research Co, New York.

1,457,786—Recovery of Gasoline From Natural Gas, etc E S. Merriam, Marietta, Ohio

1,457,791—Process of Making Succinic Acid J F Norris and E O. Cummings, Cambridge, Mass.

1,457,793—Process for Obtaining Sulphur R. S. Perry, Cave Springs, Ga., P. W. Webster, Pelham Manor, and V. K. Boynton, New York, assignors to Perry & Webster, Inc.

1,457,794—Settling Apparatus W. E Piper, New Canaan, Conn., assignor to Dorr Co., New York.

1,457,803—Apparatus for Separating Solids from Liquids. A. J. White, San Antonio, Tex.

1,457,810—Screening Apparatus P J Alwart, Chicago, Ill.

1,457,811—Displacement Element for Liquid Containers. L. E. Baker, Fort Wayne, Ind., assignor to Wayne Oil Tank & Pump Co, Fort Wayne.

1,457,835—Process for Producing Catalytic Material for Hydrogenating Unsaturated Oils and Fats to Harden Them J. P Harris, Chicago, Ill, assignor to Allbright-Nell Co., Chicago

1,457,848—Agitator T. Mojonnier, Oak Park, Ill., assignor to Mojonnier Bros Co, Chicago.

1,457,865—Apparatus for Comminuting, Refining, and Triturating Paper or Cardboard Pulps K. A. Thorsen, Grenoble, France

1,457,877—Recovery of Ammonia L E. Doty, Elyria, Ohio.

1,457,915—Method of Making Paper Pulp B S Summers, Port Huron, Mich

1,457,934—Method of Making Precipitated Barium Sulphate and Sodium Sulphydrate J B Pierce, Jr., Charleston, W. Va.

1,457,935—Method of Making Precipitated Barium Sulphate J. B. Pierce, Jr., Charleston, W Va.

1,457,941—Cooler for Reclaimed Liquor and Gas in Paper-Pulp Processes. G F Shevlin, Glens Falls, N. Y.

1,458,001—Method of Burning Sulphur A. T. Prentice, Somerset West, Cape of Good Hope, South Africa.

1,458,016—Method of Treating Siliceous Ores. G. H. Wigton, Eureka, and S. M. Seddon, Salt Lake City, Utah.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

—that is, that it be finely divided. (1,453,655, Harold R. Berry, assignor to Petroleum Research & By-Products Co., Wilmington, Del., May 1, 1923.)

Retort for Low-Temperature Gas Making

The efforts along the line of low-temperature carbonization and gas manufacture have been of increasing interest. One of the pioneers in this field was the International Coal Products Corporation. It is now putting forward a patent covering a new type of primary retort in connection with its well-known process.

This particular design, the patent of Charles E. Richardson (1,454,338, Charles E. Richardson, assignor to the International Coal Products Corporation, Richmond, Va., May 8, 1923), is concerned with the structural details of this type of retort. It claims to improve the support of the retort, to improve the design so that it may be more easily assembled and disassembled, and to improve the arrangement of both burners and flues.

Coking Non-Coking Coal

One of the greatest desiderata of the byproduct coke and gas field is an oven that will coke certain high-volatile coals of low agglutinative power and give good results. A solution of this difficulty is offered by Paul Goffart (1,455,527, assigned to Belgian-American Coke Ovens Corporation, Wilmington, Del., May 15, 1923).

This patent claims that in order to convert coal of this type into dense coke, distillation must be rapid at the top of the charge, thus preventing the formation of sponge coke at the top. To accomplish this result, the vertical heating flues are divided into pairs of adjacent flues. The fuel gas is admitted at the top at a point between the flues of each pair. The air for supporting combustion travels upward in one flue of each group and the gases of combustion pass downward in the other flue of the group. From time to time a reversal occurs as between these two flues. Means is provided for regulating both the length and the intensity of the flame. In this way a controllably higher heat may be maintained at the top of the oven than elsewhere.

Doing Away With Reversing Engines

Designers of coke ovens have long sought for a means of eliminating the reversing engines. The expense and added complication due to these mechanisms and the repair cost which they entail are sometimes a serious burden.

As a means of accomplishing this end William E. Roberts has obtained a patent (1,453,605, assigned to Foundation Oven Corporation, New York, May 1, 1923) on an oven of novel type. In this oven the flues are arranged in pairs, vertically. Gas and air enter at the bottom of one of the flues of each pair, burn up this flue and down the next, the products of combustion passing out through the waste gas ducts. The combustion flues of one tier of flues are adjacent to the waste gas or downward flues of the next tier, which is designed to assist in heat distribution.

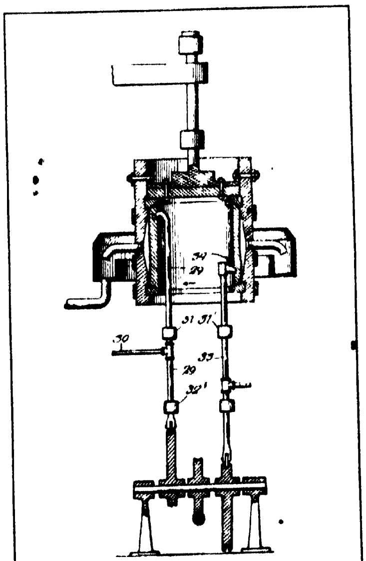
The waste gas ducts are common for all the waste gas flues of one tier of flues. The air passages for admitting the air are located on the sides of the waste gas ducts and their parallel length is sufficient to preheat the entering air thoroughly.

It will be noticed that this design of oven permits continuous combustion without reversal and does away with regenerators.

Patented Ideas in Chemical Engineering Equipment

A Continuous Centrifuge and New Plate for Column Stills Are Featured in Recent Patent Specifications

Broadly speaking, the use of centrifugal force in the separation of liquids from solids is a comparatively old process, although advances are being made continually in the equipment for applying this useful principle. Recently the trend has been toward developing and perfecting a continuous centrifugal separator, notwithstanding the fact that in certain of the chemical industries "batch" operation is sometimes of importance. For instance, it is frequently necessary to remove a precipitate from a mother liquor, and then in order to obtain the desired degree of purity the solid must be washed free from the mother liquor while it is still in the rotor. A separator invented by Sylvester S. Howell and assigned to the United Chemical & Organic Products Co., of Chicago, takes advantage of both of these requirements, since it is suitable for either continuous or intermittent operation. A feature of this piece of equipment is the arrangement of introducing the material to be separated and the removal of the solid matter through the open bottom of the rotating cylinder or rotor. The solid may be conveniently removed through this open bottom of the rotor while it is in motion and the materials to be separated can be introduced into the cylindrical rotor without stopping it, thus rendering the separating operation continuous.



Two points of interest are the methods by which the material to be separated is fed into the centrifuge and the provision for withdrawing the solid cake or residue. Referring to the accompanying figure, it will be noted that the material from which the liquid to be separated comes in through the supply pipe 29 and the hose 30. This pipe is supported on bearings 31 and 32 and can be moved in a vertical direction as the material is sprayed on the filtering lining 24 while the latter is in rotation. The pipe 33 is provided with a nozzle through which compressed air is forcibly projected toward the filtering lining in a direction opposite to its direction of rotation. This nozzle produces a thin blade or jet of compressed air which is discharged upon the interior of the centrifugal rotor. By the operation of this sort of nozzle, the filter cloth or lining, when such is used, is maintained quite free of material, thus increasing the filtering capacity of the machine. This has the advantage over a mechanical scraper plow in that it is not possible with the latter to run very close to the inside surface of the cloth for fear of rupturing it. The pneumatic plow, on the other hand, is remarkably flexible. (1,453,678, issued May 1, 1923.)

A Still Plate With Check Valves

An unusual feature in the construction of diaphragm plates for a column still is brought out in a recent patent by Ralph H. Twining, of Marquette, Mich. (1,453,735, issued May 1, 1923.) Instead of the usual cup or sieve construction, provision is made for a diaphragm plate having a large number of perforations, in each of which is a rivet-shaped check valve. This valve consists of an ordinary rivet having its head normally resting on the upper surface of the plate and its stem projecting through the perforation. The pressure of the rising vapor in the column causes the heads of these valves to be lifted from their respective plates and the vapor is permitted to pass through the perforation. If the pressure of the vapor is

variable over the different portions of the plate, the valves in any portion not subjected to sufficient pressure will not be raised, as each of the valves is entirely independent of the other in its action. This is particularly important, as it prevents the escape of the fluid at points where the pressure is inadequate to support it.

Fighting Oil Fires

In fighting oil fires by means of a fire-extinguishing foam, it has been repeatedly found that when an explosion occurs in the oil tank—this being generally preliminary to the beginning of a fire where lightning is the cause—the roof or tank top is forced or blown off violently. The mouth of the foam delivery system attached to it is usually broken or put out of use, thus resulting in the failure of the fire-extinguishing apparatus. To overcome this objection, the delivery system for the foam is sometimes placed in the side of the tank above the "normal" oil level. This sort of installation, however, has the disadvantage that the normal oil level is never constant, and that a rise above the predetermined level will often result in the oil leaking into the foam delivery mixing chambers. Willis D. Witter, of Roselle Park, N. J., in a patent assigned to the Foamite Fire-Foam Co., of New York, retains the type of installation in which the foam is allowed to enter through the tank roof or top, but at the same time he makes provision so that in case of the violent removal of the tank top by an explosion, it will not disrupt or break down the foam delivery system. (1,454,839, May 8, 1923.)

To Facilitate Pipe-Line Pumping

In pumping heavier grades of petroleum through pipe lines, it is often found that the oils are so heavy and viscous that their handling is extremely difficult. In fact, some grades of oil are so heavy that it is practically impossible at ordinary temperatures to pump them through the pipe. Various means have been used to make the oil more fluid. John P. Persch, of Houston, Tex., has patented a process of agitating the oil in a cylindrical chamber connected with the pipe line and introducing into the oil during the process of agitation a strong blast of air. There is formed an emulsion of air and oil of considerably lower specific gravity than the original oil. If the air has previously been heated to a suitable temperature, it is claimed that it will have the effect of breaking up the hydrocarbon molecules to a certain extent and thus make the oil permanently more fluid and that it will not return to its original viscous state. The agitating apparatus consists of mechanically operated paddles attached to a central shaft. (1,454,485, issued May 8, 1923.)

Important Articles In Current Literature

More than fifty industrial technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem & Met* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers Those that are of unusual interest will be published later in abstract in this department, but since it is frequently impossible to prepare a satisfactory abstract of an article this list will enable our readers to keep abreast of current literature and direct their reading to advantage The magazines reviewed have all been received within a fortnight of our publication date.

EXCESS AIR IN GAS-FIRED APPARATUS J M. Davies and T T Gill Calculations given based on the CO_2 content of flue gases *Gas Age-Record*, June 9, 1923, pp 727-728

CHEMISTRY THE KEY TO INTERNATIONAL RELATIONS H E Howe The initial chapter of a non-technical, economic review of world significance of the science. *Chem & Ind*, May 25, 1923, pp 510 13

HYDROGENATION E J Lush Development of a new method and its demonstration in a small model oil-hardening plant *J Soc Chem. Ind*, May 25, 1923 pp 219T-223T

THE ACTIVATED SLUDGE PROCESS. Edward Arden and William T Lockett Results at large-scale demonstration of plant installed at Withington works of the Manchester Corporation *J Soc Chem Ind*, May 25, 1923, pp. 225T-230T

RECOVERY OF NITROGEN FROM SEWAGE IN ACTIVATED-SLUDGE PROCESS. Edward Arden, Clarence Jepson and Percy Grant. *J. Soc. Chem. Ind.*, May 25, 1923, pp. 230T-234T.

BUILDINGS FROM THE MANAGER'S VIEWPOINT (Part IV). G. L. H Arnold How the roof, partitions, doors and building equipment should be planned to fit the industry. *Management Engineering*, June, 1923, pp. 417-421.

Men in the Profession

JOHN DAVIS has been selected to take charge of experiments being conducted by the Board of Helium Engineers working under the Bureau of Mines on the government reservation at Fort Worth, Tex.

Prof. GRAHAM EDGAR sailed for Europe on June 11. While in England he will be one of the American representatives at the International Union of Chemistry.

J. N. GUNN of New York has resigned as president of the United States Tire Co. and vice-president of the United States Rubber Co., the parent organization. C. B. SEGER, president of the United States Rubber Co., has been elected to a similar position with the tire division, succeeding Mr. Gunn.

WILLIAM M. KEELING, who was graduated from the Missouri School of Mines in May, is now chemist with the American Smelting & Refining Co.'s lead refinery at Omaha, Neb.

EDMUND LEAVER, who has been serving as superintendent of the Bureau of Mines experiment station at Tucson, Ariz., has been assigned to the superintendency of the precious metal station at Reno, Nev. S. P. HOWELL, the bureau's specialist in blasting and explosives, has been made superintendent of the Tucson station.

R. WALTER LEIGH has been elected vice-president of the American Beet Sugar Co., New York, succeeding the late H. T. Oxnard.

J. M. LESSELL, research engineer, Pittsburgh, gave the principal address at the meeting of the local chapter of the American Society of Steel Treating, at the William Penn Hotel, June 5, on the subject "Methods of Static and Dynamic Testing of Metal."

CHARLES A. MEADE, vice-president of E. I. du Pont de Nemours & Co., Wilmington, Del., has resigned to devote his time to private enterprises. He became connected with the development department of the company in 1915, and in 1919 was elected vice-president and director.

E. C. MOFFETT, formerly with the Ideal Disinfectant Corporation, Woodbridge, N. J., is now with the Cyanide Co., Warners, N. J.

THOMAS W. STREETER has been elected chairman of the board of directors of the Simms Petroleum Co., N. Y., to succeed Harry Bronner, resigned.

W. H. WALKER, of the U. S. Department of Commerce, is in California conducting a survey of the agricultural needs of that state for nitrogen compounds.

Obituary

CLYDE MITCHELL CARR, until recently president of Joseph T. Ryerson & Son, Inc., died on June 5 at his residence in Chicago. Mr. Carr was born in Will County, Ill., July 7, 1869. For 12 years he was president, but for the last 4 years had been unable to take an active part and last January resigned as president, although continuing until the time of his death as a member of the board of directors.

Calendar

AMERICAN CHEMICAL SOCIETY, fall meeting, Milwaukee, Wis., Sept. 10 to 14.

AMERICAN ELECTROCHEMICAL SOCIETY, forty-fourth meeting, Dayton, Ohio, Sept. 27 to 29 (dates provisional).

AMERICAN ELECTROPLATERS SOCIETY, eleventh annual meeting, Providence, R. I., July 2 to 5.

AMERICAN GAS ASSOCIATION, annual convention, Atlantic City, Oct. 15 to 20.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, summer meeting, Wilmington, Del., June 20 to 23.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS, iron and steel exposition, Buffalo, N. Y., Sept. 24 to 28.

AMERICAN SOCIETY FOR TESTING MATERIALS, twenty-sixth annual meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, June 25 to 30.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (NINTH), New York, Sept. 17-22.

NATIONAL SAFETY COUNCIL, twelfth annual safety convention, Statler Hotel, Buffalo, Oct. 1 to 5.

Industry and Trade

Current News and Market Developments

Summary of the Week

Imports of chemicals and allied products in April were valued at $12,276,199.

Treasury Department has revoked anti-dumping order against calcium carbide from Province of Quebec, Canada.

Annual census of coal-tar products completed by Tariff Commission and will be sent to public printer about June 20.

Production of industrial alcohol for 9 months ending March, was larger than in fiscal year ending June 30, 1921.

Canadian decree prohibits manufacture and importation of oleomargarine in Dominion.

Sales of new crop crude cottonseed oil have been made on a basis of 7c. per lb. f.o.b. mills.

Resale offerings of phenol reached the market and the price declined to 42c. per lb.

Supreme Court denies application to review the decision in the case of the Mennen Co.

Case of government against the Chemical Foundation weakened by testimony of Polk. Court holds much evidence presented by government irrelevant. Defense to ask dismissal.

Dr. Samuel W. Stratton inaugurated president of M.I.T. with impressive ceremonies in which eminent scientists participated.

Canada to survey domestic heating problem from by-product coke.

Imported copper sulphate shows slight recovery from recent weakness.

Permanganate of potash sold at new low and is very irregular in price.

Export demand for caustic soda is very quiet and prices are subject to shading.

Several crushers of linseed have caught up on deliveries of oil and the market is approaching a normal supply basis.

Syndicate in Control of German Potash Industry

ADVICES coming from the American Consulate at Frankfort-on-Main state that rumors of attempts by American and Dutch interests to obtain control of German potash properties have brought out discussions on the potash situation in Germany. A prominent publication in Frankfort says that the object of the publication of these rumors is probably to arouse German interests in potash shares and to increase public confidence in the industry. Whenever the danger of foreign control is really felt, it is stated, preference shares are issued and taken over by the companies' members, each share granting the right of 10, and in some instances as many as 25 votes.

Falling off in orders in the German potash industry which began in December, 1922, continued throughout the first 3 months of the present year. In February certain quantities of potash were stocked by producers and full production was maintained, but in March the shutting down of several shafts was reported. The German Potash Syndicate complains that a late announcement by the government of price reductions in certain nitrogen fertilizers, accompanied as it was by the statement that a reduction in prices of other fertilizers would shortly follow, has unfavorably affected potash sales. The farmer was led to expect reductions in potash prices which, aside from certain usual summer rebates, it will be impossible for the syndicate to make without cutting prices below cost of production.

Export trade in March is reported to have been satisfactory, but this is declared to be doubtful. When export trade in potash is good, it is pointed out, few complaints of a poor domestic market are heard. The fact that the abolishment of export duties was urgently demanded is said to show that the export situation was not satisfactory.

The Berlin correspondent of the Boston News Bureau in an interesting report says: "German potash industry is very well organized. Its supreme controlling body, the Potash Syndicate, is compulsory in character and disposes of the out-turn of the individual mines according to their productive capacities. Therefore it is the goal of every member to acquire as many mines or mining claims as possible, to sell larger quantities through the syndicate, the more so as the latter also disposes of exportable surpluses. These circumstances have contributed to the creation of large combines, such as the Wintershall - Gluckauf - Sondershausen concern, which disposes of 40 per cent of the total German production; the Salzdetfurth concern, with 20 per cent, Burbach-Krugershall, Gumpel-Heldburg and Ronnerberg.

"The self-government of the industry is represented by the Imperial Potash Council, in which the interests of the farmers, the chemical and other consuming trades, along with those of the producers, are given full scope for all complaints, as in this potash parliament the prices, freights and expenses made up by the syndicate are scrutinized.

"There is another examining body, the object of which is to reduce number of shafts sunk to the needs of the industry, for, despite surrender of 17 big Alsatian works to France, the number of actual works now stands as 208, against 191 at the beginning of the war.

"Production of potash salts shows a big increase over pre-war figures, outstripping 1913 by 2,000,000 quintals annually apart from present Alsatian production of 1,100,000 quintals.

"Competition for the American market has led to conclusion of a contract with the Potash Importing Corporation of America in New York, which is believed to be backed by important American shipping and banking interests. The corporation's agents are to start a lively propaganda campaign among the farmers of the United States in the interest of spreading the use of potash salts as fertilizer. While the French Government grants bounties to exporting Alsatian firms in order to help them to gain a footing in overseas markets, the German Kali-Syndikat seeks to recapture the American market by allowing abatements to the corporation to the extent of 30 per cent or so of invoice amounts.

"The German-American potash contract is to run 5 years. The value of surplus of potash in Germany is calculated at $50,000,000."

Canada Prohibits Manufacture and Importation of Oleomargarine

Prohibition Measure Effective August 31—Expected to Curtail Canadian Demands for Vegetable Oils

THE Canadian Parliament has voted to put an end to the oleomargarine industry in Canada. War-time legislation that permitted the manufacture and sale of oleomargarine in Canada will expire on Aug. 31 this year. That is, the manufacture and importation of the product must cease on Aug. 31, but its sale may continue until March 1, 1924. While it is still possible for the government to bring in new legislation this session that would permit the people of Canada to use oleomargarine products, there is little probability that anything of the sort will be done.

Previous to 1917 oleomargarine was not allowed to be manufactured or sold in Canada. But when the war placed an unusual drain on the food supplies of the world, the Canadian Parliament permitted the manufacture and sale of the product. The main argument behind the agitation, which has been long and vigorous, is that it has been hurting the Canadian butter industry.

The oleomargarine question has engaged the attention of Parliament to an unusual degree this session and has provoked many long discussions as to its merits and demerits. The climax finally came during an all-night session recently. It was the end of an all-session lobby, with the dairying interests carrying on a persistent warfare against the commodity and the oleomargarine manufacturers almost equally active in support of it. It was not a party question, for the discussion saw W. S. Fielding, Minister of Finance, taking a position diametrically opposed to the Prime Minister. The Conservatives and the Progressives likewise were divided. In the last analysis, after 9 hours of strenuous debate, the antis won out by 125 to 54.

Laborites Fight for Oleo

W. F. Carroll of Cape Breton, who comes from a laboring constituency where a good many tons of the commodity are used in a year, put up a determined fight to have its manufacture and sale continued permanently. He argued that there was no more reason for dictating what a person should eat, so long as it was healthful, than there was reason for dictating the kind of apparel he should wear. He was supported by the Minister of Agriculture in the late government, Dr. Tolmie, who went into a microscopic analysis of the whole subject, treating it from the standpoint of palatability and nutrition and from other angles, and, though as a dairyman he would benefit by the prohibition, he upheld the right of the import and manufacture in the natural color.

The Prime Minister contended that the permit was only a war measure, involving a specific pledge to the dairy interests that when the war ended it would be abandoned. On the other hand, Mr. Fielding steered a course directly opposite to his chief, quite discounting the argument of any pledge to the dairymen and maintaining that the issue was on the merits and the vital question whether or not the intelligence of the Canadian people enables them to determine what they want to eat—butter or a substitute.

Butter Coloring Permitted

Dr. Tolmie reminded the House that butter makers were permitted to heighten the color of their butter in winter when it was a light color and low in vitamine contents as compared with summer butter. This gave no indication to the purchaser of the value of the goods in that respect. He further argued that during the war Canadian troops used oleomargarine; British troops used it, and now it was on the regular ration list of both the British army and navy. He urged that only half of the people of the world used milk and it was idle to say that the milk industry would be damaged by oleomargarine. As to cottonseed oil, which was one of the main ingredients of oleomargarine, this was used in salad oils and other edible products. There was much more to fear, Dr. Tolmie added, from the making of inferior dairy products than the making of oleomargarine. Since 1919 there had been 489 prosecutions against butter makers in Canada as against 48 oleomargarine prosecutions.

Arthur Meighen, leader of the Opposition, pointed out that in 1918 the government had permitted the sale of oleomargarine as a temporary measure under the war measures act. This was made plain in the legislation and at the next session the government recommended to Parliament that this temporary measure be continued as such. His own attitude was that the use of oleomargarine should be permitted. He did not see any reason why a genuine food should not be manufactured in Canada if the people wished it. He believed that there should be a fair protective tariff on the product. The United States had a duty of 8 cents against Canadian butter and 8 cents against oleomargarine. Why should Canadian dairymen have to compete against American manufacturers of butter substitutes in the Canadian market?

This action of Parliament is expected to have a decided bearing on importations of various vegetable oils into Canada. Large amounts of coconut, cottonseed, peanut and other oils are used in the manufacture of nut butters and margarines.

Dr. S. W. Stratton Inaugurated President of M.I.T.

Impressive Ceremonies With Many Eminent Scientists Present Mark His Taking Chair

On June 11 the attention of the academic world was focused on M.I.T. Dr. Stratton, former head of the Bureau of Standards, officially took the president's chair of the Massachusetts Institute of Technology at that time. Speakers of note were present to address the large body of faculty, students and alumni gathered at Horticultural Hall, where the ceremonies took place.

Frederick P. Fish acted as master of ceremonies at the inauguration. Major-General George O. Squier spoke with feeling of his 15 years' close association with Dr. Stratton in connection with army problems. For the faculty, Prof. Edward P. Miller greeted the new president, pledging co-operation and firm loyalty. Governor Channing Cox glorified the commonwealth of Massachusetts in having such an institution, with such a faculty, within its bounds. The founders of Technology, Mr. and Mrs. William Barton Rogers, received a tribute from President Emeritus Charles W. Eliot of Harvard. Professor C.-E. A. Winslow of Yale represented the alumni at the ceremonies. He voiced the sincere admiration and respect of that body for the new president of their alma mater and emphasized the immense potentialities of the scientific spirit in solving industrial and social problems. Dr. John Campbell Merriam, president of the Carnegie Institution of Washington, expressed the regret of Dr. Stratton's colleagues there at losing his constant association. He spoke at length of the new president's qualifications, emphasizing the fact that he is a thoroughly constructive scholar. In his own address, to which reference is made elsewhere in this issue, Dr. Stratton stressed the effect of science in the evolution of industry.

Banquet at Algonquin Club

In the evening the new president acted as toastmaster at a banquet at the Algonquin club. Dr. A. Lawrence Lowell, president of Harvard, Prof. Edgar Odell Lovett and Prof. Theodore W. Richards were among the speakers at this gathering. Professor Lovett, of the Rice Institute in Texas, spoke of education in that state. Professor Richards presented greetings from the Royal Society, the Royal Institution and the Chemical Society of London. President Ira Nelson Hollis of Worcester Polytechnic Institute, an old friend of Dr. Stratton, spoke in praise of the man "who, if he can persuade Congress to support the Bureau of Standards, is well equipped to meet Tech's problems."

Professor Allard of the Ecole Normale Supérieure of Paris, Dean Kimball of Cornell, Dr. Zook of the U. S. Bureau of Education and Dean Clark of the University of Illinois also spoke. The prevailing theme both of the day and of the evening is discussed editorially on page 1060 of this issue.

Chemicals on Free List Form Major Part of April Imports

Total Imports for Month Less Than in March, but Larger Than in April, 1922

IMPORTS of chemicals and allied products during April were valued at $12,276,199. Of that amount $8,598,464 represents the value of imports not subject to duty. Imports on the dutiable list totaled $3,677,735. The free list imports are less by $1,500,000 than those in March. There was a falling off of about $150,000 in the total value of imports on the dutiable list. In April of 1922 the value of free list imports was $5,528,218, and of dutiable imports $3,003,094.

The value of imports of coal-tar chemicals was $1,196,248 in April, a decrease of $250,000 over the imports of March, but still a slight increase over the total imported in April of 1922.

The value of paints, pigments and varnishes imported during April was $348,807. This is a slight increase over March, when $300,525 were brought into the country. Imports of these commodities, however, are measurably less than they were in April of 1922. The value of fertilizers imported in April was $7,033,299, a decrease of $800,000 as compared with March, but double the value of the imports in April of 1922. Nitrate of soda alone contributed $4,898,762 to the April total. This is nearly five times the rate of imports in April, 1922, but imports in March were valued at $5,691,097.

Some of the individual items which show marked changes in the trend of imports in April of last year are as follows:

	April, 1922	April, 1923
Creosote oil (gal.)	3,270,081	4,621,537
Naphthalene (lb.)	274,815	1,789,425
Toluene (lb.)	337	122,460
Quinine salts (oz.)	123,096	
Quinine sulphate (oz.)		185,928
White arsenic (lb.)		1,476,066
Formic acid (lb.)		144,292
Oxalic (lb.)	18	129,737
Sulphuric (lb.)		3,402,917
Nitrate of ammonia (lb.)		910,613
Arsenic sulphide (lb.)	1,348,280	207,750
Barium compounds (lb.)		974,553
Glycerine (lb.)	221,905	1,821,602
Cyanide of potash (lb.)	282,360	597,627
Carbonate of potash (lb.)	242,542	
Sodium cyanide (lb.)	2,566,195	1,445,643
Calcium cyanamide (tons)	1,441	3,906
Sulphate of ammonia (tons)	601	

The figures are those of the Department of Commerce. Due to the great amount of additional work occasioned by the passage of the new tariff bill, these figures still require more than the usual time to compile. Progress is being made, however, and the April figures were prepared on the department's work sheets less than a month later than required for the task of compilation prior to the passage of the new tariff act.

German Goods Free From Export Regulations

Exporters Must Quote in High Exchange but Accept 40 Per Cent in Paper Marks

Cable advices from Berlin recently announced that export price control, export taxes and licensing of a number of general classes of German goods had been abolished by the Federal Economic Council. Further details are now available and show that the decree became effective on May 27.

Among the articles specifically mentioned as free from the previous export regulations are: All vegetable fiber, except flax; animal fats, waxes and products; liquid resins, aromatic greases, solid tanning extracts; all hides, leather goods, excepting hairy hides; all rubber goods; fish oils, bristles, horn, antler, bone, hoof, whalebone, shells and their products; tanning bark and logs; mineral gums; mineral oils and products.

It is also added that export prices must be quoted in high exchange currency, and at least 40 per cent of the resulting credit must be surrendered to the Reichsbank, which in turn reimburses the exporter in paper marks at the current rate.

Maine Offers Paper Courses in Summer School

The chemistry department of the University of Maine will conduct a summer school course in pulp and paper chemistry and technology from June 25 to Aug. 4.

The work given is designed to meet the specific needs of students who desire and are qualified to take pulp and paper courses and also for pulp and paper mill men who may or may not have technical training, but who have had practical experience and desire to gain a scientific knowledge of important phases of pulp and paper manufacture and testing or phases of work with which they are unfamiliar.

All work completed will be given the regular university credit for either the bachelor's or master's degrees. Transference of credits to other institutions will be arranged for as during past years for those so desiring.

The courses to be offered this summer give an option of six different subjects, whereas in former years only three have been given. Three courses are offered to those interested in pulp and three to those interested in paper. Anyone wishing to take part pulp work and the rest paper may do so providing the courses do not conflict.

Supreme Court Upholds Mennen Co. Price Policy

The application of the Federal Trade Commission for a writ of certiorari in the Mennen Co. case was refused last Monday by the United States Supreme Court. This means that the decision of the Circuit Court of Appeals will not be reviewed. The original complaint against the Mennen Co. was filed April 15, 1920 and was amended Jan. 27, 1921. It alleged that the company, in addition to being guilty of the general charge of unfair methods of competition, also was operating in violation of section 5 in classifying its customers into two groups according to a basis of selection by allowing to purchasers of the same quantity and quality of its products different discount rates, according to the classification of such purchasers. On March 3, 1922, the commission entered a cease and desist order against the Mennen Co. The respondent appealed, and the United States Circuit Court of the Second District held adversely to the commission.

The decision of the Supreme Court is regarded as very important, as the case will be regarded generally as a precedent and establishes that a manufacturer may adopt price schedules that seem fair to him and may select its own customers and distinguish between wholesale and retail branches of the trade.

Larger Sales of German Potash

The German Potash Syndicate in 1922 sold 1,295,579 tons of pure potash, says the annual statement of the Deutsche Kaliwerke. This is an increased output over 1921, when 921,147 tons was produced. The 1922 sales in Alsace are estimated at 250,000 tons. About 50,000 tons K_2O was produced from all other sources.

The annual statement points out that had the normal pre-war increase continued, 1922 sales should have aggregated 2,400,000 tons, or 800,000 tons more than the 1922 sales. The 1922 sales were divided 74.4 per cent inland and 25.6 per cent export. The statement comments on the improved sales to Poland and to the United States. The "closing down law" has been extended until July 1, 1924.

The statement reveals that 181 plants contributed to the 1922 production throughout the year. In addition there was some contribution from 22 other plants.

Coal-Tar Census Completed

Final tabulations of the annual census of coal-tar products and synthetic organic chemicals have been completed by the Tariff Commission. W. N. Watson, acting chief of the chemical division, expects to send the report to the public printer about June 20. It is probable that a summary of the census, in the form of a press release, will be made public before the complete report comes from the printer.

Government Suit Against Foundation Making Little Progress

Evidence Produced Largely Regarded as Irrelevant by Court—Request for Dismissal of Suit Likely in Near Future

THE SECOND WEEK of the federal court trial of the government's suit against the Chemical Foundation has produced no startling developments. Very much of the evidence produced by Assistant Attorney-General Henry W. Anderson, who is pressing the case for the government, is regarded as irrelevant by the court. Frank L. Polk, who was Under Secretary of State during the Wilson administration and who signed the order making valid the sale of the disputed 4,800 patents to the Chemical Foundation, upset the assertion of Anderson that he was duped into the deal. As a result the case of the government is regarded as being much weakened. Dismissal will probably be asked by the defense at next week's session.

The legal point upon which the case hinges is the right of the courts "to review executive discretion." The defense argues that such a right does not exist. The court apparently holds the same view. That being the case, the arguments of the government, which are based on the assumption that the opposite view should hold, lose much of their significance. In reply to a direct question by the court as to why he signed the order Mr. Polk said:

"Because I felt here was an opportunity to build up a real chemical industry in this country, something we had never had before."

Further on, Mr. Polk said that he thought it was a wise plan to turn these patents over to the Foundation to make American industry independent. The witness added that he knew of no suppression of facts relative to the seizure of the patents. The charge made that President Wilson did not realize the significance of the act of sale of the patents to the Foundation was likewise refuted by the evidence of Mr. Polk.

Nitrate Patents Under Fire

Introducing documentary evidence Colonel Anderson endeavored to prove that the idleness of Muscle Shoals is due to the refusal of the Foundation to grant patent rights to the government, except under conditions which the government insists made it impossible to go ahead with its development plans. He contended that the program of the War Department was seriously impeded by the failure of A. Mitchell Palmer, as Alien Property Custodian, to sell the department patents it required for "offensive and defensive" purposes. In effect, it was charged that the government was "double crossed." After assuring the War Department that it would receive the patents it needed for war and peace purposes, including Muscle Shoals, Palmer sold them to the Chemical Foundation.

Isidor J. Kresel, counsel for the defense, asserted that the War Department asked only for licenses; that the Custodian had granted the Navy Department licenses on 5,700 patents that never went into the hands of the Foundation, and that the Haber patents, which the government said were necessary to the Muscle Shoals development, were not necessary to that project.

Friendly Litigation Attacked

Colonel Anderson tried to make a big point out of a proposal by Ramsey Hoguet, former patent attorney for the Alien Custodian, that the Foundation and the government engage in friendly litigation. But even here the points emphasized by the government were minimized by Judge Morris. The court has already indicated a number of times its intent to hold with the defense that war acts of a President are not reviewable by the courts. On this principal contention rests the fate of the suit in equity.

Hammermill Offers Fellowship

The Hammermill Paper Co., through its chemical director, Dr. Bjarne Johnson, has offered to the trustees of the New York State College of Forestry a fellowship for the coming year (September, 1923-24) to be known as the "Hammermill Fellowship in Pulp and Paper Manufacturing."

The fellowship requires that the recipient be a graduate student at the college (his work leading to the degree of M.S.). His major problem, which is to be chosen jointly by the Hammermill company and the department of forest chemistry, is to be of fundamental nature.

Burton L. Kassing, of Utica, N. Y., a member of the graduating class, has been designated by the company and the college as the recipient of this honor.

Germany Using Ash Fuel

With the idea of reducing fuel costs, the German chemical industries have been advised to recover combustible carbon from old ash piles. The occupation of the Ruhr has resulted in such increases in fuel costs as to make it impossible to produce certain chemical products in competition with world prices.

Under ordinary conditions, one-sixth of the carbon content of coal passes into the ash. The percentage is much higher in the coke used at smelters and gas plants. Under present conditions in Germany it is believed that many large ash dumps can be reworked at a profit. It also indicates the determined effort the Germans are making to keep their chemical industry alive.

Lime to Get Main Efforts at Non-Metals Station

Impossible to Carry On Research in Several Fields Because of Small Staff—Slate Follows Lime

The principal problems to be undertaken on the opening of the new non-metals experiment station of the Bureau of Mines at New Brunswick, N. J., will be a continuance of the study of the difficulties met with in the quarrying and preparation of limestone and in lime manufacture, and a continuance of the work which has been in progress at the Tuscaloosa station on mineral fillers.

The work necessarily will be limited, as the appropriation permits of the employment of three technical men only. Since considerable work has been done on lime and mineral fillers, it is felt that the greatest good can be accomplished by carrying through the work already well in hand.

In lime the most important portion of the work probably centers around efforts to utilize waste. There is reason to believe that improved methods of burning can be brought to the point where the smaller sizes can be burned.

It is possible that some work on slate will be taken up early in the life of the station. This is encouraged by the success which has attended large-scale pulverization of waste slate, and the increasing demand for this material as a filler in asphalt, roofing materials, paint and rubber.

The problems of the non-metals are of such a character that field work is required in much larger proportion than laboratory work. The studies and the experiments must be carried on under operating conditions. For that reason Oliver Bowles, who will be in charge of the new station, believes it is better to expend the appropriation in a way that will allow all necessary field work. Consequently he must limit the personnel of the station to a mineral technologist and a physical chemist. In case co-operative arrangements can be made with the industries concerned, it will be possible to expand the work further.

Calcium Carbide Order Revoked

The Treasury Department has revoked its order against calcium carbide from the Province of Quebec, Canada, issued May 16 under the anti-dumping act, and has instructed collectors to disregard the order and to discontinue any pending proceedings which may have been started by its authority.

It is understood that the anti-dumping order was issued as the result of suspicion by an appraiser at a border port that a consignment of calcium carbide from Quebec was invoiced at too low a price, indicating that it had been sold for export at less than its fair value. Canadian producers protested the order and at a hearing before Judge McKenzie Moss, Assistant Secretary of the Treasury in charge of customs, convinced customs officials that there was no dumping of the chemical.

Washington News

African Company Has Large Soda Deposits

A report from Consul W. L. Jenkins says that the Magadi Soda Co., at Lake Magadi, Kenya Colony, Africa, has a property covering 90 square miles, including the lake area of 34 square miles of carbonate of soda. There are very few natural deposits of soda in the world, and in this one the percentage of pure soda is as high as 96. The supply is practically inexhaustible, owing to the rapidity with which the soda re-forms. A prominent employee of the company states that only 4 square miles have been worked since operations began in 1912-13, and that by the time work was begun on the third square mile the first already had re-formed.

The Magadi company has a capital of over £2,000,000. It suffered greatly during the war, but present prospects are much brighter. It now has a capacity of 6,000 tons a month, which was expected to be increased to 12,000 in March or April of this year. The proposed increase is all the more striking since customs figures show that total exports of soda amounted to only 16 tons in 1913, 12,061 tons in 1919 and 12,829 tons in 1921. The values for these 3 years are given as £1,200, £269,258 and £107,166, respectively.

Shipments to the United States began in 1922 and tend to increase. The other principal markets are England, the Netherlands, Denmark, South America and Japan.

April Output of Acetate of Lime Shows Decline

The Department of Commerce announces the April production of acetate of lime and methanol based on reports received by the Bureau of the Census in co-operation with the National Wood Chemical Association.

The following table shows total comparative figures for the first 4 months of 1923, as reported by firms with a daily capacity of 4,500 cords, or prorated to that capacity in months where some reports were lacking, taken from the *Survey of Current Business:*

	Production		
1923	Acetate of Lime Thous. of Lb.	Methanol Gallons	Stocks of Wood End Month Cords
January	16,544	933,171	833,767
February	13,894	733,179	807,782
March	15,569	831,784	769,174
April	13,575	738,059	746,626

Argentine Tariff Revision

A report from Buenos Aires states that a proposal has been submitted to the Argentine Congress for an increase of 50 per cent on customs import valuations, and recommending also the exemption from import duties for lumber and certain other construction materials, as well as industrial machinery.

Gain in Industrial Alcohol Production

Because the production of industrial alcohol during the 9 months ended with March reached a total of 48,857,894 wine gallons, Prohibition Commissioner Haynes, in reviewing the administration of the Prohibition Unit of the office of the Commissioner of Internal Revenue, holds that "this clearly demonstrates that the administration of the alcohol laws, by this unit, has interfered in no way with normal commercial processes." He points out that trade alcohol production in those 9 months was greater than during the 12 months of the fiscal year beginning July 1, 1920.

"The number of plants now qualified to produce alcohol," says the Prohibition Commissioner's report, "is practically the same as 2 years ago, or about seventy in number, but at present they are working at a greater capacity than they were then."

The report gives the following figures covering withdrawals of specially denatured alcohol: During the 12 months ended with February, 1923, 25,505,940 gal.; during the corresponding period ending February, 1922, 12,719,452 gal.; during the corresponding period ended with February, 1921, 11,767,587 gal. The figures for completely denatured alcohol follow: During 12 months ended with February, 1923, 22,766,389 gal.; during the corresponding period ended with February, 1922, 15,483,003 gal.; during the corresponding period ended with February, 1921, 13,319,230 gal.

Standards Augments Staff

The Bureau of Standards has just appointed two additional chemists to be members of its sugar laboratory research staff. Dr. C. S. Hudson, who has done a great deal of work on rare sugars and organic chemical research in connection with these substances, will join the bureau organization shortly to continue his researches in this field. The Corn Products Refining Co. has appointed Dr. H. Berlin as a research associate in this same organization. He will be engaged on physical chemical research in connection with starch and its hydrocarbon derivatives. The work of this section of the bureau is directed by Dr. F. J. Bates.

Appraisers Sustain Protest on Soap

Perfumed toilet soap, assessed at 40c. per lb. and 60 per cent ad valorem under paragraph 48 of the tariff act of 1913, should have been assessed at the rate of but 30 per cent ad valorem under paragraph 66, according to an opinion just handed down by the Board of United States General Appraisers, sustaining a protest of Park & Tilford.

Rarer Chemicals Require Greater Protection

Applications for increases in duty on amino acids and rare sugars have been filed with the Tariff Commission by the Special Chemicals Co., Highland Park, Ill. No action has been taken by the commission.

Amino acids are included in the basket clause of paragraph 5 of the tariff act of 1922 at 25 per cent ad valorem. They are used to supply missing elements in certain foodstuffs and as medicinals. Rare sugars are in paragraph 504 of the tariff act at 60 per cent ad valorem. They are used principally in laboratory bacteriological tests.

While the total volume of each consumed in the United States is small, due to their uses, they are said to be highly important to medical science and the development of a domestic producing industry is viewed as of importance by military medical officers.

Germany is the principal competitor in the production of these acids and sugars. In the case of both, the protection given by the 1922 tariff act is described by the applicant as ineffectual. German rare sugars, for instance, are laid down in this country $25 per pound cheaper than the cost of production in the United States. The application asks that the duties be transferred from foreign valuation to American valuation, which would leave the figures in the act the same but would increase the duties several hundred per cent.

German Plant to Produce Synthetic Urea

A report from D. S. Haven, consul at Leipzig, states that during the war the Germans erected near Merseburg, in the Province of Saxony, the great chemical plant known as the Leuna Works. This establishment covers an area of approximately 1½ square miles and employs 18,500 men. It was designed for the purpose of extracting nitrogen from the air. This product was intended exclusively for agricultural purposes. Present plans are to devote a large portion of the plant to the manufacture of synthetic urea by the Haber and Bosch processes. It is probable that the urea will be converted into the nitrate of urea containing 46.6 per cent of available nitrogen, which the Germans claim will be the principal source of nitrogen in the fertilizers of the future.

Resin Found in Mexico

A report from Mexico City announces the discovery of a new resin in Mexico. This resin is said to be suitable for commercial purposes and is taken from a tree known by the name of "Cuapinole," found in the tropical zone of Mexico. When analyzed the resin was found to be of such quality that it can be used in the manufacture of the finest varnishes. One of the features of this new resin is that it is not soluble in either alcohol or gasoline.

Trade Notes

The J. A. & W. Bird Co., Boston, Mass., has been formed under state laws with a capital of $200,000, to succeed to and expand the plant and business of the company of the same name, with offices at 88 Pearl St. The company specializes in the manufacture of glue, floor oils, etc., and the new charter provides for the production of chemicals, paper products, etc. Reginald W. Bird is president; John B. A. Regnier, vice-president; and Adrien E. Regnier, treasurer.

A receiver has been appointed for the Joslin Schmidt Co., Cincinnati, O., manufacturer of chemicals and fertilizer, on application of the American Oak Leather Co. Liabilities are stated as approximately $400,000, and assets $1,290,000 "depreciated valuation."

The American Can Co. will build two large additions to its plant at San Francisco. The improvements will include a manufacturing and storage building as well as an office building.

H. A. Forbes, 81 Fulton St., New York, has been designated as agent of the recently formed Potash Importing Co. of America, which is a Delaware corporation.

A special meeting of the Paint, Oil and Varnish Club of New York has been called for June 26. The meeting will be held during and in connection with the annual outing of the club and will be held for the purpose of considering applications for membership.

George S. Whitty, chemist for 28 years at the Brooklyn plant of Devoe & Raynolds Co., Inc., resigned on June 1 to take charge of production for the Amalgamated Paint Co., Jersey City, N. J.

The erection of a refinery and the mining of asphalt at Flint, Ala., is contemplated in the near future by the Southern Rock Asphalt Co., according to an announcement made by L. D. Powell, Alabama manager of this concern. At present Mr. Powell is directing a series of "core-drilling" tests near Flint and stated that several samples of the Alabama asphalt had been analyzed and found to be even richer than the Kentucky deposits owned by the same company.

Henry H. Stiller, formerly with the Superfos Co., is now associated with the Wishnick-Tumpeer Chemical Co., in the capacity of manager of the New York office which has been opened at 130 West 42d St.

The Scientific Chemical Co., 141 West 36th St., New York, has been petitioned into bankruptcy. Susan Brandeis has been appointed receiver.

During April Singapore exported 4,500 long tons of refined tin, of which the United States took 68 per cent.

Germany's Zinc Dust Industry Explained by Commissioner Grey

Uses of This Commodity, Imports, Exports, Producing Firms and Interesting Sidelights in His Report

AN INVESTIGATION made with the co-operation of chemical engineers, brokers in chemical products and consumers of zinc dust, as well as with the aid of technical periodicals and handbooks, has yielded information with regard to zinc dust which is of considerable value to the industry in this country.

This product is extensively manufactured in the United States, Great Britain, Germany, Belgium, Holland and Australia. The commercial product is generally impure and contaminated with lead, iron and cadmium, as well as with zinc oxide. The so-called pure product is made by a very limited number of firms in Germany and contains a varying percentage of zinc oxide. The price is adjusted according to the oxide content.

Recent official import and export statistics are available only for the period covered from 1910 to 1912, inclusive, and 1920 to the beginning of 1923.

Germany's chief source of supply before the war was Belgium. The quantities imported from all sources gradually diminished to 650 tons in 1912. The figures rose to 1,238 tons in 1922, with Belgium being the origin of 459 tons and Polish Upper Silesia 667 tons. Before the Versailles treaty what is now Polish Upper Silesia was part of Germany, and products originating there were not considered imports. At the present moment more than 50 per cent of the imports are from that source.

The imports as officially published appear below:

Country of Origin	1910	1911	1912
Belgium	920 4	687 3	514 6
Austria-Hungary	226 1	79 9	119 7
Polish Upper Silesia	.	.	. .
Other countries	.		.
Total metric tons	1284 6	787 9	650 6
Value million marks	0 578	0 378	0 338

Country of Origin	1920	1921	1922
Belgium	.	. .	458 9
Austria-Hungary			
Polish Upper Silesia	.		666 6
Other countries		.	112 5
Total metric tons	65.1	30 8	1238 0
Value million marks	.	0 123	323 0

U. S. Formerly Heavy Buyer

Before the war the United States was Germany's heaviest buyer of zinc dust, but as the home production in America rose from 69 tons in 1910 to 11,339 tons in 1920, the exports to the United States dwindled to 1,030 tons in 1912, with no figures given thereafter. A resumption of statistics occurs in 1920, but for that year and for 1921 the exports of zinc dust are merged with those of zinc oxide (Zinkgrau and Zinkasche). There is no special grouping of the United States as an export outlet after 1912, the only practical inference being that it is included in the group of "other countries."

In 1922 Germany exported only 603 tons, which is less than 14 per cent of the 1912 record. Deducting this quantity from her total imports of 1,238 tons during the same year leaves 635 tons for her home consumption, a figure significantly close to the 666 tons which Germany imported that year from Polish Upper Silesia, part of her former empire.

It is interesting to follow the suggestion of the loss to Germany of the resources of this commodity as represented in the separation of Polish Upper Silesia. In 1910 Germany exported 1,806 tons more of zinc dust than she imported. The source of this overplus was unmistakably what is now Polish Upper Silesia and the Aix-la Chappelle region, occupied by the Belgians under the Versailles treaty. The suggestion is strengthened by the figures for 1911, when the exports overbalanced the imports by 3,161 tons and in 1912, when the same item was 3,696 tons. The situation may be studied with more exactness by consulting the export table below:

Country of Destination	1910	1911	1912
Belgium	203 3	154 5	535 4
Denmark	30 4	103 6	83 4
Great Britain	660 2	609 8	833 4
Netherlands	150 6	171 8	700 8
Austria-Hungary	246 3	325 8	327 4
Switzerland	107 3	164 5	39 0
British So. Africa	1 0	132 9	93 4
China	34 7	108 7	158 2
Mexico	11 5	393 7	82 0
U. S. A	1435 2	1359 5	1030 4
Japan			. .
Sweden			. .
Other countries	(a)		
Total metric tons	3091 2	3949 1	4346 7
Value in thousands of marks	1,391	1,853	2,040

Country of Destination	(b) 1920	(b) 1921	1922
Belgium	572 5	49 6	.
Denmark			
Great Britain			
Netherlands	1915 7	1630 8	207 7
Austria-Hungary	109 2	138 1	.
Switzerland			.
British So. Africa			
China			48 5
Mexico			.
U. S. A	.		. . .
Japan			63 4
Sweden	694 4	80 1	. . .
Other countries	969 4	921 5	283 9
Total metric tons	4261 2	2820 1	603 5
Value in thousands of marks	19,254	15,988	100,717

(a) The totals of German exports are not always the aggregates of the component items, but should be preferred to any true sum of the detailed items. Exporters make their entries in the export declarations and these are relied upon in making up the individual items. However, the totals recorded at the end of the year represented the exact aggregate shipped out of the country.

(b) The figures for 1920 and 1921 include both zinc dust and zinc oxide.

Among the manufacturers in Germany producing pure material there are the following: Kahlbaum, Adlershof-Berlin; Merck, Darmstadt; Schuckert, Gorlitz; Hohenlohenhuette, Upper Silesia; Gische's Erben, Breslau.

In England the main manufacturers are: H. S. Willcocks & Co., Manchester; Keeling's Oxides (est. 1921), Ltd., 35 Surrey St., London, W. C.; May & Baker, Battersea, London; Prescott & Co., Rutland Mills, Hulme, Manchester.

News Notes

Harvard University is to have a new chemical laboratory. A gift of half a million dollars from Edward Mallinckrodt, Sr., of St. Louis, is to be used for the new building. Three such buildings are regarded as necessary to provide ample laboratory facilities at the university.

Henry Ford has recently acquired the right to utilize the High Dam on the Mississippi for a period of 50 years. It is understood that Mr. Ford is planning to manufacture storage batteries for his cars at his St. Paul plant, which is near the dam. The estimated output of the plant is 6,000 batteries per day.

The Swedish glass industry, which has suffered much through foreign competition, is now recovering and activity is being resumed at most works. Both window and plate glass plants are affected. A few of the smaller establishments which rose during the war have not opened up and, according to a Reuter dispatch, probably never will.

Formulation of standards, specifications and tests for purchases of materials is being sought by the Department of Commerce at the request of state agents and representatives of private institutions. Meeting in Washington on June 11, delegates from all interested technical and business associations along with agents from 26 states conferred with Secretary Hoover with regard to the matter.

Natural gas can flow across state lines whether or not the government of the state which contains its source decrees that it may. A decision to this effect was arrived at in a verdict rendered by the Supreme Court on June 11. Ohio and Pennsylvania thereby lost a case presented against the state of West Virginia.

The soft drink industry is the United States is assuming tremendous proportions. Approximately 4,000,000,000 bottles of beverages so classed are being consumed annually. This industry is creating a large market for carbon dioxide, tartaric, citric or phosphoric acid and artificial fruit sirups.

Germany's unmined potash resources contain two billion tons of K_2O, an estimate recently published by the German Foreign Office states. This is apart from about 300,000,000 tons of K_2O in the unmined Alsatian deposits.

The oxygen enrichment committee, of which M. H. Roberts is chairman, met in the office of Dorsey A. Lyon, assistant director of the Bureau of Mines, on June 9. The committee spent the day reviewing the report submitted by F. W. Davis. The report deals with the use of oxygen or oxygenated air in metallurgical and allied processes. Before publication, the report will be submitted to the industry for criticism or suggestion.

All necessary funds have been secured for the construction of a ceramics building at the Georgia School of Technology, Atlanta, and work will be placed in progress at an early date. The structure will be the first institution of its kind in the South.

The Franklin Institute, Philadelphia, Pa., has commenced the remodeling of four old structures at 19th and Race Sts., to provide a new research laboratory department at the institution. The work will be carried out under the direction of the Henry W. Bartol Research Foundation of the Institute, and complete equipment will be installed for general research in the field of physical science. A total of twenty individual laboratories will be provided for experimental research. It is expected to have the extensions ready for use when the institute celebrates its one hundredth anniversary early in the fall.

Plans for 1923 Exposition Taking Shape Rapidly

The 1923 chemical industries exposition may be turned into a huge "buying fair" if plans discussed by the advisory committee on June 6 develop. The central idea of the scheme is to have each exhibitor display his goods in a novel manner so worked out that it will demonstrate their particular characteristics, special uses and selling points. Full sales forces of those having exhibits would be present, according to the plan, in order to attend joint as well as company conferences. Contacts resulting from such conferences were pointed out to be very desirable.

Major H. S. Kimberly, who has charge of the educational exhibits this year, provided a tentative report at the meeting. The chief object of the exhibits will be to demonstrate to the business man what chemicals can do and are doing, and, so far as possible, the place of chemistry in business. Kitchen and food chemistry are not to be neglected. Both the Chemical Warfare Service and the Bureau of Chemistry are planning exhibits for educational purposes. The actual educational work, which is to be carried in the form of a practical course in chemistry and chemical engineering, is to be in charge of Dr. W. T. Read of Yale University. Authorities in various branches of the science are to give the lectures which will cover the entire week of the exhibition.

Announcement was made at the meeting on June 6 that there will be a joint meeting of the advisory committee with all exhibitors on June 28. Those present at the last meeting included Dr. Charles H. Herty, chairman; Raymond F. Bacon, John W. Boyer, Henry Howard, Percy C. Kingsbury, T. C. Oliver, R. P. Perry, Charles F. Roth, H. J. Schnell, C. Wadsworth, T. B. Wagner, R. Gordon Walker and Milton C. Whitaker.

Southern California A.C.S. Elects Officers

At the May meeting of the Southern California Section of the American Chemical Society, held at Los Angeles on May 24, the following officers were elected for the ensuing year: President, Walter A. Schmidt; vice-president, Dr. W. C. Morgan; secretary, Mark Walker; treasurer, C. J. Martin; councilors, Dr. S. J. Bates, H. L. Payne and E. R. Miller. Mr. Payne was elected chairman for a second term. The secretary reported that the average attendance at the dinners held during the past season was 103, and the average attendance at the lectures was 144.

After the business meeting the following papers were read and discussed: Dr. I. Grageroff, "Fundamental Problems in Biological Chemistry"; Dr. H. L. White, "Chemical Nature of Some Physiological Products"; Dr. M. C. Terry, "Relation of Chemistry to Medicine From the Standpoint of the Bacteriologist."

Explosion Study at Carnegie

A study of the factors causing mine explosions will be undertaken at Carnegie Institute of Technology, according to an announcement outlining a program of research on coal-mine problems. The study of mine explosion causes will be divided into investigations of (*a*) modification of Stokes law for settling of coal dust particles; (*b*) time-pressure relations in dust explosions; (*c*) conductivity and specific heat of coal; (*d*) static charges in coal mines; and (*e*) effect of electric field in propagation of explosions.

Six college graduates will be appointed to research fellowships to conduct the investigations in co-operation with the U. S. Bureau of Mines and an advisory board of Pittsburgh coal operators and mining engineers.

Steel Treaters Nominate

The following officers have been nominated for the American Society for Steel Treating for the coming year and nomination is substantially equivalent to election, as only a single candidate has been formally proposed for each office: For president, George K. Burgess, director, Bureau of Standards; for second vice-president, R. M. Bird, engineer of tests, Bethlehem Steel Co.; for treasurer, Zay Jeffries, metallurgist, Aluminum Co. of America; for member of board of directors, J. Fletcher Harper, research engineer, Allis-Chalmers Manufacturing Co.

New Calcium Arsenate Producer

The Salt Lake Insecticide Co., of Salt Lake City, Utah, is now producing calcium arsenate, and shipments of carload lots are being made to the cotton states of the South. The distribution of the company's product has been placed in the hands of Howard W. Ambruster, 261 Broadway, New York, as exclusive sales agent.

Facts and Figures That Influence Trade in Chemical Products

Market Conditions

Current Prices Imports and Exports The Trend of Business

Improved Inquiry for Chemicals Early in Week but Interest Not Sustained

Domestic Products Fairly Steady in Price With Foreign Offerings Feeling Effects of Forced Liquidation

DIFFERENT sellers reported an improved inquiry for chemicals in the first half of the week, but later on buying interest lagged and the market closed in a quiet condition. Some of the large consuming trades are going on summer schedule and reports from the tanning and textile industries especially indicate a slowing up in operations. This has the effect of retarding inquiries for forward deliveries and makes trading for prompt and nearby positions more important.

The weighted index shows a fractional decline for the week but this was due to weakness in imported materials and a lower selling price for linseed oil. Important domestic chemicals were practically unchanged in price during the period and large amounts are passing against old contracts. Prussiates of foreign make have maintained a downward course and new lows were reached for both the soda and potash varieties. Imported copper sulphate was very weak at the close of the previous week and this weakness was carried into the current period but distressed lots were gradually absorbed and prices reacted from the low level. Domestic copper sulphate has sold freely despite the competition from imported.

Export demand for chemicals has been very moderate, and caustic soda has been forced to meet with competition which forced sellers either to lower prices or to remain out of competition. Some export inquiry is heard for bichromate of soda, but nothing like the volume noted earlier in the year.

Arsenic and calcium arsenate hold a position of prime interest, but the week was devoid of new developments and outside of a general expectancy that demand will suddenly improve, there is little to note. Prices are easy, but most holders are waiting to see if stocks on hand will be needed and are slow to force matters. It is admitted by many that prices will show a decided trend one way or the other within the next two weeks.

Acids

Acetic Acid — Several consuming trades are reported to be buying in fair volume and stocks have been well absorbed. New outlets are said to have been developed especially for the lower grades. Prices are on a steady basis with quotations at \$3.38@\$3.63 for 28 per cent; \$5.48@\$5.75 for 30 per cent; \$12@\$12.75 for glacial.

Boric Acid—Sellers say that prices already are so close to production costs that further declines are improbable. Demand has been good and evidently buyers have been impressed by the low level of prices. Export business also has been stimulated while imports of crude material are a factor in increasing selling competition. Prices for powdered and crystals are 10@10½c. per lb., in sacks, with kegs at 11@11½c. per lb.

Citric Acid — Weather conditions again have not favored active buying but in some quarters better interest has been reported. Spot material is meeting with some price cutting as a few holders are eager to move stocks. The open figure for spot offerings is 52c. per lb., but sales have been made under that level. Domestic grades are held at 49@50c. per lb., but stocks of domestic are well sold ahead.

> **Prussiates Reach Lower Price Levels—Imported Copper Sulphate Firmer—Caustic Soda for Export Lower—Permanganate of Potash Very Weak—Arsenic Waiting for Improved Demand—Imported Tartaric Acid Easy—Resale Lots Weaken Nitrate of Soda.**

Hydrofluoric Acid—There is no activity in the present market but sellers say this is a seasonable condition. Prices are easier but this fails to arouse consuming interest. Quotations are 6@7c. per lb. for 30 per cent; 10@11c. per lb. for 48 per cent; 13@14c. per lb. for 60 per cent.

Oxalic Acid—The importance of imported grades is seen from the fact that in April last year only 18 lb. came into this country whereas in April this year there were imports of 129,737 lb. Chief interest still centers in imported offerings with prices varying from 13c. to 13½c. per lb. according to seller. Domestic acid is held at 13½c. per lb. at works.

Sulphuric Acid—As confirmation of the sold up condition of domestic producers in recent months it is noted that in April imports of sulphuric acid amounted to 3,402,917 lb. as compared with nil in April 1922. Buying is not as heavy as formerly but movement to consumers is large enough to hold stocks at low levels. Prices are steady at \$9.50@\$12 per ton for 60 deg. and \$15@\$16 per ton for 66 deg. in tanks. Oleum is in limited supply and \$19@\$20 per ton is quoted for tanks, f.o.b. works.

Tartaric Acid—The position of domestic has undergone no change and the open market price is held at 37½c. per lb. Imported has been on the market in larger volume and prices have weakened under selling pressure. Sales are said to have been closed at 35½c. per lb. on spot and it was stated that this figure could still be done.

Potash

Bichromate of Potash—Reports from the large consuming trades indicate lessened activity and this is reflected in the market for bichromate. In some quarters prices are quoted as firm at 11½c. per lb. and upward according to quantity but there is not much trouble in locating stocks at 11¼c. per lb. and the latter is regarded as an actual trading basis.

Caustic Potash—While some sellers say that 7½c. per lb. could have been done throughout the week, others were inclined to hold above that level and 7¾c. per lb. is quoted in different directions. Shipment prices also are given at 7¾c. per lb. but buying is not in evidence and this is regarded as a bar to any sustained firmness in price. Domestic caustic is maintained at 9c. per lb., works.

Carbonate of Potash—Stocks have been reduced by recent transactions but inquiry is dull and it still is a buyers' market. Large lots are not moving but scattered trading is reported for smaller amounts with 80-85 per cent quoted at 6½@6¾c. per lb. Hydrated 80-85 per cent is steady at 7¼@7¾c. per lb. On offerings of 90-95 per cent 6¾c. per lb. can be done and on 96-98 per cent 7@7¼c. per lb. is asked.

Cyanide of Potash—There has been very little call for this material in recent weeks and business has been confined to jobbing lots. Prices are irregular with a range according to seller, the inside price being 47c. per lb. and up to 50c. per lb. is asked.

Permanganate of Potash—The position of permanganate is shown by the fact that sales were made last week

at 17c. per lb. whereas 19c. per lb. is quoted by many holders of stocks. Irregularity in price has been a feature for some time and there is no indication that the market is approaching a more stable position. As a matter of fact distressed lots were said to have changed hands last week at 16c. per lb. which emphasizes the difference in views of sellers. Some of the material held on spot is said to have originally cost from 18½c. to 21½c. per lb. to import.

Prussiate of Potash—Yellow prussiate was one of the weak selections on the market. Buyers have been holding off and sellers have pressed matters with the result that values weakened and spot material was offered as low as 31c. per lb. The price ranged from this level up to 35c. per lb. but the latter figure was purely nominal.

Sodas

Bichromate of Soda—In spite of reports of differences in price according to seller, competition is keen enough to hold values on an even basis and 8½c. per lb. is regarded as a general price for carlots at works. Demand is not heavy but sellers say large amounts have passed on contracts and new business has been satisfactory. High cost of production is still heard as a steadying factor on prices and as surplus stocks are unusually light the market seems to be in a healthy condition.

Bisulphite of Soda—A quiet week was reported for both powdered and liquid. Consumers are buying only for current needs and this confines transactions to jobbing quantities. Prices are given at $1.40@$1.50 per 100 lb. for liquid and $4.25@$4.50 per 100 lb. for powdered.

Caustic Soda—Export business has fallen off to such an extent that it is difficult to quote a definite figure as representing the market. On outside brands $3.18¾ per lb. was heard but no business was reported at that price and with actual business in sight it is possible that lower prices could be worked. Open quotations were placed at 3.20c.@ 3.25c. per lb., f.a.s. On standard brands 3.35c. per lb. is still held as an open asking price but it is admitted that business is impossible at that level and it would require definite bids to determine just how much the quotation will be lowered on actual business. The domestic branch of the trade is fairly good with 2½c. per lb. asked for carlots, f.o.b. works. Spot material also is holding unchanged at 3½c. per lb. and upward according to quantity.

Cyanide of Soda—A lot of 25 tons now afloat was offered at 21c. per lb. Low priced lots on spot appear to have been cleaned up and 22c.@23c. per lb. was asked for spot material. For nearby shipment from abroad it was possible to do 20c. per lb. but this was qualified by the statement that this price was subject to cable confirmation.

Nitrate of Soda—The market is suffering because of fairly heavy offerings and little disposition on the part of buyers to operate. Resale lots are making the market price and spot goods can be secured at $2.45 per 100 lb. In Southern markets supplies are heavier than in the North and $2.40 per 100 lb. is given as the trading basis. There has been no change in the schedule price for future shipments from Chile but interest is not keen at present in forward positions. Refined nitrate is quiet with prices at 4¼@4½c. per lb. for granulated and 5¼@5½c. per lb. for powdered.

Nitrite of Soda—Imported nitrite held a weak position and the recent reduction to 7¾c. per lb. for spot goods still held good with the market barely steady at that figure. Domestic goods also were said to be available at the 7¾c. level but 8c. per lb. was generally held as the asking price.

Prussiate of Soda—Sentiment was bearish and prices moved accordingly. The trend of value has been steadily downward and it appears as though a market is sought for imported irrespective of price. Prices for spot material were as low as 14¾c. per lb. and the lowering of prices failed to bring out any appreciable gain in buying. For shipment over the last half of the year, there were sellers at 14½c. per lb. but this price also failed to attract orders.

Miscellaneous Chemicals

Arsenic—Feeling that demand will improve appears to have gained ground but there was no marked improvement last week and prices remain irregular. Domestic producers quote prompt shipment at 13½c. per lb., but this has no bearing on the spot market as the domestic output is passing direct to consumers. In the spot market, however, it was possible to find sellers at 13½c. per lb., and from that level up to 14½c. per lb. is asked. On shipments over the last half of the year domestic producers quote 11c. per lb. Japanese grades are offered at 11½@11¾c. per lb. and European makes at 10½c. per lb. Import figures show that 1,476,066 lb. of arsenic came in during April as compared with none in April last year.

Calcium Arsenate—The market is in a waiting position. So far demand has not materially improved. Unsold stocks are large and it is a question whether buying or selling will set in first. Prices are quoted around 16c. per lb., but on firm business this might be shaded.

Copper Sulphate—Distressed imported material has been disposed of and the market presented a slightly firmer appearance on spot goods. Early in the week some business went through at 4½c. per lb., but later bids at this figure were turned down. Asking prices on foreign goods on spot settled at 4⅞@5c. per lb. Imported sulphate for shipment was nominal at 4¾c. per lb. Domestic producers reported the market as unchanged. Large crystals settled at 5.75c. per lb., with the small crystals at 5.65c. per lb., carload basis.

Pyridine—Cables from abroad were higher and with little on spot prices at the close were strong. Importers refused to quote less than $4 per gal., in drums, forward delivery.

Metal Salts—The market for tin was easier, but not so as to bring out a lower trading level in tin oxide. Leading factors held out for 48c. per lb. Tin crystals were unchanged at 34½c. per lb. Nickel sales were inactive, but with no change in the metal situation prices were repeated on the basis of 11½c. for the single. Imported copper oxide was steady at 20@21c. per lb., with inquiry fair.

Barium Chloride Offerings in some directions were freer and this brought out an easier feeling in the market. However, prices are considered low and no real pressure developed. On carload business it was possible to do $80 per ton, prompt shipment. On less than carload lots $83 represented the market.

Sal Ammoniac There was some question about quality on some of the goods offered during the past week or so, and several traders were not disposed to follow in marking prices downward. Imported material did sell as low as 6c. on the recent break, but at the close last week operators were asking from 6¼@6¾c. per lb. on standard goods.

Alcohol

Several small shipments of denatured alcohol arrived here from the West Indies. The market was a steady affair so far as the domestic producers were concerned, demand being satisfactory, especially in the special grades. Formula No. 1, special, held at 35c. per gal., in drums, and 41c. per gal., in barrels. The completely denatured, formula No. 1, was offered by leading interests at 43c. per gal., in drums. Ethyl spirits, U.S.P., 190 proof, was nominally unchanged at $4.70 per gal., in barrels. Butyl alcohol, in drums, f.o.b. works, held at 26@27c. per gal. Production of methanol in April amounted to 738,059 gal., which compares with 831,784 gal. in March. The market was unchanged but steady at $1.18@$1.20 per gal., the price depending upon the grade.

Higher Prices for Potash

A Reuter's despatch from Berlin states that the Reich Potash Council has decided to increase the prices of potash by 45.72 per cent as from June 1.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	177.88
Last week	178.17
June, 1918	272.00
June, 1919	229.00
June 1920	274.00
June, 1921	147.00
June, 1922	157.00

An easier feeling prevailed and the decline in spot linseed oil was a factor in lowering the index number 29 points.

Coal-Tar Products

Phenol on Spot Offered Down to 42c.—Naphthalene Unsettled—Benzene Moving Slowly—Salicylates Quiet

PRODUCERS reported no price revisions, but second-hands offered spot material in a more liberal way and in order to move goods were disposed to meet the views of prospective buyers. The volume of business placed last week was disappointing. In the case of phenol the talk of increased production has restricted buying to a minimum. Actual offerings were not large, either for prompt or nearby shipment, but lack of buying interest again forced prices to lower levels and resale parcels could have been picked up at 42c. per lb. Leading producers, on the other hand, were not anxious sellers of nearby material. Cresylic acid was available on spot at slight concessions. The benzene situation was not considered favorable from the producers' standpoint, due chiefly to the low position of gasoline, but first-hands saw no reason for forcing sales, believing that the motor fuel market should improve from now on. Inquiry was reported for pure xylol. A small shipment of this commodity arrived here last week from abroad. Naphthalene demand showed moderate improvement, but offerings were plentiful and prices continued rather easy. Salicylates were unchanged.

Alpha-Naphthol—Prices named covered a wide range, depending upon the make. But actual trading was along routine lines and some selling pressure in outside channels unsettled the market. On the crude prices ranged from 60@70c. per lb.

Aniline Oil—Offerings were freer, but leading interests continued to quote on the basis of 16c. per lb., prompt shipment from works. On forward business it was possible to do slightly better, where round-lots were concerned.

Aniline Salt—Most traders held out for 23c. per lb., prompt shipment. This price was not firm, and scattered lots were available at concessions.

Benzoic Acid—A moderate inquiry was in evidence for the U.S.P. grade and prices steadied. For spot material asking price ranged from 77@80c. per lb. On forward business 72c. was the nominal quotation. The technical held at 70c. per lb. Offerings were light.

Benzaldehyde — Leading producers continued to quote the market steady at 75c. per lb. The stocks on hand were considered light, which offset temporary quietness in trading. The customary premium obtained on the U.S.P. grade.

Benzene—Offerings of the 90 per cent grade were plentiful, and with business anything but brisk, prices in some quarters presented an easier feeling. Leading interests, however, continued to quote on the basis of 25c. per gal., tanks, f.o.b works. The pure, in tanks, for prompt shipment, closed at 27c. per gal.

Cresylic Acid—Several small shipments arrived from English ports. There was no buying interest in the imported material for shipment from the other side. Scattered lots of spot goods could have been picked up below the prevailing cost of import. The 97 per cent sold down to $1.10 per gal. In general traders held out for $1.15. The lower grade was nominal at $1.05@$1.10 per gal.

Naphthalene—Moderate improvement was reported in flakes for immediate delivery, but with offerings fairly large, the market failed to steady. In fact it was possible to pick up scattered lots at concessions. During the week business went through at 8@8½c. per lb. The market for the crude was neglected and on English material for shipment offerings at 3@3½c. per lb., c.i.f., attracted little or no attention. On continental crude there were sellers around 2¾c. per lb., c.i.f. basis.

Paranitraniline — While the market settled at 70@75c. asked, as to make, scattered lots of spot goods did sell down to 68c. per lb. The demand was slow all week.

Phenol—The market was inactive and prices for spot material in outside channels were considered little more than nominal. Some traders continued to quote around 50c. per lb. on the U.S.P. grade, but admitted that better could have been done in other directions. Several parcels of resale material were around at 42c. per lb., a new low for the movement. Buyers were disposed to operate in a hand-to-mouth way only, believing that enough new production will come out by this fall to put the market on a fairly normal trading basis. Leading interests would not name a flat price on nearby material, but intimated that business might be acceptable around 30c. per lb.

Salicylic Acid—The demand was inactive, but no further price revisions were named by producers. Quotations settled nominally at 40@45c. per lb. on the U.S.P. grade.

Solvent Naphtha—A firm undertone featured the market as the supply was inadequate and producers could not see their way clear to bring out larger supplies in view of the peculiar marketing conditions in coal-tar crudes. The water-white held around 27@32c. per gal., tank car basis, f.o.b. works.

Xylene—Some buying interest was reported in the pure material, but with offerings scanty, the market for spot goods was wholly nominal, ranging from 95c.@$1 per gal. On contract 75c. could have been done.

Financial Notes

Merck & Co. have declared a dividend of $2 per share on the preferred stock of the company, payable July 2 to holders of record June 16. This is the first dividend on the issue since July 1, 1921.

The Tennessee Copper & Chemical Corp. has declared a regular quarterly dividend of $25 a share, payable July 16 to stock of record June 30.

The Dominion Textile Co., Ltd., of Montreal, has declared the regular quarterly dividend of 1¾ per cent on preferred stock and $1 per share on common stock. Three months ago a dividend of 3 per cent was declared on the common stock.

The Vulcan Detinning Co. reports for the quarter ended March 31 last net profit of $67,705, after charges and taxes, against $21,442 in the first quarter of last year. Sales amounted to $544,143, against $308,460, and expenses $435,226, against $291,433.

Latest Quotations on Industrial Stocks

	Last Week	This Week
Air Reduction	65	65
Allied Chem. & Dye	71	69½
Allied Chem. & Dye pfd	109½	109½
Am. Ag. Chem.	18¾	16½
Am. Ag. Chem. pfd	45	43½
American Cotton Oil	8	7½
American Cotton Oil pfd	17	*16
Am. Drug Synd.	5½	5⅝
Am. Linseed Co.	25	22½
Am. Linseed pfd.	47	43
Am. Smelting & Refining	62	62½
Am. Smelting & Refining pfd.	97¾	97½
Archer-Daniels Mid. Co., w i.	33½	33
Atlas Powder	170	170
Atlas Powder pfd.	*90	87½
Casein Co. of Am.	*60	*60
Certain-Teed Products	38	*38
Commercial Solvents	28	30
Corn Products	132½	131½
Corn Products pfd	118	116½
Davison Chem.	30	29¾
Dow Chem. Co.	46	*42
Du Pont de Nemours	128	121⅞
Du Pont de Nemours db.	87½	85⅝
Freeport-Texas Sulphur	13¾	13⅝
Glidden Co.	8	7½
Grasselli Chem.	133	133
Grasselli Chem. pfd	104½	105
Hercules Powder	105	103
Hercules Powder pfd	105	103
Heyden Chem.	1¾	2½
Int'l Ag. Chem. Co.	4⅝	4½
Int'l Ag. Chem. Co. pfd	15¾	14
Int'l Nickel	15	14½
Int'l Nickel pfd	80½	84⅝
Int'l Salt	*90	*90
Mathieson Alkali	49	47
Merck & Co.	87	*87
National Lead	123½	119
National Lead pfd	112	112
New Jersey Zinc	162	157
Parke, Davis & Co	77½	78
Pennsylvania Salt	88	85
Procter & Gamble	*140	*130
Sherwin-Williams	*29	29
Sherwin-Williams pfd	*101	*102
Tenn. Copper & Chem.	*9⅝	9⅝
Texas Gulf Sulphur	60¾	59½
Union Carbide	59⅝	56⅝
United Drug	81⅝	80½
U. S. Industrial Alcohol	56½	54½
U. S. Industrial Alcohol pfd	98	*102
Va.-Car. Chem. Co.	10	9⅝
Va.-Car. Chem. pfd	27⅝	26

*Nominal. Other quotations based on last sale.

Vegetable Oils and Fats

New Crop Cottonseed at 7c. f.o.b. Mills—Spot Linseed Lower—Palm Oils Decline—Soya Easier on Coast

PURCHASING AGENTS took the stand that the outlook favored buyers and with new crop developments in cotton and flaxseed gaining in importance as market factors operations during the week were held down to a minimum. Some speculative transactions in new crop cottonseed oil took place, but these did not assume large proportions and most traders were inclined to fight shy of this class of business. Spot linseed was easier on reports that several crushers have caught up on deliveries.

Cottonseed Oil—Trading in cottonseed oil options on the Produce Exchange was inactive. Early last week the July option firmed up on covering by shorts, but as soon as this demand was satisfied prices eased off. In futures the undertone was rather easy because of the uncertainty surrounding the new crop. The season is 2 weeks late throughout the South and reports on the new crop were not exactly encouraging. Private preliminary estimates on cotton production range all the way from 11,000,000 to 12,000,000 bales, a rather wide difference of opinion. Business in refined oil was moderate only, but with a tight statistical situation on old crop oil bears were inclined to go slow. Live hogs were unsettled on liberal receipts and Chicago reported the market at \$6.85@\$7.05 per 100 lb. Cash lard in Chicago held around 11.20c. per lb. In the opinion of some traders cheap hogs and lard tend to offset the bullish statistics on cottonseed oil. Trading in old crop crude cottonseed oil was limited because of the scanty supply and the market settled at 10c. per lb., buyers' tanks, f.o.b. mills. Transactions in new crop crude of a speculative character were few and far between, but some business did go through at 7c. per lb., f.o.b. Texas points, November-December-January shipment. New crop October oil was offered at 8¼@8½c. per lb., f.o.b. mills, Texas. Bleachable for prompt shipment from the South was nominally unchanged at 10½c. per lb., buyers' tanks, f.o.b. mills. Lard compound in New York held at 13@13½c. per lb., carload basis.

Linseed Oil—Several crushers were in a position to quote on prompt carload business and this resulted in lower prices for nearby oil. On futures, however, the market appeared to be a little firmer as crushers were not disposed to force the market until a better survey of the world's seed situation is possible. The crop outlook in the Northwest is regarded as favorable and according to reports received here late last week seeding in North Dakota is still in progress. One operator went so far as to predict that the acreage figures, when available, will make the best showing in several years. Where the new crop is above ground the condition is said to be good. Argentine shipments continue at a liberal rate, but covering last week by July shorts revealed that the supplies must be in pretty firm hands. Indian offerings are being absorbed by the United Kingdom. Demand for linseed oil during the week was moderate only. Distressed foreign oil on spot was purchased by a crusher and this steadied the imported commodity. Domestic oil sold for prompt shipment at \$1.10 per gal., cooperage basis. July was offered at \$1.06 per gal., with August forward at \$1.03 per gal. Linseed cake for export was quiet, but quotably unchanged at \$34 per ton.

China Wood Oil—The market was quiet and prices at the close were barely steady. July shipment oil was offered at 26c. per lb., in bbl., carload lots, with futures available at 22@23c. per lb. There was no buying interest in futures.

Coconut Oil—One tank car of Ceylon type oil sold for prompt shipment at 8½c. per lb. On the coast the market held at 8@8¼c. per lb. for Ceylon type oil, sellers' tanks, prompt and forward shipment. Demand was dull. Copra was nominally unchanged at 4⅝c. asked, Manila sun dried, c.i.f. coast ports.

Olive Oil Foots—Several parcels were pressing on the market all week and this imparted an easy feeling and held prices down. There were sellers of prime green foots on spot at 8c. per lb. On futures the market settled at 8⅜@8½c. per lb., c.i.f. New York.

Palm Oils—Importations were heavy, but most of the oil went directly to soapers. New business was inactive, due in part to the low position of tallow. Resale material on spot sold at 7c. on the Lagos grade, and at 6⅝c. on Niger. Lagos for shipment was nominal at 7½c. per lb., while Niger for forward delivery settled at 6¾@7c. per lb.

Sesame Oil—There was a little trading in spot at 11⅞@12c. per lb. Refined oil for shipment was offered down to 11c. per lb., c.i.f. New York.

Soya Bean Oil—There were sellers of crude for future shipment from the Pacific coast at 9⅝c. per lb., sellers' tanks, duty paid. One car of spot oil sold at 10c. per lb., f.o.b. New York. Several large shipments are about due here, which tends to unsettle the market.

Fish Oils—Crude menhaden oil was quiet at 50c. asked. Reports on the fishing operations along the Atlantic coast were unfavorable. Some traders look for a "lean" year. Newfoundland cod oil was offered in a small way and prices held at 70@72c. per gal.

Tallow and Greases—Extra special tallow closed at 7½c. bid, with the market for outside goods equal to extra at 7⅝c. sales. The undertone was a shade firmer. Yellow grease sold at 6c. per lb., Chicago. Oleo stearine was offered at 9c. per lb., carload lots, New York.

Miscellaneous Materials

Glycerine—The market for c.p. glycerine on spot was unsettled, but most refiners continued to quote on the basis of 17c. per lb., in drums, carload lots. Trading was inactive and this resulted in freer offerings from factors not so bullish on the general situation. In some directions c.p. glycerine might have been picked up around 16½c. per lb. In the middle-west dynamite was offered at 15½c. per lb., in drums, carload basis. No sales were reported in New York territory and prices at the close were nominal. Soaplye crude, basis 80 per cent, sold in the middle-west at 10½c. per lb., loose. Saponification, basis 88 per cent, held at 11½c. in the middle-west, while in New York 12c. was asked, carload lots, loose.

Naval Stores—The market advanced early in the week on a showing of business, but as soon as the inquiry fell away prices eased off. At one time scattered business in turpentine went through as high as \$1.10 per gal. Just before the close there were offerings at \$1.06 per gal., with the undertone easy. Receipts in the South were considered liberal. Export demand was slow. In rosins not much business came to light and prices went off from 10@15c. per bbl. The lower grades closed nominally at \$5.80 per bbl.

Shellac—The market was a shade firmer, on higher cables from Calcutta, but not much business developed. The arrivals were heavy and this brought out some ex-dock selling at concessions. Nominally the market for T.N. settled at 59c. per lb., with the superfine orange at 64c. per lb., and bleached bonedry at 72c. per lb.

Varnish Gums—The past week witnessed heavy importations of copals. Several shipments of damar also were noted. The spot offerings were liberal and it was possible to pick up supplies at concessions from the prevailing cost of import. Batavian damar settled at 27¾@28½c. per lb. Demand was routine.

White Lead, Etc.—Leading producers of white lead announced late last week that the guarantee against decline provisions in the sales contract would b extended until November 30. This new gave traders more confidence in the market and business held up well in all directions. Standard dry white lead held at 9¾c. per lb., in casks.

Zinc Oxide—The easier market for the metal had little or no influence upon prices for oxide. Producers appear to be well sold up and the old price schedule was maintained in all directions. American process, lead free, was traded in on the basis of 8c. per lb. French process, red seal, held at 9¾c. per lb.

London Tallow Auction

At the regular auction of tallow, held in London June 13, the offerings consisted of 1,685 casks. Sales amounted to 1,283 casks and prices realized were unchanged to 6 pence higher.

Imports at the Port of New York

June 8 to June 14

ACIDS—*940 bbl. tartaric, Grieste, Order, 650 bbl. tartaric, Trieste, Order; 53 dr. cresylic, Liverpool, W. E. Jordan & Bro., 62 dr. cresylic, Liverpool, Order; 40 keg tartaric, London, Order;* 100 csk. citric, Palermo, R. F. Downing & Co.; 400 csk. citric, Palermo, W. Neuberg; 100 csk. citric, Palermo, Order.

ALIZARINE—13 csk., Liverpool, A. Klipstein & Co.

ALCOHOL—50 bbl. denatured, Arecibo, M. Feigel Bros.; 55 bbl. do, Arecibo, C. Estevas; 52 csk. butyl, Bordeaux, Commercial Solvents Corp.; 55 bbl. denatured, Arecibo, G. Esteva.

ANTHRACENE—211 pkg. crude, Manchester, Order.

ANILINE OIL—3 bbl. Barcelona, Order.

ANTIMONY OXIDE—200 bg. Shanghai, Rare Metals Products Co.

AMMONIUM—60 csk. perchlorate, Marseilles, Order; 15 csk. carbonate, Liverpool, J. Turner & Co.; 25 pkg. do, Liverpool, Brown Bros. & Co., 20 keg persulphate, Liverpool, J. Turner & Co.; 720 csk. nitrate, Hamburg, Kuttroff, Pickhardt & Co.

ARSENIC—87 csk., Antwerp, Order, 150 cs., Rotterdam, Lundham & Moore; 101 bbl. Tampico, Am. Metal Co.; 33 dr. and 20 csk., London, C. Tennant Sons & Co.; 200 csk., Hamburg, Ore & Chemical Corp., 100 csk., Hamburg, A. J. Marcus, 100 bbl. arsenic, Tampico, Order.

ASBESTOS—701 bg., Southampton, W. D. Crumpton & Co.

BARYTES—363 bg., Bremen, New York Trust Co.; 300 bg. and 100 csk., Bremen, Order.

BRONZE POWDER — 14 cs., Bremen, B. F. Drakenfeld & Co., 22 cs., Hamburg, H. Pietzsch.

CALCIUM CHLORIDE—322 dr., Hamburg, Irving Bank-Col. Trust Co.

CASEIN—256 sk., Bordeaux, National City Bank; 532 sk., Bordeaux, Martin Cantine; 100 sk., Bordeaux, Order, 200 bg., Hamburg, Order; 88 bg., Hamburg, Order, 100 bg., Havre, Monite Waterproof Glue Co.; 174 bg., Hamburg, A. Klipstein & Co., 667 bg., Buenos Aires, Equitable Trust Co., 1,167 bg. Buenos Aires, Order, 350 sk., Auckland, Asia Banking Corp., 630 sk., Wellington, Bankers' Trust Co.; 417 bg., Buenos Aires, Irving Bank-Col. Trust Co.

CHALK—450 bg., Antwerp, Irving Bank-Col. Trust Co.; 200 bbl., Antwerp, Bankers' Trust Co.; 500,000 kilos, Dunkirk, J. W. Higman & Co.

CHEMICALS — 230 csk., Bremen, W. Schall & Co.; 18 csk., Bremen, Order; 270 csk., Rotterdam, Order; 18 cs., Hamburg, National Am. Bank, 50 bbl., Hamburg, Roessler & Hasslacher Chem. Co.; 249 pkg., Bremen, Roessler & Hasslacher Chem. Co.

COPPER SULPHATE—100 csk., Hamburg, A. J. Marcus; 74 csk., Liverpool, Order; 91 cs., London, Ore & Chemical Corp.

COPPER OXIDE 50 dr., Hamburg, Am. Metal Co.

COLORS — 32 csk. umber, Hull, L. H. Butcher & Co.; 215 sk. do, Hull, H. A. Robinson & Co.; 50 csk. dry, Hull, J. Lee Smith & Co.; 27 csk., Hamburg, Kuttroff, Pickhardt & Co.; 11 csk., Hamburg, H. A. Metz & Co.; 7 csk., Hamburg, E. C. Foster; 11 csk. dry, Hamburg, Palm Bros. & Co.; 2 csk. aniline, Rotterdam, L. & R. Organic Products Co.; 34 csk. earth, Rotterdam, C. J. Osborn & Co.; 17 csk do, Rotterdam, Reichard-Coulston, Inc., 2 csk. aniline, Liverpool, Irving Bank-Col. Trust Co.; 91 csk. coal-tar colors, Hamburg, Order.

COPRA—32 bg., San Andreas, Franklin Baker Co.

CREAM TARTAR—50 csk., Bordeaux, R. W. Greeff & Co; 25 csk., Bordeaux, Order; 100 csk., Marseilles, Brown Bros. & Co.

DYES—3 bbl. aniline, Danzig, Organic Products Co.; 2 cs. aniline, Hamburg, Franklin Imp. & Exp. Co.; 3 csk., Rotterdam, Bank of Manhattan Co.; 4 cs. aniline, Hamburg Carbic Color & Chemical Co.

DIVI-DIVI—540 bg., Pampatar, Eggers & Heinlein; 225 bg., Pampatar, Goldsmith & Co.; 656 bg., Curacao, Ultramares Corp.

EPSOM SALT — 1,000 bg., Bremen, E. Suter & Co.

FERRIC OXIDE — 152 bbl., Hamburg, Order.

FLUORSPAR—*170 tons, Cape Town, Order.*

FUSEL OIL—*35 bbl., Trieste, Continental Shipping Co., 14 bbl., Dunkirk, Eastman Kodak Co.; 29 dr., Hamburg, Order.*

GALLNUTS—400 cs., Hankow, Mallinckrodt Chem. Works, 500 cs., Souraboya, J. D. Lewis.

GAMBIER—161 bg., Singapore, Order.

GUMS—580 bg. copal, Antwerp, Order; 384 bg. damar and 128 bg. copal, Singapore, Chemical National Bank; 280 bg. damar and 140 bg. copal, Singapore, L. C Gillespie & Sons, 464 bg. copal, Singapore, Order; 1,430 bg. copal, Antwerp, Central Union Trust Co.; 640 bg. copal, Antwerp, Chemical National Bank, 965 bg. copal, Antwerp, Order, 15 cs. tragacanth, Southampton, Order, 60 pkg. tragacanth, London, Brown Bros. & Co.; 14 cs. do., London, Gullabi Gulbenkian & Co.; 250 pkg arabic, London, Order, 937 bg. arabic, Port Sudan, Brown Bros & Co., 1,275 bg. do., Port Sudan, Order; 1,560 sks. copal, Matadi, L. C. Gillespie & Sons; 3,198 sk. and 455 pkg., Matadi, Niger Co.; 385 bg. copal, 100 cs. do. and 350 bg. damar, Singapore, Baring Bros. & Co.; 140 bg. damar, Singapore, Standard Bank of So. Africa; 175 bg. copal, Singapore, Irving Bank; 240 bg. copal and 350 bg. damar, Singapore, L. C. Gillespie & Sons, 70 bg. copal, Singapore, Chem Nat'l Bank, 140 bg. damar and 214 bskt. copal, Singapore, Kidder, Peabody & Co.; 350 cs. damar, Singapore, Order.

GLYCERINE—25 dr., Marseilles, Brown Bros & Co; 90 dr., Marseilles, Order.

GLAUBER SALT—111 csk., Hamburg, E. M. Sergeant Co.

IRON OXIDE—38 csk., Hull, J. Lee Smith & Co., 65 bbl., Malaga, National City Bank; 228 bbl., Malaga, C. J. Osborn & Co, 200 bbl., Malaga, Am Exchange Nat'l Bank; 18 bbl., Malaga, F. B. Vandegrift & Co; 33 bbl., Malaga, L. H. Butcher & Co., 56 bbl., Malaga, E. M. & F. Waldo; 31 bbl., Malaga, J Lee Smith & Co.; 25 csk., Liverpool, R. J. Waddell & Co., 45 csk., Liverpool, J. A. McNulty; 53 csk., Liverpool, L. N. Butcher & Co.

LITHOPONE—600 csk., Antwerp, B. Moore & Co.; 200 csk., Hamburg, A. Klipstein & Co.

LOGWOOD CRYSTALS—12 bbl, Cape Haitian, Logwood Mfg. Co.

LOGWOOD EXTRACT—77 bbl., Cape Haitian, Logwood Mfg. Co.

MAGNESITE—313 bg., Rotterdam, Speiden-Whitfield Co.

MAGNESIUM—22 csk. sulphate, Manchester, Order; 528 dr. chloride, Hamburg, Innis, Speiden & Co.; 145 dr. do., Hamburg, A. Kramer & Co.; 113 bg. carbonate, Glasgow, E. M. Sergeant & Co.

MANGROVE BARK—2,600 pkg., Singapore, Order.

MYROBALANS — 2,600 pkt., Calcutta, National City Bank; 10,140 pkt., Calcutta, Standard Bank of South Africa; 12,000 pkt., Calcutta, Order.

NAPHTHALENE—663 bg., Antwerp, Order; 1,000 bg., London, Order, 1,416 bg., Rotterdam, Lunham & Moore.

OCHER—150 csk., Bordeaux, Order; 387 csk., Marseilles, American Exchange Nat'l Bank; 100 csk., Marseilles, J. Lee Smith & Co.; 91 cs., Marseilles, L. H. Butcher & Co.; 90 csk., Marseilles, F. B. Vandegrift & Co.; 46 bbl., Alicante, Hummel & Robinson.

OILS—Castor—105 bbl., Hull, Order. **China Wood**—330 bbl., London, Order; 30 bbl., Liverpool, Royal Bank of Canada; 108 bbl., London, Royal Bank of Canada; 150 bbl., London, Bank of America. **Cod**—120 bbl., Hull, I. R. Boody & Co.; 450 bbl., Hull, Order; 38 bbl., Antwerp, Order. **Fish**—100 bbl., Hull, I R. Boody & Co. **linseed**—300 bbl., Hull, Baring Bros. & Co.; 500 bbl., Hull, Order; 817 tons (bulk), Antwerp, Order; 301 bbl., Antwerp, Order; 603 tons (bulk), Hull, Am. Linseed Co.; 30 bbl., Rotterdam, W. Benkert & Co.; 289 dr., Rotterdam, Order; 329 bbl., Manchester, Order. **Olive Oil** (denatured)—25 bbl., Marseilles, Order. **Olive Oil Foots**—200 bbl., Naples, Brown Bros. & Co.; 150 bbl., Naples, Banca Comm. Ital.; 600 bbl., Seville, J. B. Dewsnap. & Co. **Palm**—720 csk., Opobo, Niger Co.; 400 csk., Abonama, Irving Bank-Col. Trust Co.; 160 csk., Port Harcourt, Thornett & Fehr; 280 csk., Port Harcourt, Niger Co.; 80 csk., Port Harcourt, Order; 725 csk., Warri, African & Eastern Trading Corp.; *406 csk., Warri, J. Holt & Co.; 163 csk., Warri, W. & A. Leaman; 323 csk., Lagos, Grace & Co.; 193 csk., Lagos, Irving Bank-Col. Trust Co.; 316 csk., Lagos, Niger Co.; 34 csk., Iddo, Niger Co.; 200 csk.,* Iddo, Order; 74 csk., Rotterdam, African & Eastern Trading Co.; 32 csk., Rotterdam, Order; 34 pipes, 14 tcs. and 211 bbl., Loanda Sousa, Machado & Co.; 3,252 csk., Matadi, Niger Co.; 62 csk., Cotonou, Irving Bank-Col. Trust Co.; 53 csk., Cotonou, Order. **Rapeseed**—150 bbl., Hull, Hudson Oil Co.; 175 bbl., Hull, Nat'l City Bank; 200 bbl., Hull, Balfour, Williamson & Co.; 550 bbl., Hull, Order. **Sesame**—147 bbl., Rotterdam, Nat'l City Bank; 293 bbl., Rotterdam, Order.

OIL SEEDS—Castor—104 bg., Port de Paix, Huttlinger & Struller; 39 bg., Port de Paix, H. Mann & Co.; 2,000 bg., Pernambuco, Central Union Trust Co.; 2,000 bg., Pernambuco, Baker Castor Oil Co. **Linseed**—131,122 bg., Buenos Aires, Spencer Kellogg & Sons.

OPIUM—12 cs., Constantinople, Order.

POTASSIUM SALTS—15 csk. carbonate, Bremen, P. H Petry & Co.; 1,000 bg. sulphate and 1,000 bg. muriate, Bremen, Potash Importing Corp. of America; 30 dr. permanganate, Hamburg, Pfaltz & Bauer; 1,000 bbl. chlorate, Hamburg, Order; 3,000 bg. muriate, Hamburg, Order; 3,646 bg. manure salt, Hamburg, Potash Importing Corp. of America; 500 bbl. chlorate, Marseilles, Asia Banking Corp.; 375 csk. chlorate, Marseilles, Order; 300 csk perchlorate, Marseilles, Order; 50 dr. permanganate, Hamburg, Du Dont de Nemours & Co; 236 csk. carbonate, Hamburg, Order; 2 dr. permanganate, Hamburg, Order; 5,500 bg. manure salt and 1 lot do., Hamburg, Order; 65 cs. caustic, Gothenburg, Merck & Co.

QUICKSILVER—26 flasks, Tampico, J. Elizondo; 30 flasks, Seville, C. L. Huisking, Inc.; 250 flasks, Seville, Du Pont de Nemours & Co.

QUEBRACHO—17,800 bg. extract, Buenos Aires, Tannin Corp.; 4,206 bg. Buenos Aires, Beekman, Winthrop & Chartman.

SAL AMMONIAC—88 csk., Hamburg, Philipp Bauer Co., 44 csk., Hamburg, Innis, Speiden & Co.

SHELLAC—50 bg. garnet lac, Hamburg, Irving Bank-Col. Trust Co.; 205 cs stick lac, Bangkok, Order; 163 csk. stick lac, Marseilles, Order; 300 bg., Calcutta, Chase National Bank; 232 bg., Calcutta, National City Bank; 1,225 bg refuse, Calcutta, Bank of the Manhattan Co.; 100 bg., Calcutta, London & Liverpool Bank of Comm.; 25 bg., Calcutta, Bank of America; 50 bg., Calcutta, Mechanics & Metals National Bank; 50 bg., Calcutta, Standard Bank of South Africa; 1,358 bg., Calcutta, Order; 112 cs., Calcutta, Order; 600 bg., Calcutta, First Nat'l Bank of Boston; 250 bg., Calcutta, Mech. & Metals Nat'l Bank; 200 bg., Calcutta, Br. Bank of So. Am.; 871 bg., Calcutta, Order; 30 bg., Hamburg, Kasebier-Chatfield Shellac Co.

SODIUM SALTS—300 bg. chlorate, Hamburg, Order; 110 bg. fluosilicate, Hamburg, Order; 49 cs chlorate, Venice, Order; 112 cs. cyanide, Marseilles, National City Bank; 120 csk hyposulphite, Marseilles, Order; 190 dr. caustic, Hamburg, A. Klipstein & Co.; 223 dr. sulphide, Hamburg, Order; 49 csk. fluoride, Hamburg, Order; 25 bbl. bicarbonate, Hamburg, K. A. Blank.

SUMAC—10 bg., Glasgow, American Dyewood Co.

TALLOW—500 pkg. vegetable, Hankow, American Linseed Co.; 190 tcs. beef, Vancouver, Van Iderstine Co.; 299 tcs. beef, Rio Grande do Sul, Swift & Co.

TANNING EXTRACT—700 bg., Beira, Cooper & Cooper.

TARTAR—39 csk., Naples, Tartar Chemical Works; 9 csk., Naples, C. B. Richard & Co., 578 sks., Marseilles. Tartar Chemical Co.; 110 pkg., Marseilles, C. Pfizer & Co.; 351 sk., Alicante, C. Pfizer & Co.

WAXES—600 bg. montan, Bremen, Order; 128 bg. bees, Antwerp, Order; 5 bg. bees, Santiago, Order; 79 bg. bees, Rio de Janeiro, London & Brazilian Bank; 150 bg. do., Rio de Janeiro; American Trading Co.

WOOL GREASE—100 bbl., Hull, Marden Wild Corp.

WHITING—1,000 bg., Antwerp, Bankers' Trust Co.

XYLENE—5 dr., London, Van Oppen & Co.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available. In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb.	$0 38	
Acetone, drums	lb	25 -	25½
Acid, acetic, 28%, bbl	100 lb	3 38 -	3 50
Acetic, 56%, bbl	100 lb	6 75 -	7 00
Glacial, 99½%, bbl	100 lb	12 00 -	12 50
Boric, bbl	lb	.10½-	
Citric, kegs	lb	.49 -	52
Formic, 85%	lb.	14 -	16
Gallic, tech.	lb	45 -	50
Hydrofluoric, 52%, carboys	lb	11 -	12
Lactic, 44%, tech., light, bbl.	lb	11½-	12
22% tech., light, bbl	lb	05½-	06
Muriatic, 18° tanks	100 lb	90 -	1 00
Muriatic, 20°, tanks	100 lb.	1 00 -	1 10
Nitric, 36°, carboys	lb	04½	05
Nitric, 42°, carboys	lb.	06 -	06
Oleum, 20%, tanks	ton	18 50 -	19 00
Oxalic, crystals, bbl.	lb.	.13 -	
Phosphoric, 50% carboys	lb	07½-	08
Pyrogallic, resublimed	lb	1 50 -	1 60
Sulphuric, 60°, tanks	ton	9 50 -	11 00
Sulphuric, 60°, drums	ton	13 00	14 00
Sulphuric, 66°, tanks	ton	16 00 -	16 50
Sulphuric, 66° drums	ton	20 00 -	21 00
Tannic, U S P, bbl	lb.	.65 -	.70
Tannic, tech., bbl	lb.	.45 -	.50
Tartaric, imp., powd, bbl.	lb	.35½-	36
Tartaric, domestic, bbl.	lb	.37½-	
Tungstic, per lb	lb.	1 10 -	1 20
Alcohol, butyl, drums, f o b works	lb.	.26 -	.28
Alcohol ethyl (Cologne spirit), bbl	gal.	4 75 -	4 95
Ethyl, 190 p'f U S P, bbl	gal	4 70	
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 190 proof			
No 1, special bbl	gal.	41 -	
No. 1, 190 proof, special, dr	gal	35 -	
No 1, 188 proof, bbl	gal	42	
No. 1, 188 proof, dr	gal	36 -	
No 5, 188 proof, bbl	gal	40 -	
No. 5, 188 proof, dr	gal	34 -	
Alum, ammonia, lump, bbl	lb	03½-	04
Potash, lump, bbl	lb	02¾-	03
Chrome, lump, potash, bbl	lb.	.05½-	05
Aluminum sulphate, com., bags	100 lb	1 50 -	1 65
Iron free bags	lb	.02½-	03
Aqua ammonia, 26°, drums	lb	06½	.07
Ammonia, anhydrous, cyl	lb.	.30 -	.30½
Ammonium carbonate, powd casks, imported	lb.	.09½-	10
Ammonium carbonate, powd. domestic, bbl	lb.	.13 -	.14
Ammonium nitrate, tech, casks	lb.	10 -	11
Amyl acetate tech, drums	gal.	3 50 -	3 75
Arsenic, white, powd., bbl	lb	13½-	.14
Arsenic, red, powd, kegs	lb	.15½-	16
Barium carbonate, bbl	ton	70 00 -	75 00
Barium chloride, bbl	ton	80 00 -	83 00
Barium dioxide, drums	lb.	.18 -	18½
Barium nitrate, casks		.08 -	08½
Blanc fixe, dry, bbl	lb.	.04 -	.04½
Bleaching powder, f.o.b. wks, drums	100 lb.	1 90 -	
Spot N. Y. drums	100 lb.	2.40 -	
Borax, bbl.	lb.	.05½-	05¾
Bromine, cases	lb.	28 -	.30
Calcium acetate, bags	100 lb.	4 00 -	4 05
Calcium arsenate, dr.	lb.	.16 -	16½
Calcium carbide, drums	lb.	05 -	05½
Calcium chloride, fused, drums	ton	22 00 -	23 00
Gran. drums	ton	28.00 -	30 00
Calcium phosphate, mono, bbl	lb.	.06½-	07
Camphor, cases	lb.	.86 -	.88
Carbon bisulphide, drums	lb.	.07 -	.07½
Carbon tetrachloride, drums	lb.	.09½-	.10
Chalk, precip.—domestic, light, bbl.	lb.	.04½-	04¾
Domestic, heavy, bbl	lb.	.03½-	.03¾
Imported, light, bbl	lb.	.04½-	.05
Chlorine, liquid, tanks, wks	lb.	.05½-	.05¾
Cylinders, 100 lb., wks	lb.	.06 -	.06½
Cylinders, 100 lb., spot	lb.	.09 -	
Chloroform, tech., drums	lb.	.35 -	.38
Cobalt oxide, bbl	lb.	2 10 -	2 25
Copperas, bulk, f.o.b. wks	ton	20 00 -	21.00
Copper carbonate, bbl	lb.	.19 -	.20
Copper cyanide, drums	lb.	.47 -	.50
Coppersulphate, dom., bbl.,	100 lb.	5.75 -	
Imp. bbl.	100 lb.	4.75 -	5.00
Cream of tartar, bbl	lb.	.25½-	.26½
Epsom salt, dom., tech., bbl	100 lb.	1.90 -	2 15
Epsom salt, imp., tech., bags	100 lb.	.90 -	1.00
Epsom salt, U.S.P., dom., bbl	100 lb.	2.50 -	2.60
Ether, U.S.P., resale, dr	lb.	.13 -	.15
Ethyl acetate, 85%, drums	gal.	.80 -	.81
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 -	1.00
Formaldehyde, 40%, bbl	lb	$0 14½ -	$0 15
Fullers earth—imp, powd, net	ton	30 00 -	32 50
Fusel oil, ref, drums	gal.	-	
Fusel oil, crude, drums	gal	3 50 -	3 75
Glaubers salt, wks, bags	100 lb	1 20 -	1 40
Glaubers salt, imp, bags	100 lb	90 -	95
Glycerine, c p, drums extra	lb	.16½	17
Glycerine, dynamite, drums	lb	15½-	16½
Glycerine, crude 80%, loose	lb	10½-	11
Iodine, resublimed	lb	4 55	4 65
Iron oxide, red, casks	lb.	.12 -	18
Lead:			
White, basic carbonate, dry, casks	lb.	.09¾-	10
White, basic sulphate, casks	lb	09½	
White, in oil, kegs	lb.	.12½-	14
Red, dry, casks	lb	.11½-	12
Red, in oil, kegs	lb.	13½-	.15
Lead acetate, white crys, bbl	lb	14 -	14½
Brown, broken, casks	lb	13	13
Lead arsenate, powd, bbl	lb.	23 -	24
Lime-Hydrated, bbl	per ton	16 80 -	17 00
Lime, Lump, bbl	280 lb	3.63 -	3 65
Litharge, comm, casks	lb	10½ -	11
Lithophone, bags	lb	.07 -	.07½
in bbl	lb	07½-	.07¾
Magnesium carb, tech, bags	lb	.08½-	.08½
Methanol, 95%, bbl	gal.	1 18 -	1 20
Methanol, 97%, bbl	gal.	1 20 -	1.22
Nickel salt, double, bbl.	lb.	10½-	
Nickel salts, single, bbl	lb	11½-	
Phosgene		60 -	.75
Phosphorus, red, cases	lb	-	
Phosphorus, yellow, cases	lb	35 -	.40
Potassium bichromate, casks	lb.	.11½-	.11¾
Potassium bromide, gran, bbl	lb	19 -	.20
Potassium carbonate, 80-85%, calcined, casks	lb.	.06½-	.06¾
Potassium chlorate, powd	lb.	.07½-	.08
Potassium cyanide, drums	lb.	.47 -	.52
Potassium, first sorts, cask	lb.	.08½	.08¾
Potassium hydroxide (caustic potash) drums	lb.	.07 -	.09
Potassium iodide, cases	lb.	3 65 -	3.75
Potassium nitrate, bbl	lb.	.06½-	.07½
Potassium permanganate, drums	lb.	.17½-	.19
Potassium prussiate, red, casks	lb.	65 -	67
Potassium prussiate, yellow, casks	lb.	.31 -	.33
Salammoniac, white, gran., casks, imported	lb.	.06 -	.06½
Salammoniac, white, gran, bbl, domestic	lb.	.07½-	.07¾
Gray, gran., casks	lb.	.08 -	.09
Salsoda, bbl.	100 lb.	1.20	1 40
Salt cake (bulk)	ton	26.00 -	28.00
Soda ash, light, 58% flat, bags, contract	100 lb.	1.60 -	1.67
Soda ash, light, basis, 48%, bags, contract, f.o.b. wks	100 lb.	1.20 -	1 30
Soda ash, light, 58%, flat, bags, resale	100 lb.	1.75 -	1 80
Soda ash, dense, bags, contract, basis 48%	100 lb	1.17½-	1.20
Soda ash, dense, in bags, resale	100 lb.	1.85 -	1 90
Soda, caustic, 76%, solid, drums, f.a.s	100 lb.	3.20 -	3.30
Soda, caustic, basis 60%, wks., contract	100 lb.	2.50 -	2 60
Soda, caustic, ground and flake, contracts	100 lb.	3.80 -	3.90
Soda, caustic, ground and flake, resale	100 lb.	3.72½-	...
Sodium acetate, works, bags	lb.	.05½-	.06½
Sodium bicarbonate, bbl	100 lb.	2.00 -	2.50
Sodium bichromate, casks	lb.	.08½-	.09
Sodium bisulphate (niter cake)	ton	6.00 -	7.00
Sodium bisulphite, powd., U.S.P., bbl	lb.	.04½-	.04½
Sodium chlorate, kegs	lb.	.06½-	.07
Sodium chloride	long ton	12.00 -	13.00
Sodium cyanide, cases	lb.	.21 -	.23
Sodium fluoride, bbl	lb	$0 08½ -	$0 10½
Sodium hyposulphite, bbl	lb	.02½-	.03
Sodium nitrite, casks	lb	.07½-	.08½
Sodium peroxide, powd., cases	lb.	.28 -	.30
Sodium phosphate, dibasic, bbl	lb	03½-	.04
Sodium prussiate, yel drums	lb	.14½-	16
Sodium salicylic drums	lb	47 -	52
Sodium silicate (40°, drums)	100 lb.	75 -	1.15
Sodium silicate (60°, drums)	100 lb.	1 75 -	2.00
Sodium sulphide, fused, 60-62% drums	lb.	.04½-	.04½
Sodium sulphite, crys, bbl	lb	.03½-	.03½
Strontium nitrate, powd, bbl.	lb	.12½-	.13
Sulphur chloride, yel drums.	lb.	04½-	.05
Sulphur, crude	ton	18.00 -	20 00
At mine, bulk	ton	16 00 -	18 00
Sulphur, flour, bag	100 lb.	2.25 -	2.35
Sulphur, roll, bag	100 lb.	2.00 -	2.10
Sulphur dioxide, liquid, cyl	lb.	.08 -	08½
Talc—imported, bags	ton	30.00 -	40.00
Talc—domestic powd, bags.	ton	18.00 -	25.00
Tin bichloride, bbl	lb.	.12½-	.13
Tin oxide, bbl	lb.	.48 -	...
Tin crystals, bbl	lb	.34½	.35
Zinc carbonate, bags	lb	.14 -	.14½
Zinc chloride, gran, bbl	lb.	.06½-	.06½
Zinc cyanide, drums	lb.	.37 -	.38
Zinc oxide, lead free, bbl.	lb.	.08 -	.08½
5% lead sulphate, bags	lb.	.07½-	......
10 to 35% lead sulphate, bags	lb	.07 -	......
French, red seal, bags	lb	.09½-	......
French, green seal, bags	lb.	.10½-	......
French, white seal, bbl	lb.	.12 -	......
Zinc sulphate, bbl	100 lb.	2.50 -	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl	lb	$0.62 -	$0.75
Alpha-naphthol, ref., bbl	lb	.70 -	.80
Alpha-naphthylamine, bbl	lb.	.35 -	37
Aniline oil, drums	lb.	.16 -	.16½
Aniline salts, bbl	lb.	.23 -	24
Anthracene, 80%, drums	lb.	.75 -	1.00
Anthracene, 80%, imp., drums, duty paid	lb.	.70 -	.75
Anthraquinone, 25%, paste, drums	lb.	70 -	.75
Benzaldehyde U S.P., carboys	lb.	1 40 -	1.45
tech, drums	lb	75	80
Benzene, pure, water-white, tanks and drums	gal.	.27 -	.32
Benzene, 90%, tanks & drums	gal.	.25 -	.30
Benzene, 90%, drums, resale	gal.	.28 -	.32
Benzidine base, bbl.	lb.	.80 -	.85
Benzidine sulphate, bbl.	lb.	.70 -	.75
Benzoic acid, U.S.P, kegs	lb.	.75 -	.80
Benzoate of soda, U S P., bbl.	lb.	.57 -	.65
Benzyl chloride, 95-97%, ref., drums	lb.	.45 -	...
Benzyl chloride, tech., drums	lb.	.30 -	.35
Beta-naphthol, tech., bbl	lb.	.21½-	.22½
Beta-naphthylamine, tech.	lb.	.80 -	.90
Cresol, U.S P., drums	lb.	.25 -	.29
Ortho-cresol, drums	lb.	.28 -	.32
Cresylic acid, 97%, resale, drums	gal.	1.15 -	1.20
95-97%, drums, resale	gal.	1.10 -	...
Dichlorbenzene, drums	lb.	.07 -	.09
Diethylaniline, drums	lb.	.50 -	.60
Dimethylaniline, drums	lb.	.41 -	.42
Dinitrobenzene, bbl,	lb.	.19 -	.20
Dinitroclorbenzene, bbl	lb.	.22 -	.23
Dinitronaphthalen, bbl	lb.	.30 -	.32
Dinitrophenol, bbl	lb.	.35 -	.40
Dinitrotoluene, bbl	lb.	.20 -	.22
Dip oil, 25%, drums	gal.	.25 -	.30
Diphenylamine, bbl	lb.	.50 -	.52
H-acid, bbl	lb.	.75 -	.80
Meta-phenylenediamine, bbl.	lb.	1.00 -	1.05
Michlers ketone, bbl	lb.	3.00 -	3.50
Monochlorbenzene, drums	lb.	.08 -	.10
Monoethylaniline, drums	lb.	.95 -	1.10
Naphthalene, flake, bbl	lb.	.08 -	.08½
Naphthalene, balls, bbl	lb.	.08½-	.09
Naphthionate of soda, bbl	lb.	.58 -	.65
Naphthionic acid, crude, bbl.	lb.	.55 -	.60
Nitrobenzene, drums	lb.	.10 -	.12
Nitro-naphthalene, bbl	lb.	.30 -	.35
Nitro-toluene, drums	lb.	.13½-	.14½
N-W acid, bbl	lb.	1.25 -	1.30
Ortho-amidophenol, kegs	lb.	2.30 -	2.35
Ortho-dichlorbenzene, drums	lb.	.17 -	.20
Ortho-nitrophenol, bbl	lb.	.90 -	.92
Ortho-nitrotoluene, drums	lb.	.10 -	.12
Ortho-toluidine, bbl	lb.	.13 -	.14½
Para-amidophenol, base, kegs	lb.	1.20 -	1.30
Para-amidophenol, HCl, kegs	lb.	1.25 -	1.35
Para-dichlorbenzene, bbl	lb.	.17 -	.20
Paranitroaniline, bbl	lb.	.70 -	.75
Para-nitrotoluene, bbl	lb.	.60 -	.65
Para-phenylenediamine, bbl.	lb.	1.45 -	1.50
Para-toluidine, bbl	lb.	.90 -	.95
Phthalic anhydride, bbl	lb.	.35 -	.38
Phenol, U.S.P., resale, dr	lb.	.42 -	.48
Picric acid, bbl	lb.	.20 -	.22
Pyridine, dom., drums	gal.	nominal	

Pyridine, imp., drums	gal.	$4 00 - $4.25
Resorcinol, tech., kegs	lb.	1.50 - 1 60
Resorcinol, pure, kegs	lb.	2.25 -
R-salt, bbl.	lb.	.55 - .60
Salicylic acid, tech., bbl.	lb.	.37 - .42
Salicylic acid, U.S.P., bbl.	lb.	.40 - .45
Solvent naphtha, water-white, drums	gal.	.27 - .32
Crude, drums	gal.	.24 -
Sulphanilic acid, crude, bbl.	lb.	.18 - .20
Thiocarbanilide, kegs	lb.	.35 - .38
Toluidine, kegs	lb.	1 20 - 1 30
Toluidine, mixed, kegs	lb.	.30 - .35
Toluene, tank cars	gal.	.30 - .35
Toluene, drums	gal.	.34 - .36
Xylidines drums	lb.	.49 - .50
Xylene, pure, drums	gal.	.75 - 1 00
Xylene, com., drums	gal.	.37 -
Xylene, com., tanks	gal.	.32 -

Naval Stores

Rosin B-D, bbl.	280 lb.	$5 80 -
Rosin E-I, bbl.	280 lb.	5 90 -
Rosin K-N, bbl.	280 lb.	6 10 -
Rosin W.G.-W.W., bbl.	280 lb.	6 25 - 7 25
Wood rosin, bbl.	280 lb.	5 90 - 6 00
Turpentine, spirits of, bbl.	gal.	1 06
Wood, steam dist., bbl.	gal.	.98 -
Wood, dest. dist., bbl.	gal.	.68 -
Pine tar pitch, bbl.	200 lb.	6 00
Tar, kiln burned, bbl.	500 lb.	- 13 00
Retort tar, bbl.	500 lb.	- 12 00
Rosin oil, first run, bbl.	gal.	.45 -
Rosin oil, second run, bbl.	gal.	.48 -
Rosin oil, third run, bbl.	gal.	.52 -
Pine oil, steam dist.	gal.	.70 -
Pine oil, pure, dest. dist.	gal.	.65 -
Pine tar oil, ref.	gal.	.48 -
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal.	.32 - .32½
Pine tar oil, double ref., bbl.	gal.	.75
Pine tar, ref., thin, bbl.	gal.	.25
Pinewood creosote, ref., bbl.	gal.	.52

Animal Oils and Fats

Degras, bbl.	lb.	$0 03½ - $0 04½
Grease, yellow, bbl.	lb.	.06½ -
Lard oil, Extra No. 1, bbl.	gal.	.90 - .92
Neatsfoot oil, 20 deg. bbl.	gal.	1.30 -
No. 1, bbl.	gal.	.92 - .94
Oleo Stearine		.09 -
Red oil, distilled, d.p. bbl.	lb.	.10½ - .10¾
Saponified, bbl.	lb.	.10½ - .10¾
Tallow, extra, loose	lb.	.07½ -
Tallow oil, acidless, bbl.	gal.	.94 - .96

Vegetable Oils

Castor oil, No. 3, bbl.	lb.	$0 14 -
Castor oil, No. 1, bbl.	lb.	.14½ -
Chinawood oil, bbl.	lb.	.28 -
Coconut oil, Ceylon, bbl.	lb.	.09½ -
Ceylon, tanks, N.Y.	lb.	.08½ .08½
Coconut oil, Cochin, bbl.	lb.	.09½ - .10
Corn oil, crude, bbl.	lb.	.12½ -
Crude, tanks, (f.o.b. mill)	lb.	.09½ -
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.10 -
Summer yellow, bbl.	lb.	.12½ - .13
Winter yellow, bbl.	lb.	.13½ - .13½
Linseed oil, raw, car lots, bbl.	gal.	1 10 -
Raw, tank cars (dom.)	gal.	1 05 -
Boiled, cars, bbl. (dom.)	gal.	1 12 -
Olive oil, denatured, bbl.	gal.	1 10 -
Sulphur, (foots) bbl.	lb.	.08 - .08½
Palm, Lagos, casks	lb.	.07 -
Niger, casks	lb.	.06½
Palm kernel, bbl.	lb.	.08½ - .08½
Peanut oil, crude, tanks (mill)	lb.	.12½ - .13
Peanut oil, refined, bbl.	lb.	.16½ -
Perilla, bbl.	lb.	.15½ - .16
Rapeseed oil, refined, bbl.	gal.	.83 - .84
Rapeseed oil, blown, bbl.	gal.	.88 - .89
Sesame, bbl.	lb.	.11½ - .12
Soya bean (Manchurian), bbl.	lb.	.12½ -
Tank, f.o.b. Pacific coast	lb.	.09½ - .09½
Tank, (f.o.b. N.Y.)	lb.	.10 -

Fish Oils

Cod, Newfoundland, bbl.	gal.	$0 70 - $0 72
Menhaden, light pressed, bbl.	gal.	.76 -
White bleached, bbl.	gal.	.78 -
Blown, bbl.	gal.	.82 -
Crude, tanks (f.o.b. factory)	gal.	.50 -
Whale No. 1 crude, tanks, coast	lb.	-
Winter, natural, bbl.	gal.	.76 - .78
Winter, bleached, bbl.	gal.	.79 - .80

Oil Cake and Meal

Coconut cake, bags	ton	$26 00 - $28.00
Copra, sun dried, bags, (c.i.f.)	lb.	.04½ - .05
Sun dried Pacific coast	lb.	.04½ - .04½
Cottonseed meal, f.o.b. mills	ton	36 00 -
Linseed cake, bags	ton	34 00 -
Linseed meal, bags	ton	36 00 -

Dye & Tanning Materials

Albumen, blood, bbl.	lb.	$0.45 - $0 50
Albumen, egg, tech., kegs	lb.	.90 - .95
Cochineal, bags	lb.	.33 - .35
Cutch, Borneo, bales	lb.	.04½ - .05
Cutch, Rangoon, bales	lb.	.13 - .13½
Dextrine, corn, bags	100 lb.	3 69 - 4.01
Dextrine, gum, bags	100 lb.	3.99 - 4.09
Divi-divi, bags	ton	38.00 - 39.00
Fustic, sticks	ton	30.00 - 35.00
Fustic, chips, bags	lb.	.04 - .05
Logwood, sticks	ton	26.00 - 30.00
Logwood, chips, bags	lb.	.02½ - .03½
Sumac, leaves, Sicily, bags	ton	70.00 - 72.00
Sumac, ground, bags	ton	$65 00 - $67 00
Sumac, domestic, bags	ton	40 00 - 42 00
Starch, corn, bags	100 lb.	2.97 - 3 07
Tapioca flour, bags	lb.	.06 - .06½

Extracts

Archil, conc., bbl.	lb.	$0 17 - $0 18
Chestnut, 25% tannin, tanks	lb.	.02 - .03
Divi-divi, 25% tannin, bbl.	lb.	.04 - .05
Fustic, crystals, bbl.	lb.	.20 - .22
Fustic, liquid, 42°, bbl.	lb.	.08 - .09
Gambier, liq., 25% tannin, bbl.	lb.	.08 - .09
Hematine crys., bbl.	lb.	.14 - .18
Hemlock, 25% tannin, bbl.	lb.	.04 - .05
Hypernic, solid, drums	lb.	.24 - .26
Hypernic, liquid, 51°, bbl.	lb.	.10 - .12
Logwood, crys., bbl.	lb.	.18 - .20
Logwood, liq., 51°, bbl.	lb.	.09 - .10
Quebracho, solid, 65% tannin, bbl.	lb.	.04½ - .05
Sumac, dom., 51°, bbl.	lb.	.06½ - .07

Dry Colors

Blacks-Carbongas, bags, f.o.b. works	lb.	$0 20 - $0 24
Lampblack, bbl.	lb.	.12 - .42
Mineral, bulk	ton	35 00 - 45 00
Blues Bronze, bbl.	lb.	.55 - .60
Prussian, bbl.	lb.	.55 - .60
Ultramarine, bbl.	lb.	.08 - .35
Browns, Sienna, Ital., bbl.	lb.	.06 - .14
Sienna, Domestic, bbl.	lb.	.03½ - .04
Umber, Turkey, bbl.	lb.	.04 - .04½
Greens-Chrome, C.P. Light, bbl.	lb.	.32 - .34
Chrome, commercial, bbl.	lb.	.12 - .12½
Paris, bulk	lb.	.28 - .30
Reds, Carmine No. 40, tins	lb.	4 50 - 4 70
Oxide red, casks	lb.	.10 - .14
Para toner, kegs	lb.	1 00 - 1 10
Vermilion, English, bbl.	lb.	1 30 - 1 32
Yellow, Chrome, C.P. bbls.	lb.	.20 - .21
Ocher, French, casks	lb.	.02½ - .03

Waxes

Bayberry, bbl.	lb.	$0 30 - $0 32
Beeswax, crude, bags	lb.	.20 - .21
Beeswax, refined, light, bags	lb.	.32 - .34
Beeswax, pure white, cases	lb.	.40 - .41
Candelilla, bags	lb.	.20½ - .21½
Carnauba, No. 1, bags	lb.	.42 - .43
No. 2, North Country, bags	lb.	.23 - .23½
No. 3, North Country, bags	lb.	.18½ - .19
Japan, cases	lb.	.15 - .16
Montan, crude, bags	lb.	.04½ - .04½
Paraffine, crude, match, 105-110 m.p.	lb.	.04 - .04½
Crude, scale 124-126 m.p., bags	lb.	.02½ - .03
Ref., 118-120 m.p., bags	lb.	.03 - .03½
Ref., 125 m.p., bags	lb.	.03½ - .03½
Ref., 128-130 m.p., bags	lb.	.03½ - .03½
Ref., 133-135 m.p., bags	lb.	.04 - .04½
Ref., 135-137 m.p., bags	lb.	.05 - .05½
Stearic acid, sgle pressed, bags	lb.	.12½ - .12½
Double pressed, bags	lb.	.13 - .13½
Triple pressed, bags	lb.	.14½ - .14½

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb.	$3 25 - $3 30
F.a.s. double bags	100 lb.	3 85 - 3 90
Blood, dried, bulk	unit	4 00 -
Bone, raw, 3 and 50, ground	ton	27 00 - 30 00
Fish scrap, dom., dried, wks.	unit	3 75 -
Nitrate of soda, bags	100 lb.	2 45 - 2 52½
Tankage, high grade, f.o.b. Chicago	unit	3 60 - 3 70
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$4 00 - $4.50
Tennessee, 78-80%	ton	8 00 - 8 25
Potassium muriate, 80%, bags	ton	34 55 -
Potassium sulphate, bags basis 90%	ton	43 67 -
Double manure salt	ton	25 72 -
Kainit	ton	7 22 -

Crude Rubber

Para—Upriver fine	lb.	$0 28½ -
Upriver coarse	lb.	.26 -
Upriver caucho ball	lb.	.26½ -
Plantation—First latex crepe	lb.	.27½ -
Ribbed smoked sheets	lb.	.27½ -
Brown crepe, thin, clean	lb.	.25½ -
Amber crepe No. 1	lb.	.27½ -

Gums

Copal, Congo, amber, bags	lb.	$0.12 - $0 13
East Indian, bold, bags	lb.	.23 - .23½
Manila, pale, bags	lb.	.20 - .20½
Pontinak, No. 1 bags	lb.	.20 - .20½
Damar, Batavia, cases	lb.	.28 - .28½
Singapore, No. 1, cases	lb.	.34 - .35
Singapore, No. 2, cases	lb.	.23 - .23½
Kauri, No. 1, cases	lb.	.65 - .67
Ordinary chips, cases	lb.	.21 - .22
Manjak, Barbados, bags	lb.	.09 - .09½

Shellac

Shellac, orange fine, bags	lb.	$0.62 -
Orange superfine, bags	lb.	.64 -
A. C. garnet, bags	lb.	nominal
Bleached, bonedry	lb.	.72 -
Bleached, fresh	lb.	.60 -
T. N., bags	lb.	.59 -

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh. ton	$500.00 -
Asbestos, shingle, f.o.b., Quebec	sh. ton	$65.00 - $85 00
Asbestos, cement, f.o.b., Quebec	sh. ton	20.00 - 25 00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	16.00 - 20 00
Barytes, grd., off-color, f.o.b. mills bulk	net ton	13.00 - 15 00
Barytes, floated, f.o.b. St. Louis, bbl.	net ton	28.00 -
Barytes, crude f.o.b. mines, bulk	net ton	10 00 - 11 00
Casein, bbl., tech.	lb.	.17½ - .18½
China clay (kaolin) crude, f.o.b. Ga.	net ton	7.00 - 9 00
Washed, f.o.b. Ga.	net ton	8.00 - 9 00
Powd., f.o.b. Ga.	net ton	14.00 - 20 00
Crude f.o.b. Va.	net ton	8 00 - 12 00
Ground, f.o.b. Va.	net ton	14 00 - 20 00
Imp., lump, bulk	net ton	15 00 - 20 00
Imp., powd.	net ton	45 00 - 50 00
Feldspar, No. 1 pottery	long ton	6 00 - 7 00
No. 2 pottery	long ton	4 00 - 5 50
No. 1 soap	long ton	7 00 - 7.50
No. 1 Canadian, f.o.b. mill	long ton	20 00 - 22 00
Graphite, Ceylon, lump, first quality, bbl.	lb.	.06½ -
Ceylon, chip, bbl.	lb.	.05½ -
High grade amorphous crude	ton	15.00 - 35 00
Gum arabic, amber, sorts, bags	lb.	.14½ - .15
Gum tragacanth, sorts, bags	lb.	.48 - .56
No. 1, bags	lb.	1 50 - 1.60
Kieselguhr, f.o.b. Cal.	ton	40 00 - 42 00
F.o.b. N.Y.	ton	50 00 - 55 00
Magnesite, crude, f.o.b. Cal.	ton	14 00 - 15.00
Pumice stone, imp., casks	lb.	.03 - .05½
Dom., lump, bbl.	lb.	.05 - .05½
Dom., ground, bbl.	lb.	.06 - .07
Silica, glass sand, f.o.b. Ind.	ton	2 00 - 2.50
Silica, sand blast, f.o.b. Ind.	ton	2 50 5.00
Silica, amorphous, 250-mesh, f.o.b. Ill.	ton	17 00 - 17.50
Silica, bldr. sand, f.o.b. Pa.	ton	2 00 - 2.75
Soapstone, coarse, f.o.b. Vt., bags	ton	7 00 - 8.00
Talc, 200 mesh, f.o.b., Vt., bags	ton	6 50 - 9.00
Talc, 200 mesh, f.o.b. Ga., bags	ton	7 00 - 9.00
Talc, 200 mesh, f.o.b. Los Angeles, bags	ton	16 00 - 20.00

Mineral Oils

Crude, at Wells

Pennsylvania	bbl.	$3 25 - 3 50
Corning	bbl.	1 85 -
Cabell	bbl.	1 91 -
Somerset	bbl.	1 75 -
Illinois	bbl.	1 97 -
Indiana	bbl.	1 98 -
Kansas and Oklahoma, 28 deg.	bbl.	1 30 -
California, 35 deg. and up	bbl.	1 04 -

Gasoline, Etc.

Motor gasoline, steel bbls.	gal.	$0 21½ -
Naphtha, V. M. & P. deod, steel bbls.	gal.	.20½ -
Kerosene, ref. tank wagon	gal.	.14 -
Bulk, W. W. export	gal.	.07 -
Lubricating oils:		
Cylinder, Penn., dark	gal.	.20 - .22
Bloomless, 30@31 grav.	gal.	.18½ - .20½
Paraffin, pale	gal.	.24 - .26
Spindle, 200, pale	gal.	.21 - .22
Petrolatum, amber, bbls.	lb.	.05 - .05½
Paraffine wax (see waxes)		

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	ton	$45-50
Chrome brick, f.o.b. Eastern shipping points	ton	50-52
Chrome cement, 40-50% Cr_2O_3.	ton	23-27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	40-46
2nd quality, 9-in. shapes, f.o.b. wks.	1,000	36-41
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65-68
9-in. arches, wedges and keys	ton	80-85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48-50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	48-50
F.o.b. Mt. Union, Pa.	1,000	42-44
Silicon carbide refract. brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N.Y.	ton	$200.00 - $225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11½ - .11½
4-6% C	lb.	.12 - .13
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	125.00 -
Spiegeleisen, 19-21% Mn.	gr. ton	40.00 -
Ferromolybdenum, 50-60% Mo, per lb Mo.	lb.	2.00 - 2.50
Ferrosilicon, 10-15%	gr. ton	48.00 - 50.00
50%	gr. ton	95.00 -
75%	gr. ton	150.00 - 160.00

Ferrotungsten, 70-80%, per lb. of W	lb.	\$0.90 - \$0.95
Ferro-uranium, 35-50% of U. per lb. of U	lb.	6.00 - ....
Ferrovanadium, 30-40%, per lb. of V	lb.	3.50 - 3.75

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	\$6.00 - \$9.00
Chrome ore Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 - 23.00
C.i.f. Atlantic seaboard	ton	20 50 - 24 00
Coke, fdry., f.o.b. ovens	ton	7 00 - 7 50
Coke, furnace, f.o.b. ovens	ton	6 00 - 6 50
Fluorspar, gravel, f.o.b. mines' Illinois	ton	20.00 - 21 50
Ilmenite, 52% TiO_2	lb.	.01½- .01¾
Manganese ore, 50% Mn, c i f. Atlantic seaport	unit	.33 - ....
Manganese ore, chemical (MnO_2)	ton	75 00 - 80.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N. Y.	lb.	.65 - .70
Monazite, per unit of ThO_2, c i f, Atl seaport	lb.	.06 - 08
Pyrites, Span., fines, c.i.f Atl seaport	unit	.11½- .12
Pyrites, Span., furnace size, c.i f Atl seaport	unit	.11½- .12
Pyrites, dom fines, f.o.b. mines, Ga.	unit	.12
Rutile, 95% TiO_2	lb.	.12 - ....
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.50 - 8.75
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	8 00 - 8.25
Uranium ore (carnotite) per lb of U_3O_8	lb.	3.50 - 3.75
Uranium oxide, 96% per lb U_3O_8	lb.	2.25 - 2.50
Vanadium pentoxide, 99%	lb.	12 00 - 14 00
Vanadium ore, per lb V_2O_5	lb.	1.00 - ....
Zircon, washed, iron free, f o.b. Pablo, Fla.	lb.	.04½ - .13

Non-Ferrous Materials

	Cents per Lb
Copper, electrolytic	15-15½
Aluminum, 98 to 99%	25-26
Antimony, wholesale, Chinese and Japanese	6½- 7½
Nickel, virgin metal	27-29
Nickel, ingot and shot	29-
Monel metal, shot and blocks	32.00
Monel metal, ingots	38.00
Monel metal, sheet bars	45 00
Tin, 5-ton lots, Straits	41 12½
Lead, New York, spot	7.25
Lead, E. St Louis, spot	7 00
Zinc, spot, New York	6.40
Zinc, spot, E St. Louis	6.05

Other Metals

Silver (commercial)	oz.	\$0.65
Cadmium	lb.	1.00
Bismuth (500 lb lots)	lb.	2.55
Cobalt	lb.	2 65@2.85
Magnesium, ingots, 99%	lb.	1.25-
Platinum	oz.	114 00
Iridium	oz.	270 00@280 00
Palladium	oz.	80 00
Mercury	75 lb.	68 00

Finished Metal Products

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	24 25
Copper bottoms	29 75
Copper rods	25.25
High brass wire	19 37½
High brass rods	17.00
Low brass wire	21.10
Low brass rods	22.00
Brazed brass tubing	24.25
Brazed bronze tubing	29 00
Seamless copper tubing	25.25
Seamless high brass tubing	23.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11 60@11.8
Copper, heavy and wire	11 50@11.6
Copper, light and bottoms	10 00@10.1
Lead, heavy	5.75@ 6.0
Lead, tea	3.50@ 3.7
Brass, heavy	6.50@ 6.7
Brass, light	5.75@ 6.0
No. 1 yellow brass turnings	6.75@ .70
Zinc	3.75@ 4.2

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	\$3.29	\$3.14
Soft steel bars	3.19	3.04
Soft steel bar shapes	3.19	3.04
Soft steel bands	3.29	3.19
Plates, ¼ to 1 in. thick	3.29	3.14

Industrial

Financial, Construction and Manufacturing News

Construction and Operation

Alabama

FLINT The Southern Rock Asphalt Co., recently formed with a capital of \$600,000, has plans under way for the construction of a local refining plant, estimated to cost in excess of \$100,000, with machinery. Equipment for asphalt mining will be installed on local property. L. D. Powell is general manager.

BIRMINGHAM—The Murray Tire Co. has work nearing completion on a new plant at 27th Ave. and 26th St. and plans to install machinery and place the works in service at an early date. The company recently increased its capital to \$200,000, for expansion.

California

LOS ANGELES—The French China Co, Sebring, O. has preliminary plans under consideration for the construction of a new pottery on site now being selected near Los Angeles, totaling about 100 acres. It will consist of a number of buildings, estimated to cost approximately \$1,000,000, with machinery. O. H. Sebring is president.

LONG BEACH—The Specialty Glass Co is having plans completed for the erection of a new plant on local site, recently purchased It will cost approximately \$45,000. The H. L. Dixon Co, Rosslyn Rd, Pittsburgh, Pa, is engineer

INDIO—The Interlocking Tile & Sewer Pipe Co, Ontario, Calif, is perfecting plans for the erection of a new plant in the vicinity of Indio, estimated to cost about \$75,000. J F. Gale and D. E. Bulger head the company.

Connecticut

MERIDEN—The Wolf New Process Abrasive Wheel Co, Inc., Hanover St, will break ground at once for the erection of a 1-story addition to its plant A general contract for the work has been awarded to Lewis A. Miller, Meriden

WINDSOR LOCKS—C H. Dexter & Sons, Inc, has broken ground for the construction of a new 4-story and basement building at its paper mill, 55x100 ft The general contract has been let to the R. G. Bent Co, 83 Ann St, Hartford, Conn Greenwood & Noerr, 847 Main St., Hartford, are engineers

Florida

TAMPA—The Roesch Paper Co., Hampton and Franklin Sts., has plans under way for the erection of a new 3-story plant. 100x150 ft., on South Florida Ave, to more than double the capacity of its present plant. It is purposed to remove the existing works to the new location and install considerable additional machinery. Henry Roesch is president.

LEESBURG—The Florida China Clay Co., recently organized, is planning for enlargements in its commercial clay plant to increase the present output of about 50 tons per day. Additional machinery will be installed. J. S Morris is president and manager, and L. A. Morris, secretary and treasurer.

LAKE CITY—The Lake City Dehydrating Co. is planning for the erection of a new plant, 42x100 ft. A. K. Purdy is president and manager

Illinois

CHICAGO—The American Linseed Oil Co., 2209 Lumber St., will soon commence the rebuilding of the portion of its plant recently destroyed by fire, to be 4-story, 70x100 ft., estimated to cost \$80,000. Francisco & Jacobus, 39 South La Salle St., are architects. R. H. Adams is president.

BLUE ISLAND—Fire, May 30, destroyed a portion of the vat department at the refining plant of the Consumers Oil Co., with loss estimated at \$22,000. It is planned to rebuild.

Kansas

COFFEYVILLE—The Sinclair Consolidated Oil Corp, 45 Nassau St., New York, will make extensions and improvements in its local refining plant, including the installation of additional equipment. Enlargements will also be carried out at the oil and gasoline refineries at Kansas City, Kan.; East Chicago, Ind.; Cushing, Okla., and other locations. A new refining plant is now being constructed at Marcus Hook, Pa., and is expected to be ready for service at an early date.

Louisiana

HAMMOND—The Louisiana Utilities Mfg. & Agricultural Co, recently formed with a capital of \$1,000,000, has preliminary plans under consideration for the construction of a commercial fertilizer plant, in connection with local utility properties. H. G. Hungate is secretary.

SHREVEPORT—The Henderson Cotton Oil Co. will commence the immediate rebuilding of the portion of its plant, recently destroyed by fire. It will cost close to \$25,000.

Maryland

BALTIMORE—The Cast Stone Products Co., 16 South Eutaw St., will commence the erection of a new plant at 3rd and Maryland Aves., Brooklyn district, for the manufacture of blocks, hollow tile and other cast stone specialties

Massachusetts

WEST SPRINGFIELD—The General Fibre Box Co., Circuit Ave., has awardede a general contract to the Samuel M. Green Co., 293 Bridge St., Springfield for the construction of a new 1-story building at its plant, 96x100 ft

Michigan

DETROIT—Berry Brothers, Inc., foot of Leib St., manufacturer of varnishes, oils, etc, has acquired property adjoining its plant, formerly occupied by the Detroit Heating & Lighting Co., and will raze two of the three buildings on the site for the erection of new plant additions. A 4-story extension will be built at once, to be equipped as a color-grinding works. Frederick L. Colby is president, and W. R. Carnegie, vice-president and general manager.

MONROE—The Monroe Board & Lining Co., Barberton, O., has work under way in the first unit of a new mill, 200x300 ft, and plans to occupy the structure at an early date for the manufacture of corrugated board and other paper products. The present Barberton plant will be removed to the new location and additional equipment installed. Other plant units will be built later. William G. Gutmann is president, and J. D. Miller, vice-president, treasurer and general manager.

Nevada

RENO—The Nevada Magnesite Products Co, recently organized, is planning for the construction of a plant for the production of artificial stone products, including tiles, blocks, etc., utilizing magnesite under a special process. A large raw material deposit has been secured about 8 miles from Reno. Charles H. McCarthy is president, and Paul Butler, vice-president.

New Jersey

BEVERLY—The Beverly Wall Paper Co. has plans in progress for the erection of a new 1-story building at its plant, 60x200 ft. Harry G. Aitkin, American Mechanics Bldg., Trenton, N. J., is architect.

LYNDHURST—The Century Cement Products Co. is planning for enlargements in its local plant, to include the installation of additional machinery. The company specializes in the manufacture of blocks, tile and kindred products under a special process. John H. McGuire, Passaic, N. J., mayor of that city, is president and David Slayback, vice-president and treasurer.

New York

PALMYRA—The Palmyra Packing Co., Inc., recently formed with a capital of $100,000, will operate a local plant for the manufacture of rubber, asbestos and other industrial packings. Plans are being arranged for early production. John N. Todd, Canandaigua St., heads the company.

NEW YORK—The American Smelting & Refining Co., 120 Broadway, has tentative plans under way for the construction of coke ovens and a byproducts plant in the vicinity of its properties in the Rosita coalfield, Sabines, State of Coahuila, Mexico. An appropriation of more than $2,500,000 has been arranged for this and other expansion work in that district. The coke production will be used at the company's smelting plants at Chihuahua, Monterey, Asarco and Calientes, Mexico.

PLATTSBURG—A new company is being organized by H. P. O. Newstrand, Greenwich, N. Y., to operate a paper mill at Plattsburg. The former Lezier mill has been acquired and it is purposed to construct a 1-story addition to cost about $75,000.

Ohio

CINCINNATI—The Mammolith Carbon Paint Co., Cincinnati, has been acquired by new interests, headed by J. H. Kresge, Pittsburgh, Pa., for a consideration said to be about $300,000. The new company has plans for extensions and improvements for larger capacity. The carbon mines in Arkansas, also purchased, will be expanded.

COLUMBUS—The Brocalsa Chemical Co. has plans in progress for extensions and improvements in its plant and properties at Syracuse, O., and vicinity. Additional equipment will be installed. The company is arranging for a bond issue of $500,000, a portion of the proceeds to be used for the expansion.

LOWELLVILLE—The Grasselli Powder Co. has plans under consideration for the rebuilding of the portion of its local plant, including press and corning mills, destroyed by fire, June 6. An official estimate of loss has not been announced. Headquarters of the company are in the Guardian Bldg., Cleveland, O.

NORTH INDUSTRY—The Stark Oil Refining Co., 1110 George D. Harter Bank Bldg., Canton, O., has plans in progress for the erection of a new local oil-refining plant, estimated to cost approximately $350,000, including equipment. Edward Keiser heads the company. Walter Cross, Kansas City, Mo., is engineer.

Oregon

SALEM—The Oregon Pulp & Paper Co. will take bids at once for the erection of a 2-story addition to its mill, 128x220 ft., estimated to cost about $100,000, including equipment. Knighton & Howell, United States National Bank Bldg., Portland, are architects.

Pennsylvania

BRISTOL—The Paterson Parchment Paper Co., Modena, Pa., has construction under way on a new local mill, to comprise about 5 acres of floor space, estimated to cost close to $2,000,000, with machinery. To provide for a portion of the work, the company is disposing of a bond issue of $1,500,000. A plant is now being operated at Modena, and a parchmentizing mill at Passaic, N. J. It is purposed to double the present output. William F. Brunner is president.

PITTSBURGH—The Pennzoil Co., Oil City, Pa., formerly known as the Oil City Oil & Grease Co., has leased a building at 1739 Penn Ave. for a term of years, for the establishment of a new oil storage and distributing plant.

Tennessee

CLEVELAND—The Manufacturers' Soap & Chemical Co., recently organized with a capital of $50,000, has plans under way for the erection of a new 3-story plant for the manufacture of soaps, washing powders, etc. George S. Hardwick, Sr., is president.

Texas

HOUSTON—The Board of Directors, Rice Institute, will soon take bids for the construction of a new chemical laboratory at the institution, to be 3-story and basement, estimated to cost about $375,000. Twelve large laboratories will be installed, and sixteen smaller laboratories and research rooms. William Ward Watkin, Houston, is architect.

FORT WORTH—The Texas Steel Co., lately formed with a capital of $5,000,000, to take over and operate the local plant of the Armstrong Steel Co., will remodel and extend the works, providing an electric furnace department, steel and iron casting plant and steel bar mill. John H. Kirby, Houston, Tex., heads the new organization.

Vermont

SHELDON SPRINGS—The Missisquoi Pulp & Paper Co. has commenced the construction of a new unit at its local mill for considerable increase in capacity. Additional machinery will be installed and a power plant erected. The expansion is estimated to cost in excess of $400,000. The company specializes in the manufacture of bristol board.

West Virginia

WELLSBURG—The Specialty Glass Co., recently organized with a capital of $100,000, has plans under way for the erection of a new plant for the manufacture of a line of glass products, for which a local site will soon be selected. It is estimated to cost about $65,000, and is expected to be ready for service by the close of the year. The new company is headed by A. L. Rowing, Wellsburg; John N. Dean and A. E. Bowlder, Wheeling, W. Va.

Wisconsin

MANITOWOC—The Manitowoc Portland Cement Co., a subsidiary of the Newaygo Portland Cement Co., Newaygo, Mich., has plans nearing completion for the erection of a new cement mill on local site, consisting of a number of buildings, equipped for a capacity of 3,000 bbl. per day. It is estimated to cost approximately $1,500,000. To provide funds, the parent organization is disposing of a bond issue in the amount noted. Clay H. Hollister is president.

New Companies

BADER CHEMICAL CO., Passaic, N. J.; chemicals and chemical byproducts; $100,000. Incorporators: John Bader, Hans O. Hirsch and E. J. Zillessen, 353 Van Houten Ave., Passaic.

FLORIDA EAST COAST FERTILIZER CO., Miami, Fla.; fertilizer products; $200,000. M. C. Alford is president, and Thomas B. Nuttall, secretary, both of Miami.

ATLANTIC INDUSTRIAL ALCOHOL CO., Richmond, S. I., N. Y.; industrial alcohol and kindred products; $400,000. Incorporators: G. R. Franklin, F. T. Davis and M. E. Muniz. Representative: Bush & Crawford, 30 Broad St., New York.

LEA OIL CO., Boston, Mass.; refined oil products; 1,000 shares of stock, no par value. Arthur F. Ray is president, and Charles F. Dutch, 4 Brook St., Winchester, Mass., treasurer.

CENTRAL STEEL TREATING CO., Detroit, Mich.; heat-treating and hardening metals; $10,000. Incorporators: Karl B. Goddard, James I. McClintock and L. C. Dunn, 5324 Burns Ave., Detroit.

CITIZENS WINDOW GLASS CO., New Bethlehem, Pa.; glass products; $1,000,000. H. E. Andrews, New Bethlehem, is treasurer.

CRESCENT OIL CO., Martindale, Tex.; refined petroleum products; $50,000. Incorporators: R. E. Martindale, M. E. Barrow and E. L. Crook, all of Martindale.

GABIS OIL & CHEMICAL CORP., Linden, N. J.; chemicals, oils and kindred products; $25,000. Incorporators: A. J. David, M. S. Graff and Hyman Rosenfeld, Linden. The last noted is representative.

NORTH AMERICAN CHEMICAL CORP., New York, N. Y.; chemicals and chemical byproducts; $7,500,000. Incorporators: Maurice E. Davis, Ernest G. Metcalfe and Gotthilf Lehmann. Representative: United States Corporation Co., 65 Cedar St.

SAGADAHOC FERTILIZER CO., Bowdoinham, Me.; fertilizers and chemical products; $150,000. Horace S. Dodge, president and treasurer; and C. L. Andrews, Bowdoinham, clerk and representative.

MEMPHIS OXYGEN CO., Memphis, Tenn.; industrial oxygen products; $75,000. Incorporators: C. H. Reynoll, L. B. Lovitt and R. S. Polk, all of Memphis.

MACARTHUR MFG. CO., Seattle, Wash.; oil products; $100,000. William MacArthur, 521 Lyon Bldg., Seattle, heads the company.

FLAMINGO SUGAR MILLS, INC., Philadelphia, Pa.; construct and operate sugar mills; $100,000. A. W. Howe, Jr., 2032 De Lancey St., Philadelphia, is treasurer.

PAPER MILLS CORP., Wilmington, Del.; paper products, cardboard, etc.; $5,000,000. Representative: Corporation Trust Co. of America, du Pont Bldg., Wilmington.

TROMITE CORP., Carteret, N. J.; soap and kindred products; organized. Plun[illegible] Wheeler and Louis Neuberg, Carteret, he[illegible] the company.

PIGMY CORP., Marion, Ky.; to oper[illegible] fluorspar properties and reduction mil[illegible] $20,000. Incorporators: George B. Fra[illegible] and F. H. Burgher, Washington, Ky.; a[illegible] C. S. Nunn, Marion.

CHEMICAL SUPPLY CO., 5 Mount Vern[illegible] St., Providence, R. I.; chemicals and che[illegible]ical byproducts; organized. Philip [illegible] Lown heads the company.

EAST COAST OIL CO., Jacksonville, Fl[illegible] refined petroleum products; $500,000. I[illegible]corporators: George B. Monroe and D. [illegible] Anderson, both of Jacksonville.

FREEDOM PAPER CO., New York, N. Y.; paper products; $45,000. Incorporators: Friedland and M. Schlanger. Represent[illegible]tive: Isidore Lowenbraun, 116 Nassau S[illegible] New York.

CREZOIN CHEMICAL CORP., Camden, N. [illegible] chemicals and chemical byproducts; $25,000. Incorporators: Francis J. D. Bar[illegible] William B. and J. Benton Childers. Re[illegible]resentative: Adam R. Sloan, 531 Fede[illegible] St., Camden.

TEXAS CARBON INDUSTRIES, INC., Wilmin[illegible]ton, Del.; carbon and oil products; $650,0[illegible] Representative: Corporation Trust Co. [illegible] American, du Pont Bldg., Wilmington.

ATBLAKE LABORATORIES, INC., Syracu[illegible] N. Y.; chemicals and chemical byproduct[illegible] $25,000. Incorporators: J. G. Blaken[illegible] H. V. Curtiss and J. S. Atkins. Represent[illegible]tive: George W. O'Brien, The Bastab[illegible] Syracuse.

Industrial Notes

THE HERCULES POWDER CO. announc[illegible] the removal of its San Francisco office [illegible] the New Standard Oil Bldg., Bush a[illegible] Sansom Sts.

THE B. F. STURTEVANT CO., Hyde Par[illegible] Boston, Mass., announces that due to i[illegible]creased business and the desire to be [illegible] greater service to its customers, it has pu[illegible]chased the plant of the Wisconsin Engi[illegible] Co., maker of Corliss pumping engines [illegible] Corliss, Wis. This new acquisition cove[illegible] nearly 10 acres and the buildings have a[illegible]proximately 150,000 sq.ft. of floor space. [illegible] full manufacturing and engineering sta[illegible] will be maintained and closer co-operati[illegible] given to Western customers. The new pla[illegible] will be under the same direction as t[illegible] other factories at Hyde Park, Galt, Sa[illegible] Francisco and Philadelphia, with ex-Gove[illegible]nor E. N. Foss as president. Harry V[illegible] Page has been selected as general ma[illegible]ager and will be in entire charge of t[illegible] Wisconsin plant.

THE PENNSYLVANIA CRUSHER CO., Phil[illegible]delphia, Pa., in order to provide more ad[illegible]quate facilities for its business in the Pitt[illegible]burgh district, has moved the offices fro[illegible] the Peoples Bank Bldg., to the Oliver Bldg[illegible] where operations will be continued und[illegible] the management of H. M. Hallett.

R. M. SISK, vice-president and assista[illegible] treasurer of the Sharonville Boiler Work[illegible] Co., Sharpsville, Pa., recently severed h[illegible] connection with that company and has n[illegible] yet announced his plans for the future.

Opportunities in th[illegible] Foreign Trade

Parties interested in any of the followin[illegible] opportunities may obtain all available in[illegible]formation from the Bureau of Foreign an[illegible] Domestic Commerce at Washington or fro[illegible] any district office of the bureau. The num[illegible]ber placed after the opportunity must b[illegible] given for the purpose of identification.

BLACK DECOLORANT for bleaching. Turin, Italy. Agency.—6792.

CHEMICALS, OILS AND GREASES. Valparaiso, Chile. Agency.—6765.

DYES. Valparaiso, Chile. Agency.—6765.

PAINTS AND VARNISHES. Valparaiso, Chile. Agency.—6765.

LINSEED CAKE. Hamburg, Germany. Agency.—6756.

CASEIN. Dublin, Ireland. Purchase.—6744.

COCONUT OIL. 100,000 lb. Manzanillo, Mexico. Purchase.—6720.

GLUCOSE. Saloniki, Greece. Purchase.—6755.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY and IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor

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Competition for Natural-Gas Supplies

AS A RESULT of the intensive search for petroleum, one of the largest natural-gas fields which the world has ever known was discovered near Monroe, La. This field lies more than 200 miles away from New Orleans and not much closer to any other prospective municipal user. As a consequence it is not at all likely that this territory can ever be profitably developed for city gas supply, since experience in other parts of the country indicates that pipe lines of such length are highly unprofitable investments with local regulation of the prices charged for gas. The question has been, therefore, and still remains, Who will use this natural gas to best advantage?

The first large users of natural gas in the Monroe field have been manufacturers of carbon black. Almost for the first time in history this use of gas has been encouraged by the federal government experts as perhaps the only economic method for the early development of this natural-gas territory. Now comes the question, however, as to whether other industries should not be encouraged to come in and use this splendid cheap fuel supply instead of allowing it to be consumed at rather low efficiency in the production of carbon black. Those who urge a change from the present policy insist that a larger number of workers and a greater value of finished product would result from many other industries using equivalent quantities of the gas. Those who contend on behalf of the carbon-black producer say that the other man can have the gas any time he is willing to pay more for it than it is worth for the manufacture of gasoline and carbon black under conditions now prevailing. Thus the carbon-black industry stands upon the dollars-and-cents argument—namely, that he who can afford to pay the most is entitled to the gas.

At the present time this question is decidedly acute. In fact, it is of such importance that the different groups within the Democratic party in that state are making an important campaign issue of the question of what should be done by the Governor and other state officials to control carbon-black manufacture in that state. As yet, however, there is no direct competition between industrial use and municipal gas supply. There is much talk about a pipe line to New Orleans; but capital will undoubtedly be very chary of making so large an investment with uncertain prospect as to the price that will be realized for the gas after it is delivered over these long distances. However, so long as there is threat of use for city supply, all gas-consuming industries are equally chary of making investments in this district.

Altogether this is another case where the best interest of the public is not being served because of extravagant claims or unjustifiable promises for cheap city supplies of natural gas. Such claims and promises never give a city any better gas supply and they certainly discourage that industrial development which is most wholesome and valuable for the community as a whole.

It will be well if officials and gas producers of the country at large refrain from encouragement of the public in the expectation of natural gas supplies from fields far distant from the municipal center. The officials and the producers will do far better for themselves, as well as for the public, by the encouragement of industrial developments for use of the gas, aiding either carbon-black plants or fuel-gas users who give promise of the greatest economic contribution to the community.

Awaiting A Moses

HUMBLE and chastened by the trials of the past few years, the fertilizer industry stands today hesitant as to the further road, but willing to follow leadership toward better business methods and the observance of those economic principles essential to permanent industrial success. There can be no question as to these facts in the mind of anyone who participated in the recent convention of the National Fertilizer Association.

There are few industries that have suffered more through the post-war period of depression, and almost no other prominent industry has remained so long in the period of hard times. This has been the inevitable consequence of the financial difficulties that have confronted the agricultural community. Without ready money, with severely curtailed income, and with exhausted credit, the farm interests as a whole have been unable to buy fertilizer in quantities comparable with their needs. But increased buying power of the farmers alone will not save the industry. There is need also of constructive, idealistic leadership; and this leadership must be such as to inspire the industry to follow into the ways of progress.

In the past the business methods, particularly the price cutting and conditional sales practiced by the industry, have been inexcusable. The extension of credit by the industry has been far beyond that limit fixed by sound business. The industry now recognizes these facts. It will be the first to admit that change in business practices must be made. The response to recommendations of this sort made at White Sulphur Springs was spontaneous and apparently unanimous.

But someone must show the way. It is not enough that the industry know the destination. A Moses to lead out of the wilderness of hard times, bad business practices and mutual distrust and suspicion is sorely

needed. Let him arise and the industry will gladly and obediently follow into a period of assured business success. No one can deny that the welfare of the entire nation demands greater use of fertilizer than has ever been practiced in this country; all will profit by right leadership.

The Radioactive Appliance as a Cure-All

TECHNOLOGY is continually being bombarded with questions propounded by the laymen as to the probable value of radioactive appliances the ostensible purpose of which appears to be to remedy almost all the ills that flesh is heir to. A satisfactory answer is difficult to formulate. The value of radium in medical work is indisputable, provided it is used with caution and by those with experience and knowledge. It is not surprising, therefore, that its curative powers have been exploited by the unscrupulous and the uninformed, although it is extremely difficult to substantiate a charge of fraud.

For instance, an enterprising individual might purchase a sufficient number of those luminous appendages that are used to hang on the electric-light cords, incase each in a pad and sell the article for the cure of rheumatism. Radium cures; the pad contains radium; where is the sting? Our manufacturer proclaims that "This company guarantees the —— —— —— pad to contain a definite quantity of actual radium." If his statement is questioned, he might retort that one-billionth part of one milligram is a definite quantity. When it comes to safeguarding the public against danger of burns, little trouble would be involved in proving that the radium in most of these appliances exists in so minute an amount that the possibility of physical injury to the wearer may be discounted. But whether such a pad as the one we have in mind could improve one's state of health, other than by auto-suggestion, is a problem that could be solved only by expert testimony and extensive investigation.

When the manufacturer of the radioactive pad departs beyond an elaboration of the simple statement that his apparatus contains radium and that radium may cure disease, he is likely to provide food for doubtful thought, if not evidence for conviction. It is well known, for instance, among scientists that the rate of emission of radiation from radium and radioactive substances cannot be controlled or altered or checked by human intervention. One manufacturer in California sells an appliance in which the radioactivity, according to the prospectus, may be "further increased by exposing the pad to sunlight, for," we learn, "the pad also possesses the property of absorbing the rays and radiant energy of the sun." Such a statement prompts inquiry into the good faith of the manufacturer and provides justification for suspicion; for the man who can develop an apparatus to insure the absorption of the "rays and radiant energy of the sun," which afterward can be "distributed throughout the system by placing the pad in contact with the body," has achieved what is unknown to science.

Another type of radioactive apparatus, also manufactured in California, purports to energize drinking water. It consists of a stoppered bottle in which there is a perforated container or cylinder, apparently of zinc or aluminum. The inventor and his Maker alone know what is inside this. Instructions indicate that the patient should drink four or five glasses of the water per diem, filling up the bottle with plain water after each withdrawal. This may be a device to persuade people with simple complaints to drink more water, the beneficial effect of which might be sufficient to deflect fame toward the manufacturer of the apparatus; or it may be that the generator provides an efficient method of treating water for effective medicinal purposes. We confess we do not know. However, it is to be noted that the apparatus is constructed so that the metals or other materials of which the cylinder is composed and incases continually produce a small amount of a very fine flocculent precipitate, the formation of which suggests to the chemically uninitiated that something effective is happening within.

The opinions of the American Medical Association on the subject of radioactive appliances such as those to which we have alluded should be worthy of dissemination. There is a great deal of misconception current; and many sufferers, physical and financial, are wondering whether the sale of radium for medicinal purposes should not be placed under control.

A Danger to Scientific Progress

THE REV. ARTHUR T. ABERNATHY offers to bet the Rev. HENRY VAN DYKE or "any other Biblical infidel" $1,000 that he—i.e., Dr. VAN DYKE et al.—cannot prove "the materialistic evolution of man out of a lower order of species."

It is our good fortune to know Dr. VAN DYKE as a faithful minister of the gospel, for many years a professor at Princeton University, United States Minister Plenipotentiary to Holland during the war until the entry of the United States, when he resigned to put on a uniform and go with the troops as chaplain; president of the American Institute of Arts and Letters, author, poet, traveler, a gentleman and a scholar. We venture to predict that he will not enter the betting ring with this Abernathy preach-wallah. But the incident brings up a timely question.

ABERNATHY is one of a type of heresy-hunters and persecutors that has obtained a considerable foothold in this country since the war. It is a recrudescence of the witch-burning of Salem, of the holy Inquisition of Spain, of the championing of hatred, malice and persecution that seems to crop up whenever the morale of civilization is low. Its exponents press their gospel of the denial of the right of man to think for himself. They are all the same: Fundamentalists, witch-burners and holy inquisitors. The Ku-Klux Klan is the fruit of this same illusion of ignorance, grafted upon the lay mind.

They are not of the intelligentsia. In so far as they boast of being "100 per cent American" they are the left-overs, the shorts that develop in every race from imprudent matings in earlier generations. They are natural-born haters. Just now the philosophy of evolution is their target, but that is merely incidental. Anything that they cannot understand will serve them equally well.

ABERNATHY shows his character when he declares that his fight is "against Christian ministers and teachers who . . . violate every principle of spiritual and intellectual integrity by accepting pay to proclaim

a set of principles . . . and then . . . teach antagonistic doctrine." He can't see any further than the dollars, although the few that clergymen receive are usually contributed by the parishes which they serve.

Evolution, we repeat, is a great system of philosophy. Nobody claims inspiration or immutability for it. It seems to the learned and intelligent to be a dim vision of the process of creation. It is constantly undergoing transition, and it is in no sense considered as the frozen words of dogma. Just now a great change is in process in the evident eclipse of WEISSMANN'S theory that acquired characteristics are not transmitted. One may believe in special creation and still believe in evolution. One may accept the theory in whole or in part. It does not beget hatred and malice except among the inferiors who can't understand it, or among vindictive men who, owing to a defective social order, have been able to gain a cloak of authority and who fear for the security of their commands.

There are certain formulas that are designed to satisfy minds of a low order that lack the gift of understanding. Of such are six days of creation and a flat earth. Or man as a perfect creature designed for erect walking. But men like ABERNATHY or the Rev. JOHN ROACH STRATON or WILLIAM JENNINGS BRYAN can't understand these things, and so they are angry and want to destroy those that can understand them.

The Fundamentalists of today are cruel, un-Christian, vindictive, and they are the champions of ignorance. They behave according to their natures, and we can't change that. But when they proceed to write their vicious notions into the laws of the land it is time to recognize them as the pests that they are. They are entitled to life, liberty and the pursuit of happiness, but to allow them to rule or to dictate means the destruction of our liberties and the death of progress.

Selling the Ultimate Consumer

FROM the viewpoint of extending public appreciation of the importance of the chemical engineering industries it is most unfortunate that so few of the products of these industries are recognizable as such by the ultimate consumer. We may be thankful, perhaps, for the extent that our manufacturers are thus relieved of catering to the evanescent whims of the consuming public, but we should not lose sight of the fact that serious problems are sometimes involved in the marketing and advertising of even the few chemical products that do reach the consumer directly.

An indication of the nature of these problems can perhaps best be brought out by considering a condition that might easily arise in almost any industry. Markets being established through national advertising, keen competition results in which one manufacturer may find himself at a decided disadvantage as regards access to supplies of certain raw materials. In an effort to retain his business he may find it possible to take other, more expensive raw materials and compound them in such a way as to produce a product that will present a more attractive appearance, although in reality it may be inferior to the original product for the purpose intended. Through intensive advertising this manufacturer may develop a wide public demand for his new, more attractive product, with the result that competing manufacturers are practically compelled to bring out a similar line in order to retain their share of the business. Even though the public is supplied with an inferior product, this condition may pass unnoticed for an indefinite period—simply because there may be no standards by which the individual can judge the relative efficiency of such products. Who can say, for instance, how little sodium silicate or how much naphtha should be used in a laundry soap? Is it safe to leave this to the housewife's preference, influenced as it is by some of the chemically ridiculous ads that grace the present-day billboard or magazine cover? Or should we insist on a more scientific basis of valuation and see that the public is converted to that basis?

National advertising, when rightly used, is a powerful tool for convincing the ultimate consumer of the inherent merits of those chemical products that pass directly to him. If in the past advertising has been misused to establish false standards of quality and usefulness, the responsibility lies with our own industries.

Curtailment Of Education

AT INTERVALS during the past few years various states have undertaken to regulate the operations of schools conducting their courses in foreign languages. On June 4 the Supreme Court of the United States passed upon such legislation, ruling that any such state or municipal statutes are unconstitutional. But there is another form of curtailment which cannot be regulated by court degree, and it is almost equally deserving of criticism. It is the suppression of scientific information and technical knowledge regarding progress in the arts and industries that results from an unduly selfish management policy.

This sort of restriction upon general progress is all the more to be condemned because of its very insidious nature, being justified in the minds of many on the score of the right of the individual to the exclusive use of his own achievements. Fortunately, however, it is constantly becoming more and more clear that this undue restraint upon the distribution of technical information is far from profitable to the management following this practice. Industries are coming to see that the more persons they can encourage to begin investigation and development work in fields of peculiar interest to themselves the more rapid will be the advance of their industries and the greater will be the rewards that come to themselves and their individual companies. The day of the patent written to conceal rather than reveal has passed; the courts have been emphatic in their rulings that such patents are not valid. The day of secret processes is also rapidly passing; there are far too many competent investigators working in almost every field for any management to hope that it can long retain exclusively and secretly any outstanding technical developments that its own staff may make.

The time has come when industry must cease its efforts to curtail public knowledge of products or processes. The unrestrained acquirement of knowledge must be encouraged, with the sole restriction that the rights of the inventor or the owner of the patent shall be adequately and honestly conserved under the patent laws. Greater secretiveness than this is not alone contrary to public interest; it is inexpedient for industry itself.

"The fertilizer business is a material business, but it is not necessary that we who have charge of its conduct should all turn into materialists. Ideals are necessary in business as well as in life, and without them we cannot succeed. As I see it, the industry, in the last 2 or 3 years, has been conducted on about a hundred per cent selfish basis."

A Challenge to an Industry

The President of the National Fertilizer Association, Frankly Criticising Some Business Practices, Makes a Stirring Appeal for Farsightedness

THE ADDRESS of the president of the National Fertilizer Association has always been filled with business statesmanship. It is a document which the business and technical world may well anticipate with eagerness. Not only does it present the progress and position of a great industry but it holds up to the membership and the world methods, standards and ideals that must inspire to saner business thinking and cleaner business practice.

Everyone knows of the difficulties which the fertilizer industry has been through—difficulties not only of prodigious, heartbreaking liquidation, of unbelievable frozen credits, but difficulties of unstable prices during the reconstruction period. This instability was caused by the disorganized, selfish scramble after business by a few who not only disorganized the market but failed to help themselves materially.

So much by way of background. Hear then the president: "I asked a man close to the industry about the association. He replied that he thought there was a better feeling, a broader acquaintance and more real friendship among the members of the association than any association with which he had ever come in contact, but, he added, there is less real co-operation."

"The co-operation which the members have so generously given to the officers of the association, often at great personal sacrifice, declines, when it becomes a matter of business, to about the square root of minus one. Some evidence on this can be inferred from the report of the Federal Trade Commission dealing with an investigation of the industry. The report is a clean bill of health, but the correspondence attached is not particularly edifying. It was the old army game of 'passing the buck,' but to an extent almost never equaled. It was always the other fellow who was at fault, never the man who was writing.

"The result of this spirit of selfishness has been chaos in many departments of the industry. There has been more talk and discussion of conditions the last 3 years than

Gustavus Ober, Jr.
President of the National Fertilizer Association

probably there was in the whole previous history of the business. The result of these discussions, where the analysis was carried far enough, was a statement that the difficulties of the industry were brought about by a lessened consumption on the part of the farmer. There was every readiness by the individual to recognize this and admit it, but there was no willingness to admit that that particular difficulty applied to the individual himself. It was a bad situation that must be borne by the other man.

"It is my firm conviction that individual prosperity is and can only be measured by the prosperity of the industry itself, and without prosperity in the industry there cannot be individual success. It may possible to beat the game for one season or more, but not over a period of years. Until this is realized, understood and accepted, there will be no foundation for future prosperity in the business. The fertilizer industry is itself, as has been stated repeatedly, basic and fundamental. There is a place for it and we all long for the day when it will again take its place as one of the best managed in the country.

"It has been said that Boston was not a place but a state of mind, and I sometimes think the industry has lost its standing as a business and has become a state of mind, and until that state of mind is changed, the industry will not prosper.

"The needs of the association, as I now see them, are re-establishment of confidence of each one in his fellow man. This means the elimination of insincerity, and, in many cases, actual hypocrisy, and an honest-to-goodness desire to co-operate intelligently with one another. I am frank to say this last, I think, has largely been lacking. If this can be accomplished, we shall be a long way toward better business methods and practices, and until these are re-established upon a firm and sound basis, I, for one, believe that prosperity cannot be achieved.

"The industry, as a whole, has drifted without anchor and at the mercy of any opportunist wind that blew. This has been reflected in the lack of a definite policy of many of the individual companies.

"Many of the individual representatives of the fertilizer business have definite convictions as to business principles and economic theories, but most of us have without hesitation thrown these overboard and subscribed to policies that we know in our own hearts were unsound and unsafe. I ask for the re-establishment of our convictions and ideals, and I believe that with such to guide us, we cannot go far wrong."

Such enlightened leadership must ultimately have its effect. The enthusiasm with which this address was greeted had a spontaneity that was unmistakable. With leadership and enthusiasm the industry will shake itself free, but not until the individual can visualize himself as a part of the whole, successful in its success and growing with its growth.

Conventions of National Fertilizer Association and Southern Fertilizer Association at White Sulphur Springs, W. Va., June 12 to 14, 1923, Deal With Industry's Problems of Production and Distribution

EDITORIAL STAFF REPORT

MORE "high-analysis" fertilizers and better selling methods were the two ideas that dominated the discussion at all sessions of both the National Fertilizer Association and the Southern Fertilizer Association, which held their meetings in White Sulphur Springs, W. Va., June 12 to 14. Each of these organizations was responsible for one of the open sessions; special meetings for consideration of the work of the soil improvement committee of the National Fertilizer Association and for executive discussion of some of the N.F.A. problems filled the remainder of the convention time.

The attendance, though not as large as during many former years, was at least 20 per cent above last year's. This and many other factors indicated an increasing confidence throughout the industry that the future business would be greater and more profitable. Although the individual companies composing the membership of this association have not been prosperous during the past few years, the association itself continued to show a good financial condition. The treasurer's report at the 1923 meeting indicated disbursements of approximately $18,000 and a generous balance still in the treasury. The secretary's report showed a net loss of only one member during the past year, a great contrast with the results during the preceding year, when the decrease in membership was 76.

Officers and Executive Committee Elected

As the five members of the executive committee who had served for the term ending 1923 were not eligible for re-election, the following five gentlemen were elected to succeed them for the term ending in 1926: L. A. Bailer, Swift & Co., Chicago; R. S. Cope, Reliance Fertilizer Co., Savannah, Ga.; W. D. Huntington, Davison Chemical Co., Baltimore; E. E. Newhouse, Arkansas Fertilizer Co., Little Rock, Ark.; A. E. Sheldon, Federal Chemical Co., Louisville, Ky.

All four officers of the association were re-elected to serve again for the coming year. They are: President, Gustavus Ober, Jr., G. Ober & Sons, Baltimore; vice-president, Spencer L. Carter, Virginia-Carolina Chemical Co., Richmond, Va.; treasurer, Irvin Wuichet, Wuichet Fertilizer Co., Dayton, Ohio; secretary, John D. Toll, *The American Fertilizer*, Philadelphia.

Presidential Address

Gustavus Ober, Jr., president of the National Fertilizer Association, not only reviewed the present situation in the industry as a national organization but also sounded words of warning and gave recommendations for further progress which proved the keynote of the proceedings of the convention. He urged a much broader view for the future, with especial attention to the elimination of bad practices which the industry as a whole seems willing to admit to be wrong. The time is ripe, in Mr. Ober's opinion, for these reforms, because liquidation of the industry appears practically complete, and reduction of the industry's indebtedness and the reduction of bad debts of users seems to have progressed as far as it can go.

Mr. Ober discussed the important progress which had been made through the Washington office of the association in legislative matters and through the great advances of the soil improvement committee, which has brought about the adoption of standard formulas for "high-analysis" goods. In this connection, however, he pointed out that too rapid an advance to high-analysis

product must not be expected, for immediate adoption of high analyses to the exclusion of all other brands would undoubtedly make impractical the use of certain valuable raw materials which should not be altogether eliminated.

The permanent prosperity of the industry demands, in his opinion, a great reform which must include three things:

1. A re-establishment of mutual confidence within the industry as to the honesty and fair dealing of other members of the business.

2. The elimination of unsound business principles in sales and uneconomic practices with respect to price-cutting, credits and business methods generally.

3. The re-establishment in the mind and practice of each individual, as well as of each company, of high ideals and high principles of practice.

Among the ends for which the association should strive are greater co-operation and co-ordination in research; the extension of the period of fertilizer purchase over longer times both spring and fall; uniform standards of nomenclature and standard formulas for commercial fertilizers; and a trade code of ethics for the guidance of the business. The last of these recommendations was developed at considerable length by Mr. Ober.

The spontaneous and hearty applause which greeted Mr. Ober's recommendations indicated that the association as a whole was prepared to accept this plan and follow this leadership.

Mixed Fertilizers in General Farming

Prof. Firman E. Bear, of the College of Agriculture, Columbus, Ohio, presented the one technical address of the association meeting, discussing the subject "Using Mixed Fertilizer in General Farming." He answered the question naturally raised in the minds of economists by the demonstration that the policy of using mixed fertilizer for general farming is sound. Professor Bear's paper is reproduced in slightly condensed form elsewhere in this issue.

Responding to Professor Bear's recommendations, Horace Bowker, of New York, congratulated him on the more practical and valuable service the agricultural stations of the country are now doing in fertilizer work. He pointed out that under the present conditions the industry and the investigators are working on such common basis as to permit active exchange of information to their mutual advantage.

What the Soil Improvement Committee Does

Prof. William D. Hurd, director of the soil improvement committee, reported briefly at the regular session of the association on the purposes and scope of the work carried on by this agency. This committee also held a special evening meeting at which an illustrated lecture descriptive of some of the achievements and methods of work by the staff of the committee was given. The scope of this committee's activity is best explained in the form of a brief statement and statistical summary which it presented to the membership on this occasion, answering the question: "What does the soil improvement committee (N.F.A.) do?"

It maintains a staff which is constantly in the field gathering facts for "The Fertilizer Story," and it spreads this through all available channels for the benefit of the whole industry.

It co-operates with all existing agencies "in procuring and disseminating useful knowledge and information pertaining to the scientific and practical development of agriculture."

It keeps in contact with soil-fertility developments in twenty-six states.

Its staff attends the principal agricultural meetings and conventions, making contacts with the leaders in soil-fertility work, gathering material, and keeping the viewpoint of the fertilizer industry before these workers.

It is a service organization to its subscribers.

It maintains research fellowships at Vermont, Maryland, Indiana, Wisconsin and Iowa Experiment Stations, for the study of important problems affecting the fertilizer industry.

It assists in carrying on co-operative fertilizer tests with experiment stations, county agricultural agents and other agencies on important crops.

It issues a "News Bulletin" which goes monthly to 9,500 college and experiment station workers, county agricultural agents, representatives of the industry, bankers, railroad agriculturists and others.

It has waged an active campaign to eliminate low analyses and the wasteful multiplicity of brands. Sectional meetings have been held in Chicago, Boston and Baltimore. State meetings of salesmen held in five states—more to follow. Nineteen states now co-operating.

It furnishes educational material to colleges, county agents, vocational instructors and the industry; 1,200 sets of charts on commercial plant food, 1,026 sets of experiment station photo panels, 36 sets of lantern slides and 11 exhibits are in constant circulation and use by these agencies.

It operates a "News Service" to farm and other papers. More than 1,200 articles, picture strips, news items, etc., were sent out to and used by nearly 500 papers having a circulation of more than 58,000,000 readers.

It distributes literature to subscribers, education agencies, etc. More than 150,000 copies were sent out during the year.

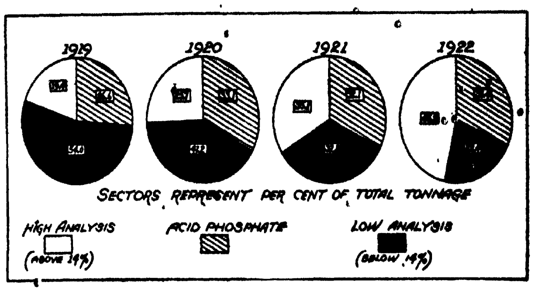


FIG. 1—PROGRESS OF HIGH ANALYSIS IN INDIANA
Prepared by soil improvement committee, National Fertilizer Association.

The outstanding achievement of the committee during the past year is unquestionably its work in securing the adoption of standard high-analysis fertilizer formulas in various districts of the country. This work, which has previously been reported in the news pages of *Chem. & Met.*, is illustrated by Fig. 1, showing the progress in adoption of high-analysis goods in Indiana during the past few years.

Cost Accounting Methods Recommended

On behalf of the cost accounting committee B. A. McKinney reported the great progress that has been made in the formulation of a system of cost accounting for companies that are engaged only in dry mixing. A system for companies manufacturing acid phosphate has not yet been developed, as this is a much more elaborate problem. The committee report on dry mixing is an elaborate text book of cost keeping and accounting methods. The committee felt this was essential since no simple outline of the classification of accounts would serve. The full report was not presented to the association in its general meeting, but was discussed in preliminary form at the executive sessions of the convention. It is planned that the changes and additions suggested as necessary by this executive consideration

be incorporated in the report and that it then be circulated in proof form for final comment before adoption. Pending this final criticism and revision, the report is not to be given out by the association except to members.

In the absence of C. F. Hagedorn, chairman of the chemical control committee, only a brief written communication describing this part of the association work was presented. During the past year the committee has been active in co-operation with the A.O.A.C. and the American Chemical Society in revision of methods of fertilizer analysis. The committee has recommended to the A.O.A.C. fertilizer referee certain definitions. Among these are a definition for basic phosphatic slag, which defines this as a material containing not less than 12 per cent P_2O_5, of which 80 per cent should be soluble; a definition for lime, providing that only oxide and hydroxide or equivalent magnesium compounds should be rated as available; and a definition of dry pulverized or shredded manure, which eliminates mixing other constituents.

The committee is giving particular attention to work on nitrogen availability. It urges further investigation on this subject as well as of methods for analysis of manure salts and for determination of ash.

Southern Fertilizer Association Meeting

One of the high lights of the convention week was the session on Tuesday, June 12, devoted to the mid-year meeting of the Southern Fertilizer Association. As members of this district association are also generally members of the national association, the attendance was excellent and the meeting was of great interest.

President J. Russell Porter, of the Porter Fertilizer Co., Atlanta, Ga., summarized the general feeling of the membership in his presidential address at the opening of the session. Distinct progress toward normal conditions and general encouragement of the industry was noted, with particular confidence because of the improved financial situation of most fertilizer users and the distinct progress that has been made by the soil improvement committee of the association. The president, however, cited two distinct notes of warning to the membership. The first was a warning against overproduction, an outstanding cause of curtailed profits; the second was an indictment of conditional sales, not alone because of their bad effects upon the industry itself but also because of the severe condemnation by others which these practices bring upon the industry.

As objectives for the coming year, Mr. Porter recommends abundant but not excessive production; sale at definite prices without undue extension of credit and without discounts; the increase in proportion of "high-analysis" goods; the elimination of as large a number of the unnecessary brands and kinds as possible; and encouragement of co-operative buying on a county basis rather than through state-wide contracts, which are impractical if not impossible of successful application.

Boll Weevil a Dominating Factor

The agricultural program of the South was discussed by Dr. J. M. Harper, the director of the soil improvement committee of the association. The respects in which this territory demands a different fertilizer program than the rest of the country was emphasized, with particular attention to the dominance of the boll weevil trouble in all phases of the subject. For real progress, Dr. Harper believes that the industry must encourage greater production per acre, and to this end he points out that "the intelligent use of fertilizer is the only answer to the problems of the industry." He prophesies that with the understanding of the boll weevil problems this pest can be controlled within a few years so that prosperity will return to the Southern agricultural territory. He estimates, therefore, an increased output of 500,000 to 1,000,000 tons per year for the eleven Southern states alone. On this basis, he forecasts an annual demand for not less than 7,000,000 tons of fertilizer in this territory within a period of approximately 5 years.

C. A. Whittle, boll weevil expert of the soil improvement committee, insisted that plowing under by Oct. 15 insures killing of at least 97 per cent of the boll weevil and that early use of poison, generally about June 15 to June 30, will adequately control the rest. Other systems of boll weevil control may be successful, but none of them has been proved sufficiently so to justify support by the fertilizer industry. In the practice of these two recommended methods, it should be understood that control on a community basis is essential, for migration from farm to farm offsets any advantage of control by the individual on his own land alone.

The growing belief that generous use of fertilizer for boll weevil control is a measure of value is somewhat justified; but the risk is too great for one to depend upon this, upon cultural methods, or upon other remedies without the use of calcium arsenate also. In the use of calcium arsenate, the most successful poison yet thoroughly tested, dusting is the best practice yet proved. Some liquid applications still in trial stages are probably going to be demonstrated to be of value, but

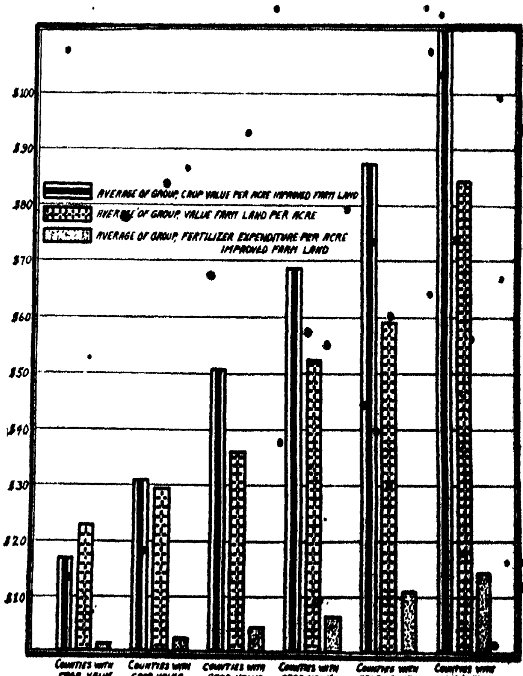


FIG. 2—CROP VALUES—FERTILIZER, EXPENDITURE—LAND VALUES

Showing relationship among these items for all counties of North Carolina, South Carolina and Georgia. Compiled from U. S. Census of 1920, by David D. Long, soil specialist, soil improvement committee, Southern Fertilizer Association.

one has yet reached the proved stage, in the judgment of Mr. Whittle.

With respect to the calcium arsenate situation in the South, Mr. Whittle pointed out that much delay had occurred in purchasing this year because of the belief that lower prices would follow and that perhaps the large quantities which were recommended for use might not be needed. He forecasts the crest of buying of calcium arsenate for about July 1. Until that peak of purchases is reached, it is difficult to tell whether the South will really experience a shortage.

Fertilizer Use and Crop Values

The diversification of crops in the South has long been urged as a means of improving agricultural conditions and protecting against the boll weevil. But D. D. Long, soil specialist and economist of the soil improvement committee, pointed out that this tendency to diversify agriculture was severely limited by economic facts. At present the South, considered on the basis of acreage, is really diversified in its agriculture, but the fact that cotton is valued at more than 50 per cent of all the crops shows that it is not well diversified in value of products. However, even with generous fertilization, it is difficult to substitute other crops for cotton, as the yield in dollars per acre is almost invariably much less. For example, oats, forage and other substitutes yield from $17 to $30 per acre, while cotton averages more than $80 per acre. Moreover, many of the substitutes suggested are not suited to the soil conditions of the South, and others, such as sweet potatoes and tobacco, which give high yields in dollars per acre and which are suited to much of the Southern territory, are crops of limited market demand.

From the standpoint of the fertilizer industry, the South must be sold its fertilizer on the basis of increasing crop value per acre and increasing market value of land, rather than upon any basis that the fertilizer will afford opportunity for much greater diversification of crops. To show the relation between fertilizer use and crop and land values, Mr. Long presented statistics in graphic form. Fig. 2, which groups all counties of the three states North Carolina, South Carolina and Georgia, the largest fertilizer using states of the country, shows most convincingly how both crop value per acre and land value per acre increase with increasing consumption of fertilizers. Similar charts which have been published recently in the *Fertilizer Green Book* show in detail for various other states and other crops that the same relationship holds—namely, that crop value and land value increase markedly with increasing fertilizer consumption.

Fertilizer Lowers Producing Costs

J. C. Pridmore, director of the soil improvement committee for the Shreveport district, discussed another phase of the relationship of fertilizer use to financial conditions at farm. Particularly he showed how the actual cost for lint cotton decreased per pound with increasing consumption of fertilizer and the attendant increase in yield. In one set of figures, an increase in yield from 100 to 300 lb. of lint per acre resulted in decrease from 30c. to 18c. per lb. as the net cost. Corresponding figures estimated for 1922 showed decrease from 25c. to 15c. as the net cost per pound of lint cotton.

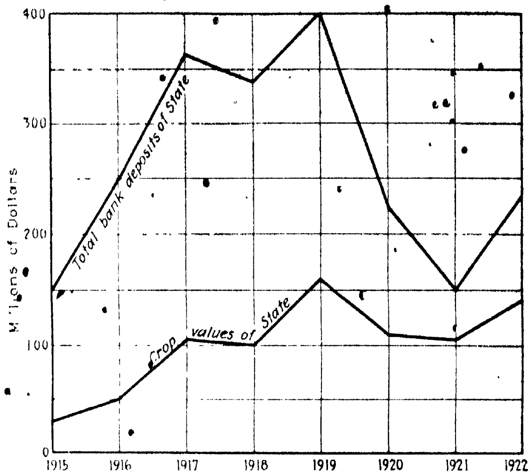


FIG. 3—RELATIONSHIP OF ARKANSAS CROP VALUE AND BANK ACCOUNTS

The increase in yields which produces this decrease in cost can be accomplished only by generous fertilizer application.

Financing Fertilizer Sales

Recognizing the criticism commonly made of the fertilizer industry for conditional sales and excessive credits in sale of fertilizers, Mr. Pridmore argued for a future development of credit by the local merchants and the local banks instead of by the fertilizer manufacturer. As evidence that the banks and merchants would be justified in granting such credit for fertilizer purchase, he showed the direct relationship between the value of crops, which of course depends upon quantity of fertilizer used, and the bank deposits of any season. Very striking figures are shown in Fig. 3, which applies to the entire state of Arkansas for the period 1915 to 1922, inclusive. In view of the great increase in prosperity resulting from fertilizer use, Mr. Pridmore argues that the banker would be amply justified in financing purchases of fertilizer if the industry would decline to give the large credits now afforded. In fact this willingness has already been shown in some districts, where improved conditions prevail.

Improved Selling Methods the Big Need

Discussing the industry as a whole, Mr. Ashcraft, of the Ashcraft-Wilkinson Co., Atlanta, urged in a vigorous manner an entire revision of the selling system of the Southern fertilizer industry. He pointed out as the great need of the present "the placing of really big men in the selling game." He urged, if no other way was found to accomplish it, that the cheap traveling salesman now employed be discharged and a limited number of high-caliber men who will take fair prices and stick to them be put in their place. At the present time the industry in the South "simply makes a price to cut it." As a consequence no one accepts seriously the prices quoted by the industry and the whole industry as a consequence is in disrepute.

The response to Mr. Ashcraft's arraignment of present practices indicates that the membership of the Southern Fertilizer Association is ready to accept this advice individually, if some means can be found for uniform practice of the methods proposed.

Calculation of Vapor Recompression Evaporators

By L. A. Pridgeon
Department of Chemical Engineering, University of Michigan

> **It is possible to calculate with a moderate degree of accuracy the heat economy and capacity of vapor recompression evaporators.**
>
> **The apparatus will come to equilibrium and establish its own temperature difference. This temperature difference is a direct function of the heat losses from the system.**
>
> **The power required is a direct function of the temperature difference.**
>
> **The economy is an inverse function of the temperature difference.**
>
> **Elevation of boiling point decreases the working temperature difference, and therefore decreases the capacity of a given heating surface.**

The essential organs of a vapor recompression evaporator are shown in Fig. 1. They are a preheater for heating the feed liquor with the condensate leaving the evaporator, an evaporator, and a compressor, which in this case is a motor-driven turbo-blower.

It should be noted that there are two parts to the fluid circuit, the high pressure, P_2, and the low pressure, P_1; also that any portion of the fluid traverses the circuit but once. The fluid enters the low-pressure circuit at the preheater as feed liquor, passes through the preheater into the body of the evaporator, vaporizes and leaves through the vapor line to the compressor. The fluid enters the high-pressure circuit at the discharge side of the compressor, passes to the steam basket, condenses, leaves the machine through the preheater and is collected in a trap below the evaporator.

The action of the machine may be studied to advantage in connection with the temperature-entropy diagram shown in Fig. 2. The vapor is drawn into the compressor through the suction pipe from the vapor space of the evaporator. It may be assumed that the vapor entering the compressor is in the saturated state at the temperature T_1, which may be taken equal to the temperature corresponding to the pressure P_1 in the vapor space of the evaporator. This state is represented by point B. The vapor is compressed adiabatically to a final pressure P_2, which is the pressure corresponding to the temperature T_2 of saturated steam in the steam basket. Adiabatic compression is represented by BC.

The superheated vapor in the state C is discharged into the steam basket, where heat is abstracted from it by the liquor in the evaporator. First the superheated vapor is cooled to the state of saturation; this process is represented by the line CD, and the heat abstracted by the area C_1CDD_1. Then heat is further removed at the constant temperature T_2 (and pressure P_2) and the vapor condenses. At the end of the process the fluid is in the liquid state. Its state is represented by the point E on the liquid curve, and the heat abstracted by the area D_1DEE_1. The condensate then leaves the steam basket and enters the preheater, where it is cooled to the temperature T_0 of the entering liquor. Its state is represented by the point F and the heat abstracted by the area E_1EFF_1.

The feed liquor enters the preheater at the temperature T_0, and its state is represented by the point F. In this theoretical case the temperature of the condensate leaving the preheater is taken as the temperature of the entering feed liquor. The reason for this is obvious from the discussion that follows. In practice, however, the temperature of the condensate leaving the preheater would be above that of the entering feed liquor. The temperature of the liquor entering the evaporator lies along the line FA. Assuming no elevation of boiling point, the liquor is raised to the temperature T_1, corresponding to the pressure P_1 of the vapor space. Its state is then represented by the point A, and the heat absorbed in raising its temperature from T_0 to T_1 is represented by the area F_1FAA_1. The temperature of the vapor in the steam basket being higher than that of the liquor, heat is absorbed by the liquor and it vaporizes at constant pressure P_1. This process is represented by the line AB and the heat absorbed from the vapor in the steam basket by the area A_1ABC_1.

The work done on the fluid is the difference between Q_1, the heat absorbed by the liquor, and Q_2, the heat rejected to the steam basket and preheater. We have then

$$Q_2 = \text{area } C_1CDEFF_1$$
$$Q_1 = \text{area } F_1FABC_1$$

The area F_1FAA_1 is common to both.

Therefore, if AW represents work expressed as heat units,

$$AW = \text{area } C_1CDEAA_1 - \text{area } A_1ABC_1 = \text{area } BCDEAB$$

In the cycle above described, the heat rejected to the steam basket and preheater is equal to the heat absorbed by the liquor, therefore $Q_2 = Q_1$ and $AW = 0$. In practice, a temperature difference must be maintained between the heating steam and the evaporating liquor, and a temperature difference consequently implies a pressure difference. Therefore AW cannot be equal to zero. Since work is done in maintaining this pressure difference, means must be provided for removing this work from the system in the form of heat. In this particular case this can be done in only two ways: heat removed by the thick liquor and by radiation. These being constant, AW is constant and therefore the temperature difference is constant and rather small.

The amount of heat added to any system in a given time must necessarily be taken away from the system in the same time if the initial condition of the system is to be maintained. So in our case if a specified temperature difference (which is a pressure difference) is to be maintained between the steam and boiling liquor by the compressor, the heat added by the compressor in the form of work must be removed. If the heat lost by radiation and through thick liquor discharge is not sufficient to remove all the heat added by compression.

Paper presented at the Wilmington, Del., meeting of the American Institute of Chemical Engineers, June 20-23, 1923.

it will be necessary to blow off steam from the vapor space. If steam were not blown off, the pressure of the vapor space would rise and thus decrease our temperature difference, thereby decreasing the work of compression and decreasing the heat added to the system in unit time. If the heat discharged from the system by radiation and through thick liquor is greater than that added by work of compression, heat must be added from some external source in order to maintain the specified temperature difference. If heat is not added from an external source, the temperature difference will increase until the work of compression is equal to the heat lost from the system by radiation and through thick liquor. With a given set of conditions it is impossible to maintain a predetermined temperature difference. The machine will come to equilibrium and maintain its own temperature difference. If no heat were lost from the apparatus, the boiling point would rise to that of the steam temperature, and there would be no temperature difference and consequently no evaporation. The temperature difference is a function of the net amount of heat lost from the apparatus per unit time.

Calculation of Work Required

The cycle of the vapor recompression evaporator transferred to the total heat-entropy plane is shown in Fig. 3. (This figure is a part of the Mollier diagram, which can be found in Marks and Davis' "Steam Tables and Diagrams.") The same letters in Figs. 2 and 3 denote the same states. Adiabatic compression is represented by BC, the point B lying on the saturation curve S'' (dry and saturated steam) at its intersection with the constant pressure line P_1. Line CE represents the cooling and condensation of the steam at constant pressure P_2, and line EF the cooling of the condensate in the preheater. The heat q_2 given up by unit weight of steam in the steam basket and by the condensate in the preheater is therefore the difference of thermal potential (total heat) between the states C and F:

$$q_2 = ic - if \quad (i = \text{total heat in 1 lb. of steam})$$

This heat is represented by the segment CF_1. Point E represents condensate at the pressure P_2 in the steam basket. Point A represents the state of the liquor in the evaporator. Point F represents the state of the condensate leaving the preheater and the state of the liquor entering the preheater. The process FA is the heating of the liquor in the preheater, and the process AB is the vaporization in the evaporator, during which heat q_1 is abstracted from the preheater and steam basket.

$$q_1 = ib - if$$

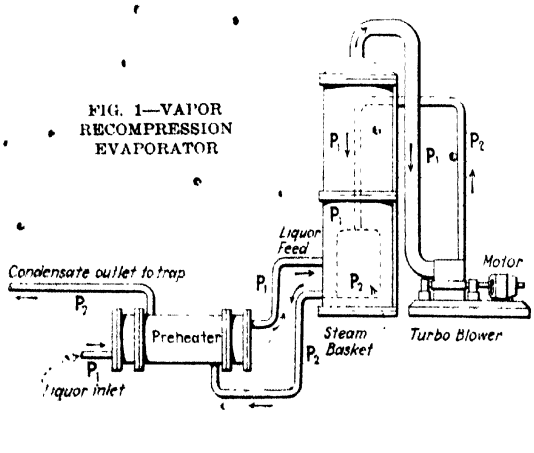
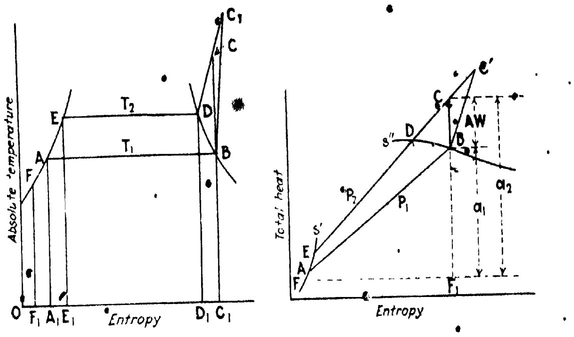


FIG. 1—VAPOR RECOMPRESSION EVAPORATOR



FIGS. 2 AND 3—TEMPERATURE-ENTROPY AND HEAT-ENTROPY DIAGRAMS

This heat is represented by the segment BF_1

$$AW = q_2 - q_1 = (ic - if) - (ib - if) = ic - ib$$

That is, the work required in thermal units is the change of thermal potential during the adiabatic compression.

If M equals the weight of liquid evaporated per hour, the work required per hour expressed in thermal units is $M\ (ic - ib)$, and the net power in kilowatts required to drive the machines $= M\ \dfrac{(ic - ib)}{3420}$

If n = efficiency of the compressor

$$\text{Gross kw.} = M\ \frac{(ic - ib)}{3420n}$$

The conceptions of steam compression differ from air compression in that adiabatic instead of isothermal compression is taken as 100 per cent efficiency. Steam compressors are not 100 per cent efficient. Internal friction between the moving parts and between the steam and its path through the compressor is converted into heat, which tends further to superheat the compressed vapor above that corresponding to adiabatic compression. This causes an increase in total heat, entropy and temperature without increasing the pressure.

If the compressor were water-jacketed this superheat could be removed at least in part. The work of compression for a given pressure difference would be decreased, thus increasing the efficiency of the compressor. The heat taken up by the water jacket is not available for evaporation, as it would be if allowed to remain as superheat in the compressed steam. Water-jacketing compressors is established practice in air compression. It might well be considered in connection with steam compression. In the following problems, however, the compressor is assumed to be not water-jacketed. Since the compressor is not 100 per cent efficient, compression is represented in Fig. 2 and Fig. 3 by the line BC' and not by BC.

Following are four problems representing hypothetical cases and are not to be taken as the conditions that actually exist but conditions that are assumed to exist.

Problem I

How much power is required to evaporate 10,000 lb. water per hour from a solution boiling at 212 deg. F., assuming heat losses by radiation, etc., are equal to the heat added in form of work to maintain the temperature difference of 18 deg. F.? Compressor and motor efficiency 60 per cent (based on adiabatic compression as 100 per cent).

***Solution*—A temperature of 230 deg. F. corresponds to a pressure of 20.77 lb. for dry and saturated steam. To**

find the total heat in a pound of steam which has been compressed adiabatically from 14.7 lb. to 20.77 lb., start on the Mollier (total heat-entropy) diagram at the intersection of the constant pressure line 14.7 lb. with the saturation curve and follow the constant entropy line vertically upward to the constant pressure line 20.77 lb. and read at the left of the diagram off the constant total heat line 1,177 B.t.u.

The power required is:

$$\frac{M(ic - ib)}{3420n} = \frac{10{,}000(1177.0 - 1150.4)}{3420 \times 0.60} = 129.5 \text{ kw.}$$

Problem II

From 12,000 lb. of solution fed to the evaporator per hour 10,000 lb. is evaporated. Boiling point is 212 deg. F., vapor dry and saturated. Liquor enters preheater at 60 deg. F. Condensed steam leaves preheater at 100 deg. F. Radiation 0.25 per cent (based on evaporation). Compressor efficiency 63 per cent (based on adiabatic compression as 100 per cent). Motor efficiency .95 per cent. Specific heat of solution leaving and entering is 1.

(a) What is the temperature difference?

(b) How much power is required?

(c) If the coefficient of heat transmission is 250 B.t.u. per hr. per deg. F. per sq.ft., how much heating surface is required in the evaporator?

Solution—To simplify calculations, use 60 deg. F. as a datum for calculating total heat entering and leaving machine.

Heat entering apparatus:

(a) Heat entering the apparatus as such equals 0, as the feed liquor enters at 60 deg. F.

Heat leaving apparatus:

(a) In condensate
10,000(100 − 60) 400,000 B.t.u.

(b) In thick liquor
2,000(212 − 60) = 304,000 B.t.u.

(c) By radiation
10,000 × 970.4 × 0.0025 24,260 B.t.u.

Total 728,260 B.t.u.

All of this 728,260 B.t.u. leaving the apparatus is added by the compressor in the form of work; therefore

$$\frac{728{,}260}{10{,}000} = 72.8 \text{ B.t.u. added to each pound of vapor by the compressor.}$$

1150.4 + 72.8 = 1223.2 B.t.u. total heat in 1 lb. of heating steam. If the compressor were 100 per cent efficient, use the figure 1223.2. Since the compressor is 63 per cent efficient, use 1150.4 + (72.8 × 0.63) = 1196.2. To find the pressure of the steam leaving the compressor enter the Mollier diagram at 1196.2 and move horizontally to right to a point on constant entropy line directly above the intersection of the saturation curve with the constant pressure line for 14.7 lb. This falls on the constant pressure line for 26.4 lb. The temperature corresponding to 26.4 lb. from steam tables is 243.1 deg. F. The temperature difference is 243.1 − 212 = 31.1 deg. F. Temperature differences are taken as the difference in temperature between dry and saturated steam at the pressure P_1 and the temperature of the boiling liquid. From steam tables steam at 26.4 lb. with a total heat of 1,223.2 B.t.u. is superheated 130 deg. F. The actual temperature of the steam is 243.1 + 130 = 373.1 deg. F.

(b) The power required is:

$$\frac{M(ic - ib)}{3420n} = \frac{10{,}000 \times (1196.2 - 1150.4)}{3420 \times 0.63 \times 0.95} = 229 \text{ kw.}$$

(c) The heating surface $= \frac{10{,}000 \times 1011.6}{250 \times 31.1} = 1300$ sq.ft.

Problem III

Conditions are the same as Problem II except vapor is wet. The qaulity is 99.

(a) From the Mollier diagram the total heat in a pound of vapor at 14.7 lb. and quality 99 is 1140.4. The total heat in 1 lb. of heating steam is 1140.7 + 72.8 = 1213.5 B.t.u.

If the compressor were 100 per cent efficient, use the figure 1213.5. Since the compressor is 63 per cent efficient, use 1,140.7 + (72.8 × 0.63) = 1,186.5. To find the pressure of the steam leaving the compressor, enter the Mollier diagram at 1,186.5 and move horizontally to the right to a point on the constant entropy line directly above the intersection of the constant quality 99 with the constant pressure line for 14.7 lb. This falls on the constant pressure line 26.8 lb. The temperature corresponding to 26.8 lb. from the steam tables is 244 deg. F. The temperature difference is 244 − 212 = 32 deg. F. From the steam tables steam at 26.8 lb. with a total heat of 1,213.5 B.t.u. is superheated 107 deg. F. The actual temperature of the steam is 244 + 107 = 351 deg. F.

(b) The power is the same as in Problem II.

(c) The heating surface $= \frac{10{,}000 \times 1001.1}{250 \times 32} = 1250$ sq.ft.

Problem IV

From 14,000 lb. of brine fed to an evaporator per hour 10,000 lb. of water is evaporated and 4,000 lb. of wet salt is drawn from the machine. Pressure in the vapor space is atmospheric. Elevation of boiling point is 15 deg. F., hence boiling point is 277 deg. F. Brine enters preheater at 60 deg. F. Condensed steam leaves preheater at 100 deg. F. Radiation 0.25 per cent (based on evaporation). Compressor efficiency 63 per cent. Motor efficiency 95 per cent. Specific heat of condensate taken as 1. Specific heat of wet salt taken as 0.30.

(a) What is the temperature difference?

(b) How much power is required?

(c) If the coefficient of heat transmission is 250, how much heating surface is required in the evaporator?

Solution—As in Problem II, use 60 deg. F. as a datum.

Heat entering apparatus:

(a) Heat entering apparatus as such equals 0, as brine enters at 60 deg. F.

Heat leaving apparatus:

(a) In condensate
10,000(100 − 60) = 400,000 B.t.u.

(b) In wet salt
4,000 × 0.3(227 − 60) = 200,400 B.t.u.

(c) By radiation
10,000 × 970.4 × 0.0025 = 24,260 B.t.u.

Total 624,660 B.t.u.

$$\frac{624{,}660}{10{,}000} = 62.5 \text{ B.t.u. added to each pound of vapor by the compressor.}$$

1150.4 + 62.5 = 1212.9 total heat in 1 lb. of heating steam. If the compressor were 100 per cent efficient, use the figure 1212.9. Since the compressor is 63 per cent efficient, use 1150.4 + (62.5 × 0.62) = 1189.8. Using the Mollier diagram as before, find the pressure of the steam leaving the compressor to be 24.4 lb. The temperature corresponding to 24.4 lb. is 238.7 deg. F. The temperature difference is 238.7 − 227.0 = 11.7 deg. F. From the steam tables, steam at 24.4 lb. with a total heat of 1212.9 B.t.u. is superheated 111 deg. F. The actual temperature of the steam is 238.7 + 111 = 349.7 deg. F.

(b) The power required is:

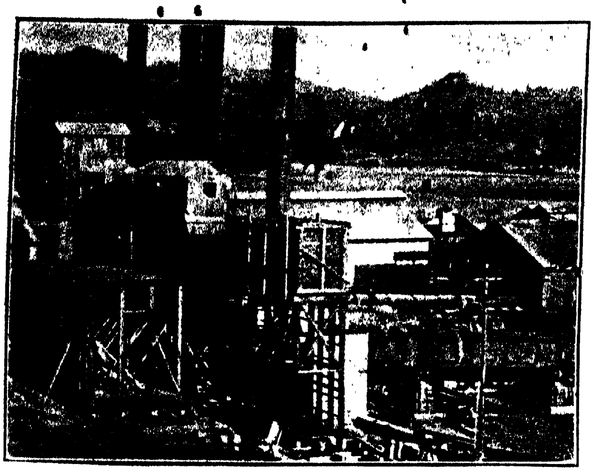
$$\frac{10{,}000 \times (1189.8 - 1150.4)}{3420 \times 0.63 \times 0.95} = 192.4 \text{ kw.}$$

(c) The heating surface is:

$$\frac{10{,}000 \times 1005.9}{250 \times 11.7} = 3340 \text{ sq.ft.}$$

Perils in Petroleum Production

At recent gatherings of oil men there was sounded a note of warning to the petroleum industry because of overproduction of crude and excessive stocks of gasoline. The members of the American Oil Men's Association have recently urged a vigorous buying movement by jobbers and distributors as a means of preventing imminent complete occupation of storage capacity. H. G. James, president of the Missouri Oil Men's Association, said that in some producing sections of the mid-continent field only 50 per cent of the companies' refining capacity is in operation and that many refiners were offering gasoline to jobbers at less than production cost. The cool weather is blamed for the condition.



Opening Up New Fields for an Industry

EDITORIAL STAFF REPORT

National Lime Association shows remarkable technical strength at its fifth convention. The development of quick-setting lime plaster, the manufacture of lime partition blocks and the extended use of lime in both asphalt and concrete roads are announced by the association's research organization.

THE National Lime Association sandwiched an open meeting between the executive sessions (which are open only to National Lime Association members) during its fifth annual convention in New York City, June 13 to 15. The effort was distinctly worth while. It gave a picture of the activities of the National Lime Association and of the excellent research work which is being carried out.

President Charles Warner presided, in the West Ball Room of the Hotel Commodore. In his opening remarks he pointed out that the Lime Association was not aiming to increase dividends this year or next year, but was working for the lime industry 10 years from now. The association can never be a trouble-shooter for the industry. It must have a long-time vision to be of any service. The president then introduced W. R. Phillips, general manager of the National Lime Association, who briefly outlined the work and the organization of the association. He enunciated the policy of the management of the association as being that of specializing in several of the most important problems and of making an intensive, rather than an extensive, survey. Naturally, all efforts cannot be confined along a few lines, but much better progress is made if problems are cleaned up and finished.

Four department reports were read by the men most closely associated with the various lines of activity. J. A. Slipher discussed the use of lime in agriculture. A survey of twenty states showed that, in spite of intensive campaigns on the part of universities and experiment stations, limestone has never been popular or widely used. Many reasons lie back of this unwillingness to adopt this material, the principal reasons being practical ones, in that the use of limestone does not fit in well with conditions of work on a farm. Mr. Slipher reported an increased use of burnt lime, pointing to a still greater use in time to come.

R. F. Brown discussed the work of the construction department, and interesting figures were read which showed an increase of 48 per cent in the tonnage of lime used in building in 1922 over 1921.

W. A. Freret took up the use of lime in highways—both in their construction, whether they be of asphalt or of concrete, and in the painting of objects along the side of the road and the borders on the roads, to make driving at night easier.

M. E. Holmes, chemical director of the association, outlined the activities of this department, including a brief résumé of the work done by the Fellows of the National Lime Association in the great institutions where these Fellows are located and by the central laboratory of the National Lime Association.

Following this, two papers were presented on manufacturing subjects. The first was by Oliver Bowles, mineral technologist, U. S. Bureau of Mines, and recently appointed head of the New Brunswick Experimental Station, which is to be devoted to non-metallic minerals. Mr. Bowles announced that one of the men at this laboratory would undoubtedly be placed principally on the utilization of limestone quarry waste.

Heat Losses in Limekilns

The second was by V. J. Azbe, on the heat loss in limekilns. A great deal of trouble in lime plants comes from the improper proportioning of fuel and air. CO_2 is a very significant figure in boiler gases, but it is even more significant in limekilns, for the percentage of CO_2 can be tied in very closely with the production of lime per ton of coal. For example, with 25 per cent CO_2 in the waste gases from the kilns a production of perhaps 3 tons of lime per ton of coal is indicated, whereas with 31 per cent CO_2 a 5 to 1 ratio is approached. Similarly, the loss of lime output can be determined by oxygen analysis, 2 per cent being about the optimum. An additional loss of heat, due to the withdrawal of hot lime, is accounted for and estimated from another chart, the temperature of the lime being variable and the amount of loss being due to the quantity of lime removed and the temperature. In addition to the losses already enumerated, there is an additional radiation loss which can also be estimated.

Lime Partition Blocks—A Remarkable Advance

The amazing story of the manufacture of lime partition blocks was told by Mr. Freret and W. E. Emley of the Bureau of Standards, illustrated with motion pictures of the machine in operation, taken in the plant of the International Clay Machinery Co., where the machines for manufacturing these blocks are being constructed. Investigation was started on March 3, 1923, and completed blocks were tested in the Bureau of Mines during April, so that the association can plead "guilty" of efficiency of the first order in conducting this interesting preliminary work. Thirty different types of blocks were manufactured, containing lime putty, lime hydrate, ground wood, wood shavings,

asbestos and other materials in widely varying proportions. The manufactured blocks will compete with gypsum blocks and with clay tile. In the test of the Bureau of Standards the lime blocks were found to be, in general, heavier than gypsum but lighter than clay, stronger than gypsum but again not as strong as clay, both in transverse and compressive strength. They have a greater absorption than clay but considerably less absorption than gypsum, and the permeability is so low that the block would probably have to be scored in order to hold plaster well.

Quick-Setting Lime Plaster

Perhaps the most dramatic story of all was that on quick-setting lime plaster. The investigation has been under way somewhat less than 6 months at the present time. What was wanted above everything else was a lime plaster that would set quickly and comparably with gypsum plaster. Lime plaster requires about 20 hours to set, whereas gypsum plaster sets in about 4 hours. The work was carried out along very comprehensive lines. One Fellow of the association working under R. T. Haslam at M.I.T. studied merely the compounds of lime, water and carbon dioxide. Another Fellow, under F. C. Mathers of Indiana University, undertook an Edison research to determine what materials, if any, would hasten the set of lime plaster. The third Fellow, under J. R. Withrow, of Ohio State University, studied the effect of burning conditions on time of set.

Professor Mathers' work met with a considerable measure of success, inasmuch as several methods of decreasing time of set were worked out. The first was by the addition of carbon dioxide to not over 5 per cent by weight. The second was by the addition of a water-soluble sulphate, ferric, magnesium and sodium sulphates being among the best. A mixture of 60 parts calcium oxide, 61 parts of water, 1 part of ferric sulphate and 3.6 per cent of carbon dioxide set in half an hour, as against 20 hours for a straight lime process. It is a simple matter to retard these quick-setting plasters as is done in the case of gypsum plasters, pure sugar being used in experimental work.

Professor Withrow reported that no relation between the time or temperature of burning and the set of lime plaster could be determined. Professor Haslam's report was an exceedingly interesting physical chemical study of the compounds that exist between calcium oxide and water, calcium oxide and carbon dioxide, and calcium oxide and carbon dioxide and water. Two general methods were adopted in carrying out this work. One was the study of a physical property of compounds or mixtures to see at what point a definite change of this particular property indicated a change in composition. The other method was to make the compounds themselves in several different ways, and then by analysis determine whether a new compound had been prepared.

Plotting data obtained from the literature on the solubility of lime, a transition point was noted at 60 deg. All attempts, however, to prepare a di-hydrate or a higher hydrate of lime failed, and on a redetermination of solubilities no transition point was noted. Also the vapor pressure plotted as the logarithm against the reciprocal of the temperature showed no breaks in the curve, indicating a single compound, the mono-hydrate. Similar results were obtained with calcium carbonate, only one compound being recognized. And, finally, the system CaO-H_2O-CO_2 was studied on both the acid and basic side of equilibrium and at absolute neutrality, three compounds being established.

Data on Quick-Setting Lime Plaster Summarized

In bringing together all the data related to the work on quick-setting lime plasters, G. J. Fink, research chemist of the association, stated that 2,000 mixtures had been investigated, using 220 addition agents in varying amounts and combinations. The tests made usually consisted of time of set, workability and tensile strength. Note was taken over the period of hardening, of shrinkage, water absorption, etc. The plaster was taken to be satisfactorily hardened when it showed a penetration of 2 cm. of the Gilmore needle.

The classes of substances tried out as addition agents include: oxides, with especial reference to those of lead and iron; oxidizing agents, such as calcium hypochlorite; acids; various siliceous materials, including infusorial earth, asbestos, etc.; greases and oils; and finally such unclassified materials as phenol compounds, sulphite waste liquor and carbon black.

Several materials were found to increase the strength of the plaster. Portland cement, calcined gypsum, cryolite and calcium chloride are included in this list. Carbonates in general impart the same property, while lead acetate affects plaster in this way to a remarkable degree.

The results with regard to those materials that reduce the time of set indicate that cement clinker, calcium aluminate, or a combined addition of inorganic sulphate with carbon dioxide, gives greatest promise in bringing about the effect desired. While a plaster containing 25 per cent of cement required 21 hours 35 minutes to set, the time was reduced to 5 minutes by the addition of $MgSO_4$ and CO_2 in relatively small proportion. In some cases the acceleration brought about was so great that the use of a retarder was found to be necessary. Gypsum or sugar in small quantities was found to be most satisfactory for this purpose.

The following combinations were suggested as being most likely to yield satisfactory results upon commercial development: Lime and calcined gypsum; lime and portland cement; lime and calcium aluminate; lime and cement clinker; hydrated lime and ground quicklime; lime and an inorganic sulphate (with the possible addition of CO_2); lime and a dry silicate; lime and an inorganic carbonate; lime and a soluble aluminate; lime and cryolite; lime and a substance containing tannin.

Lime in Agriculture

A bulletin, "Lime in Agriculture," has been prepared by the dominion chemist, Dr. F. T. Shutt, in response to many inquiries from Canadian farmers, respecting the application of lime and the relative merits of lime, ground limestone and other related substances. Dr. Schutt points out that there is a use and misuse of lime and that, unless rationally employed, the immediate advantages may be followed by decreased yields due to soil impoverishment. On the other hand, lime and carbonate of lime, if correctly used, are of much benefit, increasing crop production without impairing the soil's fertility. The author states that the exclusive and excessive use of the more caustic forms (quick and slaked lime) must inevitably lead to exhaustion of fertility, as they act as stimulants, setting free, but not adding to, the soil's store of plant food.

Abatement of Industrial Stenches by Means of Activated Carbon

A Review of Previous Efforts at Eliminating Industrial Stenches and a Description of an Installation Using Activated Carbon That Successfully Cured the Stench Nuisance in a Rendering Plant

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Industrial activity is egocentric and breeds forgetfulness and lack of consideration of the rights of others. Sometimes it becomes necessary for sluggish law to take a hand. So arose employers' liability and workmen's compensation. This other problem of industrial stenches has crept into that category too. Their economic elimination, whether on account of compulsion of law or as an expression of a more genial spirit, will be a great public gain. A technical problem that bears directly upon public happiness and comfort! This article discusses a suggested solution of wide application and great promise. It is a significant signpost.

THERE are many industrial processes which unavoidably give off objectionable odors or vapors. Many of us are familiar with the particularly obnoxious odors given off from the processes of rendering slaughter-house waste and other waste fats to recover tallow and have noted from time to time the publicity given to controversies between the health authorities and the operators of these processes. Other industries rather well known by reason of their odoriferous byproducts are the glue, fertilizer, soap, varnish and hide-treating industries. There are also numerous chemical plants which not only give out foul odors but in some cases more or less toxic vapors and gases.

In many cases, plants which give off particularly obnoxious odors and fumes are located in isolated sections as far away from habitation as possible. But obviously such an enforced isolation is rarely economical, so the operators of these plants have tried to satisfy the health authorities by various attempts at abating the nuisance.

Where these processes are operated and attempts are made to abate the nuisance, it is customary to cover or hood the containers and apparatus in which the processes are carried out, and by keeping a positive suction upon them by means of suction blowers to prevent the immediate dissemination of the objectionable odors and vapors. This protects the operators and persons in the immediate vicinity of the apparatus. The question then arises as to what disposal to make of the air laden with obnoxious fumes and vapors.

Various methods of disposing of this foul air have been suggested and tried. One of the simplest schemes is merely to pass the air into the tall stack from the boilers, the idea being that by mixing the foul air with the hot combustion gases from the boilers, some of the foul material will be destroyed and the rest disseminated in such a tenuous form as to cease to be a nuisance. Unfortunately, such a simple scheme does not satisfactorily solve the problem in the large majority of cases. Very little of the foul matter is destroyed in such a process and although the concentration is reduced, the nuisance is not abated, as many inhabitants of sections adjacent to rendering plants can and do testify vigorously. Putting the foul vapors into a stack really aids in their dissemination over wider areas.

Passing the air laden with foul matter through water sprays has been tried, but, except in certain cases where the objectionable matter such as acid fumes, etc., is readily soluble in water, this procedure is of practically no value. In some cases attempts have been made to mask or neutralize the foul odors given off from certain processes by injecting into the foul air a volatile material having a pleasant odor. Some of the volatile materials used are claimed to disinfect the air as well as mask the foul odors. In other cases, the foul air is passed over pots in which sulphur is burned or tar is boiled and thus is mixed with sulphur dioxide or tar fumes with the idea of reducing the obnoxiousness of the odor.

A recently developed process attempts to render the foul matters innocuous by causing them to react with chlorine. In the successful operation of this process, a careful adjustment of the proportion of chlorine and foul matter must be maintained, since either an insufficiency or an excess of chlorine is undesirable. It is obvious that such a process can be operated only under constant supervision. As a matter of fact, it was developed and intended to be employed in connection with large city garbage and waste disposal plants.

An Activated Carbon Installation That Proved Satisfactory

It is evident, therefore, that the methods discussed are either ineffective or too complicated for general use. If a rendering plant, for instance, could not by these known means cease to pollute the atmosphere with foul odors when ordered by the health authorities to do so, it had no alternative but to shut down. This was the situation exactly when we were asked by the officials of a rendering plant to devise some means that would permit the plant to operate without disseminating

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the foul odors which had prompted the order to abate the nuisance or shut down.

It was an emergency, and we acted accordingly by hastily designing, with very little data to guide us, an installation which was rather crude from an engineering standpoint but which we thought would solve the problem. It did. The fumes and odors from the rendering kettles are caused to pass into a bed of activated carbon

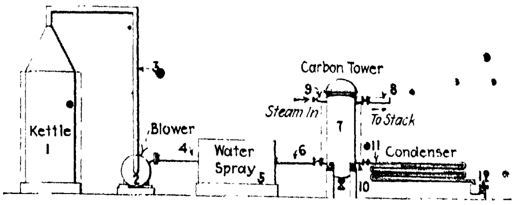


FIG. 1—DIAGRAMMATIC LAYOUT OF STENCH-ABATING INSTALLATION USING ACTIVATED CARBON

which absorbs them completely. When the carbon, after use for some time, becomes saturated with the impurities it is revivified *in situ* and used for another period.

After the erection of the installation in October, 1922, the plant officials and the town authorities expressed their perfect satisfaction with its operation.

Type of Activated Carbon Employed

The activated carbon successfully used in the installation is a granular, highly activated coconut charcoal of around 8 to 14 mesh. This carbon is the best for the purpose because (1) it has a high absorptive capacity for odors and vapors; (2) it selectively absorbs the organic and odoriferous substances in preference to water vapor; (3) it is mechanically strong and so resists crushing and abrading action; and (4) it is relatively dense so that a minimum volume has a maximum absorptive efficiency.

Operation of Installation

An elevation of the installation is shown in Fig. 1. Reference numeral 1 denotes a closed rendering kettle which is the source of the objectionable odors or fumes. Blower 2 draws the kettle fumes through pipe 3 and forces them through pipe 4 into chamber 5, where they are cooled by passage through a water spray. A draw-off pipe is provided at the bottom of this chamber and leads to a sewer. The cooled gases and fumes with or without drying then pass through pipe 6 to the purifying tower 7, which contains granular activated carbon. The gases from which all obnoxious matter has been removed by the activated carbon are then discharged in the air through pipe 8.

When it becomes necessary to revivify the carbon, it may be heated by any suitable means, but preferably by passing steam through it, to cause it to release the impurities it has taken up. In the installation shown, steam under 15 to 25 lb. pressure enters through pipe 9, passes downward through the carbon and out through pipe 10. The discharged steam is run to condenser 11 and the condensate trapped off into a sewer. Any uncondensed steam or other vapors and fixed gases are passed through pipe 12 into the firebox of the boiler used in generating steam for the plant or are otherwise readily burned under conditions to insure complete combustion. The revivified carbon is cooled by passing cold air or water through it and is then ready for re-use. If desired, the carbon may be dried by passing air through it while it is hot.

The details of construction of the carbon tower employed in the emergency installation are as follows: The cylindrical container of ¼-in. steel is provided with a horizontal partition in grid form in its lower portion. On the grid are placed a 4-mesh galvanized iron wire screen and a 20-mesh brass wire cloth to support the carbon. Similar screens are placed on top of the carbon to prevent particles of carbon from being carried upward by the ascending gas current. The top screens are weighted and freely movable so that they may follow the charge if it settles. Valves control the inlet and outlet of gases and are closed during the revivifying operation. Other valves control the inlet and outlet steam or hot water used in revivifying the carbon and are closed during the absorbing operation. A draw-off pipe with valve is also provided in the base of the tower. A 6-in. flanged pipe is provided for withdrawing the carbon at any time. The tower is jacketed with heat-insulating material to reduce radiation losses during revivifying operation. The tower as it appeared installed is shown in Fig. 2.

General Principles Applying to Any Installation

It is obvious that the dimensions and details of construction of the carbon container and the general arrangement of the apparatus may be varied to meet the needs of a particular installation. The amount of carbon used and the depth of layer may be varied. A number of small towers may be used in series or parallel. The foul air may be sucked through instead of blown through. The foul gases may be cooled by passing through coils externally cooled by air or water. If cooled by passage through a water scrubber, the gases may be dried by passage through a drying agent such as lime or calcium chloride. It is pointed out, however,

FIG. 2—ACTIVATED CARBON ABSORBER (CONTAINS 1,000 LB. OF GRADE 4 CARBON, 8-14 MESH)

that drying is not necessary, since the carbon selectively absorbs organic vapors and particles in preference to water vapor and will, therefore, effectively purify foul air which carries a large amount of water vapor.

The particular installation described was not designed for continuous operation, because the plant is not operated continuously. There is ample time at this plant for revivifying the carbon and getting it ready for re-use between the operating periods. However, if continuous operation is desired, the carbon tower may be duplicated and suitable connections and valves added so that one tower may be in operation while the carbon in the other is being revivified.

The length of time which the carbon may be in service before it becomes saturated with the foul substances and must be revivified will, of course, depend upon the amount of foul materials passed in per hour. The capacity of the carbon for absorbing and retaining the foul materials is very large. It will take up and retain more than 50 per cent of its weight of certain vapors. So, since the actual weight of foul materials in the air is usually very small, the carbon will remain effective for a considerable time. At the installation described, it has been the practice to revivify the carbon once a week, but the indications are that the carbon is not saturated by a week's use, and that the periods between revivifications could be longer.

No Attention Necessary

The installation requires no attention during operation. The only power required is that necessary for the operation of the suction blower which keeps a suction on the kettles, etc., and which forces the foul air through the bed of carbon. The resistance of the carbon to the passage of air is of course dependent upon the depth of bed and volume of air passed per sq.ft. per minute. It has been determined by actual plant operation that the pressure drop through a bed of 8 to 14-mesh carbon 5 ft. deep is approximately as follows:

2.25 lb. when 75 cu.ft. per sq.ft. is passed,
1.25 lb. when 50 cu.ft. per sq.ft. is passed, and
0.5 lb. when 25 cu.ft. per sq.ft. is passed

The passage of 150 cu.ft. of air per minute through a cylindrical bed of 8 to 14-mesh carbon 5 ft. deep and 3 ft. in diameter will require a pressure of around 0.5 lb. This rate is sufficient to keep a positive suction on several vats or kettles, for instance, and can be obtained by the use of a small Roots positive blower or other suitable blower.

The total cost of operation includes the cost of operating the pressure blower, supplying, if necessary, cooling water to cool the air and vapors before they enter the purifier, heating the carbon in the revivifying process by introducing steam or hot water or by other means, and cooling the carbon by passing cold air or water through it. Without going into details, it is obvious that the total operating cost is very small.

Conclusions

We have demonstrated that industrial stenches can be effectively abated by the use of a simple installation employing activated carbon as the absorbing medium. Highly activated granular coconut charcoal is the type of carbon successfully used. The original cost of the installation is not large and the operating cost is very small. The installation requires no attention except during the periodical revivification, which is carried out by simply heating the carbon *in situ* by steam or other means. The signal success of the installation now in operation leads us to believe that the principles employed in this case may be applied to solving similar problems at other plants and may be of real value to those industries which are so unfortunate as to have obnoxious fumes and odors for disposal. With such an installation available, there is no reason why any industrial process should be operated so as to pollute the atmosphere with foul odors.

The authors desire to express their appreciation of the engineering assistance given by H. D. Edwards, of the Linde Air Products Co.

Glass Wool Heat Insulation in Europe

Data on glass wool, a heat-insulating material practically unknown in this country but coming into intensive use in Europe, are given by A. D. Saborsky in an article in the May, 1923, *Journal of the American Ceramic Society*.

In the first machines developed for the manufacture of glass wool, the tips of a number of horizontal glass rods were melted by rotating them in gas flames and the drops thus formed were carried to the surface of a revolving drum upon which the threads of glass were wound. Breaks had to be renewed by an operator, of course, and the obvious improvement of supporting the rods vertically so that the threads would be self-renewing was delayed for a long time. The high cost of thin rods next directed efforts toward the use of scrap glass as raw material, and the present method is to melt scrap in a tank provided with a number of small openings in the bottom through which the glass flows to form threads which are wound up as before on drums. Drops are thrown off by centrifugal force so that only light wool accumulates on the drums. To insure steady flow, the openings may be heated with individual electric coils, or air pressure may be put above the molten mass. In a factory under construction in Dresden, Saxony, every furnace will feed three vats of 200 openings each. From present production figures it is estimated that about 6,500 lb. of wool will be produced in 24 hours. The help required would be two spinners, one melter and one helper per furnace, which would result in an output of almost 70 lb. per man-hour. The fuel consumption is 32 cu.ft. of artificial gas per pound of wool. Glass wool insulation is selling for 12c. per pound and the writer estimates the manufacturing cost at about 2½ to 3½c. per pound.

The product is cut off the drums, carded and loosened up by hand. It weighs about 13.8 lb. per cu.ft. as against an average of 156 lb. for solid glass, so that it contains approximately 90 per cent dead air cells by volume. It may be exposed to temperatures far above the melting point of the glass when used in insulating very hot pipes—for example, the exhaust pipes of heavy oil engines—and the only effect will be the baking or melting of a ⅛- or ¼-in. layer directly in contact with the heated surfaces, the rest of the wool being unaffected.

Glass wool may be applied in several forms, the most common being bands ⅜ to ½-in. thick and 2 to 10 in. wide. Larger pipe line and other objects are often insulated by first surrounding them with coarse wire mesh in a position representing the outline of the finished insulation. The space between is then simply stuffed with the wool. For locomotives, boilers, etc., where the insulation has to be removed periodically, mattresses are formed between two templets of fine wire mesh

Co-ordinating Colloid Data

First National Symposium on Colloid Chemistry at University of Wisconsin Affords Opportunity for Interchange of Views

FROM MANY ANGLES, the Symposium on Colloid Chemistry held under the auspices of the University of Wisconsin at Madison June 12 to 15 was unique among scientific gatherings in this country. Forces of attraction brought into play by the interest taken in colloid chemistry at Wisconsin and the presence of Professor Svedberg drew together more than a hundred enthusiasts normally dispersed throughout the country. For 4 days the theories and facts of colloids were discussed without interruption. Papers for the program had been carefully chosen and ample time was given for presentation and discussion, points that contributed in no small measure to the great success of the meeting. Papers were limited to 40 minutes, but discussion was unlimited and in many cases exceeded the time of presentation. It was recognized that one of the most valuable features of such a gathering lies in the free exchange of views among men of varied experience. The symposium attracted engineers and biologists as well as men interested in plastics and in agriculture, and the important thing is that each was able to help the other. In addition, there were the stimulating criticisms and suggestions by Professor Svedberg.

The University of Wisconsin is planning to publish the papers and all the discussions as a special monograph, copies of which may be reserved by notifying Prof. J. H. Mathews, chairman of the department of chemistry, University of Wisconsin. Further recognition of the important start made by Wisconsin is to be found in the decision of the colloid committee of the National Research Council to hold a second symposium next June at Northwestern University.

From what has been said it should not be inferred that the weighty deliberations precluded social features. Madison affords most delightful natural surroundings for such a gathering and the Wisconsin hosts provided an automobile excursion, launch ride, picnic supper and other entertainment. The total attendance was about 250.

Turning to the technical program, this was opened by Professor Birge of Wisconsin, who expressed the hope that through such meetings it might be possible to co-ordinate and simplify the facts of science, which are increasing at such a rapid rate. The papers presented are given in abstract in the following paragraphs:

Properties of Sols and Gels

Studying the thermochemistry of sulphur sols, F. L. Browne found that the heat effects of coagulation of colloids are due to interaction of ions, not to energy changes accompanying the changes of aggregation. Accurate measurements were made with an adiabatic calorimeter with NaCl, KCl, $MgCl_2$ and $AlCl_3$. They are particularly interesting because they are reversible With NaCl a greater heat was observed on partia coagulation than on complete coagulation. With AlCl no heat was evolved on coagulation for either large or small particles.

A study of precipitation of sols by alcohol led Prof W. D. Bancroft to suggest that our values for the singl potentials of metals may be in error by as much as 0.7 v in certain cases. Dr. Bancroft and J. B. Nichols als noted that camphor peptizes pyroxylin and has no effec upon its freezing point unless water is present.

H. N. Holmes advanced the "brush heap" structur for gels. An analogy is the "false gel" found by th crystallization of 4 per cent caffein from water, givin a mass of interlocking crystals and water which can b inverted without flow of the liquid. The fibrous stru ture of cotton still exists in guncotton and can b observed by precipitation with alcohol. Various meth ods of making gels were illustrated. A new silica ge precipitated by nickel chloride was found to adsorb 10 per cent of its weight of benzene vapor. This pape was followed by an experience meeting on gels. Late in the week H. B. Weiser outlined the factors influ encing the formation of inorganic jellies. Coagulatio

at proper rate was found to be important, although the H-ion concentration was not. In the majority of cases it is beneficial to mix cold and then raise the temperature.

Demonstration of Colloid Technique

Recent advances in colloid chemistry have been made possible by improved apparatus and technique, factors that were demonstrated Tuesday afternoon by Prof. The Svedberg. The ultra-microscope, sedimentation and deposition of gold on small colloid particles as nuclei are used in determining particle size. Distribution curves are established by the sedimentation balance and by photography. Shape is studied by X-ray methods and by polarized light. The charge on proteins is determined by cataphoresis experiments, using their fluorescence in ultra-violet light to follow the moving particles. A recent improvement in electrical methods for preparing colloids consists in inclosing the arc in a quartz tube and blowing through nitrogen. Professor Svedberg's apparatus was shown on slides and after the meetings his researches at the university were described in the laboratories.

> **In any field where a large number of workers are pursuing various lines of endeavor, nothing is more conducive to real progress than an occasional opportunity for free exchange of ideas. Such an opportunity was afforded those interested in colloid chemistry by the symposium on this subject held under the auspices of the University of Wisconsin and the results have so far exceeded even the most optimistic expectations that a second symposium has been arranged for next year. Accordingly, we may predict a rapid yet co-ordinated development of colloid chemistry in this country, a development which will reflect great credit upon the forward-looking originators of this plan.**

Problems of adsorption from the standpoint of catalysis were considered by Prof. H. S. Taylor. The heat of adsorption of hydrogen on nickel is calculated to be 13,000 calories, a value which agrees with calorimetric measurements. Since the heat of vaporization is 450 calories, something more drastic than liquefaction must occur during adsorption.

R. E. Wilson called attention to the importance in lubrication work of studies on solutions which give abnormal surface tensions and whose surface films may be considered as plastic solids.

It was pointed out by E. F. Burton that the Helmholtz double layer is not applicable to colloid systems in general, since the particles are charged and do not come in contact with one another. For concentrated colloid systems the calculation of Avogadro's number is not valid, because the particles exert a force on one another which is not considered in the equation. Charges are neutralized and Brownian movement slowed down before coagulation.

A new theory of emulsification was enunciated by Prof. J. Hildebrand. Emulsifying agents form a monomolecular layer at the interface with the polar part in the water and the non-polar part in the oil. The relative atomic volumes of the two parts determine the radius of curvature, which in turn determines whether the water or the oil is to function as the dispersed phase.

Lively Discussion on Protein Behavior

Thursday's program on protein behavior and allied subjects brought out some lively discussion, particularly that on the ionic theory which followed J. A. Wilson's review of the applications of the Donnan equilibrium. Other papers included were those of Dr. J. Loeb, on the relation between various properties and the H-ion concentration; J. H. Mathews and B. W. Rowland, on calorimetric studies to determine whether protein behavior on the addition of electrolytes is due to chemical action or adsorption; M. H. Fischer, on the theory of lyophilic colloids; David Klein, on the conditions necessary for the commercial production of enzymic and animal glandular products; I. I. Ostromuislenskii, on the relation of colloid chemistry, particularly adsorption, to medical therapy; A. W. Thomas and Lucille Johnson, on mutual precipitation which is caused by chemical reactions between ions adsorbed on the surfaces of the oppositely charged particles. R. H. Bogue discussed the conditions affecting the hydrolysis of collagen to gelatine. Digestion of various hides at different temperatures and different p_H values, followed by analysis for free amino groups throws light on the mechanism.

Of the papers presented on Friday, that of Jerome Alexander is already familiar to our readers through the series of articles on the "Colloidal State in Metals and Alloys" published in *Chem. & Met.* from Jan. 11 to Feb. 1, 1922. E. B. Spear discussed the many phases of the rubber colloid system, the influence of compounding ingredients on physical properties and milling studies made possible through rapid acceleration at low temperatures.

Experiments on photographic behavior were reported by S. E. Sheppard. Photographic emulsions of identical grain distribution behave differently. Svedberg's method of determining the percentage of developable grains has been of great service in this field. The development nuclei are scattered at random and it is important to know whether or not they exist prior to exposure, and if so, whether they are all of equal sensitivity. Apparently the nuclei are colloid particles distributed through the halide crystal rather than crystals distributed through the colloid gel. It is impossible to distinguish between the classical theory and the quantum of light from these experiments.

Agricultural applications were considered by R. Bradfield and R. A. Gortner.

Hardness of Very Hard Steel

An attempt has been made by the Bureau of Standards for the past 3 or 4 years to obtain a very hard steel ball which will carry the load of 3,000 kg. in a Brinell testing machine when working on very hard metal, but up to the present without success. Tungsten carbide has been suggested, but it has been impossible to obtain this material in suitable condition in either this country or Germany. Recently a very hard vanadium steel made at the bureau's laboratories has been tried and shows promise of success.

Steel Treaters Meet at Bethlehem

Regional Meeting Well Attended—Toughness of Steel Measured at Normal and Low Temperatures—Cracking and Bursting of Steel Tools Thoroughly Discussed—Comprehensive Study of Case-Hardening Practice

EDITORIAL STAFF REPORT

ANOTHER very interesting and successful meeting was held by the American Society for Steel Treating, at Bethlehem, Pa., June 14 and 15. Participating in this gathering were all the local organizations in the Eastern states, which sent about 100 of their members to enjoy the technical sessions and the inspection of the Bethlehem Steel plant. Five important papers were presented and discussed; space limitations permit us to summarize but three of these.

BRITTLENESS OF COLD METAL

Dr. F. C. Langenberg and his co-workers at the Watertown Arsenal have been engaged in a lengthy investigation of the impact strength of several steels, when tested at temperatures ranging from 80 deg. below zero, F., to 1,000 deg. He presented an account of this investigation as far as it compared the impact strength of steel at normal and cold temperatures. This is a matter of considerable importance. The behavior of rail steel and railroad axles in very cold weather has been exhaustively studied, but it is seldom realized that motor cars or trucks may be called upon to resist heavy shocks in the coldest weather, or that airplanes may hop off on a hot summer day and rapidly mount to a sub-arctic temperature.

A large Charpy impact testing machine was used. Specimens 3 cm. square with the usual round-bottomed notch were broken. Temperatures from 0 deg. to 50 deg. F. were obtained by working with windows open in winter; lower temperatures were had by immersing the sample in an acetone bath, to which CO_2 snow was added. When the specimen had maintained the desired temperature for some time, it was withdrawn quickly and tested; the operation required about 10 seconds, and the temperature of the specimen changed no more than ½ deg. F. during that time.

In general it is found that the impact resistance of steels, both annealed and heat-treated, is very low at low temperatures. With rising temperature, however, there comes a range when the toughness increases very rapidly, and at 200 deg. C. most of the steels that were heat-treated attain their maximum toughness. Annealing generally increases the brittleness at low temperatures, and the piece has small toughness until tested at a materially higher temperature than the same steel when heat-treated. This is only another demonstration that alloy steels should not be used except in the heat-treated condition. Or, said in another way, coarse-grained, banded ferrite will give considerably lower impact than finely disseminated ferrite.

A nickel-chromium steel (S.A.E. 3220) and a carbon steel (S.A.E. 1020) used for case-hardened parts and heat-treated to give the conditions existing in a toughened core, are compared as follows:

Temperature Deg. F.	Steels No. S.A.E. 3220	Steels No. S.A.E. 1020
—60	420	273
—40	450	400
0	470	800
+50	590	960
110	650	1,030

The alloy steel has higher impact resistance at low temperature, but the relation reverses at summer heat (although the carbon steel gave very erratic results under test). The alloy steel is varying in toughness at a rapid rate at room temperatures, so it is necessary to control this item in routine tests if they are to be consistent.

Medium carbon 3½ per cent nickel steel (S.A.E. 2335) and chromium-nickel steel (S.A.E. 3240) have quite similar impact properties when heat-treated; the latter, however, registers 230 ft.-lb. at —80 deg. F., considerably higher than the gun steel.

WHY DID IT CRACK?

A discussion of that ever-present question "Why did it crack?" was presented by F. R. Palmer of the Carpenter Steel Co. in his paper, "Equalization of Internal and External Strains in Tool Steel." Starting from the evident proposition that a steel cracks when the total of the internal and external strains exceeds the strength inherent to that piece of steel, he showed how many occurrences during manufacture of a tool cause cumulative internal stresses of unsuspected magnitude.

First, the steel may be defective when it leaves the maker—containing either internal bursts, pipe or segregated impurities. Such occurrences have happened. The chief danger here is the "internal notching" effect, which causes concentrations of stress in the region of the defect many times the average across the entire section. Such defects can be made apparent by cutting off a slab and pickling it in 1:1 HCl.

Second, even the best steel can be destroyed by a poor designer. Especially should he avoid sharp corners at the root of notches and keyways. Re-entrant angles and unbalanced sections (heavy masses adjoining light wings) are sometimes necessary, but then the designer must make every effort to relieve the stresses by proper proportioning of adjacent parts.

Third, the act of machining puts strains into the surface layers of the steel, especially if the cutting tool is not in first-class condition or is overworked.

These three effects may be cumulative and at times will crack the tool before it gets to the hardening bath. But if any tool is the least suspicious, it should be carefully annealed to relieve the internal stress as much as possible, so as to enter the hardening furnace in the best possible shape.

Hardening practice unavoidably introduces very severe strains in the metal. To minimize the danger, heating should be slow and uniform so the entire tool will expand at the same rate; special care should be exercised when passing the critical range, where a sharp contraction in volume occurs. In quenching it is obvious that heavy thermal and transformational stresses must occur, and it should be apparent that the steel must be in the best condition to withstand the punishment if disaster is to be averted.

When judging temperatures by eye, the tendency is

to overheat the steel. With pyrometric control, the operator is more often likely to withdraw the piece before it is hot enough. Water-quenched tools, cracked after underheating, have a quite characteristic appearance: the corners shell off and the piece parts along a surface which apparently was at equal temperature. The shelled-off corners are file-hard with good fracture, smooth and fine grained; the core, however, never having been through the critical range, is coarse grained and soft.

Appearances of cracked oil-hardened tools are somewhat different. If the steel is defective, the crack usually runs along the bar, following a segregated streak. If cracking is due to poor design, the cracks are regularly found in certain places and have regular directions and similar depths. If the tool shatters into a number of fragments it is usually a poorly hardened tool, reheated at too rapid a rate. Such a failure is an exaggerated grinding crack. The cracks originate during heating and oxidize, then split further during quenching. Such ruptured surfaces are partly oxidized, partly clean.

But suppose the tool to withstand successfully the quenching operation; it is obvious that the drawing operation should immediately proceed to remove as much of the internal strain as possible without removing any more of the hardness than necessary. A long, low draw is the way to effect this desired end. The maximum amount of softening caused by a tempering heat occurs in 15 minutes; it takes 5 hours or more to relieve quenching strains—draws of indefinite length do not damage the quality of the piece.

If any straightening is done, it should be done immediately after the drawing operation, while the metal is still warm. Any damage to the elastic properties caused by the overstrain of a straightening press will then correct itself while the metal is cooling. If cold straightening must be done, the damage to the elastic properties may be cured by a short stay in boiling water.

Finally, a perfectly sound tool may be cracked during grinding. Here Mr. Palmer distinguished two types of troubles, grinding checks and grinding cracks. Checks are only a few thousandths deep and are caused by too rapid grinding or rubbing against a dirty, dull wheel. (Wheels are rapidly fouled if they are working on pieces the skin of which has been decarbonized during heat-treatment.) Grinding cracks, however, are much deeper, and represent the deepened check which opens up in a badly strained tool.

Study of Carburizing

An exhaustive study of the carburizing process was presented by B. F. Shepherd, of the Ingersoll-Rand Co. Since a considerable portion of their carburized work goes into air hammers and drills where it must resist not only wear but very violent and repeated shocks, it is clear that their metallurgists must be able to control that hardening operation within close limits. Their general practice is to avoid the use of carbonized pieces if the part can be made satisfactorily of heat-treated alloy steel, despite the fact that it may be cheaper to machine the softer steel, carbonize and harden. Since carbonizing is a process that may be expected to magnify any defect in the original steel, it is good practice to keep the number of analyses at the minimum, obtain from the manufacturer whose metal gives greatest uniformity, and to inspect rigidly upon receipt of shipments.

Several different steels of first quality and analyses usually put into carburized work were studied by Mr. Shepherd, varying the type of cement, the time and the temperature. Carbon penetration was determined by analyzing successive shells, carefully machined from the surface. Most of the samples were carbonized 24 hours at 1,600 deg. F. The results were presented in a series of diagrams, and only the most general conclusions can be noted here.

Properties Which Should Influence Selection of Carbonizers

In general, it may be stated that a light compound and one which does not settle when packed is desirable, since it is sold by weight but used by volume. During heat, the compound should shrink very little, and quite uniformly. To avoid discomfort to workers and clogging small openings in the metallic pieces, the material should be reasonably free from dust. It should not be too heavily "energized," since such a compound will damage the finish of machined steel. Its thermal conductivity is always low, but the higher it is the less time is required to bring the work to heat.

Home-made carbonizers of wood charcoal and $BaCO_3$ are not to be recommended for miscellaneous work. Their shrinkage is high, they pack badly, and are very dusty and dirty. If they must be used, it will be found that a mixture with 40 per cent carbonate gives no better results than a much lower proportion.

Service is the real test of carbonized work; routine tests are quite indirect. Samples from each heat should be broken in a standardized manner and the depth of case and refinement of grain noted. Files and scleroscope may be used to test the hardness—the standard Brinell requires too much metal to be applicable to carburized work. Sclerscope tests are usually quite high until the carbon drops to 0.50 per cent. File tests vary with the files, the method of testing, and the operator, but notwithstanding this, file testing is the usual method.

Soft spots on hardened carburized pieces may be due to many causes. In good work on first-class metal they are quite rare. Mr. Shepherd said they had observed a few examples of the "abnormal structure" of carburized, unhardened metal, described by E. W. Ehn, of Timken Roller Bearing Co. and blamed upon oxidized metal. However, such abnormal structures as had been found at the Ingersoll-Rand plant hardened perfectly and uniformly.

Testing of Molding Sand

In the issue of *Chem. & Met.* for May 14, 1923, page 860, a report of the Foundrymen's meeting at Cleveland contained some misinformation on the testing of molding sand. It is reported that R. E. Kennedy of the University of Illinois reported these tests to the meeting, but as a matter of fact the gentleman who spoke was H. B. Hanley, chairman of the subcommittee on tests. Furthermore, the quoted dimensions of the molding box are in error. Mr. Kennedy informs us that the box finally recommended by the testing committee is designed to give a bar 2 in. wide and 16½ in. long, while the height varies according to the amount the sand compresses after uniform ramming.

What Is the Future of the Mixed Fertilizer?

Use of High-Analysis Mixtures Held to Be Sound Policy in General Farming and a Most Effective Supplementary Means of Increasing Crop Yields*

BY FIRMAN E. BEAR†
Agronomist

THERE is rather general agreement among those who have given consideration to national problems that increases in the acre yields of crops are essential to our welfare. That the use of a well-chosen mixed fertilizer will result in a marked increase in the productive capacity of almost any soil which has been under cultivation for 25 years or more has been amply demonstrated by experiment station tests. Even in Liebig's day the effects from the use of his chemical manures "excited the wonder of all who passed by." That the manure, clover, limestone and phosphate program can be made equally effective is not questioned. The fundamental error in many men's conception of the problem of unproductive soils lies in their assumption that its solution lies in the adoption of some *one* system of soil management. Undoubtedly it lies in the supplemental use of *several* systems, sometimes more of one, at other times more of another.

MEASURING FERTILIZER EFFECTIVENESS

A complete fertilizer is usually more effective in increasing crop yields than is acid phosphate or any other single ingredient of the fertilizer when used alone. This is rather generally accepted as a fact and is supported by a large amount of experimental and circumstantial evidence. Choosing an example from the long-continued and carefully conducted field tests on the experimental farm at Wooster, Ohio, the following data are presented as being of interest in this connection:

EFFECT OF FERTILIZERS ON CROP YIELDS—WOOSTER SILT LOAM SOIL

Rotation—Corn, Oats, Wheat, Clover, Timothy.
Twenty-five Year Average Acre Yields, 1894-1918.

Fertilizer Per Rotation	Lb.	Corn, Bu	Oats, Bu.	Wheat, Bu.	Clover, Cwt.	Timothy, Cwt.
None	0	28.0	32.0	11.4	16.3	25.4
Acid phosphate	320	35.5	42.0	19.6	22.3	30.6
Muriate of potash	260	33.2	35.4	12.6	19.4	27.9
Nitrate of soda	480	33.2	36.1	13.3	20.8	29.6
Phosphate-potash	580	43.7	44.9	20.9	25.9	30.7
Complete fertilizer	1,060	46.8	51.2	28.1	29.8	34.5

It is not a difficult matter to find objections to such a type of experimentation if its purpose is that of determining directly what the fertilizer practice should be. On the other hand, it is difficult to decide upon some scheme of field experimentation that will satisfy the requirements when one takes into consideration the fact that the economic factors involved are constantly changing. If the cost of each ingredient in the complete fertilizer continued to bear a constant ratio to the total cost of the fertilizer and if the selling prices of crops remain the same, the problem would be relatively simple. Yet even then it would be necessary to have in mind that if the productivity of the soil is increasing as a result of the fertilizer treatment the analysis that gave the best return per acre when the test was initiated would not be likely to be the one that would be the most effective 10 years later. The very exactness with which the experimental field test is repeated each year defeats in part the purpose for which it is ordinarily intended. The soil is dynamic and not static.

FLEXIBLE FERTILIZER PRACTICE

Having these points in mind, it seems desirable to examine somewhat carefully another type of field comparison of fertilizers in which the quantities and analyses applied are more in keeping with what experimental as well as circumstantial evidence indicates to be good fertilizer practice. Such a comparison is also available at Wooster, having been begun after some years of study of the results obtained from the tests previously mentioned. The data follow:

COMPARISON OF EFFECTIVENESS OF VARIOUS FERTILIZER ANALYSES

Corn, Oats, Wheat, Clover Rotation—Wooster Silt Loam Soil.
Eight-Year Average Acre Increases From 1,000 Lb. of Fertilizer.*

Analysis	Corn, Bu.	Oats, Bu.	Wheat, Bu.	Clover, Cwt.
0-16-0	9.2	2.5	7.2	8.1
0-12-4	10.0	6.5	7.7	8.3
2-8-2	11.0	2.4	11.6	4.7
2-12-2	12.9	4.8	13.6	8.6
4-8-4	13.1	4.1	12.7	7.9
Unfertilized yield	55.3	51.5	24.0	39.7

* Fertilizer applied half on corn and half on wheat

The soil was in a fairly high state of productivity, as indicated by the average yields on the unfertilized plots. The rotation included clover once in 4 years and enough limestone was applied to prevent its lack from being a limited factor for this crop. Comparisons were made among equal weights of the several analyses used in the tests. In almost every case the mixed fertilizers produced larger increases than the acid phosphate alone. Of the list employed, the most effective analysis seemed to be the 2-12-2.

The thing that impresses one most in the Wooster data is the fact that the increases in yield with the 2-12-2 fertilizer were so much larger than they were when the acid phosphate was used alone. Does it not seem remarkable that one can take 4 per cent of phosphoric acid out of a fertilizer, substitute for it an equal percentage of ammonia and potash and raise the increase in yield of corn 40, of oats 92, of wheat 89 and of clover 36 per cent? Figuring these increases on the basis of weighted averages according to the Dec. 1 farm prices for the period 1912-21, the increase for the rotation from the use of the 2-12-2 over the acid phosphate alone is 63 per cent.

It might be argued that the conditions of the test were not fair. The clover crop was not plowed under; no manure was applied. With reference to the former it is my opinion that the plowing under of clover at any

*From a paper presented before the meeting of the National Fertilizer Association at White Sulphur Springs, W. Va., June 12-14, 1923.

†Professor of Agriculture, Ohio State University, Columbus, Ohio.

place east of the Mississippi River, and before long even west of it, is not good business. What is the logic of growing a crop to plow under except as this is made necessary in intensive systems of farming where livestock cannot be kept? With reference to manure requirements for high yields should be satisfied with acid phosphate, limestone and the frequent growth of legumes. But supposing the field hasn't had manure! It is now time to plant corn or sow wheat! Shall we suggest the use of acid phosphate or of a well-chosen mixed fertilizer?

The low state of productivity of a considerable percentage of the land east of the Mississippi River is due to certain economic conditions which have obtained over which farmers have had no control. As a result of the demoralizing effect of the Civil War the farmers of the South have had more or less of a hand-to-mouth existence. Meanwhile farmers in the Eastern states have found themselves in competition with millions of acres of virgin farm land in the West which are being exploited for their resources. As a result of these conditions we are approaching what may be termed a "national soil emergency condition." In overcoming this emergency condition complete fertilizers rightly used have been found to be a valuable aid. By the time their use for this purpose is no longer required, the more intensive systems of farming now practiced in the Eastern states will have spread over most of the area east of the Mississippi River and the need for complete fertilizers will be greater than ever.

There is nothing fundamentally wrong with the practice of using high-analysis mixed fertilizers. Every one of the analyses included in the Ohio Standard Dozen and in the similar lists suggested by agronomists of other states will be found to be a good investment on most of the land which has been under cultivation for 25 years or more. Fertilizers are not intended to take the place of manure and clover on a livestock farm. But as long as they can be used with additional acre profit, why not use them? The mere fact that they have been misused cannot be construed as any very legitimate argument against the mixed fertilizer.

The arguments against the 2-8-2 and other low grades as well as low-percentage analyses no longer apply. No intelligent farmer need buy anything but high-analysis fertilizers, made up of materials of known availability. If the farmer desires or should move in the direction of more intensive livestock farming and a bigger and better manure program, why not suggest that he may be able to "arrive" more quickly by the use of a complete fertilizer? Of course a 2-12-2 will not supply an adequate amount of nitrogen to satisfy alone the needs of large yields of crops, but if by its use the farmer can get a greater acre profit, leave a larger amount of crop residue in and on the soil and at the same time produce more manure to return to the soil, why shouldn't he use it?

The question might be raised as to whether we have any guarantee that the 2-12-2 on the market will duplicate in its effect the 2-12-2 of the experiment stations. There is still abundant opportunity for manufacturers to use organic ammoniates of low availability in their 2-12-2 and lower analyses. However, each year finds more of the control chemists "checking up" the availability of this organic nitrogen. If the National Fertilizer Association desires to rid itself of a large share of the criticism that still is directed against complete fertilizers, we commend for its consideration the following proposal regarding the nitrogen in mixed fertilizers which might well be embodied in a resolution to be presented to the Association of Official Agricultural Chemists at its next annual convention:

> The active water insoluble nitrogen *found* must be equal to or greater than the inactive water insoluble nitrogen *found*, as determined by the alkaline permanganate method of the A.O.A.C., unless the percentage of water-soluble nitrogen is equal to 70 per cent or more of the total *guaranteed* if the fertilizer is to be *passed.*

Fortunately the ratio of the organic to the total ammoniates decreases with the increased consumption of fertilizers. Furthermore, a larger percentage of the organic carriers are being acidulated. There is reason to believe that acidulated ammoniates contain their nitrogen in as available a form as that of dried blood or perhaps sulphate of ammonia. The comparison of the commercial 2-12-2 and the experiment station 2-12-2 is reduced therefore largely to a comparison of sulphate of ammonia and nitrate of soda as carriers of nitrogen.

The opinion, based on the experimental work of Wagner, later supplemented by that of Wheeler and Hartwell, is that sulphate of ammonia has an availability on limed soil of 90 as compared to 100 for nitrate of soda. Comparative trials on the Ohio Experiment Station farm at Wooster, on limed soil, the data for which are given below, indicate for sulphate of ammonia as a relative effectiveness of 70 on corn, 53 on oats, 80 on wheat and a residual effect of 69 on clover and 55 on timothy as compared to 100 in each case for nitrate of soda. The weighted average for these crops based on relative Dec. 1 prices for the years 1912-21 would be about 70.

COMPARATIVE EFFECTIVENESS OF VARIOUS CARRIERS OF NITROGEN

Soil Limed and Treated With Phosphate-Potash Mixture*
Increase from Nitrogen Calculated on Basis of Nitrate of Soda at 100

Carriers of Nitrogen	Corn	Oats	Wheat	Clover	Timothy
Nitrate of soda..........	100	100	100	100	100
Oil meal.......	69	61	43	27	31
Dried blood	61	44	49	41	19
Sulphate of ammonia	70	53	80	60	55

* The analysis of the mixture after the addition of the carrier of nitrogen was approximately 4½-7-13. This was applied at the rate of 980 lb. per acre per rotation and distributed among the first three crops.

We must admit that the substitution of sulphate of ammonia and of organic ammoniates for nitrate of soda in a fertilizer tends toward a reduction in efficiency. This is true at the rates in which fertilizers are applied in general farming. It may not be true when large amounts are used, but probably in the latter case applications of the most available carriers of nitrogen from time to time through the season rather than in one initial application are to be preferred. On the other hand, it must be kept in mind that the farmer has a much better opportunity to make a profit from the use of fertilizers than the experiment station data indicate. An important reason for this is that he can vary his fertilizer from year to year or from crop to crop to fit the need, a thing which cannot be done in the fertilizer tests.

Machinery and Appliances for Production and Control

Equipment News

From Maker and User

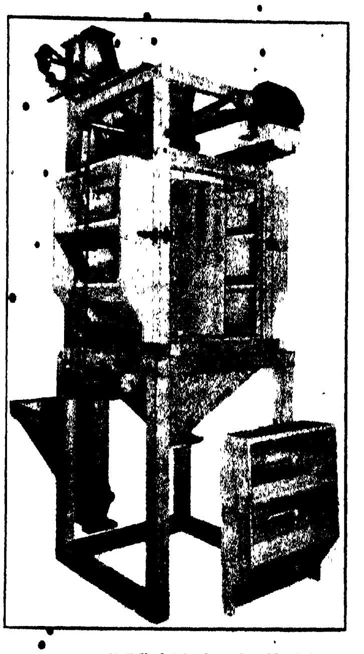
Materials and Accessories for Chemical Industries

New Bolting Reel

A machine that will sift finely powdered materials through a fine mesh, will at the same time aërate them, will prevent separation of the lighter and heavier ingredients and has a continuous large capacity is presented in the new vertical bolting reel made by the J. H. Day Co., Cincinnati, Ohio.

This reel has a vertical cylindrical bolting drum, inside of which are placed a series of disks and a fan. The shaft revolves at 1,200 r.p.m. The feeder, which is on top of the machine, allows the material to fall evenly upon these disks and the air current created by the fan blows the material through the screen.

A brush is caused to revolve inside of the screen against the surface of the mesh, thereby keeping it free from an accumulation of material. Around the screen is an expansion chamber inclosed by four doors. These doors are covered with muslin, which permits part of the air to pass out but retains the sifted material. This material slides down inclined surfaces on the doors and falls into the hopper below the screen. The majority of the screened material falls directly into the hopper. On the bottom of the hopper is placed a cylinder which acts in two capacities—one half of this cylinder is used to catch the dust from the air circulation between the outside of the sifter drum and inside and is connected to a cylindrical dust collector at the bottom, which has a spiral conveyor in the middle. All air passing through this drum and against the baffles in it deposits the dust in suspension, and it is conveyed to the discharge hopper. The material which falls to the middle of the cylindrical chamber, however, is carried by a conveyor running in the opposite direction to the tailing discharge. The air that passes through the muslin in the doors is replaced by air coming in through the intake, thereby reclaiming as much as possible of the material in suspension. A can or other container may be placed under the discharge valve and the sifted material removed from the hopper, if desired. This connection can vary, depending upon the installation requirements.



THE DAY VERTICAL BOLTING REEL

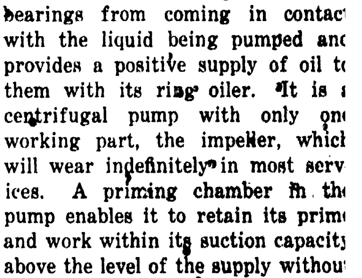
From the above description it can be seen that within the walls of this machine is a complete unit, capable of automatically feeding material into the sifter, accumulating all of the sifted material in the hopper, and discharging the material into a container. The advantages of this machine lie in the fact that the material is passed through the screen by the action of an air fan instead of by the ordinary method of gravity or vibration. The material is given a gyratory motion and is blown through the screen, which is stationary, around a cylindrical drum. It provides a continuous operation, which is very essential for large capacities. The capacity of this machine is four or five times greater than that of the ordinary bolting reel; it occupies less floor space and is very efficient in operation. These machines are motor driven from the top and the operation is comparatively quiet. It aërates the powder, thoroughly blending any materials of lighter or heavier density, and will even operate successfully where slight traces of moisture are present. The material passing through the screen has the appearance of a cloud, and the sifting of all powders can be taken care of.

A few of the users of this machine are: Pompeian Co., Cleveland and Toronto; the Armand Co., Des Moines, Iowa; Potter Drug & Chemical Co., Malden, Mass.; Andrew Jergens Co., Cincinnati, Ohio; Columbia Carbon Co., Charleston, W. Va.; Crown Chemical Co., Indianapolis, Ind.

New Chemical Pump

The Arrow Pump Co., Buhl Building, Detroit, Mich., has incorporated its ring-oiled packing gland feature in a motor-driven centrifugal pump. While it is an economical and effective unit for a number of various purposes, it is distinctly so in chemical industry service, where it is important that a pump be immune from injurious effects of the liquid being handled.

The construction protects the bearings from coming in contact with the liquid being pumped and provides a positive supply of oil to them with its ring oiler. It is a centrifugal pump with only one working part, the impeller, which will wear indefinitely in most services. A priming chamber in the pump enables it to retain its prime and work within its suction capacity above the level of the supply without the use of mechanical prime retainers such as foot or check valves which in service where liquid contains foreign matter are not dependable on account of such substance



ARROW CENTRIFUGAL PUMP

preventing valves from seating tightly.

The unit is compact. It requires no base and can be assembled for floor or side wall mounting. As both motor and pump bearings are ring oiled from large oil wells, they may be located in isolated places where little or no attention is given them over long periods.

Pendulum Hardness Tester

Edward G. Herbert, Ltd., of Manchester, England, has put on the market an interesting machine for testing hardness. As seen in the illustration, the instrument is unique and simple. A yoke, containing adjustable weights, is balanced upon a ball of ruby or of steel 1 mm. in diameter. By means of the adjusting nut immediately above its support, the position of the inclosed weights, and therefore of the center of gravity of the entire instrument, may be varied somewhat. For ordinary tests, these adjustments are so made that the center of gravity is slightly below the ball, the entire mechanism being equivalent to a pendulum 0.1 mm. in length.

If this instrument is placed carefully upon a surface, is tilted to one side until an attached spirit level comes to zero and is then released, it will swing pendulum fashion, the oscillations gradually decreasing owing to the fact that some energy is absorbed by the supporting ball rolling out or elongating the original indentation. Consequently the energy absorbed in thus displacing the metal is taken from the potential energy of the pendulum, and the swing is shortened. The position of the bubble on the scale at the end of the first swing shows the work done by the ball on the specimen and measures its hardness.

DETERMINING HARDNESS OF A MILLING CUTTER HELD IN A UNIVERSAL FIXTURE

SHRIVER DIAPHRAGM PUMP

Another useful method of conducting the test as recommended by the makers is to measure the time consumed in making ten swings. It is stated that tests taken either way are consistent among themselves and comparable each to each. An empirical relationship between hardness as determined by the pendulum hardness tester and the Brinell hardness scale has also been established.

Diaphragm Pump for Filter Presses

A pump designed with parts moving in the liquid pumped is liable to excessive wear when pumping liquids containing gritty solids in suspension, such as are encountered in filter press work. With this fact in mind, T. Shriver & Co., of Harrison, N. J., have designed and are now marketing a diaphragm pump for use in conjunction with this filtering equipment.

In this pump the diaphragm is moved by a series of concentric rings on the one side and by a crescent shaped disk on the other. It is supported at all points during the discharge stroke and should have a very long life. The diaphragm and liquid end can be removed for cleaning or replacing in a few minutes by taking out a few bolts. The liquid passages are oversize so as to minimize friction, and the ball valves are of the self-cleaning type. The moving parts run in a bath of oil.

The makers claim that this pump is very efficient, generates pressure up to 100 lb. and has a very good suction lift. It is of the duplex type and is fitted with a large expansion chamber. The pressure generated is steady and shows very little fluctuation. The liquid end, being a simple casting, can be made of suitable materials such as cast iron, bronze, lead, hard rubber, etc., and the pump can be used for handling acids and corrosive liquids by choosing a suitable liquid end.

Correction

To the Editor of Chem. & Met., Equipment News Department:

SIR—I note that you inserted, on May 28, an article on our C-22 brick under the heading of "High-Temperature Refractory." This is unfortunate, for our material is not recommended as a direct refractory except in certain cases, and we are anxious not to create an impression that might cause misuse of the material.

It is true, of course, that it will withstand conditions which in many cases would classify it as a refractory material. The material, however, is recommended and used as an insulating material and is very seldom exposed directly to the action of furnace gases, as is often the case with refractory materials.

We trust, therefore, that you will make this correction in an early issue of *Chemical & Metallurgical Engineering*.

CELITE PRODUCTS CO.,
A. W. KNIGHT,
General Sales Manager.

Catalogs Received

CONVEYORS CORPORATION OF AMERICA, Chicago, Ill.—New booklet on steam jet conveyors.

AMERICAN FOUNDRY EQUIPMENT CO., New York City.—Bulletin 532. Bulletin on cloth screen type of dust arresters. Bulletin 535, on sandblast pressure tanks.

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis.—Bulletin 1822. A bulletin describing the Jones-Belmont flotation machine.

DWIGHT P. ROBINSON & CO., New York City—A folder showing some recent work of this firm of consulting engineers, including several chemical plants.

AJAX ELECTROTHERMIC CORPORATION, Trenton, N. J.—Bulletin 3. A new bulletin describing the Ajax-Northrup high-frequency induction furnace of 35-kva. capacity for use in obtaining temperatures up to 3,000 deg. C.

THE FOXBORO CO., Foxboro, Mass.—Bulletin 151. A new bulletin on the Foxboro type of triplex draft gage.

THE PFAUDLER CO., Rochester, N. Y.—A booklet entitled "A New Era in Milk Transportation," describing the new Pfaudler line of car tanks, truck tanks and container car tanks which are of interest to industry other than milk distribution.

Review of Recent Patents

Of Interest to the Ceramic Industries

Developments in Manufacture of Glass, Refractories and Electrical Insulators

WITH the development of continuous tanks, automatic blowing machines and traveling leers, the production of bottles has become almost automatic. There is a break, however, between the blowing machines and the leers, this transfer being made almost entirely by hand, although a great deal of thought is directed toward the elimination of manual labor at this point. For example, Michael J. Owens has offered a solution in patent 1,455,966, issued May 22, 1923, and assigned to the Owens Bottle Co. As the bottles or other objects are hot and somewhat plastic as discharged from the forming molds, means must be provided for preventing them from knocking against one another or coming in contact until they have cooled to a certain extent. For this reason, the bottles slide down an inclined chute from the forming machine to a rotating disk, from which they are delivered by means of a stationary deflector to a belt conveyor which extends into and across the feed end of the leer. It is evident that the disk will serve to space the bottles on the carrying-in belt and thus prevent contact. If desired, the disk may be perforated and air blown through to assist in cooling the ware. From the carrying-in belt, the ware is discharged periodically onto the leer conveyor by means of a cam-operated pusher bar.

Improving Structure of Bauxite Refractories

In order to destroy the cleavage planes present in natural materials such as bauxite used in the manufacture of refractories and at the same time obtain properties which will permit molding without the use of a bond, Louis P. Kraus, Jr., of New York, first mixes the material with twice its volume of ground wood. An aqueous bonding agent is added and the mixture formed into blocks, which are dried and then heated to within 300 deg. F. of the melting point of the refractory material. The blocks are then crushed to the desired extent. The refractory material thus formed is composed of refractory grains of highly irregular shape with rough surfaces well adapted to knit together under pressure and with a high percentage of voids, the material being of a highly spongy nature. It can be compressed and molded dry with no bonding material, and is then able to withstand burning in the kiln to a higher temperature than usual, thus giving a more serviceable product. (1,453,468; May 1, 1923.)

Slag Substitute for Magnesite Brick

Magnesite converter linings are subject to rapid deterioration and their renewal is frequently a matter of serious concern, for there are times and localities when and where it is practically impossible to obtain magnesite brick. Attention is called by Calvin Payton of Douglas, Ariz., in patent 1,453,993, issued May 1, 1923, to a substitute which is readily available wherever a converter is being run. This is nothing more than converter slag so prepared as to be high in magnetite and low in silica. Copper matte is blown in a converter without the addition of the usual excess silica and, as

American Patents Issued June 5, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,458,167—Method of and Apparatus for Feeding Molten Glass. S. Davidson, Hillsboro, Ill., assignor to Schram Glass Mfg. Co., St. Louis, Mo.

1,458,204—Pump. R. W. Tibbetts, Roxbury, Mass.

1,458,234—Separating Solids From Liquids. H. C. Miller, Bakersfield, Calif., assignor to Standard Oil Co. of California.

1,458,256—Cellulose Ether Composition. A. P. H. Trivelli, Rochester, N. Y., assignor to Eastman Kodak Co.

1,458,273-4—Welding Apparatus and Process. M. S. Clawson, Upper Montclair, N. J.

1,458 283—Furnace for Melting Metals. G. D. Faulds, Philadelphia, Pa.

1,458,291—Apparatus for Dehydrating Petroleum Oils. F. W. Harris, Los Angeles, Calif., assignor to the Petroleum Rectifying Co.

1,458,309-10—Method and Process of Making Sulphite and Bisulphite Liquors. G. A. Richter, Berlin, N. H., assignor to the Brown Co., Berlin, N. H.

1,458,322—Process of Manufacturing Abrasive Disks. S. M. Bullock and H. S. Lloyd, Chicago, Ill.

1,458,338—Height Indicator for Liquids. R. Grimshaw and C. J. Weis, Clyde, Ohio.

1,458,351—Method and Apparatus for Producing Carbon. C. Matlock, Brooklyn, assignor to Munroe-Louisiana Carbon Co., Munroe, La.

1,458,357—Apparatus for Extracting Volatile Matter. C. Postel, New York City, assignor to American Shale Reduction Co., New York City.

1,458,376—Method of Making Ceramic Products. Edward Anderson, Dayton, Ohio, assignor to the A. A. Simonds-Dayton Co., Dayton.

1,458 389—Manufacture of Viscose Silk. E Bronnert, Mulhouse, France.

1,458,403—Vacuum Dehydrator. C. E. Glessner, Portland, Ore.

1,458,410—Method of and Apparatus for Producing Charcoal and Byproducts. S. Hiller, San Francisco, Calif., assignor to Pacific By-Products Co., San José, Calif.

1,458,442—Method of Storing Salt. A. Schilling, San Francisco, Calif.

1,458,443—Process of Treating Hydrocarbons. A. Schwarz, Montclair, N. J., assignor to the Petroleum Sand Products Corp. of Delaware.

1,458,461—Process for Bleaching Barytes. L. K. Ayers, St. Louis, Mo.

1,458,467—Method of and Apparatus for Concentrating Ores. S. H. Dolbear, San Francisco, Calif., assignor of one-half to E. L. Oliver, San Francisco.

1,458,478—Process of Producing a Catalyst From Vanadium Pentoxide and the Product Thereof. H. D. Gibbs, Penns Grove, N. J., dedicated to the government and people of the United States.

1,458,491—Method of Making Oxidized Aromatic Substances. R. H. McKee, New York City, and H. C. Cooper, White Plains, N. Y., assigned to said McKee.

1,458,491—Apparatus for Mixing. P. L. Mathews and R. M. Willis, Newark, N. J.

1,458,493—Varnish Composition. L. Mauerhofer, New York City.

1,458,525—Process for Fixation of Atmospheric Nitrogen. F. Daniels, East Falls Church, Va., and O. R. Wulf, Norwich, Conn.

1,458,542—Process for the Manufacture of Dispersoids. H. Plauson, Hamburg, Germany.

1,458,543—Condensation Product and Method of Making Same. F. Pollack, Vienna, Austria.

1,458,568—Method of Producing a Rustless Iron Alloy. W. Bennett, Wellington, New Zealand.

1,458,595—Process for Utilizing Impure Gases or Exhaust Gases Containing Carbon Dioxide. F. Riedel, Essen, Germany, assignor to Riedel Fertilizing Process Co., Elizabeth, N J.

1,458,646—Process for Absorbing Ethylene and Its Homologs. R. Engelhardt, W. Lommel, A. Assenbeck, Cologne, Germany, assignors to Farbenfabriken, Leverkusen, Germany.

1,458,650-1—Process for Production of Calcium Chloride. V. M. Goldschmidt, Christiania, Norway.

1 458,670—Manufacture of Alkylized Derivatives of Hydrocupreine. H. Thron, Frankfort, assignor to Vereinigte Chininfabriken Zimmer & Co., Frankfort, Germany.

1,458,715—Process of Making Nitrobenzoic Acid and Intermediates. E. A. Lloyd, New York, and V. P. Gershon, Brooklyn, N. Y., assignors to W. M. Grosvenor, New York City.

1,458,723—Refractory Compositions. J. L. Ohman, Buffalo, N. Y., deceased, by C. A. White, assigned to Buffalo Refractory Corp., Buffalo.

1,458,858—Process of Producing Homogeneous Porous Materials. M. O. Sem, Christiania, Norway, assignor to Norsk Industri Hypotekbank, Christiania, Norway.

1,458,898—Registering Mechanism of Gas Analysis Apparatus. O. Rodhe, Stockholm, Sweden.

1,458,899—Refrigerating Apparatus. H. W. Wolfe, Philadelphia, Pa.

1,458,913—Non-Recrystallized Refractory Material. W. A. Farish, Buffalo, N. Y., assignor to the Buffalo Refractory Corp., Buffalo, N. Y.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

a result, a slag high in magnetic iron oxide and low in silica is produced, and this slag while molten may be poured into suitable molds and will upon cooling form bricks which may be employed for the purpose stated. In producing this magnetite slag, in the manner above pointed out, the temperature within the converter will rise as high as 2,600 to 2,700 deg. F., and it is at this temperature that the rapid oxidization of the iron content occurs and the magnetic oxide is formed. As the ordinary working temperature of a converter ranges from 2,200 to 2,350 deg. F., it will be understood that a lining of the magnetite slag will readily withstand this lower temperature. Of course the slag may be employed in various ways. It may, as stated, be molded in the form of bricks, it may be cast in lining sections of various shapes and dimensions, crucibles may be cast therefrom, and in fact the material may be employed as a lining or as a body material wherever the reduction of metals by fusion is to be accomplished.

Electrical Insulators From Powdered Talc

Massive or solid talc, when free from seams or fissures, is in itself highly di-electric and is especially adapted for use in insulating articles, but is impractical from a manufacturing standpoint owing to the difficulty of obtaining large quantities in block form free from fractures and uniform in texture. It has also been found almost impossible to mold powdered talc and subsequently treat it without minute fractures being formed. It has recently been noted, however, that phenol condensation products may be used as temporary binders for powdered talc with excellent results. The mixture is molded into the desired shape under pressure, which for spark plug cores may be 25,000 lb. per sq.in. It is also desirable to apply a vacuum to the mold just before compressing, in order to eliminate entrained air. Heating to 200-400 deg. F. puts the molded material in condition for machining to final shape and dimensions, allowance of course being made for the slight, very uniform shrinkage which occurs in the subsequent operation of heating to about 2,000 deg. F. In some cases, the di-electric capacity at high temperature may be increased by impregnating the ware with soluble metallic compounds, sulphates and chlorides of aluminum, iron and chronium being preferable. After this treatment, the ware is again heated. (1,453,726; Theodore C. Prouty, of Los Angeles, assignor to Proutyline Products Co., May 1, 1923.)

A Filter Press for Wax

The filtration of paraffine wax from chilled oil is in many ways an ideal filtering operation, particularly in the ease with which the filter cake can be removed from the press. High-pressure steam is normally used for the purpose of melting the wax away from the plate. Difficulties, however, are often encountered in completely removing the cake in this manner, and it is for the correction of these difficulties that George H. Fifield, of Culver, Ind., has been granted a patent, assigned to the Standard Oil Co. of Whiting, Ind. He provides a filtering apparatus, circular in form, having openings at least half the radius of the disks above their centers. On either side of the plate is mounted a disk of woven wire, provided with openings aligning with those in the plate.

In the process of removing the wax, steam is introduced through a small pipe in the inside of the larger filter openings. The heated pipe melts the wax surrounding it and enlarges the open passage for liquids through the press. Water, preferably at about 200 deg. F., is then introduced into this passage and rapidly melts the wax in the press. The relatively high position of the liquid passage through the press causes all the wax above the passage as well as below it to be melted. The melted wax drains through the filter cloth and out of the press, being separately collected for further treatment after separation of water from the melted wax by settling.

In many cases the introduction of steam for the purpose of melting the wax in the passageway may be entirely dispensed with, the hot water being directly introduced into the press and traveling through same channels as the oil and wax. (1,455,436, issued May 15, 1923.)

Book Reviews

Mechanical Preparation of Ores and Minerals

Authoritative Treatment of an Important Phase of Chemical and Metallurgical Engineering

BY A. W. ALLEN
Assistant Editor, *Chem. & Met.*

TEXT BOOK OF ORE DRESSING. By S. J. *Truscott.* 680 pp, illus. New York: The Macmillan Co. Price, $11.

In these days of too-frequent irresponsible publication it is a pleasure to welcome the appearance of a technical treatise that breathes the atmosphere of the operating plant, yet withal is characterized by the ease of scholarly presentation. The treatise under review is such; and there can be no doubt that it will be given front rank among text books on the subject, which is one that is so intimately connected with chemical and metallurgical engineering that no excuse need be made for the appearance of a review in these pages.

The inadequacy of existing text books is given in the preface as the principal reason for the compilation of the volume; to the contention that such inadequacy exists few will disagree. Professor Truscott modestly attributes his competence for the task mainly to the published work and experiences of others. Lest this should be taken too literally, it will not be amiss to point out that he achieved an international reputation as a successful engineer and technical writer long before becoming professor of mining at the Royal School of Mines in London.

All text books on ore dressing begin with a definition of the term, which, to Professor Truscott, comprises "that series of preparatory operations to which crude ore is submitted till any further work to extract the metalliferous content is best conducted metallurgically." The impossibility of limiting the scope of metallurgical operations permits considerable latitude in the definition. The present volume deals with comminution, sizing, gravity concentration, flotation, magnetic and similar types of separation. Other text-book writers have included amalgamation as an essential phase of ore-dressing operations. Almost all consider flotation outside of consideration, possibly because it is a comparatively recent art. There may be disagreement that its practice should now be considered as non-metallurgical. "A few years ago I endeavored to simplify matters by pointing out that "the various processes involved in the extraction and recovery of the valuable portions of an ore have specific designations," and that a clarification of ideas on the subject might result if ore dressing were considered as "covering the reduction or other mechanical handling of the ore, whereby one or more products are obtained in a condition to be treated for the isolation of their valuable contents by amalgamation, concentration, wet-chemical, smelting or other process of recovery." The disadvantage of Professor Truscott's classification is that flotation metallurgists and millmen may ignore the book, thinking that their specialty is not treated; others may be disappointed at the exclusion of what they have been accustomed to find in standard text books. However, these comments are by the way and of little moment. If fault can be found with

the book, it will be that the author has been generous in his interpretation of the scope of the subject, and readers will benefit accordingly.

Comminution is dealt with in a thorough manner. A discussion of the theory of crushing shows that the Kick-Rittinger controversy is by no means dead. Strong support for Kick's law is based on the fact that "if bodies of the same material and shape but of different mass be dropped separately from a height just sufficient to break them, it will be found that the height is much the same whatever the mass. Dropping from the same height the velocity factor in the energy developed remains constant, and that energy must vary as the mass; and since in each case the result is fracture, it may be assumed that the energy required to produce fracture varies as the mass or volume of the piece."

Chapters on sizing and what is termed water concentration are followed by a well-rounded account of the flotation process—methods, machines, agents, general aspects and theory. A feature of the book is the thorough manner in which magnetic, electrostatic, pneumatic and centrifugal separation has been treated. Final chapters discuss heat-treatment, the control of operations, ore-dressing systems and plants. Taken altogether, the volume gives evidence of careful and painstaking presentation, based on an intimate knowledge of the subject and an ability to present facts and theories with unusual clarity of expression. It will take its place in every technical library as an essential book of reference on the mechanical preparation and concentration of ores and minerals.

Elements of Agricultural Analysis

QUANTITATIVE AGRICULTURAL ANALYSIS. By *Edward G. Mahin, Ph.D.* and *Ralph H. Carr, Ph.D.* 329 pp. McGraw-Hill Book Co., Inc., New York. Price, $2.75.

The authors state in the preface, "We recognize the futility of attempting to train students for technical or professional careers by teaching them only the technical notions and processes of chemistry without the scientific development of fundamentals." They have then proceeded, with this thought clearly in mind, to produce an excellent small volume dealing with the chemical analysis of agricultural products.

Part I contains chapters on the theory and general principles of analysis of most interest to the student of agricultural chemistry, with methods for the determination of some of the more common elements.

Part II covers special measures—namely, density and specific gravity, heat of combustion, index of refraction, optical rotation and hydrogen-ion concentration. In Part II the authors have performed a distinct service in emphasizing the importance to every chemist of a knowledge of the instruments and methods used in industrial work. It is to be regretted that the size of the volume limits, in several instances, a more detailed description of some of the instruments employed in every well-equipped laboratory.

In Part III consideration is given to the materials and products of chief interest to the agricultural chemist, such as feeds, oils, fats and waxes, dairy products, soils, fertilizers, insecticides and fungicides. The methods given for the necessary determination of the constituents of these products are, as stated by the authors, official where practicable.

The book is so well gotten up and such a valuable addition to our text books on chemistry, it is hoped that its reception may be such as to induce the authors to prepare a larger and more comprehensive text along similar lines.

W. W. SKINNER.

Metals and Alloys

METALS AND THEIR ALLOYS. By *Charles Vickers.* Henry Carey Baird & Co., New York. 6x9 in., xix plus 767 pp., with 110 engravings. Price, $7.50.

Mr. Vickers has prepared a book that as a practical treatise on the non-ferrous metals and alloys is almost encyclopedic in its scope. Although conceived originally as a revision of Brannt's "Metallic Alloys," the necessary process of modernization has produced a work that is altogether unrecognizable as any kin of its acknowledged progenitor, and Brannt's name is preserved probably through sentiment on the part of its author. The book is comprehensive almost to a fault, including as it does nearly all that one would expect in the way of topics in a book on non-ferrous metals and several things—for example, a very casual chapter on iron, steel, cast iron, etc.—that could very logically have been omitted. Without the one chapter on iron the book would be 100 per cent non-ferrous. The one-book type of student turning to non-ferrous metallurgy would find this work a wonderful boon, because between its two covers is embraced something about almost everything.

One of several things that add value to this work is the fact that the author has drawn liberally from current technical journals and other more fragmentary sources for much of his material. This has given it an air of freshness and helped produce a volume that in matter is representative of modern conditions. Of course the specialist will find considerable that has been overlooked or that is slightly incorrect in reference to his own peculiar field, which will ever be the fate of general treatises.

One of the best chapters and by far the longest is the one on the history, production methods, properties and uses of the elements, especially those of metallurgical importance. Also the two chapters on the history, fundamentals, definitions and characteristics of alloy groups contain information of decided educational value to more than a few foundrymen and other metal workers. In the section on hardness and strength it is to be regretted that the important theories of Jeffries and of Rosenhain have not been included.

The chapter on alloying and melting is slightly too attenuated for so large a subject. Brasses and bronzes are treated quite fully in a half-score chapters on copper, aluminum bronze, copper-tin alloys, bell metal and other hard bronzes, phosphor and silicon bronzes, railroad alloys, steam metals and red brass, brass for rolling, brass for sand casting, manganese bronze and white brass. The industrially important light aluminum alloys receive a full chapter, but not nearly so much space as is given to the less important aluminum bronzes.

A noteworthy chapter, and one that our book literature has needed for some time, is that on nickel alloys, including Monel metal. Tin alloys and lead alloys each receive a chapter; and in the former the babbitt metal formulas of the Society of Automotive Engineers are missing; in fact the inclusion of the S.A.E. alloys in several other places in the book would have added considerable interest in this motorized age. Near the end of the book there is a chapter on the chemical analysis of babbitt metals—the only discussion of analysis in the whole book—that seems unnecessary in a work of this type.

The chapter on amalgams should be

Important Articles In Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem. & Met.* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. Those that are of unusual interest will be published later in abstract in this department; but since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage. The magazines reviewed have all been received within a fortnight of our publication date.

THE COLLOID MILL. Anonymous. Current British practice in the use of Plauson's apparatus for producing colloidal solutions. *Engineering* (London), June 8, 1923, pp. 705, 706.

BULK MATERIALS HANDLING AND THE COMMON LABOR SHORTAGE. Matthew W. Potts. The various types of apparatus available and methods of operation described from the labor-saving standpoint. *Industrial Management*, June, 1923, pp. 338-345.

SEPARATING THE GASES FORMED IN THE *n*-BUTYL ALCOHOL-ACETONE FERMENTATION PROCESS. E. W. Blair, T. S. Wheeler and J. Reilly. Investigation of a fractional solution method for separation and collection of carbon dioxide and hydrogen. *J. Soc. Chem. Ind.*, June 1, 1923, pp. 235T-240T.

RECENT DEVELOPMENTS IN CHEMICAL PLANT. Arthur B. Scover. (*a*) Details of an acid-resisting centrifugal pump with equivalent height of lift 100 ft., delivery 4,500 gal. per hr., sp. gr. 1.7. (*b*) A new type of gas scrubber. *J. Soc. Chem. Ind.*, June 1, 1923, pp. 240T-242T.

THE SORPTION ACTIVITY OF CARBON. J. B. Firth. Method of activation, factors affecting activity and theory of mechanism. *J. Soc. Chem. Ind.*, June 1, 1923, pp. 242T-244T.

PROFIT AND LOSS METERS FOR STEAM PLANTS. S. H. Childs. Application of a standard cost system to the paper mill. *Paper Trade Journal*, June 14, pp. 57-59.

very welcome, since it contains considerable matter of not very common knowledge. Another chapter valuable for the same reason is the lengthy one on the alloys of the precious metals. Fusible alloys, along with cadmium and bismuth, receive such recognition as is due.

Other subjects treated in separate chapters are magnesium alloys, zinc alloys, die castings and their alloys, soft solders and brazing alloys, and miscellaneous alloys. The chapter on the surface coloring of alloys is well worth while. The closing chapter is a general miscellany of the usual nondescript data that is more or less typical of foundry handbooks. This chapter ends with a rather anemic glossary which needs careful revision. For example, "binder" in many foundries means something quite other than a mechanical clamp for molds; nor is "air-hole" a correct definition for "blow-hole"; also if "facing" is defined, why is "parting" omitted? and lastly we do not believe that many authorities will agree that an alloy may be defined always as a solid solution of two or more metals.

The book has the great advantage of having been written by an experienced technical writer whose English is clear and facile. For this reason as well as for its wealth of material and for its freshness this book is to be recommended. G. K. ELLIOTT.

New Publications

DIE ENTWICKLUNG DER CHEMISCHEN TECHNIK, BIS ZU DEN ANFÄNGEN DER GROSSINDUSTRIE. By Gustav Fester. Published by Verlag von Julius Springer, Berlin, Germany. Price $1.80 A comprehensive history of chemical technology from the time of the early Egyptians to the beginning of the nineteenth century

COLUMBIA UNIVERSITY has published Engineering and Scientific Paper 12, April, 1923, on "Comparative Tests of Clay, Sand-Lime and Concrete Brick Masonry," by Albin H. Beyer and William J. Krefeld, of the department of civil engineering

THE UNIVERSITY OF MINNESOTA has issued Bulletin 2, from the Engineering Experiment Station, on "The Manufacture of Portland Cement From Marl," by Raymond E. Kirk.

THE BUREAU OF STANDARDS has revised the Mollier chart of the properties of ammonia, which is available as Bureau of Standards Miscellaneous Pub 52.

Calendar

AMERICAN CHEMICAL SOCIETY, fall meeting Milwaukee, Wis., Sept. 10 to 14.

AMERICAN ELECTROCHEMICAL SOCIETY, forty-fourth meeting, Dayton, Ohio, Sept. 27 to 29 (dates provisional).

AMERICAN ELECTROPLATERS SOCIETY, eleventh annual meeting, Providence, R. I., July 2 to 5.

AMERICAN GAS ASSOCIATION, annual convention, Atlantic City, Oct. 15 to 20.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, INC., Ontario and Quebec, Aug. 20 to 31.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS, iron and steel exposition, Buffalo, N. Y. Sept. 24 to 28.

AMERICAN SOCIETY FOR TESTING MATERIALS, twenty-sixth annual meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, June 25 to 30.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (NINTH), New York, Sept. 17-22.

NATIONAL SAFETY COUNCIL, twelfth annual safety convention, Statler Hotel, Buffalo, Oct. 1 to 5.

Men in the Profession

KENNETH E. BELL has resigned his position with the Lewis Recovery Corporation to accept one as chemical engineer for the A. C. Lawrence Leather Co., Peabody, Mass.

C. F. CARRIER, JR., general manager of the Carrier Chemical Co., Charleston, W. Va., will address the annual convention of the West Virginia State Pharmaceutical Association. His topic will be "Contact Points."

EDWARD B. DURHAM has accepted the position of engineer for the Mammoth Plant of the U. S. Smelting, Refining & Mining Co., at Kennet, Shasta Co., Calif., and will take up the work there before July 1. He was formerly maintenance engineer for the Standard Chemical Co. at Canonsburg, Pa., and since March 1, 1923, has been with the Koppers Co. of Pittsburgh, Pa.

F. M. FEIKER, formerly vice-president of the McGraw-Hill Co., Inc., and more recently on leave of absence as special agent to the Department of Commerce at Washington, will, after his return from Washington, be associated with the staff of the Society for Electrical Development, New York City. Mr. Feiker will retain a consulting relation to the McGraw-Hill Co., Inc., and he will continue in a similar capacity his relation to the problems of personnel and organization of the Department of Commerce.

P. J. FREEMAN, for the past 7 years engineer of tests at the Pittsburgh Testing Laboratory, has opened offices for private practice as a consulting engineer at 311 Ross St., Pittsburgh, Pa.

DR. E. C. GANGLOFF, formerly research chemist with the National Aniline & Chemical Co., is now chief chemist with Dextro Products, Inc., Buffalo, N. Y.

J. H. HILDEBRAND, professor of chemistry at the University of California, has been appointed dean of men—an office recently instituted by the president-elect, Dr. W. W. Campbell. The appointment is a popular one, especially among the young men of the campus, by whom Dr. Hildebrand is held in high esteem.

JOHN F. KELLER of Purdue University gave an interesting address on the subject of steel and treatment of steel before a meeting of Columbus, Ind., manufacturers, at the Columbus Chamber of Commerce rooms, June 12.

A. R. KEMP, a graduate of the California Institute of Technology, arrived at Pasadena, Calif., recently, to undertake chemical and engineering work in connection with the laying of two telephone cables between San Pedro and Catalina Island. Mr. Kemp left the Institute in 1918 to accept a position as research chemist with the Western Electric Co. in New York. He has given particular study to the development of an insulating material for submarine cables.

PROF. G. N. LEWIS, dean of the college of chemistry of the University of California, has been granted leave of absence from July 1 to Dec. 31, 1923, to serve as a representative of the United States at the International Union of Pure and Applied Chemistry in England.

WILLIAM H. PIERCE has been elected vice-president of the American Smelting & Refining Co., New York, in charge of refinery operations at Baltimore, Md., Perth Amboy, N. J., and Omaha, Neb.

FRANK N. SPELLER, metallurgical engineer of the National Tube Co., Pittsburgh, Pa., received the honorary degree of Doctor of Science from the University of Toronto at its convocation, June 7.

GERALD SWOPE, president of the General Electric Co., Schenectady, N. Y., received the honorary degree of Doctor of Science at Rutgers College and State University of New Jersey, New Brunswick, at commencement, June 12.

CHARLES P. VAUGHAN of Philadelphia, Pa., president of Dungan, Hood & Co., Inc., manufacturer of glazed kid, and also president of the Philadelphia Chamber of Commerce, has sailed for Europe, where he will make a study of conditions in the leather industry in twelve different countries. He will be absent for 3 months.

DR. W. R. WHITNEY, director of the research laboratory of the General Electric Co., was recently elected a member of the corporation of the Massachusetts Institute of Technology for a term of 5 years. He was graduated from M.I.T. in 1890 and has for some time been a non-resident professor of theoretical chemistry at the institution. WALTER HUMPHREYS, '97, of Brookline, and CHARLES R. MAINE, '09, a prominent consulting engineer of Boston, were also elected to the corporation, these three succeeding PAUL W. LICHFIELD, ARTHUR D. LITTLE and EBEN S. STEVENS.

Obituary

PAUL SCHNORIENBERGER, general manager of the Heller & Merz Co., New York and Newark, N. J., died suddenly of heart disease, June 11, while seated at his desk. He was 74 years of age.

CHARLES F. WELLS, of Pittsburgh, Pa., vice-president and treasurer of the National Lead & Oil Co., died June 11, at Cedarville, Mich., where he had gone about 2 weeks previously. He was 62 years of age.

Industry and Trade

Current News and Market Developments

Summary of the Week

Oil litigation involving $800,000,000 under way in San Francisco court.

Chemical Foundation suit, adjourned for week, makes little progress.

Society for the promotion of engineering education holds important meeting at Cornell.

German financiers announce founding of factories in this country.

United States Bureau of Standards will be asked to evolve standard test for imported coal-tar products.

Rhineland High Commission places June 30 as latest date for filing applications for import and export trade with the Ruhr.

Casein probably will be first of chemical items to be granted hearing by Tariff Commission.

Leading sellers of soda ash and caustic soda announce that prices will be quoted hereafter on flat basis.

Bureau of Census report on cottonseed products shows stocks of cottonseed oil smaller than a year ago.

Lack of funds may restrict personnel of customs service throughout coming year.

Demand for calcium arsenate has not become active and prices are irregular.

Trading in cottonseed meal futures will be opened up at Memphis on July 1.

Department of Commerce will issue import and export statistics simultaneously, having caught up on import figures.

Imported copper sulphate has recovered from recent price weakness.

Arsenic is unchanged on spot, but futures were lower in price.

Foreign makers of prussiates appear eager to hold American trade and prices are weak under this selling competition.

Poduction of coke from byproduct ovens amounted to 3,328,000 net tons in May, which was an increase of 3.8 per cent over April.

High protective tariff on sulphur proposed in Spain, in order to stimulate activity in the industry.

U. S. General Appraisers give decision, holding that tankage is subject to import duty of 10 per cent ad valorem, as waste.

Consumption of Cottonseed Oil in May Estimated at 128,871 Bbl.

Bureau of Census Report Shows Light Stocks—Visible Smaller Than Last Season—Demand Less Active

THE DISTRIBUTION of refined cottonseed oil into consuming channels during the month of May, according to an analysis of the Bureau of Census report on cottonseed products for the 10 months ended with May 31, amounted to 128,871 bbl. This compares with 151,233 bbl. in April and 179,770 bbl. in May a year ago. In view of the low position of lard and the inability to export, because of the high prices, the consumption for the month of May was considered good. The report revealed nothing new to traders and the tight statistical situation was offset, as a market factor, by the less favorable condition of the vegetable oil trade.

The visible supply of refined oil on the last day of May, converting the stocks of crude oil and seed at the plants into refined, was placed at 627,000 bbl., which compares with 707,000 bbl. on the corresponding day a year ago. Seed not yet accounted for will produce approximately 38,000 bbl. of refined oil, against an actual production of 25,000 bbl. for the last 2 months of the 1922 season.

The crop year officially ends with the last day of July, but new oil will not come on the market in a large way before late September. Refiners must hold enough old crop oil in reserve to meet the regular trade requirements and, from present indications, the carry-over, on July 31, will be even smaller than last year, when the total was estimated at 434,325 bbl.

Consumption of refined cottonseed oil for the 10 months ended with May 31, reached the total of 2,040,000 bbl., which compares with 1,975,000 bbl. for this period a year ago.

Average monthly consumption of refined oil for the 10 months ended with May 31 amounted to 203,750 bbl., as against 19 500 bbl. a month for the first 10 months of the previous season. Actual monthly consumption for June and July a year ago was 144,300 bbl. Reports on the condition of trade for the first half of June this year were not encouraging, and operators do not expect so good a showing for the entire month as for June a year ago. The action of competing oils, such as soya, corn and sesame, may have some bearing upon the market. Old crop crude cottonseed oil, during the past week, held at 9c. bid and 9½c. asked, f.o.b. mills, tank car basis. New crop crude (Nov.-Dec.-Jan.) was nominal at 7c. per lb. f.o.b. mills.

Receipts of cottonseed at the mills from Aug. 1, 1922, to May 31, 1923, according to the official report, amounted to 3,208,085 tons, against 2,889,002 tons for the corresponding period a year ago. The amount of seed actually crushed for the 10 months ended with May 31 was 3,193,524 tons, which compares with 2,862,849 tons a year ago.

Production of crude cottonseed oil for the 10 months ended with May 31 amounted to 982,756,658 lb., as against 916,025,098 lb. a year ago. The production of refined oil for the 10 months period amounted to 873,994,702 lb., as against 815,116,501 lb. a year ago.

The output of cottonseed meal for the August-May period was reported at 1,462,327 tons, as against 1,335,373 tons a year ago.

The stocks of seed at the plants on the last day of May amounted to 23,098 tons, which compares with 23,880 tons on the corresponding date a year ago. The stocks of crude oil on May 31 were estimated at 24,195,802 lb., which compares with 23,703,854 lb. a year ago. The stocks of refined oil on hand on May 31 amounted to 222,863,042 lb., as against 254,518,251 lb. on the last day of May a year ago.

Text for Rhineland Order Authorizing Sale of American Owned Goods

Proceeds of Sale Less Expenses Will Form "Consignment Account"—Owner Will Be Reimbursed in Francs

THE TEXT of the order of the Rhineland High Commission, which authorized the sale of goods owned by Americans and also the sale of other merchandise held by the railway lines, was received a few days ago by domestic importers. Translation of the order is as follows:

The Interallied Rhineland High Commission regarding Order No. 149—Considering the fact that, as a result of orders given by the German Government, considerable merchandise remains standing on the railway lines of the occupied territories, and that this fact is such as to affect the interests of the population and to block public service which has been taken over by the Administration of the Railway Lines, it has been necessary, therefore, to take measures in order to remedy this situation.

Article 1—On and after June 10, 1923, cars which remain standing on the railway systems operated by the Administration of Railroads may be unloaded; and the merchandise, whether on the cars or in the warehouses, may be sold under the hereinbelow stated conditions:

Article 2—The Administration of the Railroads in the occupied territories will turn over on June 10 all loaded cars and all merchandise stored in warehouses to the Franco-Belgian Restitution Services, which will have charge of their liquidation.

An official report will be made out for each transfer made by operation of the present article.

Article 3—All claims relative to stalled freight cars or merchandise will have to be forwarded before June 10 to the Franco-Belgian Restitution Services. These will see that they are delivered to the consignees or to the shipper of the merchandise when claimed, and will sell all merchandise whose owners cannot be identified, or which has been refused, or which cannot be forwarded to its destination owing to the refusal of the German Railroad Administration to provide for uninterrupted transportation.

Article 4—Before each sale an official report will be made out, giving as far as possible all particulars which might help to identify the merchandise and subsequently enabling the owners to establish their rights to be paid the proceeds.

This official report will be completed after the sale by stating the price received and expenses reimbursed to the Administration of the Railways and to the Restitution Services.

Article 5—The proceeds of the sale of the merchandise, after deducting the expenses incurred by the Administration of Railways and the Restitution Services, will be entered by the Restitution Services in a special account, to be known as the "consignment account."

During the period of one year the owners of merchandise sold, or their assigns, may obtain, after establishing their claims, reimbursement in French francs of the sums entered in this account.

They will be entitled to no other indemnity, either from the Railway Administration or from the Restitution Services, but all their rights will be reserved as against the German departments whose default shall have caused them injury.

At the expiration of the period of one year, as provided above, the proceeds of the sale will be turned into the treasury of the administration.

Article 6—By derogation of Article 5 above, the Administration of the Railways is authorized immediately upon the expiration of the period fixed in Article 1 to use itself the fuel and generally all other material fit for use in operating the railroads which have been left standing on the tracks.

The value in French francs of this merchandise will be determined by experts appointed by the French-Belgian Restitution Services.

The Restitution Services will make out an official report covering the delivery of such fuel and material.

Article 7—The value of merchandise so utilized by the Administration will be entered in a special account to be kept by the Restitution Services.

Within one year the owners of this merchandise, or those having a right to the same, may, after establishing their rights, claim reimbursement of this value from the Restitution Services.

The Restitution Services, after verifying the rights and the identity of the claimants, will furnish them with a certificate, on the presentation of which the Railway Administration will pay them the amount in French francs of the value indicated in the special account, upon their waiving all future claims against it.

Article 8—The Railway Administration in the occupied territories cannot be considered, in any case, as responsible for damages, losses, diminution in weight or value of merchandise the liquidation of which is directed by this order.

Article 9—Judicial actions relative to differences which might arise from the enforcement of this order will be referred to arbitration commissions, the membership and functioning of which will be governed by an order of the High Commission.

Steel Men to Meet With Ordnance Officers

The board of directors of the American Iron and Steel Institute has accepted the invitation of the Army Ordnance Association to meet with it next fall at the Army Ordnance Proving Grounds, Aberdeen, Md. For this reason the next general meeting of the Institute is to be held at Hotel Commodore, New York City, a day in advance of the date previously set—that is, Thursday, Oct. 25, instead of Friday, Oct. 26. Special train accommodations are to be provided to make the journey on Thursday night so that Friday may be spent at the proving grounds.

Iodine Combine Active

The Iodine Combine, which under its former organization was to have terminated on March 31 last, has extended its time of existence as such to June 30. The object of this association of Chilean producers is to centralize sales and to market their product under terms of mutual agreement. It is now desired to introduce modifications in the statutes of the society, and the extension of the existing system has been made to afford time for study.

The proposed reforms in the statutes have now been drawn up and will be submitted to those interested in the industry. Under these new regulations, the old Iodine Combine will become the Association of Iodine Producers of Chile.

As outlined at the present time the program of the association will include encouragement of the consumption of iodine throughout the world, the consolidation of the industry by uniting all the iodine producers and stockholders of the country, the marketing of the product, the framing of agreements with producers in other countries as to the sale and supply of iodine and finally the defence and progress of the industry.

Thomas Meal Advances in Price in Switzerland

The price of "Thomas meal," a basic slag fertilizer extensively used in Switzerland, has advanced recently because many blast furnaces of the Ruhr district of Germany have been idle on account of the occupation, according to a report from American Vice-Consul William H. Mathee at Zurich.

Authentic reports are quoted by the vice-consul indicating that the production of "Thomas meal" is being reduced daily and that the lack of new stocks will be felt seriously as soon as the demand in Switzerland reaches the peak this summer.

The situation is described as similar to that of the spring of 1922, when, on account of dininished production, the price of this fertilizer rose within a short time from 40 to 48 centimes per kilogram. Today "Thomas meal" is still obtainable f.o.b. Basel for 42-43 centimes per kilogram.

News Notes

Natural clays possessing desirable properties for use in paints, stains, water colors and toilet articles have been discovered by G. C. Carver in the vicinity of Tuskegee, Ala. He claims to have used this clay with marked success in the manufacture of all these articles.

Zinc has recently been supplied to Japan by the Electrolytic Zinc Co. of Tasmania in successful competition with American producers. Japan uses approximately 40,000 tons of the metal annually. Several shipments are reported to have been made from Tasmania.

Three fellowships in the engineering experiment station of Ohio State University at Columbus are being offered jointly by the Department of the Interior and that institution. College graduates who have had sufficient training in metallurgy, pottery or chemistry to carry on ceramic work are eligible. The object in creating these fellowships is to solve definite problems confronting the pottery industry.

A new Spanish glass factory is reported. The company behind the new enterprise has been formed under the auspices of the Compagnie Internationale pour la Fabrication de la Verre, with a capitalization of 3,000,000 pesetas. According to the Reuter dispatch, the Libbey-Owens system is to be employed in manufacture.

An oxy-acetylene welding course has recently been outlined by the American Welding Society. The Federal Board of Vocational Education and the National Research Council have co-operated in the work of preparing this course, which covers the subject from the viewpoint of the person choosing and training candidates. Copies of the course may be obtained by writing the society at 29 West 39th St., New York City.

The iron ore resources of British Columbia are to be surveyed by Dr. G. A. Young of the Canadian Geological Survey. This work was begun last year by Dr. Young, who has made similar surveys in Eastern Canada.

The American Cotton Oil Co., New York, is arranging for curtailment at its different plants. The fourteen mills of the company in the South devoted to crushing will be closed gradually, and will be kept inactive until conditions in the industry improve. The oil and fertilizer plants at Gretna, La., will also be discontinued temporarily. A number of the refining plants of the company will remain on the active list.

Twenty-seven cement-producing mills represent the cement interests in Canada, according to a list just published by the Mines department. These vary in capacity from 200 bbl. per day to 12,000, the greater proportion having a capacity of from 1,000 to 4,000 bbl. daily. The Canada Cement Co., at its Montreal mill, has the maximum capacity of 12,000 bbl.

Copper and brass consumption in England is to be promoted by a new organization formed along much the same lines as the Copper and Brass Research Association in this country. In that country the organization is to be known as the Extended Uses Council. The use of solid brass hardware in place of brassed steel goods is to be particularly promoted.

Another serious oil fire occurred in Pittsburgh on June 15, when a tank at the Atlantic Refining Co.'s plant was struck by lightning. Eighty persons were injured, more than 100,000 bbl. of oil was burned and a damage of upwards of $1,000,000 was done before the flames were controlled after 26 hours of fighting.

The United States Glass Co., Pittsburgh, has taken over the mold-making establishment operated for nearly half a century by the late W. S. McKee. According to present arrangements a complete line of tableware molds and general ware molds will be produced.

The Canadian Salt Company, Ltd., has had to double the capacity of its liquid chlorine plant, which it put into operation last October. The company is also erecting a new caustic finishing building with the latest improvements which will considerably increase the capacity of that department.

Big Oil Suit Starts

Litigation between the Standard Oil Co. of Indiana and the Universal Oil Products Co. is now under way in San Francisco courts. The litigation is said to involve $300,000,000. The patent rights in question are those covering the Dubbs process, which is employed by the Universal company, and the Burton process, used by the Standard Oil Co. of Indiana.

The Universal Oil Products Co. contends, through its attorney, United States Senator James Reed of Missouri, that its patents control the basic procedure for the manufacture of high test gasoline by cracking crude oil. The Standard Oil, disputing the Universal claims of infringement, is represented by Russell Wiles of Chicago.

Approximately half of the world's production of gasoline is said to be manufactured by cracking higher boiling distillates. For that reason the sum involved is enormous. The case is being heard by Federal Judge Holmes Hall, of Sedalia, Mo.

Italy Building Celluloid Industry

Italy is trying to build up a domestic celluloid industry. The decree now before the Parliament carries a duty of 24 cents on the raw material, but an effort is being made to secure a higher rate. A large plant is under construction in the Province of Como.

Mining Engineers Planning Elaborate Fall Meeting

Final announcement of the August meeting of the American Institute of **Mining and Metallurgical Engineers** has been issued. **It is planned to gather** at the Entrance Hall of the Parliament Buildings in Toronto **Monday morning**, Aug. 20. Late **that night the party will start on a tour in a special train, visiting the** nickel operations **at Sudbury** on Tuesday, the silver mines **and mills in the Cobalt region on Wednesday and Thursday. Friday will find the members** in the Kirkland gold district, **Saturday** and Sunday **in the Porcupine district, where is located the Hollinger,** probably the most important gold **mine** in the world that is now operating.

Tuesday, Aug. 28, the party will spend sightseeing in Quebec, Wednesday will be spent at **the asbestos mines** and dressing plant at Thetford. On Thursday and Friday the **technical sessions** and banquet will be held in Montreal. **Cost of the entire excursion, starting** at Toronto and ending at Montreal, is estimated at $200, and includes transportation, pullman accommodations, meals, hotel **rooms and automobile** excursions. Reservations **must** be made prior to July 20.

Fall A.E.S. Meeting Planned

Dayton, Ohio, will be the scene of activities for the fall meeting of the American Electrochemical Society, which is to be held Sept. 27 to 29. An innovation at this meeting will be a round-table discussion of electric furnace brass foundry practice, organic electrochemistry, chlorine and electroplating.

The plans for the meeting also include two symposiums, one on electrochemistry of gaseous conduction, which is in charge of Dr. Duncan MacRae, Research Laboratory, Westinghouse Lamp Co., Bloomfield, N. J. and another on recent progress in electrolytic refining; chairman, F. R. Pyne, U. S. Metals Refining Co., Carteret, N. J.

Trips and social events will be announced later.

Larger Candelilla Wax Shipments From Nuevo Laredo

Exports of candelilla wax from Nuevo Laredo, Mexico, from Jan. 1 to April ' were 82,233 lb., which is more than the grand total for the 4 years preceding.

The practically sudden demand for the candelilla is attributable to four or five factors, but the chief explanation is unquestionably found in a low price combined with the fact that the candelilla and its uses are becoming more widely known. The present movement is probably for the account of European factories, since all of the shipments through here have been consigned to commission houses of New York City. The current prices in Nuevo Laredo average 18.5c. per pound, which is the record low quotation for the local market.

Washington News

Slow Release of Imports May Continue Over Next Year

With imports pouring into the country in quantities far surpassing any previous period, officials of the Treasury Department are confronting a problem of rendering service to the business interests involved, with a personnel smaller than the force of the Customs Division before the world war and which has just been given the additional duty of enforcing the regulations prohibiting vessels entering American waters from carrying intoxicating liquors.

Drastic reduction of the customs force in the last half of June because of an approaching illegal deficit was avoided only by the intercession of President Harding, who authorized a $60,000 deficit. The appropriation available for the fiscal year 1924, beginning July 1, for collection of customs revenues with all the duties placed upon that division of the Treasury Department, is less than $12,000,000.

Treasury officials frankly confess that unless there is a very decided decrease in imports, the appropriation available for the new year will not provide sufficient personnel to handle imports expeditiously and at the same time protect the revenue of the government. It has been difficult to hold a force of laborers at the government piers because of a limitation of $1,080 a year on the wages paid such workers. This condition has been relieved by a special law removing the limit but without providing additional funds for payment.

Congestion at New York has been relieved to a large extent, customs officials report, by dock inspections of imports, thus avoiding transfer to the appraiser's stores, and by inspecting one case as a sample of a shipment of a number of cases. They do not feel, however, that this system sufficiently protects the revenues.

With prohibition work put upon the Customs Division, thus diverting the activities of part of the force, conditions after July 1 threaten to be more serious in delaying imports than they have been unless some remedy not yet discovered is worked out.

Heavy Lac Exports From India

During the first 3 months of 1923 the exports of lac from India to the United States totaled approximately 96,000 chests of 164 lb. each. Exports to the end of April are expected to bring this figure up to 125,000 chests, which, for the 4 months, will represent about one-half the normal annual shipments to the United States. The principal lac crop comes in May and June, with heavy exports to America usually taking place in the fall, so that the figures for shipments during the early months of this year appear quite large.

Standards Bureau Giving Dyes Much Attention

Problems of dye standardization are receiving intensive attention at the Bureau of Standards of the Department of Commerce. One chemist is devoting exclusive attention to this subject and it is hoped to add to the facilities after the new fiscal year starts July 1.

Standardization is being approached through methods of identification of species, determination of color strength and determination of quality. Other problems, such as a method of assuring matching of colors in textiles, are to be taken up.

A report on dye standardization work at the bureau was submitted June 1 by Dr. C. E. Waters, chief of the Chemical Division, and W. D. Appel, dye specialist, to the main advisory committee of the Textile Division, composed of representatives of the larger textile trade associations. The advisory committee voted to request each textile trade association to appoint a committee of from one to three members to co-operate with the Bureau of Standards in its dye work.

I.C.C. Recommends Lower Rates on Acid and Feldspar

The Seaboard By-Product Coke Co. should be awarded reparation on various shipments of sulphuric acid from Grasselli and Brills to Seaboard, N. J., in the opinion of Burton Fuller, an Interstate Commerce Commission examiner. He finds that unreasonable rates were assessed on 39 carloads of sulphuric acid.

As a result of a complaint brought by the Ceramic Traffic Association, Paul O. Carter, an Interstate Commerce Commission examiner, has reported that the rates on feldspar from producing points in Maine, New Hampshire and Connecticut to New Jersey and Pennsylvania destinations are unreasonable. He suggests a series of lower rates on crude and ground feldspar which he asks the commission to prescribe for the future.

Prohibitive Tariff on Sulphur Proposed for Spain

The United States continues to supply a large proportion of the sulphur used in Spain, but an effort now is being made by the producers of sulphur in that country to secure a prohibitive tariff in the hope that their properties may be restored to their war-time activity. The proposal of the producers to place a high tariff on imported sulphur is actively opposed by the agricultural interests. The use of sulphur in connection with fertilizers and in the protection of grape vines makes it an important item in their costs.

Chilean Nitrate Sales Larger Than in Preceding Year

A survey of the Chilean nitrate trade as made by George A. Mackinson, consul at Valparaiso, states that the industry has almost completely recovered from the disastrous speculative slump of 1921. Sales effected during the first three-quarters of the present nitrate year, which began on July 1, total 21,851,078 metric quintals. This is only 15 per cent less than the quantity sold in the same nine-month period during prosperous war years and represents nearly triple the quantity disposed of during the first three-quarters of the past nitrate year.

March sales announced by the Producers' Association amounted to 1,966,331 metric quintals, as compared with 1,685,403 quintals in February and 1,960,742 in January. Sales effected by the association up to the end of March totaled 19,655,346 metric quintals, while "outside" sales, including 1,010,084 quintals credited to the two American companies, amounted to 2,133,762 metric quintals. The delivery dates of the association sales are as follows:

Month of Delivery 1922	For Export Metric Quintals	For Consumption Metric Quintals	Total Metric Quintals
July	2,407,565	1,016	2,408,581
August	1,639,599	7,586	1,647,185
September	1,809,657	9,428	1,819,080
October	1,991,361	17,289	2,008,655
November	1,618,407	5,042	1,623,449
December	109,798	1,609	111,407
1923			
January	1,977,716	508	1,978,224
February	2,701,970	3,058	2,705,028
March	2,051,595	2,032	2,053,627
April	611,124	508	611,632
May	1,016	....	1,016
June	2,687,456		2,687,456
Total	19,607,264	48,076	19,655,340

The March production of the fifty-nine plants now working amounted to 1,452,644 metric quintals—an increase of 733,031 quintals over the output of the thirty-one plants operating during the corresponding month of 1922.

Exports from the various ports of Chile during the past month totaled 2,226,017 metric quintals, as compared with 2,705,979 quintals in February and 2,225,139 quintals in January. Total exports for the first 3 months of the previous year amounted to only 1,036,480 metric quintals. Approximately 50 per cent of the 1923 exports has gone to the United States.

Stocks on the coast are being steadily reduced and at the close of the month amounted to less than 10,000,000 metric quintals, as compared with 15,713,140 at the end of the third quarter of the last nitrate year.

Tankage Held Dutiable

The claim of Gallagher & Ascher, of Chicago, for the free entrance of tankage has been overruled by the U. S. General Appraisers. Their decision is that it is dutiable at 10 per cent ad valorem as waste, not specifically provided for, under paragraph 384 of the tariff act.

Chemical Foundation Has Peaceful Week

The past week has been very quiet in the courtroom at Wilmington, Del., as far as the government's suit against the Chemical Foundation has been concerned. An adjournment was declared on June 15 for a week. Thus both sides gained an opportunity to catch second wind. The defence, with William D. Guthrie and Isador J. Kresel as leading attorneys, is expected to open its side of the case within a few days. Up to the present writing they have held the floor of the court only long enough to carry out their examination of the witnesses presented by the government. It is thought in some quarters that the entire case of the defence will be presented before dismissal is asked for. That the asking of such dismissal is regarded as likely by the court is evident from Judge Morris' question addressed to Kresel as to whether he might not take this step.

As the case stands, practically none of the evidence introduced by Colonel Anderson, attorney for the government, is held to be directly applicable. Although it is not understood at the time of going to press that Judge Morris has announced a definite decision to that effect, it is known that he has frequently questioned the right of the court to pass on acts of executive discretion carried out by the President.

The question of recompense is in dispute. The government's contention that $250,000 was entirely inadequate payment for the 4,800 patents is met by the argument of the defence that while the sum paid was not extremely high, still the Foundation has made use of these patents for the greatest good of the people and the industry at large.

Chemists Achieve New Victory Over Disease

The economic development of Africa has been greatly hindered by the prevalence there of sleeping sickness. A new compound developed by the Rockefeller Institute has recently been used successfully in combating this disease. Experiments covering a period of nearly 10 years have been required to develop the compound, which is the sodium salt of N-phenylglycineamide-para-arsenic acid. The *Journal* of the American Medical Association in a recent number outlines the history of the new drug.

Sicily Increases Exports of Sulphur Oil

The United States is taking more and more of Sicily's sulphur oil. During the first 3 months in 1923 exports to the United States from that island aggregated 1,280,011 lb. The Sicilians are in a position to offer particularly low prices on sulphur oil from the fact that it is obtained from treating the carbonate of sulphur after it has been used in extracting the residue of oil from olive pulp.

Canada Likes Idea of City Coke Plants

To Make an Extensive Survey of the Possibilities of Domestic Heating With Byproduct Coke

The possibilities of coking bituminous coal for domestic heating in Canada and some idea of the plans that are likely to materialize in that respect very shortly are given in the following extracts from the interim report of the Dominion Fuel Board, which has just been tabled in the House of Commons at Ottawa:

"The board is convinced of the importance of an investigation into the feasibility of establishing byproduct recovery coking plants in the larger centers of population. Not only are there the Nova Scotia and New Brunswick coals to draw upon but, as stated before, there are immense reserves of United States bituminous coal that could be imported for coking. Briefly, the plan would be to establish coking plants at large well-situated centers of population like Montreal and Toronto, where the coke could be manufactured and shipped to tributary territory, and the gas used at the point of manufacture.

"Other valuable byproducts, such as tar, ammonium sulphate and benzol, are obtained, and the success of such an industry depends on the disposal of these.

"The chairman of the board investigated a plant established by the cities of St. Paul and Minneapolis for the manufacture of this coke, and found that not only were the two cities above referred to being supplied but that shipments were being made to Winnipeg. More recent investigation by the board in other part of the United States, where coke is being manufactured and used for domestic purposes, have confirmed the conclusion that this should be a very fruitful field for further investigation. The board considers that developments in this connection hold out so much promise that it has by resolution placed on record its decision to employ a competent expert to report upon the matter.

Commerce Department Catches Up on Import Statistics

The Department of Commerce has issued an announcement to the effect that the delays in compilation of the import and export statistics due to the greatly increased number of items required under the last tariff act have been overcome, and the import and the export figures are again issued coincidently at the usual time.

Manila Using More Paint

A recent cable from Trade Commissioner J. A. Fowler of Manila says that paint sales in that section show still further improvement. The market for red lead remains slow. The overstocked condition of the white-lead market has been relieved and sales continue fair.

Advocate Lower Freight Rate on Nitrate of Soda

The New Orleans Joint Traffic Bureau has attacked the freight rate applicable to nitrate of soda. A large portion of the nitrate of soda imported comes through the port of New Orleans. The New Orleans Traffic Bureau contends that a reasonable rate on nitrate of soda cannot exceed the rates applying on other fertilizers. In its arguments before the Interstate Commerce Commission, it attempts to establish that nitrate of soda is not an explosive and that fires that have resulted from the shipping of nitrate of soda have been negligible. It admits that twenty-four fires during the 11-year period from 1910 to 1921 have resulted from the shipping of that commodity, but that the resulting losses did not exceed $60,000. For that reason it is contended that the fire hazard is negligible. It also is argued that the railroads themselves would benefit by charging fertilizer rates on nitrate of soda, since it would stimulate its use, thereby increasing the yield of crops, which in turn would augment the tonnage available to the railroads.

Vegetable Oil Residues Used in Netherlands Soap Trade

Vegetable oil foots and other byproducts of the refining of vegetable oils are being extensively used at present by the large soap and candle factories in the Netherlands.

The soap and candle factories are using comparatively little of the inedible tallows and inedible grease stearine which is usually the first choice in soap and candle materials. Vegetable oil residues, together with fish and whale oil, are under present conditions receiving most attention from Dutch users.

The candle and soap factories in the Netherlands, particularly the former, have very modern plants and are equipped to acidulate and concentrate these oily byproducts. The grease or acid oils resulting from this process are split again for the separation of glycerine and fatty acids, which are distilled once, twice, or three times, depending on the quality of the material and the lightness of color desired in the distilled fatty acid. The refined vegetable, whale and fish oils are also hydrogenated and used in the manufacture of soap. At present the candle factories are using to some extent a combination of any or all of these hydrogenated oils with paraffine.

German Textile Industry Quiet

The depression in the retail and wholesale textile trade of Germany which began last February has shown improvement recently, according to a report from Dresden. However, the general condition of the textile industry in that country is described as uncertain. This is shown by the refusal of buyers to enter into obligations for the future.

Casein May Be First of Chemical Items for Tariff Hearing

Investigation of This Material Has Progressed Further Than Other Chemicals Under Consideration

CASEIN probably will be the first of the seven chemical items being investigated by the Tariff Commission with a view to possible changes in duty under the flexible tariff to be docketed for public hearing. The investigation into costs of production of casein at least has progressed further than that into any of the other items of the chemical schedule into which inquiries are being made.

F. W. McSparren, one of the Tariff Commission's chemical experts, has returned from Argentina, where he spent 6 weeks investigating the costs of producing casein, regarding which coated paper manufacturers of the United States have applied to the commission for a reduction in duty. Carl R. DeLong, chief of the Chemical Section, and two assistants conducted investigations into this product in Europe at the outset of their work on a number of chemical items there. Mr. DeLong will return in July with the data secured up to the time of his departure, which are expected to include all of those relating to casein. The inquiry into costs at domestic plants is well in hand.

No date has been fixed for a public hearing on casein, but it is probable that the subject will be considered by the commissioners soon. Thirty days' notice must be given of the hearing date.

C. H. Penning, a chemist of the Tariff Commission, is visiting domestic plants securing costs of logwood extract and barium dioxide in connection with the commission's inquiries into these items. Costs of production of logwood extract in Haiti have been secured, but are to be checked by a personal visit of an agent of the commission, while figures from Europe also will be secured before the hearing on this item is set.

German Plants Coming Here

German patents and processes applied by German workmen, mechanics and chemists may be used for the development of foreign-owned factories in this country. Three prominent German bankers arrived in this country last week, who, according to press dispatches, intend to manufacture cosmetics, mouth wash, soaps, toothpaste and chemical products in the United States.

The three bankers in question are Rudolf Rosenheim, of Düsseldorf, formerly a chief executive of the banking firm of Fester & Co., a Stinnes concern; Martin Sternberg, of Sternberg & Co., a bank having headquarters in Amsterdam, and Curt Sorbeim, director of the Commercial and Private Bank in Berlin. These men have intimated to a press representative that they will not seek the support of American bankers.

American Progress to Be Reflected in Exposition

The greater number of American chemicals and the fewer foreign items being used in the United States as compared with conditions a year ago will undoubtedly be reflected in the Chemical Exposition. Early estimates indicate that the line of "Made in America" chemicals which will be shown this year will cover a broader field than even during the most active period of the war. Equipment developments in America during the year have not been affected to such a degree as the chemicals by changed conditions in Europe, although the strides forward, which will be exhibited in September, have been large.

During June the demand for chemicals in the United States has been smaller and permitted the gradual accumulation of imported stocks here, although in practically all cases American goods are commanding a premium in price over the foreign. At the exposition in September, a birdseye view of the recent developments in the American industry which have made this condition possible, considered impossible 10 years ago by all the leading authorities, will be presented. The spirit of the new chemical America will be epitomized in the 1923 show.

Paint Trade of Yucatan

There are no paint manufacturers in Yucatan, and the paints and varnishes used there are almost exclusively of American origin. Oil paints are used for interior and exterior finishes in both the better stone and wood houses. Water paints have a comparatively large field owing to their cheapness, ease of application and adaptability to stone interior and exterior walls.

American weights and measures are used, except in the case of products sold in bulk, such as powder, oil and other like commodities, which employ the metric system. Tins of a gallon and less are desirable for the general retail trade. There is no preference as to their shape. Containers are of the same type as those used in the United States, but the lettering should be in Spanish. No complaint has been made as to rusting of tins or other deterioration. Good packing, including waterproof lining, is desirable to withstand rough handling in the port of Progreso, and also to avoid injury to tins through accidental wetting with salt water in the unprotected harbor. There are no government regulations as to the composition and marking of paints and varnishes.

Trade Notes

The Lyon Engineering & Construction Co., 225 Fifth Ave., New York, has issued schedules in bankruptcy with liabilities placed $16,447 and assets $26,000.

H. D. Whittlesey, vice-president and director of sales of Sherwin-Williams Co., was elected to the office of vice-president of the National Association of Sales Managers.

Production of olive oil in Italy in 1922-23 amounted to 2,891,140 quintals. Average production of oil per 100 kilos of olives was 19.18 kilos.

While the hog industry in Denmark and Poland shows complete recovery, the number of hogs in Germany is approximately 1,000,000 less than it was a year ago and about 33 per cent below the pre-war figure.

Potash salts to the extent of 4,616 tons were produced during March at the mine at Kalusz, Galician Poland.

Charles M. Mason and Henry M. Miner have been appointed temporary receivers for Wood Oils, Inc., Blanchard St., Newark, N. J. The company specializes in the production of linseed oil, with main plant at Sidell, La. New York offices are at 19 West 44th St. Edmund W. Brown is president, and Frederick T. Snyder secretary and treasurer.

Cottonseed meal trading in spot and futures will be resumed by the Memphis Merchants' Exchange Clearing Association, beginning July 1.

The annual meeting of the International Association of Seed Crushers was held in Scheveningen, Holland, June 15 and 16.

Fertilizer Men to Gather at Storrs

Round-table discussion of fertilizer problems, especially as met in New England, is to be carried out at the second annual conference of fertilizer manufacturers and dealers. This meeting is to be held at the Connecticut Agricultural College, Storrs, Conn. Accommodations for those who spend July 11 and 12 at Storrs, the two days of the meeting, may be obtained in the quarters of the college.

The program as officially announced includes the following subjects: "Fertilizer Problems of Connecticut," E. H. Jenkins; "Significance of a Survey of Connecticut Soil Possibilities," W. L. Slate; "Economic Use of Commercial Fertilizers," J. G. Lipman; "How Can Scientific Workers and Fertilizer Men Co-operate Better to Serve the Farmer?" S. B. Haskell; "How the Farmer Looks at the Fertilizer Problem and How He Should View It," A. W. Manchester; "Field Crop Fertility Problems," J. S. Owens; "Present-Day Problems of the Industry," speaker to be announced.

Ruhr Licenses Must Be Applied For Before July 1

The State Department has received notice from the Rhineland High Commission that American firms planning to ship goods from occupied Germany must make application for export licenses before July 1. Firms wishing to ship goods into the Ruhr also must make application for license by the end of June.

The decision of the High Commission states: "The interallied authorities may authorize the foreign seller to take the place in the application for the importation license of the defaulting German importer, in cases where the sale is the object of an order placed before Feb. 1, 1923, and more particularly where the goods have been totally or partly paid for. In cases where one of the above-mentioned conditions cannot be filled the interallied authorities may authorize special importation by way of exception."

In order to enjoy the benefit of the measures indicated the foreign seller must address an application to the interallied services concerned, as follows:

To the executive committee of licenses of the High Commission for merchandise consigned to firms located in the occupied territory, with the exception of those located at the Düsseldorf and Duisburg bridgehead and the basin of the occupied Ruhr district.

To the license department of the Factory and Mine Control Mission at Essen for merchandise consigned to firms located at the Düsseldorf and Duisburg bridgehead and in the basin of the occupied Ruhr district.

The application must be accompanied by a certificate vouching for the date of the order and the total or partial payment, if any, of the goods before February 1.

This certificate must be issued:

(*a*) If the seller belongs to one of the nations represented in the High Commission, or the interallied license department, by the representative of this nation therein.

(*b*) If the seller does not belong to one of the nations represented in the High Commission, or the interallied license department, by the diplomatic representative of his government or one of the governments represented in the interallied department.

The time in which applications will be received expires June 30, 1923, inclusive.

Engineering Educators Convene at Cornell

Three Hundred Leaders Gather to Decide Lines of Endeavor

Engineering leadership and educational research were leading topics at the annual meeting of the Society for the Promotion of Engineering Education at Ithaca, N. Y., on June 20 to 23. More than three hundred leading educators from all sections expressed an enthusiastic desire to carry forward the educational research project formulated by 2 years' work of the committee of investigation and co-ordination. This calls for the investigation of the objects of engineering education and the best curriculum to attain the desired ends. A director is to be appointed, with an advisory board, and Dr. H. S. Pritchett of the Carnegie Corporation has recommended to his directors and to other foundations the expenditure of $108,000. Action is to be taken immediately by appointing a faculty committee at each school to co-operate with the director.

At the opening meeting on Wednesday afternoon Dean D. S. Kimball gave a notable address on training for leadership. He said that precedents were lacking whereby legal leadership in the nation could codify past experiences and that the present epoch utilized pure and applied science so greatly that the engineer was needed. The fundamental curriculum, he thought, should not be changed, as such a practice would undermine the standing of the engineer which has been built up over many years. Hope for solving present problems lies in the application of engineering principles by the industrially intelligent, and the present era calls for universal well-being, not private, state or corporate profits. In the opinion of Dean Kimball, the chief trouble with the present curricula as regards training leaders is that they afford no historical background. There is also an insufficient number of inspiring teachers.

Excellent arrangements were made for caring for visitors in the Cornell University building, and many entertainment features were provided for the visiting ladies. On Wednesday night President Farrand of the university, welcomed the members of the society, and President C. F. Scott of the society responded, after which an informal reception was held.

Financial Notes

The Joseph Dixon Crucible Co. has declared a regular quarterly dividend of 2 per cent, payable June 30.

Darling & Co., of Chicago, have made a bond issue loan of $1,250,000 for 20 years at 6½ per cent, for defraying construction expenses of the new grease-distillation plant at 46th and Cook Sts., Chicago.

The Ohio Leather Co., of Youngstown, O., has declared a quarterly dividend of 2 per cent on its preferred stock. This is the first dividend to be declared on the preferred stock since the financial reorganization of the company.

The A. E. Staley Mfg. Co., Decatur, Ill., manufacturer of corn products, is disposing of a bond issue of $3,000,000, a portion of the proceeds to be used for general expansion and financing. Plans are now nearing completion for the construction of a 3-story addition to the local grinding and refining plant. A. E. Staley is president.

The Pennsylvania Salt Mfg. Co. has declared a regular quarterly dividend of $1.25. An extra dividend of 50c. was declared 3 months ago.

For the first 3 months of the current year sales made by the Atlas Powder Co. were $4,901,751, an increase of about 40 per cent over same period of 1922, when sales were $3,570,833. It is estimated that business for 1923 will total more than $20,000,000, compared with $16,723,735 in 1922.

The Certain-teed Products Co. has declared regular quarterly dividends of 1¾ per cent on first and second preferred stocks, both payable July 1 to stock of record June 19.

The American Cyanamid Co. declared an initial dividend of 1 per cent on the common stock and the regular quarterly dividend of 1½ per cent on preferred stock, both payable July 2 to stock of record June 26.

Earnings of Corn Products Refining Co. for 6 months ended June 30 are unofficially reported as showing substantial improvement over those of first half of 1922. Plants are grinding at approximately 68 per cent of capacity.

Coke Production Rising

Coke production figures for May, just published by the United States Geological Survey, indicate that during that month 3,328,000 net tons were pushed from byproduct ovens. This was an increase of 122,300 tons, or 3.8 per cent, over April. Beehive production also increased, the net output amounting to 1,829,000 tons. Sixty-three of the sixty-nine plants in the country are producing at present.

Babassu Nuts in Demand

Advices from Brazil state that there is great activity in the babassu market in the northern states of Maranhao and Piauhy. Exports of babassu nuts from Maranhao during the first 4 months of 1923 amounted to 8,500 tons, as compared with 2,000 tons during the corresponding period of 1922. The babassu nut produces a vegetable oil very similar to coconut oil but somewhat higher in free fatty acid.

Oil Men Will Meet in Chicago

At an executive meeting of the Oil Men's Association, held in Chicago last week, it was decided to hold the annual convention of the association at the Congress Hotel, Chicago, on Oct. 2 and 3. Walter G. Willard, formerly field secretary of the Western Petroleum Refiners Association, was chosen to succeed Melville C. Hill as secretary of the organization. Mr. Hill recently tendered his resignation in order to return to the practice of law. The change becomes effective July 1.

Facts and Figures That Influence Trade in Chemical Products

Market Conditions

Current Prices Imports and Exports The Trend of Business

Consumers and Distributors Restrict Operations in Chemicals

Speculative Buying of Minor Importance and Manufacturing Trades Are Interested Only in Nearby Positions

THE index number shows a material decline for the week. This represents a lower price level for some chemicals, but allied products, such as cottonseed oil, linseed oil and glycerine had considerable to do in bringing down the total from the level of the preceding week.

Some of the large consuming trades are not working at capacity and this seasonable condition is felt in a diminished call for raw materials. The movement of important chemicals against contracts is very good, in fact June deliveries in some cases are larger than the totals for May. It is in new business for home and for export that the falling off in demand is most noticeable. This is especially true with reference to forward positions, as present trading is almost entirely for spot and nearby goods.

One of important features noted in the market was an announcement by a leading alkali producer that prices for soda ash and caustic soda would be on a flat basis. For many years it has been the universal custom to quote these chemicals on a basis price—48 per cent Na_2O for soda ash and 60 per cent Na_2O for caustic soda. The flat quotation simplifies quotations and they will be more readily understood by buyers. Attempts have been made, at intervals, to depart from the basis method of quoting, but nothing definite resulted until the present change was adopted.

Price changes were in evidence in numerous cases. Calcium arsenate, which is one of the items followed very closely at present, was disturbed by reports of offerings considerably below the levels previously held. This was in sharp contrast to views of sellers who had expected an increased demand and a hardening in prices. However, the low priced offerings were said to be restricted to a few cars and it is still too early to express a decided opinion on values for delivery over the next month. Arsenic was lower for distant positions with practically no change on spot. Nitrite of soda was easier and the same was true of nitrate of soda. Imported cyanide of soda weakened likewise. Low-priced offerings of imported copper sulphate were less in evidence and the market was firmer. Permanganate of potash also was steadier.

Acetic Acid—Buying has been active enough to take up the output of some sellers and stocks of the lower tests are reported to be light. Production has not been at full capacity and this has been a factor in holding supplies on a parity with consuming needs. Prices have undergone no change in the period and are quoted at \$3.38@\$3.63 for 28 per cent; \$5.48@\$5.75 for 80 per cent; and \$12@\$12.75 for glacial.

Citric Acid—Sales of imported were reported at 51c. per lb. and the asking prices ranged up to 52c. per lb. Advices from primary markets abroad indicate firm conditions there and shipment prices are about on a parity with the spot market. Domestic acid is still quoted at 49@50c. per lb., but the sold up condition of some producers makes their quotations purely nominal.

Caustic Soda and Soda Ash Now Quoted on Flat Basis—Calcium Arsenate Easier—Arsenic Lower on Futures—Metal Salts Easy—Nitrite of Soda Declines—Imported Copper Sulphate Firmer—Permanganate of Potash Steadier—Prussiates Dull and Weak

Formic Acid—Domestic grades are not prominent on the market as the quoted prices of 16@17c. per lb. are too high to interest buyers. Domestic production is said to be greatly curtailed owing to the low prices at which foreign material has been offered. Current quotations for imported are 12@14c. per lb. Demand has shown some improvement.

Muriatic Acid—The market is in a very firm position with some sellers using their output to take care of old orders. Others have only small surplus stocks. Most consumers are covered by contracts and spot business is mainly for moderate sized lots. Prices are repeated at 90c.@\$1 per 100 lb. for 18 deg., and \$1.75@\$2 for 22 deg.

Nitric Acid—Under a quiet trading movement the market has worked into an easy position and while no open change in prices has been announced there are reports that quotations can be shaded. Asking prices are on a basis of \$4.50@\$5 per 100 lb. for 36 deg.; \$4.75@\$5.25 for 38 deg., and \$5.25@\$5.50 for 42 deg.

Oxalic Acid—The market has been easier and importers were offering freely at 13c. per lb. Domestic material also was easier and 13c. per lb. at works was the asking price. Demand is fair for small lots. Domestic production is said to be on a smaller scale.

Sulphuric Acid—There is not the stringency in supplies which characterized the market recently. Lessened demand has enabled producers to accumulate small stocks but good deliveries continue on contracts and values are holding on a steady level. Quotations are \$15@\$16 per ton for 66 deg. in tanks at works.

Tartaric Acid—Buying has failed to gain in volume to the extent importers had expected and prices are easy. Bids under quoted price levels are said to have been accepted. Quotations for imported are 35½@36c. per lb. No change has been made in domestic acid and sales are said to be going through at 37½c. per lb.

Potash

Bichromate of Potash—The quiet position of the textile and leather trades has been reflected in a slower demand for bichromate. Most first hands are holding prices at 11¼@11½c. per lb. but reports are heard to the effect that sales have been made at 11c. per lb. and it is said this is the actual trading level.

Carbonate of Potash—While some grades are in light supply, there is sufficient material on hand to fill buyers' wants and total sales are said to be very small. Only small lots are changing hands and with buyers out of the market, prices are not inclined to advance. Quotations are 6½@6¾c. per lb. for 80-85 per cent; 7½@7¾c. per lb. for hydrated 80-85 per cent, and 7@7½c. per lb. for 96-98 per cent.

Caustic Potash—Some sellers are holding prices on a firm basis and report a strong market for imported. Buying, however, has been quiet and this has caused some holders to grant concessions and 7¾c. per lb. is still quoted. Asking prices range up to 8c. per lb. with grade and seller as the reasons for the difference in quotations.

Permanganate of Potash—Sales of odd lots were put through at 16¾c. per lb. Distressed lots have been pretty well taken from the market and toward the close 17c. per lb. was the lowest price at which many holders would accept orders. Shipment prices are reported to be above the spot price and

this had some influence in steadying values.

Prussiate of Potash—Continued slow demand is reported and buyers look for concessions before taking on stocks. Views of sellers vary, but 31c. per lb. is still given as a trading basis despite the fact that others are quoting 34c. per lb. as their inside price.

Sodas

Bichromate of Soda—Withdrawals against existing orders have been less persistent and this is especially true with reference to consumers in the leather industry. New business is largely restricted to small lots. Occasional lots are offered in the spot market as low as 8½c. per lb. but first hands are maintaining quotations at 8½c. per lb. at works, with the usual premiums for smaller amounts.

Caustic Soda—This market has been featured by an announcement by one of the largest sellers that quotations hereafter would be on a flat basis. This supersedes the method in vogue for many years of quoting on basis 60 per cent. The new method of quoting is said to meet with favor of buyers as more or less confusion has arisen at times because of the basis price in quoting. All sellers have not adopted the flat quotation method but it is thought that the lead as set by one of the largest factors will be followed by others. The prices as now quoted are: 76 per cent solid caustic soda in 700-lb. drums, \$3.16½ per 100 lb.; 76 per cent ground caustic soda in 475-lb. drums, \$3.60 per 100 lb.; 575-lb. bbl., \$3.85 per 100 lb.; 76 per cent flake caustic soda in 400-lb. drums, \$3.00 per 100 lb., 525-lb. bbl., \$3.85 per 100 lb.

Cyanide of Soda—Some nearby material was available at 20c. per lb. This price was for imported and shows an easier tone due to eagerness of sellers to effect sales. Demand has been rather quiet although some sellers of domestic report a good call for their product on which they quote 22@23c. per lb.

Nitrate of Soda—The spot market has been easy for some time. It is natural to look for a falling off in buying at this time of year and prices fluctuate according as stocks are in strong or weak hands. Recently spot offerings have been pressed for sale. The asking price is \$2.45@\$2.50 per 100 lb., but sales have been made under the inside figure and the market has not improved enough to hold prices steady and it is a question how much under \$2.45 per 100 lb. sellers will go in order to close transactions. Some shading of the schedule price also has been noted in the case of futures especially for shipments through December.

Nitrite of Soda—Selling competition has been very keen with imported grades leading in price declines. Sellers of domestic generally have met the low prices quoted and have openly quoted at 7½c. per lb. works. Imported offerings were quoted at 7¼@7½c. per lb., and on this basis the delivered price to some consuming centers favors the home-made product.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	175.39
Last week	177.88
June, 1918	272.00
June, 1919	229.00
June, 1920	2?4.00
June, 1921	1?7.00
June, 1922	157.00

The index number went off to the extent of 249 points. Lower prices for cottonseed and linseed oils, together with a decline in glycerine, were important factors.

Prussiate of Soda—Unsold stocks of imported appear to be ample and sellers on the other side are reported to be eager to make regular shipments to this market. This keeps the tone easy and it is difficult to give any price as representing sellers' views. In most quarters 15c. per lb. is said to be an inside price. Domestic grades are quoted at 16c. per lb. but are receiving scarcely any attention.

Soda Ash—As in the case of caustic soda, the most important occurrence in the market was the abolition of the basis price and the establishing of flat quotations by one of the largest sellers. Flat quotations are: 58 per cent light soda ash in bulk, \$1.33 per 100 lb.; 300-lb. bags, \$1.45 per 100 lb.; 150-lb. bags, \$1.50 per 100 lb.; barrels, \$1.69 per 100 lb.; 58 per cent dustless dense soda ash in bulk, \$1.42 per 100 lb.; 430-lb. bags, \$1.51 per 100 lb.; 430-lb. bbl., \$1.95 per 100 lb.

Miscellaneous Chemicals

Arsenic—The spot market shows very little change. Demand while improving a little is not heavy for this season and under the circumstances it is difficult to maintain higher price levels, although sellers seem to be more reserved. Prices heard ranged from 13½c. to 15c. per lb. depending on sellers. Futures, however, were easier and as low as 10c. per lb. was heard for the last half of the year.

Calcium Arsenate—While a better tone is noted in the market as a result of some improvement in demand, it is stated that orders are not coming to hand in volume sufficient to place the market in an active position. Just at present the main feature is furnished by the irregularity of prices.

Quotations heard have ranged from 12c. per lb. to 17½c. per lb. The 12c. quotation appears to have been a bona fide offer on the part of a seller who had a limited amount to sell but it is generally discredited as a real indication of the prevailing market price. However, it is stated that Southern buyers can shade 14c. per lb. delivered. Most sellers give 16c. per lb. as the open quotation. Impartial views hold prices are a matter of private negotiation between the 14c. and 16c. levels with this condition depending on the buying movement to bring about a decided price trend.

Copper Sulphate—Several orders for imported material at old prices could not be filled. At the close there were buyers of foreign sulphate at 4⅞c. per lb., with sellers apparently firm at 5c. on spot and nearby parcels. The season of increased consumption is near at hand and this tends to support the market. Domestic material was unsettled in some directions because of the foreign competition. Prices heard ranged from 5⅛@5⅜c. per lb.

Formaldehyde—Producers generally maintained prices on the 15c. basis, but comparatively little business was put through. Scattered lots could have been picked up through second-hand channels at 14½c. per lb.

Tin Oxide—The market for the metal was easy and this naturally led to some talk of lower prices for tin oxide. But up to the close operators continued to quote the market at 48c. per lb. Trading was confined to small lots only.

Sal Ammoniac—There were offerings of the imported material at 6½c. per lb. The market was quiet and barely steady. Domestic gray, in casks, held at 8c., with the white at 7½c. per lb.

Barium Chloride — Offerings from abroad have increased and this unsettled prices here. There were offerings at \$80@\$82 per ton, carload lots.

Fusel Oil—The market was virtually bare of supplies and dealers refused to name a flat price. A little trading in crude developed recently around \$3.75 per gal. Several small shipments arrived from abroad during the week.

Alcohol

While trading was conducted along routine lines only, producers expect that business will soon pick up, and, with stocks not burdensome, prices were firmly maintained. In denatured alcohol producers offered the special No. 1 formula on the basis of 35c. per gal., in drums, and 41c. per gal., in barrels, carload lots. Ethyl spirits, U.S.P., 190 proof, held at \$4.70@\$4.75 per gal., in barrels. Butyl spirits closed unchanged at 26@27c. per gal. With production curtailed over the summer months, the market for methanol ruled steady, first-hands quoting \$1.18 per gal. on the 95 per cent, and \$1.20 per gal. on the 97 per cent grade.

Italy Eases Export Bans

Export restrictions governing Italian products have been considerably relaxed since June 3, so that licenses are now required for only the following commodities: Hemp and flax waste, rags, excluding tow; wooden railroad cross ties; iron ore, except pyrites; copper, brass and bronze scrap, except turnings; iron and steel scraps; wheat, oats, and uncleaned rice; cattle and fresh beef; asses; bones and metallic money. This information is contained in a report just received by cable from Commercial Attaché N. C. McLean.

For some time quite a number of commodities have been on the list of goods which are prohibited from exportation.

Coal-Tar Products

Benzene Unsettled in Dull Market—Synthetic Phenol Offerings Increase—Naphthalene Easier—Solvents Firm

PRODUCERS of coal-tar byproducts reported a quiet week. With the exception of solvent naphtha the market seemed to favor buyers. An easier undertone prevailed in benzene, phenol, naphthalene and the salicylates. First-hands announced no price changes, but admitted that considerable shading was possible in outside channels. Scattered lots of benzene sold at concessions, and with no improvement in the motor fuel situation, either here or abroad, supplies on hand were considered more than ample for current needs. Offerings of synthetic phenol are increasing, but the output has not yet reached the stage where producers are willing to meet the views of larger consumers, with the result that virtually no round-lot transactions are being placed. There were willing sellers of synthetic phenol for future delivery at 40c. per lb. "Regular" buyers could have obtained the natural product around 30c. per lb. deferred delivery. On spot resale parcels were offered at prices ranging from 42c. to 50c. per lb., the top figure obtaining on small lots. Crude naphthalene was offered for shipment from abroad at concessions, but so far as could be learned no buying interest developed. Refined naphthalene on spot was unsettled and slightly lower prices prevailed on odd-lot transactions. Solvent naphthas were in scanty supply and first-hands reported the market as firm with prices more or less nominal. Pure zylene was in moderate demand, and, with stocks on spot limited, prices were firmly maintained.

Alpha-Naphthylamine — The market was barely steady, but most producers held out for 35c. per lb., immediate shipment from works. Demand was slow.

Aniline Oil—Business was confined chiefly to small lots and it was possible to pick up supplies involving less than carload lots on the 16c. per lb. basis.

Benzoic Acid—Anticipating seasonable activity in this commodity, traders were disposed to ask higher prices. The U.S.P. grade on spot held at 77@80c. per lb., with forward material available at 72@75c. per lb., as to quantity and seller.

Benzene — The market developed weakness in outside channels, but leading producers refused to meet this competition. The demand has been disappointing and with no change for the better in the motor fuel situation some traders were not disposed to hold on to supplies and stood ready to cut prices in order to interest consumers. The 90 per cent grade, so far as leading producers were concerned, held at 25c. per gal., tank cars, f.o.b. works, with the pure at 27c. per gal., tank cars, f.o.b. works. Advices from Manchester, England, report quiet trading in benzene, but the price, while barely steady, settled around 1s. 7d. per gal.

Cresylic Acid—Prices named toward the close, on imported material, ranged from $1.05@$1.15 per gal., according to grade and seller. Business was neglected and the undertone easy. Offerings from domestic sources, for nearby delivery, have increased of late, but producers announced no price changes.

Naphthalene—Scattered parcels of flake sold down to 7¾c. per lb., which compares with 8c. a week ago. The demand was not sufficient to steady the market. Crude to import was offered at 2½@3¼c. per lb., the price varying according to the seller and specifications. London advices, under recent date, indicate that the market in the United Kingdom has eased off, with sellers of crude at £7@£12 per ton, the inside figure prevailing on rather low-grade material.

Phenol—With offerings of the synthetic product increasing, sentiment favored buyers. For spot material most traders were asking from 48@50c. per lb., but several lots came on the market at concessions and prices at the close were little more than nominal. During the week actual offerings of resale material were heard of at 42c. Second-half of 1923 business could have been negotiated at 40c. per lb. Producers of the natural product refused to name a flat price, but intimated that on contract regular customers might obtain supplies around 30c. per lb.

Solvent Naphtha—Demand for this material was good and with production sold well ahead the market ruled firm. Leading producers held out for 27c. per gal., tank car basis, forward delivery, f.o.b. works.

Effects of Borax on Plant Growth

After exhaustive experiments, the U. S. Department of Agriculture claims to have proved that as little as 4 lb. of borax to the acre is detrimental to plant growth. In some instances, however, no detrimental affect was noted until borax had been applied to the extent of 20 lb. to the acre. The lengthy period of experimental work was made necessary because it damaged crops during the war, when a potash salt containing borax was used.

The experiments show that the potato can tolerate a greater quantity of borax than plants such as corn and beans, which are injured by comparatively small quantities of borax. The degree of injury, however, depends more than anything else upon the depth and distribution of rainfall.

Standard Test Requested for Coal-Tar Distillates

Owing to confusion which has arisen because of different methods of testing the quantity of distillate in certain coal-tar products, the Customs Division of the Treasury Department will ask the United States Bureau of Standards to evolve a standard test, which will be adopted uniformly by the customs service.

The issue has been brought to the front by the complaint of an importer who brought two importations of the same product through two different ports, New York and Philadelphia. At New York, the test given at the chemical laboratory of the Customs Division showed that the product was entitled to free entry under paragraph 1549 of the 1922 tariff act. The test by the customs chemist at Philadelphia produced a different result, and there the product was declared dutiable under paragraph 27 of the act, at 55 per cent ad valorem, American selling price, and 7c. per lb. A sample of the identical lot tested at Philadelphia was submitted the Chemical Division of the Bureau of Standards, and a still different result was obtained there, placing the product practically on the borderline between free and dutiable. In each case a different method of testing was used. Final liquidation of the importations has been held up pending further investigation by the Treasury officials.

Paragraph 27 declares duitable "all distillates of coal tar, blast-furnace tar, oil-gas tar, and water-gas tar, which on being subjected to distillation yield in the portion distilling below 190 deg. C. a quantity of tar acids equal to or more than 5 per centum of the original distillate or which on being subjected to distillation yield in the portion distilling below 215 deg. C. a quantity of tar acids equal to or more than 75 per centum of the original distillate."

Paragraph 1549 declares entitled to free entry these tars and "all other distillates of any of these tars which on being subjected to distillation yield in the portion distilling below 190 deg. C. a quantity of tar acids less than 5 per centum of the original distillate."

German Chemical Prices Firm

Chemical prices in Germany are regarded as showing remarkable firmness in the face of wild fluctuations in the mark and the rampant speculation which is honeycombing practically every German industry. It may be mentioned, however, that the stability of price apparently has not extended to the pharmaceuticals. The capital increases of the German chemical companies is proceeding merrily.

The fact that five months' dye quota has been taken at one fell swoop is expected to mean increased exports to the United States since the quantities are greater than can be digested at once in Europe.

Vegetable Oils and Fats

Cottonseed Oil Lower—Prompt Shipment Linseed Declines—Coconut Sells at 8¼c.—Soya Offered Freely

OFFERINGS of most oils increased, and with general unsettlement in speculative commodity markets, the undertone was easy and lower prices obtained for cottonseed, linseed, china wood, olive, oil foots and crude soya bean oil. The cottonseed statistics, which came out early last week, were regarded as bullish, but this did not inspire any confidence in the market. Lard was unsettled at the close, while in tallow the situation eased off somewhat on intimation that prospective buyers lowered their views.

Cottonseed Oil—Liquidation in the July option in the market for refined oil was the feature. The Bureau of Census report on cottonseed products revealed that 128,871 bbl. were consumed in May, a favorable showing considering the low position of competing fats. The visible supply on May 31 amounted to 627,000 bbl., against 707,000 bbl. on the corresponding date a year ago. (The report is reviewed elsewhere in this issue.) Speculative holdings of nearby oil in the contract market were larger than traders seemed willing to admit and fears for liberal tenders in July oil added to the unsettlement. There were numerous switches of July contracts to the September option. With cash trade slow refiners also were disposed to unload a little nearby oil. In the opinion of traders the speculative element will not operate on the long side in the old crop months, believing that the tight statistical situation has already been discounted. On the other hand the new crop is attracting widespread attention and, in the event of a 12,000,000 bale cotton crop, the sentiment at the close was rather bearish. Old crop crude was offered at 9⅛c. per lb., tank cars f.o.b. Texas, with buyers at 9c. per lb. Recent business in November forward was booked at 7c. per lb., f.o.b. Texas common points, about 50 tanks moving at this figure. Bleachable oil sold at 9⅜c. per lb., tank cars, f.o.b. Texas, immediate shipment. Lard compound was easier at 12⅜c. per lb., f.o.b. New York.

Linseed Oil—The seed markets eased off towards the close, and with cake higher, crushers appeared a little more anxious for business. But comparatively few inquiries came out as asking prices were considered too high, especially where September forward oil was concerned. Spot oil sold at $1.08 per gal., carload lots, cooperage included, with intimation in some quarters that this figure could be shaded on early July business. On second-half of July $1.05 represented the market, with August at $1.03, carload lots, cooperage included. The lowest price heard on August forward was $1 per gal. Consumers take the stand that September forward should be selling around 90c. per gal., based on prevailing prices for seed and cake. Foreign oil weakened on lack of buying interest from America. In London spot oil, loose, closed at 43s. 6d. per cwt. (112-lb.), which compares with 45s. 6d. per cwt. a week ago. Continental demand has been slack, soapers taking to cheaper fats. A fair increase in the United States flaxseed acreage is expected and from latest reports the crop is doing well. The Canadian acreage will not be much larger than last year, according to private advices. Indian offerings continue large. According to the final official estimate production for the 1922-23 season amounted to 21,280,000 bu., which compares with 17,360,000 bu. the previous season. Argentine shipments from January 1 to June 16 amounted to 33,248,000 bu., of which total 16,612,000 bu. were shipped to the United States. Linseed cake closed steady at $37 per ton, f.a.s. New York, which compares with $34 the recent low.

China Wood Oil—The undertone was easier on re-sale offerings. Spot material was available at 26c. per lb. August forward shipment from the Pacific coast, in sellers' tanks, was offered at 21c. per lb.

Coconut Oil—The sale of 5 cars of Ceylon type oil went through at 8¼c. per lb., f.o.b. New York. On the coast 1 car sold at 8¼c., immediate shipment. Copra was steady at 4⅝c. per lb., c.i.f. coast ports. England has been a buyer, supporting prices.

Olive Oil Foots—Spot prime green material sold at 7½@7⅝c. per lb. So far as quotations went holders were asking from 7⅞@8c. for spot.

Palm Oils—A distressed parcel of Lagos oil sold at 6⅞c. per lb. Lagos for import held around 7¼c., with Niger at 6⅞c. per lb., c.i.f. terms.

Soya Bean Oil—Prices weakened in all quarters because of the lack of buying interest. There were offerings at 9⅛c. coast and 9⅛c. New York, sellers' tanks, nearby positions, duty paid.

Tallow and Greases—Last trading in extra tallow went through at 7¼c. per lb., but just before the close the undertone was easier, with offerings at 7⅛c. per lb. Yellow grease was offered at 6⅛c. per lb., with no buyers. Oleo stearine closed at 8⅞c. asked.

Miscellaneous Materials

Casein—Imported material was offered freely, and, with no improvement in the demand, prices presented a rather easy appearance. Large handlers offered the lower grades at 16@17c. per lb. In outside channels scattered lots could have been picked up at 15½c. per lb.

Glycerine—There were sellers of the chemically pure in the West at 15⅝c. per lb., in drums, carload lots. The market in New York was unsettled at 16½@17c. per lb., in drums, the price varying according to the seller. Recent trading in dynamite was put through at 15c. per lb., in drums, carload lots, about 25 carloads being involved. At the close the market for dynamite glycerine was more or less nominal as regards prices, most holders asking from 15¼@15½c. per lb., the inside figure obtaining in the Middle West. Crude soap lye, basis 80 per cent, settled at 9⅝c. bid and 10c. asked, loose, carload lots, f.o.b. shipping point.

Naval Stores—The market went off slightly on lack of buying interest. Receipts at Southern points were liberal, but no real selling pressure developed. Spirits of turpentine closed at $1.04 per gal., but on a firm bid it was intimated that this price might be shaded. Rosins ruled steady in sympathy with the market in the South, but not much new business was put through. The "B" grade held at $5.80 per bbl.

Rubber—Reports on the state of the rubber trade were not so optimistic. Continental operators in crude showed no interest in the market, and with America less active on the buying side prices eased off. First latex and ribbed smoked sheets on spot were offered at 27c. per lb., with October-November-December nominal at 28c. per lb.

Shellac—The market was unsettled on lower cables from Calcutta. Demand was quiet and T. N. was offered ex-store at 58c. per lb. On ex-dock transactions as low as 55½c. was named during the week. Orange superfine closed at 62c. asked. Bleached, bone dry, held around 68@70c. per lb., as to position and seller.

White Lead—Withdrawals against existing contracts were liberal enough, but new business did not come forward in volume. Corroders offered lead pigments on the guarantee against decline basis, yet this did not stimulate business. The metal was easier in the West, but nominally unchanged in New York at 7¼c. per lb. Standard dry white lead held at 9⅞c. per lb., in casks, carload lot basis.

Zinc Oxide—Consumption of zinc oxide is likely to meet with a setback, as several of the larger tire manufacturers have announced that production will be curtailed over the summer months. However, this did not bring out an easier situation in zinc oxide and producers continued to quote on the former basis of 8c. per lb., on the American process, lead free. French process, red seal, settled at 9⅝c. per lb., round-lot basis. East St. Louis reported weakness in the metal, spelter closing around 5.95c. per lb.

London Tallow Auction

At the regular weekly tallow auction, held in London, June 20, 1,441 casks were offered and 1,142 casks sold. Prices realized were unchanged to 1 shilling higher.

Imports at the Port of New York

June 15 to June 21

ACIDS — Tartaric — 100 csk., Palermo, Order; 150 bbl., Genoa, L'Appula Soc Amon.; 2 bbl., San Juan, Powers-Weightman & Rosengarten.

ALCOHOL—85 bbl. denatured, Arecibo, C. Esteva; 25 bbl. do., Arecibo, M. Feigel & Bros.

ALIZARINE—2 csk., Hamburg, Kuttroff, Pickhardt & Co.

ARSENIC—100 cs., Kobe, Irving Bank-Col. Trust Co., 15 cs., Kobe, S. W. Bridges & Co.; 50 cs., Kobe, Frazer & Co., 200 cs., Kobe, Order.

BLANC FIXE—40 csk., Hamburg, P. Uhlich & Co.

BRONZE POWDER—92 cs., Bremen, Baer Bros; 23 cs., Bremen, Hensel, Bruckmann & Lorbacher; 24 cs., Bremen, Uhlfelder & Co.; 8 cs., Bremen, Order.

CAMPHOR—350 cs., Hamburg, A. Ochse & Co.

CASEIN—297 bg., Bombay, Order, 333 bg., London, Bank of America, 250 bg., Hamburg, Jungmann & Co.; 134 bg., Hamburg, A. Klipstein & Co.

CHEMICALS—98 pkg., Bremen, Pfaltz & Bauer; 300 bg., Glasgow, Brown Bros. & Co.; 17 cs., Hamburg, Morgenstern & Co; 50 csk., Rotterdam, Stanley Doggett, 40 csk., London, A. Klipstein & Co., 38 pkg., Hamburg, Hummel & Robinson; 372 pkg., Hamburg, Roessler & Hasslacher Chem. Co.; 7 csk., Hamburg, Bank of the Manhattan Co.; 270 csk., Hamburg, Jungmann Co.; 19 csk, Hamburg, Order; 21 bbl., Hamburg, A. Murphy & Co.

CHALK—506 tons, London, Baring Bros. & Co.; 2,000 bg., Antwerp, Cooper & Cooper, Inc.; 200 bg., Antwerp, Irving Bank-Col Trust Co.; 1,500 bg., Antwerp, Bankers Trust Co.; 115 bg., London, Order.

CHROME ORE—2,000 tons; Beira, E. J. Lavino & Co.

CINCHONINE—21 cs., Rotterdam, R. W. Greeff & Co.

CREAM TARTAR—50 csk, Hamburg, Order.

COLORS—20 cs., Bremen, Sigmund Ullman Co; 50 csk. earth, Bremen, L. H. Butcher & Co.; 5 csk. aniline, Havre, Sandoz Chemical Works; 7 csk. do, Havre, Irving Bank-Col. Trust Co.; 27 pkg. do., Havre, Geigy Co.; 6 csk. do., Havre, Carbic Color & Chemical Co.; 20 bbl., earth, Leghorn, Reichard-Coulston, Inc.; 68 bbl. do, Leghorn, Order; 16 csk. earth, Marseilles, C. F. Gledhill; 3 csk, Bremen, O. Hommel Co.; 21 csk. earth, Hamburg, P. Uhlich & Co.; 25 csk. earth, Hamburg, J. L. Smith & Co., 34 csk. aniline, Hamburg, Kuttroff, Pickhardt & Co.; 4 csk do. Hamburg, Order, 15 csk., Hamburg, Gresselli Chem. Co.; 3 csk. do., Hamburg, Carbic Color & Chem. Co.; 4 csk do. Hamburg, G. A. Kuhl; 7 csk aniline, Rotterdam, H. A. Metz & Co.; 14 bbl., Hamburg, Fezandie & Sperrle

COPPER OXIDE—50 dr., Hamburg, Am. Metal Co.

COPRA—327,000 lb., Belize, Franklin Baker Co.; 169 bg., Morant Bay, Franklin Baker Co; 303 bg., Port Antonio, Fandrell Import Co.; 37 bg., San Juan, Order.

DYESTUFFS—33 csk., Naples, Irving Bank-Col Trust Co.; 16 csk., Naples, Am. Exchange Nat'l Bank; 10 csk., Naples, Order; 5 csk., Naples, Ladenburg, Thalmann & Co.; 2 csk., Naples, Ackermann Color Co.; 7 cs., Havre, Selchow & Righter; 4 cs., Havre, R. H. Meehan & Co.; 2 cs., Havre, B. F. Drakenfeld & Co.; 4 csk., Havre, Sandoz Chem. Wks.

FULLERS EARTH—1250 bg, London, L. A. Salomon & Bro.

FUSEL OIL—21 dr., Rotterdam, G. W. Sheldon & Co.; 3 dr. Rotterdam, Order.

GLAUBER SALT—335 csk., Hamburg, Innis, Speiden & Co.; 200 bg., Hamburg, A. J. Marcus; 251 bbl., Hamburg, E. Suter & Co.

GUMS—324 bg. copal, Antwerp, Equitable Trust Co.; 200 bg. do., Antwerp, Brown Bros. & Co; 124 cs. kauri, Auckland, Baring Bros. & Co.; 48 pkg. do., Auckland, Brown Bros. & Co.; 47 cs. do., Auckland, Equitable Trust Co.; 332 bg. do., Auckland, Am. Foreign Banking Corp.; 95 cs. do., Auckland, Guaranty Trust Co.; 122 cs. and 359 sk., Auckland, Chemical Nat'l Bank; 1204 pkg. kauri, Auckland, Order; 209 bg. yacca, Port Adelaide, Baring Bros. & Co.; 400 bg. do., Port Adelaide, W. Schall & Co.; 546 bg. ghaty, 527 bg. karaya, 259 pkg. tragacanth, 56 bg. asafoetida, 225 bg. olibanum, Bombay, Order, 290 bg. copal, Antwerp, Order; 1,400 cs. damar, Batavia, National City Bank; 200 cs. do., Batavia, Innes & Co., 100 cs. do Batavia, W. Schall & Co.; 200 cs do., Batavia, Bank of Cent. & South Am., 2,250 cs. do., Batavia Order; 487 bg. copal, Antwerp, W. Schall & Co.; 620 pkg do Antwerp, Central Union Trust Co.; 205 bg do. Antwerp, Chemical National Bank, 105 bg. do Antwerp Brown Bros & Co.; 26 cs kauri, London, Order; 1,240 bg. yacca, Adelaide, International Banking Corp; 141 bg. do., Adelaide, Order.

IRON OXIDE—10 csk., Marseilles, C. F. Gledhill; 200 bbl. Malaga, Scott L. Libby Corp, 170 bbl., Malaga C. K. Williams & Co, 100 bbl. Malaga, E. M. & F. Waldo; 82 bbl Malaga, J. M. Rabass; 80 bbl Malaga, Nat'l City Bank; 110 bbl., Malaga, Reichard Coulston, Inc.

LITHOPONE—300 cks., Antwerp, Benja. Moore & Co.

LOGWOOD EXTRACT—141 bbl, Cape Haitian, Logwood Mfg. Corp.

MENTHOL—25 cs. Kobe, National City Bank, 25 cs., Kobe, Stanley, Jordan & Co

MAGNESITE 104 bbl., Rotterdam, Speiden-Whitfield Co

MAGNESIUM—225 cs. citrate, Naples, Order, 500 cs do., Naples, East River Nat'l Bank., 3 bg. chloride, Hamburg, Innis, Speiden & Co., 150 dr. chloride, Hamburg, Order

MYROBALANS—4,000 pkt., Calcutta, Standard Bank of South Africa, 10,972 bg., Bombay, Order, 14,426 pkt., Calcutta, Order.

OILS—Olive Oil Foots—100 bbl, Palermo Banca Comm. Italo; 100 bbl. Palermo, Order, 100 bbl, Patras, G. Barnalas. **Palm**—500 csk, Hamburg, African & Eastern Trading Corp. **Seal**—140 tons in bulk, St Johns, Cook & Sevan Co, 154 tons in bulk, St. Johns, Bowring & Co.

OIL SEEDS—Castor—10928 bg., Coconada, Volkart Bros.; 1426 bg., Bombay, Order; 89 bg., Port de Paix, Huttlinger & Struller. **Linseed**—26,429 bg. and 3,724 409 kilos, in bulk Rosario, Spencer Kellogg & Sons; 102,342 bg., Rosario, Spencer Kellogg & Sons; 36,324 bg., Rosario, L. Dreyfus & Co.; 32,537 bg., San Nicolas, L. Dreyfus & Co, 22,400 bg, Buenos Aires, Order, 17,929 bg., Bahia Blanca, L. Dreyfus & Co.; 35,392 bg., Bahia Blanca, Order; 37,316 bg., Rosario, Order; 18,813 bg., San Nicolas, Order.

POTASSIUM SALTS—1500 bg. muriate and 1500 bg. sulphate, Bremerhaven, Potash Imp. Corp. of Am.; 7,000 bg. muriate, Soc Comm. des Potasses d'Alsace; 182 dr. permanganate, Hamburg, Brown Bros. & Co; 3,000 bbl. chlorate, Hamburg, Order, 42 pkg permanganate, Hamburg, Order; 31 bbl. hydrate, Hamburg, A. J. Marcus, Inc.; 1,000 bbl. chlorate, Hamburg, Irving Bank-Col. Trust Co.; 18 csk. carbonate, Hamburg, Peters, White & Co.; 174 dr caustic, Hamburg, E. Suter & Co.; 225 csk nitrate, Hamburg, Kuttroff, Pickhardt & Co.

PYRIDINE—1 csk., Hamburg, Order.

QUEBRACHO—10,466 bg., Buenos Aires, Tannin Corp.; 8,524 bg., Buenos Aires, Beckman & Winthrop; 8,210 bg., Buenos Aires, Fourth Atlantic National Bank; 1,000 tons, Buenos Aires, Tannin Corp.

SHELLAC—750 bg., Calcutta, Order; 100 bg., and 20 cs., Calcutta, Brown Bros. & Co.; 40 cs. garnet, Calcutta, First Nat'l Bank of Boston; 300 bg., Calcutta, Chase National Bank; 100 bg., Calcutta, N. Y. Trust Co.; 100 bg., Calcutta, Mech. & Metals National Bank; 100 bg., Calcutta, Iwai & Co.; 600 bg. refuse, Calcutta, Bank of the Manhattan Co.; 100 bg., Calcutta, British Bank of South Am.; 100 chests, Calcutta, Philadelphia Nat'l Bank; 1,356 pkg., Calcutta, Order; 50 bg. garnet, Hamburg, Kasebier-Chatfield Shellac Co.; 10 cs., Rotterdam, A. Murphy & Co.

SODIUM SALTS—100 cs. chlorate, Genoa, A. H. Pickering & Co.; 144 cs. do., Genoa, Order; 19,562 bg. nitrate, Iquique, W. R. Grace & Co.; 2,755 bg. nitrate, Antofogasta, W. R. Grace & Co.; 33 csk. prussiate, Rotterdam, C. F. Smillie & Co.; 200 cs. cyanide, Havre, National City Bank; 216 cs. sulphite, Hamburg, C. S. Grant & Co.; 75 csk. nitrate, Hamburg, E. Suter & Co.

STRONTIUM NITRATE—44 bbl., Hamburg, Unexcelled Mfg. Co.

STARCH—1,250 bg., potato, Rotterdam, Stein, Hall & Co.; 250 bg. do., Rotterdam, J. Wertheimer & Sons; 200 bg. do., Rotterdam, Chic Starch Co.

SUMAC—350 bg. Palermo, American Express Co.; 550 bg., Palermo, Order.

TALC—3,500 bg., Genoa, Italian Discount & Trust Co.; 250 bg., Genoa, Bankers Trust Co

TARTAR — 16 csk., Messina, Tartar Chem. Works.

TARTRATE OF LIME—237 bg, Valencia, C. Pfizer & Co.

WAXES—875 bg. montan, Bremen, W. Schall & Co.; 97 bg. bees, Valparaiso, Duncan, Fox & Co.; 40 cs. bees, Havre, L. A. Salomon & Bros.; 377 bg. carnauba, Cara, Int'l Acceptance Bank, 223 bg. do., Parnahyba, Lazard Freres; 979 bg. do., Parnahyba, National City Bank; 19 pkg. bees, Talcahuano, W. R. Grace & Co.; 72 bg. bees, Valparaiso, Banco Aleman Trans-Atlantic; 56 bg. do., Valparaiso, W. R. Grace & Co.; 50 bbl. beeswax, Rotterdam, Knauth, Nachod & Kuhne; 1,920 bg. paraffine, London, Order; 32 bg. bees, London, Order.

WOOL GREASE—75 bbl, Bremen, Hummel & Robinson Corp

ZINC OXIDE—50 bbl., Antwerp, Reichard-Coulston, Inc.

ZINC WHITE—20 csk., Southampton, Houbigart, Inc.

Latest Quotations on Industrial Stocks

	Last Week	This Week
Air Reduction	65	60⅜
Allied Chem. & Dye	69⅛	67¼
Allied Chem. & Dye pfd	109⅛	108⅛
Am. Ag. Chem	16	16
Am. Ag. Chem. pfd	43	40⅞
American Cotton Oil	7⅛	5⅛
American Cotton Oil pfd	*16	14
Am. Drug Synd	5⅛	5
Am. Linseed Co.	22⅛	18¼
Am. Linseed pfd.	43	40
Am. Smelting & Refining	62⅛	57¼
Am. Smelting & Refining pfd.	97⅛	97
Archer-Daniels Mid. Co., w.i.	33	30
Atlas Powder	170	165
Atlas Powder (new)	....	54⅛
Casein Co. of Am.	*60	*60
Certain-Teed Products	*38	*38
Commercial Solvents	30	29
Corn Products	131⅛	130¼
Corn Products pfd	116⅛	117⅛
Davison Chem.	29⅞	30¼
Dow Chem. Co.	*42	*42
Du Pont de Nemours	121⅜	116¼
Du Pont de Nemours db.	85⅜	85
Freeport-Texas Sulphur	13⅜	11
Glidden Co.	7⅛	*7⅛
Grasselli Chem.	133	*133
Grasselli Chem. pfd.	105	*105
Hercules Powder	103	*100
Hercules Powder pfd	103	*102
Heyden Chem.	2⅛	2
Int'l Ag. Chem. Co.	4⅛	3⅛
Int'l Ag. Chem. pfd	14	10⅞
Int'l Nickel	14⅛	13¼
Int'l Nickel pfd.	84⅜	82
Int'l Salt	*90	*80
Mathieson Alkali	47	42⅞
Merck & Co.	*87	*87
National Lead	119	114
National Lead pfd.	112	110
New Jersey Zinc	157	155
Parke, Davis & Co.	78	78
Pennsylvania Salt	85	85
Procter & Gamble	*130	*130
Sherwin-Williams	29	29
Sherwin-Williams pfd.	*102	*101
Tenn. Copper & Chem.	9⅜	8⅞
Texas Gulf Sulphur	*59¼	57
Union Carbide	56⅜	54⅛
United Drug	80¼	80
U. S. Industrial Alcohol	54⅛	48
U. S. Industrial Alcohol pfd.	*102	*100
Va.-Car. Chem. Co.	9⅜	8¼
Va.-Car. Chem. pfd	26	25⅜

*Nominal. Other quotations based on last sale.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available. In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetone, drums	lb.	$0.25 - .25½
Acid, acetic, 28%, bbl.	100 lb.	3.38 - 3.50
Acetic, 56%, bbl	100 lb.	6.75 - 7.00
Glacial, 99½%, bbl.	100 lb.	12.00 - 12.50
Acetic anhydride, 85%, dr.	lb.	.58 -
Boric, bbl	lb.	.10½ -
Citric, kegs	lb.	.49 - .52
Formic, 85%	lb.	.14 - .16
Gallic, tech.	lb.	.45 - .50
Hydrofluoric, 52%, carboys	lb.	.11 - .12
Lactic, 44% tech., light, bbl.	lb.	.11½ - .12
22% tech., light, bbl.	lb.	.05½ - .06
Muriatic, 18° tanks	100 lb.	.90 - 1.00
Muriatic, 20°, tanks,	100 lb.	1.00 - 1.10
Nitric, 36°, carboys	lb.	.04½ - .05
Nitric, 42°, carboys	lb.	.06 - .06½
Oleum, 20%, tanks	ton	18.50 - 19.00
Oxalic, crystals, bbl.	lb.	.13 - .13½
Phosphoric, 50% carboys	lb.	.07½ - .08½
Pyrogallic, resublimed	lb.	1.50 - 1.60
Sulphuric, 60°, tanks	ton	9.50 - 11.00
Sulphuric, 60°, drums	ton	13.00 - 14.00
Sulphuric, 66°, tanks	ton	16.00 - 16.50
Sulphuric, 66° drums	ton	20.00 - 21.00
Tannic, U.S.P., bbl.	lb.	.65 - .70
Tannic, tech., bbl.	lb.	.45 - .50
Tartaric, imp., powd., bbl.	lb.	.35½ - .36
Tartaric, domestic, bbl.	lb.	.37½ -
Tungstic, per lb.	lb.	1.10 - 1.20
Alcohol, butyl, drums, f.o.b. works	lb.	.26 - .28
Alcohol ethyl (Cologne spirit), bbl	gal.	4.75 - 4.95
Ethyl, 190 p'f. U.S.P., bbl.	gal.	4.70 -
Alcohol, methyl (see Methanol)		
Alcohol, denatured, 190 proof		
No. 1, special bbl.	gal.	.41 -
No. 1, 190 proof, special, dr.	gal.	.35 -
No. 1, 188 proof, bbl	gal.	.42 -
No. 1, 188 proof, dr	gal.	.36 -
No. 5, 188 proof, bbl	gal.	.40 -
No. 5, 188 proof, dr	gal.	.34 -
Alum, ammonia, lump, bbl	lb.	.03½ - .03¾
Potash, lump, bbl	lb.	.02¾ - .03¼
Chrome, lump, potash, bbl.	lb.	.05½ - .05¾
Aluminum sulphate, com., bags	100 lb.	1.50 - 1.65
Iron free bags	lb.	.02½ - .02¾
Aqua ammonia, 26°, drums	lb.	.06½ - .07
Ammonia, anhydrous, cyl.	lb.	.30 - .30½
Ammonium carbonate, powd. casks, imported	lb.	.09½ - .10
Ammonium carbonate, powd. domestic, bbl.	lb.	.13 - .14
Ammonium nitrate, tech., casks	lb.	.10 - .11
Amyl acetate tech., drums	gal.	3.75 - 4.25
Arsenic, white, powd., bbl	lb.	.13½ - .14
Arsenic, red, powd., kegs	lb.	.15½ - .16
Barium carbonate, bbl.	ton	70.00 - 75.00
Barium chloride, bbl.	ton	80.00 - 83.00
Barium dioxide, drums	lb.	.18 - .18½
Barium nitrate, casks	lb.	.08 - .08½
Blanc fixe, dry, bbl.	lb.	.04 - .04½
Bleaching powder, f.o.b. wks., drums	100 lb.	1.90 -
Spot N. Y. drums	100 lb.	2.40 -
Borax, bbl.	lb.	.05½ - .05¾
Bromine, cases	lb.	.28 - .30
Calcium acetate, bags	100 lb.	4.00 - 4.05
Calcium arsenate, dr	lb.	.14 - .16
Calcium carbide, drums	lb.	.05½ - .05¾
Calcium chloride, fused, drums	ton	22.00 - 23.00
Gran. drums	ton	28.00 - 30.00
Calcium phosphate, mono, bbl.	lb.	.06½ - .07
Camphor, cases	lb.	.86 - .88
Carbon bisulphide, drums	lb.	.07 - .07½
Carbon tetrachloride, drums	lb.	.09½ - .10
Chalk, precip.—domestic, light, bbl.	lb.	.04½ - .04¾
Domestic, heavy, bbl.	lb.	.03½ - .03¾
Imported, light, bbl.	lb.	.04½ - .05
Chlorine, liquid, tanks, wks.	lb.	.05½ - .05¾
Cylinders, 100 lb., wks	lb.	.06 - .06½
Cylinders, 100 lb., spot	lb.	.09 -
Chloroform, tech., drums	lb.	.35 - .38
Cobalt oxide, bbl.	lb.	2.10 - 2.25
Copperas, bulk, f.o.b. wks.	ton	20.00 - 21.00
Copper carbonate, bbl.	lb.	.19 - .20
Copper cyanide, drums	lb.	.47 - .50
Coppersulphate, dom., bbl.,	100 lb.	5.50 - 5.75
Imp. bbl	100 lb.	5.00 - 5.25
Cream of tartar, bbl.	lb.	.25½ - .26½
Epsom salt, dom., tech., bbl.	100 lb.	1.90 - 2.15
Epsom salt, imp., tech., bags	100 lb.	.90 - 1.00
Epsom salt, U.S.P., dom., bbl.	100 lb.	2.50 - 2.60
Ether, U.S.P., resale, dr.	lb.	.13 - .15
Ethyl acetate, 85%, drums	gal.	.80 - .81
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 - 1.00

Formaldehyde, 40%, bbl.	lb.	$0.14½ - $0.15
Fullers earth—imp., powd., net	ton	30.00 - 32.00
Fusel oil, ref., drums	gal.	-
Fusel oil, crude, drums	gal.	3.75 - 4.00
Glaubers salt, wks., bags	100 lb.	1.20 - 1.40
Glaubers salt, imp., bags	100 lb.	.90 - .95
Glycerine, c.p., drums extra	lb.	.16½ - .17
Glycerine, dynamite, drums	lb.	.15½ - .15¾
Glycerine, crude 80%, loose	lb.	.10 - .10½
Iodine, resublimed	lb.	4.55 - 4.65
Iron oxide, red, casks	lb.	.12 - .18
Lead:		
White, basic carbonate, dry, casks	lb.	.09¾ - .10
White, basic sulphate, casks	lb.	.09½ -
White, in oil, kegs	lb.	.12½ - .14
Red, dry, casks	lb.	.11½ - .12
Red, in oil, kegs	lb.	.13½ - .15
Lead acetate, white crys., bbl.	lb.	.14 - .14½
Brown, broken, casks	lb.	.13 - .13½
Lead arsenate, powd., bbl.	lb.	.23 - .24
Lime-Hydrated, bbl.	per ton	16.80 - 17.00
Lime, Lump, bbl.	280 lb.	3.63 - 3.65
Litharge, comm., casks	lb.	.10½ - .11
Lithophone, bags	lb.	.07 - .07½
in bbl.	lb.	.07½ - .07¾
Magnesium carb., tech., bags	lb.	.08½ - .08¾
Methanol, 95%, bbl	gal.	1.18 - 1.20
Methanol, 97%, bbl.	gal.	1.20 - 1.22
Nickel salt, double, bbl.	lb.	.10½ -
Nickel salts, single, bbl.	lb.	.11½ -
Phosgene		.60 - .75
Phosphorus, red, cases	lb.	
Phosphorus, yellow, cases	lb.	.35 - .40
Potassium bichromate, casks	lb.	.11 - .11½
Potassium bromide, gran., bbl	lb.	.19 - .20
Potassium carbonate, 80-85%, calcined, casks	lb.	.06½ - .06¾
Potassium chlorate, powd.	lb.	.07½ - .08
Potassium cyanide, drums	lb.	.47 - .52
Potassium, first sorts, cask	lb.	.07½ - .08
Potassium hydroxide (caustic potash) drums	lb.	.07½ - .09
Potassium iodide, cases	lb.	3.65 - 3.75
Potassium nitrate, bbl.	lb.	.06½ - .07½
Potassium permanganate, drums	lb.	.17 - .18
Potassium prussiate, red, casks	lb.	.65 - .67
Potassium prussiate, yellow, casks	lb.	.31 - .33
Salammoniac, white, gran., casks, imported	lb.	.06½ - .06¾
Salammoniac, white, gran., bbl., domestic	lb.	.07½ - .07
Gray, gran., casks	lb.	.08 - .09
Salsoda, bbl.	100 lb.	1.20 - 1.40
Salt cake (bulk)	ton	26.00 - 28.00
Soda ash, light, 58% flat, bags, contract	100 lb.	1.45 - 1.50
Soda ash, light, 58%, flat, bags, resale	100 lb.	1.70 - 1.75
Soda ash, dense, bags, contract, basis 58%	100 lb.	1.51 -
Soda ash, dense, in bags, resale	100 lb.	1.85 - 1.90
Soda, caustic, 76%, solid, drums	100 lb.	3.16½ -
Soda, caustic, ground and flake, contracts	100 lb.	3.60 - 3.85
Soda, caustic, ground and flake, resale	100 lb.	3.72½ -
Sodium acetate, works, bags	lb.	.05½ - .06½
Sodium bicarbonate, bbl.	100 lb.	2.00 - 2.50
Sodium bichromate, casks	lb.	.08½ - .09
Sodium bisulphate (niter cake)	ton	6.00 - 7.00
Sodium bisulphite, powd., U.S.P., bbl.	lb.	.04½ - .04¾
Sodium chlorate, kegs	lb.	.06½ - .07
Sodium chloride	long ton	12.00 - 13.00
Sodium cyanide, cases	lb.	.20 - .23
Sodium fluoride, bbl.	lb.	$0.08½ - $0.10½
Sodium hyposulphite, bbl.	lb.	.02½ - .03
Sodium nitrite, casks	lb.	.07½ - .07¾
Sodium peroxide, powd., cases	lb.	.28 - .30
Sodium phosphate, dibasic, bbl.	lb.	.03½ - .04
Sodium prussiate, yel. drums	lb.	.14½ - .16
Sodium salicylic, drums	lb.	.47 - .52
Sodium silicate (40°, drums)	100 lb.	.75 - 1.15
Sodium silicate (60°, drums)	100 lb.	1.75 - 2.00
Sodium sulphide, fused, 60-62% drums	lb.	.04½ - .04¾
Sodium sulphite, crys., bbl.	lb.	.03½ - .03¾
Strontium nitrate, powd., bbl.	lb.	.12½ - .13
Sulphur chloride, yel drums	lb.	.04½ - .05
Sulphur, crude	ton	18.00 - 20.00
At mine, bulk	ton	16.00 - 18.00
Sulphur, flour, bag	100 lb.	2.25 - 2.35
Sulphur, roll, bag	100 lb.	2.00 - 2.10
Sulphur dioxide, liquid, cyl.	lb.	.08 - .08½
Talc—imported, bags	ton	30.00 - 40.00
Talc—domestic powd., bags	ton	18.00 - 25.00
Tin bichloride, bbl.	lb.	.12½ - .13
Tin oxide, bbl.	lb.	.48 -
Tin crystals, bbl.	lb.	.34½ - .35
Zinc carbonate, bags	lb.	.14 - .14½
Zinc chloride, gran, bbl.	lb.	.06½ - .06¾
Zinc cyanide, drums	lb.	.37 - .38
Zinc oxide, lead free, bbl	lb.	.08 - .08½
5% lead sulphate, bags	lb.	.07½ - ......
10 to 35 % lead sulphate, bags	lb.	.07 - ......
French, red seal, bags	lb.	.09½ - ......
French, green seal, bags	lb.	.10½ - ......
French, white seal, bbl	lb.	.12 - ......
Zinc sulphate, bbl.	100 lb.	2.50 - 3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb.	$0.62 - $0.75
Alpha-naphthol, ref., bbl.	lb.	.70 - .80
Alpha-naphthylamine, bbl.	lb.	.35 - .37
Aniline oil, drums	lb.	.16 - .16
Aniline salts, bbl	lb.	.23 - .24
Anthracene, 80%, drums	lb.	.75 - 1.00
Anthracene, 80%, imp., drums, duty paid	lb.	.70 - .75
Anthraquinone, 25% paste, drums	lb.	.70 - .75
Benzaldehyde U.S.P., carboys	lb.	1.40 - 1.45
tech, drums	lb.	.75 - .80
Benzene, pure, water-white, tanks and drums	gal.	.27 - .32
Benzene, 90%, tanks & drums	gal.	.25 - .30
Benzene, 90%, drums, resale	gal.	.28 - .32
Benzidine base, bbl.	lb.	.80 - .85
Benzidine sulphate, bbl.	lb.	.70 - .75
Benzoic acid, U.S.P., kegs	lb.	.75 - .80
Benzoate of soda, U.S.P., bbl.	lb.	.57 - .65
Benzyl chloride, 95-97%, ref., drums	lb.	.45 -
Benzyl chloride, tech., drums	lb.	.30 - .35
Beta-naphthol, tech., bbl.	lb.	.21½ - .22
Beta-naphthylamine, tech.	lb.	.80 - .90
Cresol, U.S.P., drums	lb.	.25 - .29
Ortho-cresol, drums	lb.	.28 - .3[illegible]
Cresylic acid, 97%, resale, drums	gal.	1.15 - 1.20
95-97%, drums, resale	gal.	1.05 - 1.10
Dichlorbenzene, drums	lb.	.07 - .09
Diethylaniline, drums	lb.	.50 - .60
Dimethylaniline, drums	lb.	.41 - .4[illegible]
Dinitrobenzene, bbl.	lb.	.19 - .20
Dinitroclorbenzene bbl.	lb.	.22 - .2[illegible]
Dinitronaphthalen, bbl.	lb.	.30 - .3[illegible]
Dinitrophenol, bbl.	lb.	.35 - .40
Dinitrotoluene, bbl.	lb.	.20 - .2[illegible]
Dip oil, 25%, drums	gal.	.25 - .30
Diphenylamine, bbl.	lb.	.50 - .5[illegible]
H-acid, bbl.	lb.	.75 - .80
Meta-phenylenediamine, bbl.	lb.	1.00 - 1.0[illegible]
Michlers ketone, bbl.	lb.	3.00 - 3.50
Monochlorbenzene, drums	lb.	.08 - .1[illegible]
Monoethylaniline, drums	lb.	.95 - 1.1[illegible]
Naphthalene, flake, bbl.	lb.	.07½ - .0[illegible]
Naphthalene, balls, bbl.	lb.	.08½ - .0[illegible]
Naphthionate of soda, bbl.	lb.	.58 - .6[illegible]
Naphthionic acid, crude, bbl.	lb.	.55 - .60
Nitrobenzene, drums	lb.	.10 - .1[illegible]
Nitro-naphthalene, bbl.	lb.	.30 - .3[illegible]
Nitro-toluene, drums	lb.	.13½ - .1[illegible]
N-W acid, bbl.	lb.	1.25 - 1.3[illegible]
Ortho-amidophenol, kegs	lb.	2.30 - 2.3[illegible]
Ortho-dichlorbenzene, drums	lb.	.17 - .2[illegible]
Ortho-nitrophenol, bbl.	lb.	.90 - .9[illegible]
Ortho-nitrotoluene, drums	lb.	.10 - .1[illegible]
Ortho-toluidine, bbl.	lb.	.13 - .1[illegible]
Para-amidophenol, base, kegs	lb.	1.30 - 1.3[illegible]
Para-amidophenol, HCl, kegs	lb.	1.25 - 1.3[illegible]
Para-dichlorbenzene, bbl.	lb.	.17 - .2[illegible]
Paranitroaniline, bbl.	lb.	.70 - .7[illegible]
Para-nitrotoluene, bbl.	lb.	.60 - .6[illegible]
Para-phenylenediamine, bbl.	lb.	1.45 - 1.5[illegible]
Para-toluidine, bbl	lb.	.90 - .9[illegible]
Phthalic anhydride, bbl.	lb.	.35 - .3[illegible]
Phenol, U.S.P., resale, dr.	lb.	.42 - .4[illegible]
Picric acid, bbl.	lb.	.20 - .2[illegible]
Pyridine, dom., drums	gal.	nominal

Pyridine, imp., drums	gal	$4 00 - $4 25
Resorcinol, tech., kegs	lb.	1.50 - 1 60
Resorcinol, pure, kegs	lb.	2 25 -
R-salt, bbl	lb.	.55 - .60
Salicylic acid, tech., bbls	lb.	.37 - .42
Salicylic acid, U.S.P., bbl	lb.	.40 - .45
Solvent naphtha, water-white, tanks	gal.	.27 -
Crude, tanks	gal.	.24 -
Sulphanilic acid, crude, bbl	lb.	.18 - .20
Thiocarbanilide, kegs	lb.	.35 - .38
Toluidine, kegs	lb.	1.20 - 1.30
Toluidine, mixed, kegs	lb.	.30 - .35
Toluene, tank cars	gal.	.30 - .35
Toluene, drums	gal.	.34 - .36
Xylidines drums	lb.	.49 - .50
Xylene, pure, drums	gal.	.75 - 1 00
Xylene, com., drums	gal	.37 -
Xylene, com., tanks	gal.	.32 - ......

Naval Stores

Rosin B-D, bbl	280 lb.	$5 80 -
Rosin E-I, bbl	280 lb	5 90 -
Rosin K-N, bbl	280 lb	6 10 -
Rosin W.G.-W.W., bbl	280 lb	6 25 - 7 25
Wood rosin, bbl	280 lb	5 90 - 6 00
Turpentine, spirits of, bbl	gal	1 03 -
Wood, steam dist., bbl	gal	96 -
Wood, dest dist., bbl	gal.	65 -
Pine tar pitch, bbl	200 lb	- 6 00
Tar, kiln burned, bbl	500 lb	- 13 00
Retort tar, bbl	500 lb	- 12 00
Rosin oil, first run, bbl	gal	
Rosin oil, second run, bbl	gal	48 - ...
Rosin oil, third run, bbl	gal	52 -
Pine oil, steam dist	gal.	70 - ..
Pine oil, pure, dest dist	gal	65 - ..
Pine tar oil, ref	gal.	48 - ..
Pine tar oil, crude, tanks f.o.b Jacksonville, Fla.	gal.	32 - .32½
Pine tar oil, double ref., bbl	gal	- 75
Pine tar, ref., thin, bbl	gal	- .25
Pinewood creosote, ref., bbl	gal	- 52

Animal Oils and Fats

Degras, bbl	lb	$0 03½ - $0 04
Grease, yellow, bbl	lb	06½
Lard oil, Extra No. 1, bbl	gal	90
Neatsfoot oil 20 deg bbl	gal	1 30 -
No. 1, bbl	gal	92 - 94
Oleo Stearine		08½
Red oil, distilled, d p bbl	lb	.10 -
Saponified, bbl	lb	10
Tallow, extra, loose	lb	07½
Tallow oil, acidless, bbl	gal	94 - 96

Vegetable Oils

Castor oil, No 3, bbl	lb	$0 14 -
Castor oil, No 1, bbl	lb	14½ -
Chinawood oil, bbl	lb.	.26 -
Coconut oil, Ceylon, bbl	lb	09½ - 09½
Ceylon, tanks, N Y	lb	08½ - 08½
Coconut oil, Cochin, bbl	lb	09½ - 10
Corn oil, crude, bbl	lb.	12½
Crude, tanks, (f o b mill)	lb.	09½ - 09½
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.09½
Summer yellow, bbl	lb.	12½ - 12½
Winter yellow, bbl	lb.	.13 -
Linseed oil, raw, car lots, bbl.	gal	1 08 -
Raw, tank cars (dom)	gal	1 03 -
Boiled, cars, bbl (dom)	gal	1 10 -
Olive oil, denatured, bbl	gal.	1 05 - 1 10
Sulphur, (foots) bbl	lb.	.07½ - 07½
Palm, Lagos, casks	lb.	.07 -
Niger casks	lb.	06½
Palm kernel, bbl	lb.	.08½ - .08½
Peanut oil, crude, tanks (mill)	lb	.12½ - 13
Peanut oil, refined, bbl	lb.	.16½ -
Perilla, bbl	lb	15½ - 15½
Rapeseed oil, refined, bbl	gal.	.78 -
Rapeseed oil, blown, bbl	gal.	.85 -
Sesame, bbl	lb	11½ - 12
Soya bean (Manchurian), bbl.	lb.	.12½
Tank, f o b Pacific coast	lb.	.09½ - 09½
Tank, (f o b. N.Y.)	lb.	.09½ - ..

Fish Oils

Cod, Newfoundland, bbl	gal.	$0 70 - $0 72
Menhaden, light pressed, bbl.	gal.	.76 -
White bleached, bbl.	gal.	.78 -
Blown, bbl.	gal.	.82 - ...
Crude, tanks (f o b factory)	gal.	.50 -
Whale No. 1 crude, tanks, coast	lb.	-
Winter, natural, bbl	gal.	76 - 78
Winter, bleached, bbl	gal	79 - .80

Oil Cake and Meal

Coconut cake, bags	ton	$26 00 - $28.00
Copra, sun dried, bags, (c i f)	lb.	05 -
Sun dried Pacific coast.	lb	04½ -
Cottonseed meal, f o b. mills	ton	38 00 -
Linseed cake, bags	ton	37 00 -
Linseed meal, bags	ton	39 00 -

Dye & Tanning Materials

Albumen, blood, bbl.	lb.	$0 45 - $0 50
Albumen, egg, tech, kegs	lb.	.95 - .97
Cochineal, bags	lb.	.33 - .35
Cutch, Borneo, bales	lb.	.04½ - .04½
Cutch, Rangoon, bales	lb.	.13 - .13½
Dextrine, corn, bags	100 lb.	3 84 - 4.25
Dextrine, gum, bags	100 lb.	4.14 - 4.34
Divi-divi, bags	ton	38.00 - 39.00
Fustic, sticks	ton	30.00 - 35.00
Fustic, chips, bags	lb.	.04 - .05
Logwood, sticks	ton	26.00 - 30.00
Logwood, chips bags	lb.	.02½ - .03½
Sumac, leaves, Sicily, bags	ton	70.00 - 72.00
Sumac, ground, bags	ton	$65 00 - $67 00
Sumac, domestic, bags	ton	40 00 - 42 00
Starch, corn, bags	100 lb	3.22 - 3.49
Tapioca flour, bags	lb.	06½ - .07

Extracts

Archil, conc., bbl	lb.	$0 17 - $0 18
Chestnut, 25% tannin, tanks	lb	02 - .03½
Divi-divi, 25% tannin, bbl	lb	04 - .05
Fustic, crystals, bbl	lb	20 - .22
Fustic, liquid, 42°, bbl	lb.	08 - .09
Gambier, liq., 25% tannin, bbl.	lb.	08 - .09
Hematine crys., bbl	lb.	.14 - .18
Hemlock, 25% tannin, bbl	lb.	03½ - .04½
Hypernic, solid, drums	lb.	24 - .26
Hypernic, liquid, 51°, bbl	lb.	09½ - .10½
Logwood, crys., bbl	lb.	17 - .18
Logwood, liq., 51°, bbl	lb.	.08½ - .09
Quebracho, solid, 65% tannin, bbl.	lb.	.04½ - .05
Sumac, dom., 51°, bbl	lb	.06½ - .07

Dry Colors

Blacks-Carbongas, bags, f o b works, spot	lb	$0 20 - $0.24
Lampblack, bbl	lb	12 - .40
Mineral, bulk	ton	35 00 - 45 00
Blues-Bronze, bbl	lb	.55 - 60
Prussian, bbl	lb.	55 - 60
Ultramarine, bbl	lb.	.08 - 35
Browns, Sienna, Ital., bbl	lb	06 - 14
Sienna, Domestic, bbl	lb	03½ - 04
Umber, Turkey, bbl	lb	.04 - 04½
Greens-Chrome, C P Light, bbl	lb.	32 - .34
Chrome commercial, bbl	lb.	12 - .12½
Paris, bulk	lb.	28 - .30
Reds, Carmine No. 40, tins	lb.	4.50 - 4 70
Oxide red, casks	lb.	10 - 14
Para toner, kegs	lb.	1 00 - 1 10
Vermilion English, bbl	lb.	1 30 - 1 32
Yellow, Chrome C P bbls	lb	.21 - 22
Ocher, French, casks	lb	02½ - 03

Waxes

Bayberry, bbl	lb	$0 30 - $0 32
Beeswax, crude, bags	lb	21½ - 22½
Beeswax, refined, light, bags	lb.	32 - 34
Beeswax, pure white, cases	lb.	40 - .41
Candelilla, bags	lb.	20½ - 21½
Carnauba, No 1, bags	lb	42 - 43
No 2, North Country, bags	lb.	23 - 23½
No 3, North Country, bags	lb.	18½ - 19
Japan, cases	lb.	15½ - .16
Montan, crude, bags	lb.	.04½ - .04½
Paraffine, crude, match, 105-110 m p	lb.	.04 - .04½
Crude, scale 124-126 m.p., bags	lb.	.02½ - 03
Ref., 118-120 m p, bags	lb.	.03 - 03½
Ref., 125 m p., bags	lb.	.03½ - 03½
Ref, 128-130 m p, bags.	lb.	.03½ - .03½
Ref., 133-135 m p, bags	lb.	04½ - .04½
Ref., 135-137 m p, bags	lb	.05½ - 05½
Stearic acid, sgle pressed, bags	lb.	12½ - .13
Double pressed, bags	lb.	.13½ - .13½
Triple pressed, bags	lb.	.14½ - .14½

Fertilizers

Ammonium sulphate, bulk, f.o.b works	100 lb.	$3 25 - $3 30
F.a.s double bags	100 lb	3 85 - 3 90
Blood, dried, bulk	unit	4 00 -
Bone, raw, 3 and 50, ground	ton	27 00 - 30.00
Fish scrap, dom., dried, wks.	unit	3 75 -
Nitrate of soda, bags	100 lb.	2 45 - 2.52½
Tankage, high grade, f o b. Chicago	unit	3.60 - 3 70
Phosphate rock, f o.b. mines, Florida pebble, 68-72%	ton	$4 00 - $4.50
Tennessee, 78-80%	ton	8 00 - 8.25
Potassium muriate, 80%, bags	ton	34 55 -
Potassium sulphate, bags basis 90%	ton	43 67 - ......
Double manure salt	ton	25 72 - ......
Kainit.	ton	7.22 - ......

Crude Rubber

Para—Upriver fine	lb.	$0.27½ - ......
Upriver coarse	lb.	.24½ - ......
Upriver caucho ball.	lb.	.25½ - ......
Plantation—First latex crepe	lb.	27 - ......
Ribbed smoked sheets	lb.	.27 - ......
Brown crepe, thin, clean	lb.	.25 - ......
Amber crepe No. 1	lb.	.26½ - ....

Gums

Copal, Congo, amber, bags	lb.	$0.12 - $0 13
East Indian, bold, bags	lb.	.23 - .23½
Manila, pale, bags	lb.	.20 - .20½
Pontinak, No 1 bags	lb.	.20 - .20½
Damar, Batavia, cases	lb.	.27½ - .28
Singapore, No. 1, cases	lb.	33 - .33½
Singapore, No 2, cases	lb.	.22 - 22½
Kauri, No. 1, cases	lb.	.65 - .67
Ordinary chips, cases	lb.	.21 - .22
Manjak, Barbados, bags	lb.	.09 - .09½

Shellac

Shellac, orange fine, bags	lb.	$0.60 - ......
Orange superfine, bags	lb.	.62 - ......
A. C. garnet, bags	lb.	58 - ......
Bleached, bonedry	lb.	.70 - ....
Bleached, fresh	lb.	.58 - .....
T. N., bags	lb.	.57 - ......

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh. ton	$500.00 - ....
Asbestos, shingle, f.o.b., Quebec	sh. ton	$65.00 - $85 00
Asbestos, cement, f.o.b., Quebec	sh. ton	20.00 - 25.00
Barytes, grd., white, f.o.b. mills, bbl	net ton	16.00 - 20.00
Barytes, grd., off-color, f.o.b. mills bulk	net ton	13.00 - 15.00
Barytes, floated, f.o.b. St. Louis, bbl.	net ton	28.00 - ......
Barytes, crude f.o.b. mines, bulk	net ton	10 00 - 11.00
Casein, bbl., tech	lb.	.16 - .18
China clay (kaolin) crude, f.o.b Ga.	net ton	7 00 - 9 00
Washed, f.o.b. Ga.	net ton	8.00 - 9 00
Powd., f.o.b. Ga.	net ton	14.00 - 20 00
Crude f.o b. Va	net ton	8.00 - 12 00
Ground, f o b. Va.	net ton	14 00 - 20 00
Imp., lump, bulk.	net ton	15.00 - 20 00
Imp., powd.	net ton	45 00 - 50 00
Feldspar, No 1 pottery	long ton	6 00 - 7.00
No 2 pottery	long ton	4 00 - 5.50
No. 1 soap	long ton	7.00 - 7.50
No. 1 Canadian, f.o.b. mill	long ton	20.00 - 22.00
Graphite, Ceylon, lump, first quality, bbl	lb.	.06½ - ....
Ceylon, chip, bbl.	lb.	.05½ - ....
High grade amorphous crude	ton	15 00 - 35.00
Gum arabic, amber, sorts, bags	lb.	.14½ - .15
Gum tragacanth, sorts, bags	lb.	.48 - .56
No 1, bags	lb.	1.50 - 1.60
Kieselguhr, f.o.b. Cal.	ton	40 00 - 42 00
F.o b N. Y.	ton	50 00 - 55.00
Magnesite, crude, f.o.b Cal	ton	14 00 - 15.00
Pumice stone, imp., casks	lb	.03 - .05
Dom., lump, bbl	lb.	.05 - .05½
Dom., ground, bbl	lb	06 - .07
Silica, glass sand, f.o.b Ind.	ton	2 00 - 2 50
Silica, sand blast, f o b. Ind	ton	2 50 - 5 00
Silica, amorphous, 250-mesh, f o b Ill.	ton	17 00 - 17 50
Silica, bldg sand, f.o b Pa	ton	2 00 - 2.75
Soapstone, coarse, f.o b Vt., bags	ton	7.00 - 8.00
Talc, 200 mesh, f.o.b., Vt., bags	ton	6.50 - 9.00
Talc, 200 mesh, f.o.b Ga., bags	ton	7.00 - 9.00
Talc, 200 mesh, f o b Los Angeles, bags.	ton	16.00 - 20.00

Mineral Oils

Crude, at Wells

Pennsylvania	bbl.	$3 00 - 3.25
Corning	bbl	1 70 - ......
Cabell	bbl.	1 71 - ......
Somerset	bbl.	1 55 - ......
Illinois	bbl	1 97 - .....
Indiana	bbl.	1 98 - ......
Kansas and Oklahoma, 28 deg.	bbl.	1 20 - .....
California, 35 deg and up	bbl.	1 04 - ......

Gasoline, Etc.

Motor gasoline, steel bbls	gal.	$0.21½ - ....
Naphtha, V M & P deod, steel bbls	gal	20½ - ....
Kerosene, ref tank wagon.	gal.	14 - .....
Bulk, W W export	gal.	.07 - ......
Lubricating oils		
Cylinder, Penn., dark	gal.	.20 - .22
Bloomless, 30@31 grav.	gal.	.18½ - .20½
Paraffin, pale	gal.	.24 - .26
Spindle, 200, pale.	gal.	.21 - .22
Petrolatum, amber, bbls	lb.	.05 - .05½
Paraffine wax (see waxes)		

Refractories

Bauxite brick, 56% Al_2O_3, f o.b. Pittsburgh	ton	$45-50
Chrome brick, f.o.b. Eastern shipping points	ton	50-52
Chrome cement, 40-50% Cr_2O_3	ton	23-27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st. quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	40-46
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	36-41
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65-68
9-in. arches, wedges and keys	ton	80-85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48-50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	48-50
F.o.b. Mt. Union, Pa.	1,000	42-44
Silicon carbide refract. brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N. Y.	ton	$200.00 - $225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11½ - .11½
4-6% C	lb.	.12 - .13
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	125.00 - ....
Spiegeleisen, 19-21% Mn.	gr. ton	40.00 - ....
Ferromolybdenum, 50-60% Mo, per lb Mo.	lb.	2.00 - 2.50
Ferrosilicon, 10-15%	gr. ton	48.00 - 50.00
50%	gr. ton	95.00 - ....
75%	gr. ton	150.00 - 160.00

Ferrotungsten, 70-80%, per lb. of W	lb.	$0.90 -	$0.95
Ferro-uranium, 35-50% of U per lb. of U	lb.	6.00 -	....
Ferrovanadium, 30-40%, per lb. of V	lb.	3.50 -	3.75

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$6.00 -	$9.00
Chrome ore Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 -	23 00
C i f. Atlantic seaboard	ton	20.50 -	24.00
Coke, fdry., f.o.b. ovens	ton	5.75 -	6 25
Coke, furnace, f.o.b. ovens	ton	5.00 -	5.50
Fluorspar, gravel, f.o.b. mines' Illinois	ton	20.00 -	21 50
Ilmenite, 52% TiO_2	lb.	.01½-	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.35 -	....
Manganese ore, chemical (MnO_2)	ton	80.00 -	85.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N. Y.	lb.	.65 -	.70
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb.	.06 -	.08
Pyrites, Span., fines, c.i.f. Atl seaport	unit	.11½-	.12
Pyrites, Span., furnace size, c.i f. Atl. seaport	unit	.11½-	.12
Pyrites, dom. fines, f.o.b. mines, Ga.	unit	.12	
Rutile, 95% TiO_2	lb.	.12 -	....
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.50 -	8.75
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	8.00 -	8.25
Uranium ore (carnotite) per lb of U_3O_8	lb.	3.50 -	3.75
Uranium oxide, 96% per lb. U_3O_8	lb.	2 25 -	2 50
Vanadium pentoxide, 99%	lb.	12 00 -	14 00
Vanadium ore, per lb V_2O_5	lb.	1.00 -	....
Zircon, washed, iron free, f.o.b. Pablo, Fla.	lb.	.04½-	.13

Non-Ferrous Materials

	Cents per l b
Copper, electrolytic	14½-14¾
Aluminum, 98 to 99%	26 27½
Antimony, wholesale, Chinese and Japanese	6¾- 7½
Nickel, virgin metal	27-29
Nickel, ingot and shot	30-32
Monel metal, shot and blocks	32 00
Monel metal, ingots	38 00
Monel metal, sheet bars	45 00
Tin, 5-ton lots, Straits	40 25
Lead, New York, spot	7 25
Lead, E. St. Louis, spot	6 92½
Zinc, spot, New York	6 30
Zinc, spot, E. St. Louis	5.95

Other Metals

Silver (commercial)	oz.	$0.65¾
Cadmium	lb.	1 00
Bismuth (500 lb. lots)	lb	2 55
Cobalt	lb.	3 25-3 75
Magnesium, ingots, 99%	lb	1 25-
Platinum	oz.	116 00
Iridium	oz.	275.00@300.00
Palladium	oz	80 00
Mercury	75 lb.	68 00

Finished Metal Products

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	24 25
Copper bottoms	29.75
Copper rods	25 25
High brass wire	19@37½
High brass rods	17 00
Low brass wire	21.10
Low brass rods	22 00
Brazed brass tubing	24.25
Brazed bronze tubing	29.00
Seamless copper tubing	25.25
Seamless high brass tubing	23.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.60@11.8
Copper, heavy and wire	11 50@11.6
Copper, light and bottoms	10.00@10 1
Lead, heavy	5.75@ 6 0
Lead, tea	3.50@ 3 7
Brass, heavy	6.50@ 6 7
Brass, light	5.75@ 6 0
No. 1 yellow brass turnings	6.75@ .70
Zinc	3.75@ 4.2

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by 3 in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.29	$3 14
Soft steel bars	3.19	3.04
Soft steel bar shapes	3.19	3.04
Soft steel bands	3.29	3.19
Plates, ¼ to 1 in. thick	3.29	3.14

Industrial

Financial, Construction and Manufacturing News

Construction and Operation

Arkansas

RUDY—The Fort Smith Fertilizer Co., Fort Smith, Ark., has leased a local tract of land, comprising about 40 acres, as a site for the construction of a new phosphate-fertilizer manufacturing plant, estimated to cost close to $100,000, with machinery. It is purposed to develop an output of 1,000 tons per day.

SUMMIT—The Thompson Paint & Color Co. is completing the erection of the first unit of a new plant at Summit, near Yellville, and plans to commence production at an early date It will be devoted to paint, varnish and kindred manufacture. It is planned to make extensions at a later date.

EL DORADO—The Lion Oil & Refining Co. has tentative plans for the construction of an addition to its refinery for considerable increase in capacity. E. C. Winters is one of the heads of the company

California

ORO GRANDE—The Riverside Portland Cement Co., Riverside, Calif., has acquired the plant and property of the Golden State Portland Cement Co., Oro Grande, near Victorville, for a consideration said to be $1,500,000. The new owner has plans in progress to increase the capacity of the mill from 1,200 to 3 600 bbl. per day, with cost estimated at close to $500,000, including machinery.

SALINAS—E. M. Galli, Hollister, Calif., operating a local plant for the manufacture of concrete pipe and kindred products, has acquired property on Market St., Salinas, as a site for a new branch plant, for which plans will be prepared at an early date. Joseph Cassi is also interested in the company.

LOS ANGELES—The Pan-American Petroleum & Transport Co is perfecting plans for the construction of its proposed oil-refining plant on tract of land at Wilmington, in the harbor section, recently acquired The initial plant will be equipped for a capacity of 12,500 bbl. per day, and is estimated to cost in excess of $2,000,000, with machinery. A second plant unit of like size will be built at a later date. E. L. Doheny heads the company.

Florida

FORT PIERCE—The Non-Acid Fertilizer & Chemical Co. has tentative plans under consideration for the construction of a local plant for the manufacture of commercial fertilizer, estimated to cost close to $100,000 with machinery. E. D. Noe is one of the heads of the company.

Georgia

SAVANNAH—The Southern Cotton Oil Co. has preliminary plans for extensions and improvements at its local plant, estimated to cost close to $75,000, including equipment.

Illinois

CHICAGO—The Gutmann Tanning Co., 1511 Webster St., has filed plans for the erection of its proposed new tanning plant at 2128-40 Dominick St., 100x150 ft., estimated to cost $150,000, with equipment. The general contract has been let to J. Kalchbrenner, 133 West Washington St.

CICERO—The Barrett Co., 12 South La Salle St., Chicago, has completed plans and will soon commence the erection of a new side addition at its varnish-manufacturing plant at 16th St. and 51st Ave. H. A. Mulder, 140 South Dearborn St., Chicago is architect.

Indiana

WHITING—The Standard Oil Co. of Indiana, Indianapolis, is reported to be planning for extensions in its local refining plant, with installation of additional equipment for increase in output.

Kansas

BAXTER ... operating ... plans under ... ing ... the por... The Uterpe Mines Co. ...perties, has tentativ... plant destroyed ... tion for the rebuild... zinc concentratio... estimated at $10... June 7, with los... including machinery

Kentucky

LOUISVILLE—The V... Packing Co. 1303 Shelby St., has ...s prepared for the construction of ... story and basement oil refining pla... ft., estimated to cost $150,000, ...uipment. Fred Erhart, Norton Bld... chitect. J E Garvin is secretary.

Louisiana

MONROE—The Consolidated C... recently organized, has prelimin... under consideration for the constr... a new local plant for the production... bon black C. A. Barbour and C. D... both of Houston, Tex., head the com...

Massachusetts

CHARLESTOWN—The Eastern Salt Co., 23 State St., Boston, has awarded a general contract to the William M. Bailey Co., 8 Broad St., Boston, for the erection of a new addition to its plant on Chelsea St., Charlestown, to cost about $80,000.

CAMBRIDGE—The Dewey & Almy Chemical Co., Harvey St., has filed plans for the construction of a new 1-story building at its plant.

FALL RIVER—The New England Oil Co. will make extensions in its local refining plant on New St., for the installation of additional agitating equipment, estimated to cost $35,000.

Michigan

HAMTRAMCK—The Detroit Foundry Co., 2642 East Grand Blvd., Detroit, has tentative plans under consideration for the construction of a new 1-story foundry on Christopher St., Hamtramck. Frank Bronley is treasurer.

Mississippi

WEST POINT—The Kill Kraw Co., recently formed with a capital of $25,000, has preliminary plans under advisement for the establishment of a local plant for the manufacture of chemical specialties for insect elimination. The new company is headed by B. H. Strong, West Point; and E. P. Bush, Macon, Miss.

Missouri

HILLSBORO—The Eagle Picher Lead Co. is considering plans for the rebuilding of the portion of its local smelting plant, destroyed by fire, June 10, with loss estimated in excess of $150,000, including equipment. Headquarters of the company are at 208 South La Salle St., Chicago, Ill.

ST. JOSEPH—The Marland Refining Co., Ponca City, Okla., has selected a site on 4th St. for the erection of a new branch storage and distributing plant to cost about $60,000, with equipment.

New Jersey

GARFIELD—The local plant of the Smith Rubber & Tire Co., bankrupt, has been acquired by the Magnum Rubber Products Corp., recently formed under Delaware laws with capital of $21,000,000. The new owner will take over the plant at once, and will make extensions and betterments. Operations will soon be commenced for the manufacture of automobile tires and other rubber products.

MALAPARDIS—The Manhattan Rubber Mfg. Co., 120 Broadway, New York, manufacturer of mechanical rubber goods, has plans for the construction of an addition to its crude rubber mill at Malapardis, near Morristown, including improvements in different departments of the present works.

ELIZABETH—The Consumers' Service Stations Consolidated, 90 West St., New York,

is planning for the construction of a new oil-blending plant at its property at Bay Way, Elizabeth.

TRENTON—Fire, June 11, destroyed a portion of the mechanical drying department and other sections of the plant of the Tain-teed Products Co., East State ... manufacturer of roofing products, etc.; loss estimated at $250,000. It is plan[ned to] rebuild. Headquarters of the com[pany] at 233 Broadway, New York.

New York

BROOKLYN—The Muller B... Paper ...n, has ...of a 1-
Co., Prospect Ave., Ridgew... Work
completed plans for the ...
story addition to its plant ... Smelting &
will be started at once. ...d, will oper-
BUFFALO—The Niaga...agara St. for
Refining Co., recently ... bronze. ingots,
ate a local plant at ... Jarvis is vice-
the production of b...ger.
special alloys, etc. ... destroyed a num-
president and gen... plant of the Union
LEROY—Fire, ...al estimate of loss
ber of building... It is planned to re-
Explosives C...
has not be...nited States Leather
build. ... has construction under
BUFFAL...t at Lovejoy St and the
Corp. of ... tract of 5½ acres of land
way on ... recently from J. F. Schoell-
city li... plant will be used for the
was ... of synthetic leather products.
kopf... is now operating at Cleve-
ma... will remove this plant to the
Th...e, installing considerable addi-
...ipment for increased output.

...ANDA—The Standard Oil Co of ...ork, 26 Broadway, New York, has ...ed a tract of property in the vicinity ...ark St, and will use the site for the ...tion of a new oil storage, blending ... distributing plant, estimated to cost in ...ess of $100,000, with equipment.

BROOKLYN—Edelstein & Dundy, Inc., 1831 Douglass St., manufacturer of glass products, has had plans completed for the erection of a new 1-story building, 50x100 ft., at 1875-79 Douglass St., estimated to cost $25,000. S. Millman & Son, 1780 Pitkin Ave., are architects.

Ohio

EAST TOLEDO—The Libbey-Owens Sheet Glass Co., Nicholas Bldg., Toledo, has completed plans and will soon award contracts for the erection of a new plant on a tract of 115 acres of land at East Toledo. It will consist of a number of buildings, estimated to cost close to $4,500,000, with machinery. E. D. Libbey is president.

ALLIANCE—The Alliance Vitreous China Co., has commenced the construction of additions in its plant for considerable increase in capacity. The company is operated by the George H. Bowman Co., Euclid Ave., Cleveland.

Pennsylvania

ORELAND—The Philadelphia Suburban Gas & Electric Co., West Washington Sq., Philadelphia, will commence the construction of a new artificial gas plant on local site, totaling 14 acres of land, estimated to cost $1,500,000, with machinery.

Texas

MINERAL WELLS—The Palo Pinto Oil & Refining Co., recently organized to take over and operate the local refinery of the Brazos Gasoline Co., has plans under way for the construction of an addition to the plant for the production of gasoline and byproducts. The expansion is estimated to cost in excess of $50,000, with equipment.

HASKINS MOUND—The Freeport Sulphur Co is occupying its new local plant recently completed at a cost of close to $2,000,000, and plans for extensive operations. It is purposed to develop an output of about 1,000 tons per day, and this will be extended at a later date.

EASTLAND—The Continental Gasoline Co. is being organized by officials of the Gordon Petroleum Co to construct and operate a local plant for gasoline production. A site has been selected for the new refinery on the [illegible] lease of the parent organization. It is estimated to cost close to $100,000, with equipment. Colonel Robert D. Gordon, president of the Gordon company, will also be head of the new organization.

Washington

VANCOUVER—The Columbia River Paper Mills Co. is arranging for the immediate ...of additions to its plant, including ...wers at the sulphite mill, and the ...ation of equipment in other departments.

VANCOUVER—The Columbia Terra Cotta ... has work in progress on a new local plant and will arrange for the equipment installation at an early date. A number of kilns will be built.

West Virginia

HUNTINGTON—The Ford Block Co., Ashland, Ky., manufacturer of cement blocks and kindred products, is considering plans for the erection of a new branch plant, estimated to cost about $30,000. A site is being selected. E. A. Ford is general manager.

MOUNDSVILLE—The Kerr Portland Cement Co., Wheeling, recently organized, has selected a site at Beech Bottom, near Moundsville, for the construction of a new cement-manufacturing plant. The initial mill will consist of a number of buildings, equipped for an output of about 3,000 bbl. per day. The plant is estimated to cost in excess of $1,000,000, with machinery, and will give employment to more than 400 men. It is expected to have the mill ready for service in about 12 months.

HUNTINGTON—The National Ultramarine Co., recently organized by local interests, has tentative plans under advisement for the construction of a plant for the manufacture of colors, dyes, chemicals, etc. A site is being considered at North Cincinnati, O. The initial works will cost close to $200,000, with equipment. The new company is headed by U. S. C. Anderson, Huntington, district manager for the Columbia National Life Insurance Co. Ralph Baugher, Huntington, is chemical engineer.

Wisconsin

WAUKEGAN—The American Lakes Paper Co, recently organized, has acquired a 4-story building at the Waukegan terminal for a consideration said to be $150,000, and has plans for the immediate establishment of a plant for the manufacture of paper products. C. C. Hockley, Appleton, Wis., heads the new company.

New Companies

PAPER PRODUCTS CO, 105 West Monroe St., Chicago, Ill.; paper products; $40,000. Incorporators: Thomas Munro, Elma Dehne and Arthur A. Aggerbeck.

STANDARD PIGMENT CO., Hudson Falls, N. Y., chemicals, pigments, etc.; $10,000. Incorporators: J. J. McCabe, P. Paris and W. A. Huppuch. Representative: W. L. Sawyer, Hudson Falls.

LORD & OLIVER MFG. CO., Newark, N. J.; polishing compounds, chemicals, etc.; $100,000. Incorporators: James Lord, Reubin S Oliver and John Goetsch. Representatives: William and Benjamin Harris, 780 Broad St., Newark.

ATLAS CLAY PRODUCTS CO, Madisonville, Ky, pipe blocks, etc; organized. N. M. Mitchell and A. F. Fox, both of Madisonville, head the company.

CENTRAL BRASS & ALUMINUM FOUNDRY CO., Cincinnati, O.; brass, bronze, aluminum and other metal castings; $15,000. Incorporators: Eldon L. Cunningham and Edward M. Boland, both of Cincinnati.

ALUMINATE CEMENT CO., Philadelphia, Pa.; cement products; $15,000. Representative: Corporation Guarantee & Trust Co., Land Title Bldg., Philadelphia.

BER-TAN LEATHER CO., Lynn, Mass.; leather tanning; $50,000. Charles V McManus, president and Benjamin I. Crowell, 7 Berkshire St., Worcester, Mass., treasurer.

MILFORD OIL CO., Irvine, Ky; refined oil products; $30,000 Incorporators: D. B. Smith, A. M. Clark and O. W. Swofford, all of Irvine.

NO-JEL PROCESS CO, New York, N. Y.; petroleum products, etc.; $50,000. Incorporators: W. C. Packard, C. T. Flach and S. C. Koff. Representative: Shaw & Flach, 256 Broadway, New York.

E. J. MCCORMICK RUBBER CO., INC., Lodi, N. J.; rubber products; $25,000. Incorporators: William Bal Albert H. Robinson and James J. Govey, Lodi. The last noted is representative.

AKIN-SHI-NALL Co. Charlotte, N C; chemicals and chemical byproducts; $100,000. Incorporators: L. W. Wingate, A. M. Akin and R. F. Stroup, all of Charlotte.

RICHARDS MFG. CO., New Haven, Conn.; pottery and kindred products; $50,000. Incorporators: Ray and Samuel Segaloff, and H. R. Coshner, 37 Bedford Ave., Hamden, Conn.

CLEAN PETROLEUM CO., Wilmington, Del.; petroleum products; $500,000. Representative: Corporation Service Co., Equitable Bldg., Wilmington.

COLUMBIA LEATHER CORP., Boston, Mass.; leather products; $75,000. William A. Spaulding, Chestnut Hill, Boston, is president and treasurer.

NO-WORRY CHEMICAL CO., Newark, N. J.; chemicals and chemical byproducts; $50,000. Incorporators: Vito Rinaldi and M. Costelli. Representative: C. W. Vail, 810 Broad St., Newark.

BARIUM REDUCTION CORP., New York, N. Y.; chemicals and affiliated products; $1,500,000. Incorporators: Robinson B. Kissell, G. Herbert Timber and George C. Barclay. Representative: United States Corporation Co., 65 Cedar St., New York.

GRAHAM GLASS CO., Evansville, Ind.; glass products; $500,000. Incorporators: William P. Rus, J. M. Lentz and John A. Merchant, all of Evansville.

TENNESSEE CARBONIC CO, Nashville, Tenn.; carbonic acid gas, etc.; $75,000. Incorporators: John S. Pope, J. B. Regen and John T. Hays, all of Nashville.

HENDERSON LEATHER CO., Brooklyn, N.Y.; leather products; $50,000. Incorporators: E. and H. Henderson, and I. Herman. Representative: Greenspan & Morris, 305 Broadway, New York.

CONSUMERS' ASBESTOS ROOFING CO, 422 North Sacramento Ave., Chicago, Ill.; asbestos products; $30,000. Incorporators: William G. Murray, B. T. McCanna and Eugene T. Sullivan.

LUXOR LTD, Portland, Me.; soaps, washing powders, etc.; $10,000. Incorporators: M. G. O'Neil and A. B. Farnham, Portland; and M. F. Foster, South Portland.

TRI-SOLVENT CO., INC., Perth Amboy, N. J.; cleansing powders, water softeners, etc.; $25,000. Incorporators: Gardner Stewart, John Ingle and John W. Collopy. Representative: Arden B. Cline, 305 Front St., Perth Amboy.

Industrial Notes

THE LINK-BELT CO., of Chicago and Philadelphia, announces that L. M. Dalton has succeeded E J Burnell as manager of the Boston branch office. Mr. Burnell resigned to enter business for himself. Announcement is also made that the Cleveland office of the Link-Belt Co is now located at 329 Rockefeller Bldg.

THE CONVEYORS CORP. OF AMERICA, Chicago, announces that the Grindley Co., 1168 Homer St, Vancouver, B. C., is handling the sale of its products in the province of British Columbia. The Grindley Co. was the Western office of Gorman, Ltd., of Edmonton, and operated under that name up to May 1, but after that date Mr. Grindley took over the business, organized his own company and enlarged his selling staff. J. H. Sinclair is associated with him.

THE TROPENAS CO. has moved its general offices to 2236 Cunard Bldg., 25 Broadway, New York City. The general South American headquarters will remain at Sala 119, Avenida Rio Branco No. 9, Rio de Janeiro, Brazil.

Opportunities in the Foreign Trade

Parties interested in any of the following opportunities may obtain all available information from the Bureau of Foreign and Domestic Commerce at Washington or from any district office of the bureau. The number placed after the opportunity must be given for the purpose of identification.

CHEMICALS. Rio de Janeiro, Brazil. Purchase or agency.—6831.

DEXTRINES AND INDUSTRIAL STARCHES. Barcelona, Spain. Agency.—6809.

PAINTS, MARINE. Vigo, Spain. Purchase.—6868

PAINTS AND VARNISHES. Barcelona, Spain. Purchase and agency.—6876.

SULPHATE OF AMMONIA AND POTASSIUM CARBONATE. Valencia, Spain. Agency.—6808

TURPENTINE, ROSIN AND CAUSTIC SODA. Milan, Italy. Purchase.—6854.

MANGANESE ORE. Bombay, India. Purchase.—6849.

GASOLINE. Warsaw, Poland. Purchase and agency.—6815.